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GCC - Iran:
Operational Analysis of Air, SAM and TBM Forces

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Introduction

Perceptions of the Iranian Threat

• It is in the view of many analysts that with the occupation of Iraq, Iran now sees new opportunities to enhance its strategic interests and to reemerge as the key power in the Arabian Gulf region. They have enumerated five threats to the region posed by Iran:

- Ambition to acquire nuclear weapons and long-range ballistic missiles;
- Support for International Terrorism;
- Opposition to the Middle East peace process and its rising political influence there;
- Offensive military buildup;
- Threat to the stability of the Gulf States. Iran has also annexed the islands of Abu Musa, which dominate the entrance to the Straits of Hormuz.

• Iran looks upon Nuclear Weapons and Ballistic Missiles as:

- attractive alternatives to expensive modern conventional weapons for Power Projection and Deterrence purposes;

- a means to increase so-called status and prestige.

• As a response, the U.S. policy objective has been not to allow the Arabian Gulf region to be dominated by a hegemonic Iran. The United States believes that Iran cannot try to dominate the Gulf region as long as a U.S. military power is present. Iran maintains that the U.S. is actually positioning itself to confront Iran, and is building military bases to be used as launching pads for a possible strike against it.

How Iran views its National Security

• Many believe that a confrontational approach to Iran will drive it to justify the pursuit of a nuclear capability as a deterrent. The Iranian National Security Doctrine is based on the perceptions that:

- Iran as having a leadership role in the Arab and non-Arab Muslim world, and to have a dominant role in the Arabian Gulf region especially in any GCC security arrangements;
- The occupation of Iraq by the U.S. and the presence of the U.S. Fifth Fleet offshore in the waters of the Gulf, and the past U.S. declared policy for “regime change” in Iran, as a grave threat to its National Security;
- Israeli intentions to destabilize Iran and attack its nuclear facilities, which Iran claims to be for the purpose of producing nuclear power;
- Iran is worried about unfriendly neighbors surrounding it, including a nuclear armed Pakistan.

U.S. - Russia

• The U.S. – Russia nuclear agreement, July 6, 2009, is considered by many as a first step in a broader effort to reduce the threat of Nuclear Weapons and to prevent their further spread. President Obama in his remarks hailed the arms agreement as an example for the world as he pursued a broader agenda aimed at countering – and eventually eliminating the spread of Nuclear Weapons.

• President Obama views Russia as an influential partner willing to help fight the proliferation of nuclear weapons mainly in Iran and North Korea. It has become clear that more collaboration between the US and Russia on nuclear non-proliferation could increase pressure on Iran, which has always taken advantage and benefitted from any disagreements between the two countries.

• It is believed that Russia could be a key player in preventing Iran from having a nuclear weapons program. However, Russia seems to have a different perception of the threat and has not shown any interest so far in applying pressure on Iran. Obama managed to link the BMD in Eastern Europe with the emerging Iranian Nuclear Threat and Long Range Ballistic Missile capability.

U.S. Position

• The Obama Administration has been sending messages to Iran trying to dissuade it from pursuing Nuclear Weapons. The message is that the Iranian Nuclear Weapons program will:

- not advance its security;
- not achieve its goal of enhancing its power both regionally and globally;
- spark an arms race in the region;
- cause Iran to become more insecure.

• The current U.S. position towards Iran is based upon the choice of:

- Further sanctions and containment if Iran continues its pursuit of Nuclear Weapons or ;
- Start a dialog with wider economic incentives if it abandons its nuclear weapons program.

• In the event that Iran continues to pursue Nuclear Weapons the U.S. Secretary of State outlined how the U.S. might deal with a such a policy:

- Washington would arm allies in the region, and extend a “defense umbrella”;
- Iran possessing nuclear weapons would be unacceptable to the U.S.;
- Iran crossing the Nuclear Threshold would not make Iran safe;
- By extending assistance and a defense umbrella, Iran will not be able to intimidate and dominate its neighboring countries in particular the GCC, as Iran believes it can, once it possesses nuclear weapons.

Iranian Response

• Iran has a 2,500 km coastline along the waters of the Arabian Gulf and the Arabian Sea, which is the only route to export oil, and around 95 percent of its foreign exchange revenues comes from exporting oil.

• In addition to viewing itself a regional power, Iran's aim is to keep the waters free from any foreign military presence and prevent outside countries from playing a role in shaping the future political and security architecture of the Gulf region.

• Iran has recently been active diplomatically trying to convince the GCC States, with regard to the U.S. and other Western Powers, that their security would be better ensured by signing mutual security agreements with it. Iran has been stressing that for longer term regional security and stability, Iran and the GCC states should replace the reliance on foreign military presence and intervention.

• With regard to a possible Israeli or U.S. attack on Iranian nuclear facilities, the following is what has been written on the possible Iranian military response:

- Immediate retaliation using its ballistic missiles on Israel. Multiple launches of Shahab-3 including the possibility of CBR warheads against Tel Aviv, Israeli military and civilian centers, and Israeli suspected nuclear weapons sites;
- Using proxy groups such as Hezbollah or Hamas to attack Israel proper with suicide bombings, covert CBR attacks, and rocket attacks from southern Lebanon;
- Give rise to regional instability and conflict as well as terrorism;
- Destabilizing Iraq through the Shia against US occupation, further arming insurgency groups when possible;
- Support and upgrade Taliban capabilities in Afghanistan;
- Increase the threat of asymmetric attacks against American interests and allies in the region;
- Target U.S. and Western shipping in the Gulf, and possibly attempt to interrupt the flow of oil through the Gulf. Danger is not simply a cut-off in the supply of oil from Iran, the GCC, or the closing of the Strait of Hormuz, but a prolonged threat to the wider Gulf region.

Israel and U.S. Position on a Military Strike against Iranian Nuclear Facilities

• The Israeli time frame as to when Iran would have a Nuclear Weapon is between 2009 and 2013, whereas the U.S. time frame is after 2013. Israel further states that Iran should not be allowed to obtain any nuclear capabilities that could eventually allow it to produce nuclear weapons.

• Israel views Iran as an Existential Threat and must be dealt with in the immediate future with a Military Strike against it's main nuclear facilities. Israel would rather see the U.S. join it in preventing Iran from developing the capability rather than the U.S. arming its allies in the region and providing a defense umbrella.

• In the month of March, Haaretz Service on March 12 reported the following statements by U.S. Defense Secretary Robert Gates:

> "The current American administration as well as those that follow it will exercise extreme caution before launching a pre-emptive military strike against an enemy state."
>
> "I think one of the biggest lessons learned in this is, if you are going to contemplate preempting an attack, you had better be very confident of the intelligence that you have" Gates further said "They're (Iran) not close to a stockpile, they're not close to a weapon at this point, and so there is some time."
>
> Gate's concludes in other interviews that any military option to force Iran to abandon its controversial nuclear program would have merely temporary ineffective results, and that imposing sanctions on Iran made more sense.

• The United States has given Iran until September, 2009, during the convening of the U.N. General Assembly to respond to President Obama's offer of dialogue.

What could accelerate a confrontation with Iran

• There is the suspicion that Iran could start an open ended dialog plus negotiations with no commitments to terminate its pursuit of nuclear weapons. The following general concerns could drive the region into conflict:

- By 2010 Iran could pose a serious threat to it's neighbors and Israel. Enough of an inventory of nuclear weapons that can serve as a deterrent against U.S. and Israeli strikes.

- Having in it's possession highly accurate short, medium and long range ballistic missiles, capable of carrying Weapons of Mass Destruction (WMD).

- A modern SAM air defense system, such as the Russian S-300PMU2 "Favorit", giving Iran an advanced Ballistic Missile Defense (BMD) capability in addition to an advanced SAM Air Defense System.

- A maritime capability that can threaten commercial shipping and Naval Forces in the Gulf , and possibly interrupt the flow of oil through the Straits of Hormuz.

- Train and control a number of Counter Insurgency groups to Increase the threat of asymmetric attacks against American interests and allies in the region and even beyond the region.

- Should Iran acquire the above capabilities the question is "would Iran become over confident to the point that it is convinced it can impose it's own political and military conditions in the Arabian Gulf region that will serve its own interests?"

• How then, should the U.S. enhance the military capabilities of the Arab Gulf states to counter any likelihood of an Iranian military aggression. The requirement would be to enhance the conventional military ability for the GCC states to achieve a specified wartime objective (win a war, or destroy a target set). It includes four major components:

- Force Structure;
- Modernization;
- Readiness;
- Sustainability.

- In addition it would include developing an asymmetric warfare capability.

GCC Strategic Depth Vulnerability

• The Arab Gulf states have been investing heavily in the modernization and upgrading of their force structures. The United States, France and United kingdom have been the major weapons suppliers.

• They also recognize that the assistance of outside regional powers will be required to deal with any military aggression in the region. As a result they have signed bilateral defense agreements with their Western allies - United States, Britain and France.

• 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.

• 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 economic centers due to the proximity to the borders. Saudi Arabia would be the only state that has strategic depth.

• Saudi Arabia 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.

• In 2002 the GCC made a major security shift from a Common Security arrangement to a Joint Defense Pact which essentially is a Collective Security arrangement. Joint Defense Pact or Collective Security is directed against an aggressor coming from outside one's sphere (see Appendix VI).

• Agreement entails a commitment by each member to join the coalition and if one is attacked that implies an attack on the other partners. This being based either on defense in it's traditional sense, or upon deterrence.

• In the foreseeable future the GCC has to plan it's defenses so as to deter Iran or any other adversary. What they can do is to build their collective and national assets 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.

• 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.
  - In parallel the capability to take the war to the enemy, fight on enemy territory.

(See Military Technology. MILTECH 11/2005. Interview with Maj. Gen. Khaled Abdullah Al-Buainain, Commander of the UAE Air Force and Air Defense)

Time lines

- Israel believes that Iran will have a nuclear weapon capability between 2009 to 2013
- U.S. believes this will be beyond 2013.
- During this time frame 2009-2013, the GCC will need to :

  - Decide as early as possible what Objective Force Level can the GCC states build their military capabilities up to. A level of military forces that needs to be attained within a finite time frame and resource level to accomplish approved military objectives, missions and tasks.

  - Develop a Flexible Response capability in the military forces for effective reaction to any threat or attack with actions appropriate and adaptable to the existing circumstances.

  - Upgrade and modernize conventional military capability and start improving capability in Asymmetric Warfare.

  - Further strengthen and update Defense Pact with Western Allies; U.S., France and Britain
  .
  - Further develop the recently U.S. proposed “Defense Umbrella” concept, with all associated Security Guarantees.

Aim and Methodology of Study:

• This study addresses and compares the Balance of Forces and operational fighting capabilities of the Air Power, SAM Defense and Theater Ballistic Missile (TBM) forces of the GCC States and Iran.

• The study consists of two parts, Part I analyses the conventional war fighting capability, Part II briefly addresses Asymmetric Warfare that Iran has been developing a fighting doctrine and a force structure for. We leave it to the reader to refer back to a number of more in-depth publications by Anthony Cordesman, CSIS, analyzing Asymmetric Warfare. (See http://www.csis.org/burke/reports)

• Each of the GCC States has its own Fighting Doctrine and subsequently its own technical requirements for the weapon systems procured which are somewhat different in specifications to what the USAF has on its platforms. To avoid going into this level of depth in Part I of the study, we use as a guideline for the analysis, the U.S. Air Force Doctrine, which defines and outlines the specific **functions** required to achieve Strategic, Operational and Tactical-level objectives.

• For instance two of these functions are Offensive and Defensive Counterair Operations, and with each of these functions we review what **operational missions** would be required then compare the availability and effectiveness of the military resources of the GCC and Iran.

• Care must be taken that referring back to the USAF Doctrine definition of Functions and Missions does not imply that the study is using the actual fighting and operations doctrine of the USAF, but in defining what these functions and missions are and how they fall under the overall Air Force plans to shape and control the battlespace. Definition of terminology is important as the study throughout refers to the various functions and missions.

• With respect to the analysis of missions and weapon systems it should be noted that there exists an extensive literature of higher resolution models that address the weapons systems in this study from Design and Performance Evaluation up to Mission, Force and Campaign Levels.

• We have left the calculations as simple as possible and just up to a first order level. The purpose being to give us a general idea on the capabilities and mission performance outcome of the GCC and Iranian Forces.

• We believe that simple analysis procedures can produce substantial insights which are sufficient to compare the Operational Fighting Capabilities of the GCC and Iran, and give a general direction for the doctrine and to the next generation weapon systems requirements.

Summary & General Recommendations

GCC	Iran
• Concerns determining doctrine: ○ Balance of Forces As the Balance of Forces is unfavorable then adopt ➢ Technological Edge ➢ Quality vs Quantity ○ Strategic Depth. None and therefore the need to take war to enemy territory. • Force Structure Planning based on: ○Defensible Borders ○Take the war to the enemy, fight on enemy territory. Needs excellent C4ISR, near-real time situation awareness of the hostile and friendly military developments in the area, and their operational levels. • Need to upgrade and further modernize conventional military capability to carry out such operational functions. • The need to develop an Asymmetric Warfare capability.	• Concerns determining doctrine: ○ Balance of Forces. As the Balance of Forces is unfavorable then: ➢ Since Iran presently does not have access to modern technology weapon systems, it will need to Develop all ranges of Ballistic Missiles to compensate for deficiencies in conventional forces capabilities. ○ No problem with Strategic Depth, can be an advantage fighting in and over familiar terrain. • Force Structure Planning based on: ○ High attrition rate inflicted on adversary civilians. ○ In depth defense, as Iran has the strategic depth. • Continue developing Asymmetric Warfare capabilities. • As Iran sees it, the need and capability to develop Nuclear Weapons to further enhance Deterrence.

• The total GCC Air Power is 491 combat aircraft, we assumed only 75% are operationally ready (full-mission capable). The total available force will then be 368 and with a sortie rate of 3 per aircraft per day the total number of sorties generated will be 1,105.

• Whereas for Iran, a total of 158 aircraft with an operational readiness rate of 60%, the available combat force will be 95 combat aircraft, and with 2 sorties per aircraft per day the total sorties generated will be 190.

• By following the guidelines of the USAF Doctrine manuals in the **missions** needed for Offensive Counterair, Defensive Counterair as well as Counterland Operations, an operational analysis is then conducted, over a 7 day conflict period, to determine possible Force Allocation requirements among the various missions.

Force Allocation Requirements

Mission	GCC	Iran
Combat Air Patrol (CAP)	60	24
Strip Launched Interceptors (SLI)	55	38
Closure of 5 Airfields for 7 days.	56	No Capability
Suppression of Enemy Air Defense (SEAD) -5 Radars	10 (2 per radar site)	15 (3 per radar site)
Escort of Strike Aircraft	40	No Capability
Fighter Sweep	35	No Capability
Total Force Allocated	266	77
Total Left for other missions	102	18

•The remaining 18 to 20 Iranian aircraft can be allocated for counterland operations (Close Air Support and Air Interdiction Missions). Based upon the advancement in weapons technology and overall survivability of GCC vs Iranian aircraft, we can safely assume the following in a 7 day conflict duration:

• GCC Daily Loss Rate is 1.5%, Sortie rate of 3 per aircraft per day, Single Shot Target Kill 75%
Iran Daily Loss Rate is 5%, Sortie rate of 2 per aircraft per day, Single Shot Target Kill 40%

7 Day Conflict	Cumulative Sortie Rates	Cumulative Single Target Kills	Aircraft Remaining
Iran : 20 combat aircraft	200	131	12
GCC: 20 combat aircraft	360	340	15
GCC: 50 combat aircraft	906	850	38

- Over a 7 day conflict during Counterland Operations:
  - GCC: 5 combat aircraft lost
  - Iran: 8 combat aircraft lost
- In the Air to Air Combat the total estimated Losses are:
  - GCC: 27 combat aircraft
  - Iran: 62 combat aircraft

•The above estimates project the weakness of the Iranian Air and SAM Power vs the GCC countries in a 7 day campaign. Throughout we find that on the average there is a substantial advantage in favor of the GCC States in all missions studied.

Iran's Current Air/Missile Defenses

• U.S. never delivered integrated system before fall of Shah.
• Only modern short-range point defense system is TOR-M.
• Other short-range systems mix of older Russian system, SHORADs, and aging – possible inactive British and French systems.
• Medium to long-range systems are low capability or obsolescent.
• HAWKS and IHAWKs do not have capable ECM. Date back to 1960s and 1970s.
• Various versions of SA-2 obsolete.
• Radar sensor and battle management/C4I systems have major limitations.
• Less than 30 export versions of MiG-29, some not operational.
• F-14s do not have ability to use primary air defense missile since 1979-1980.

(Source: Anthony Cordesman Security Challenges and Threats in the Gulf: A Net Assessment. September 2008)

Tactical Ballistic Missiles Threat:

• Iran's ballistic missiles cover the complete spectrum range from150 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.

• Deploying Ballistic Missiles against military targets would require a number that is very likely to be beyond what the Inventory in Iran is. For instance to close one airfield 9000ft in length and 200 ft in width (leaving 3000ft of Minimum Clear Length and 50ft Minimum Clear Width), using a Shahab II class missile with a range of 500km and a 700kg warhead would require some 250 missiles.

• For Suppression of Enemy Air Defense (SEAD) Missions, just to destroy 1 radar, 18 missiles would be required. This is not taking into consideration that the tactical radar site could be mobile which would then require near real time intelligence information on the exact location and definitely more missiles will have to be allocated.

• On the other hand, 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.

General Recommendations for GCC Force Structure Planning

With regard to Balance of Forces and Defensible Borders, these would require the GCC to maintain its technological and qualitative edge, mobility and the strength of the Air Power. The following are some general criteria that would be required:

- **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.

- **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.

- **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

Ballistic Missile Defense System, C4ISR & Battlefield Management.

• The Challenge for the GCC States is to design an effective multi-layered Ballistic Missile Defense System (BMDS) 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 BMD lies in regional cooperation, which can take a range of forms from coordination and cooperation between command centers and defense systems for BMD purposes - while enabling each state to control its own defenses. Similar to the “Cooperation Belt” that links together all the operations command centers in the GCC states, which produces a Common Operational Picture.

• 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 BMDs and NBC threat assessment. This requires an C4ISR capability in all it’s components.

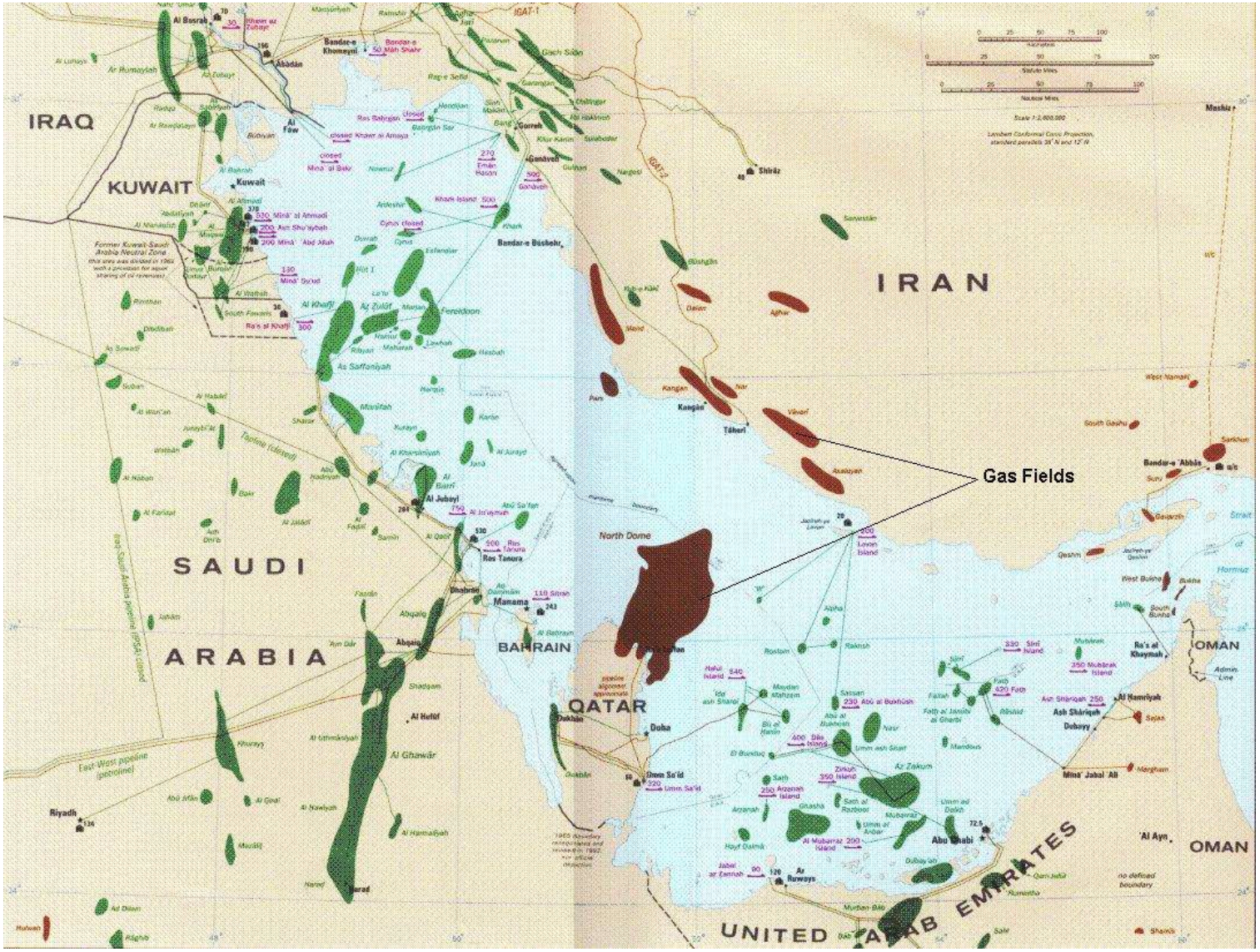
• Unmanned Air Systems (UAS’s) / Unmanned Air Vehicles (UAV’s).

• As the Front Lines will be over the Arabian Gulf region, the Navy will have to play a role in Air Defenses and in a Ballistic Missile Defense Network. Sea based systems will provide an efficient and highly mobile defense against Theater Ballistic Missiles.

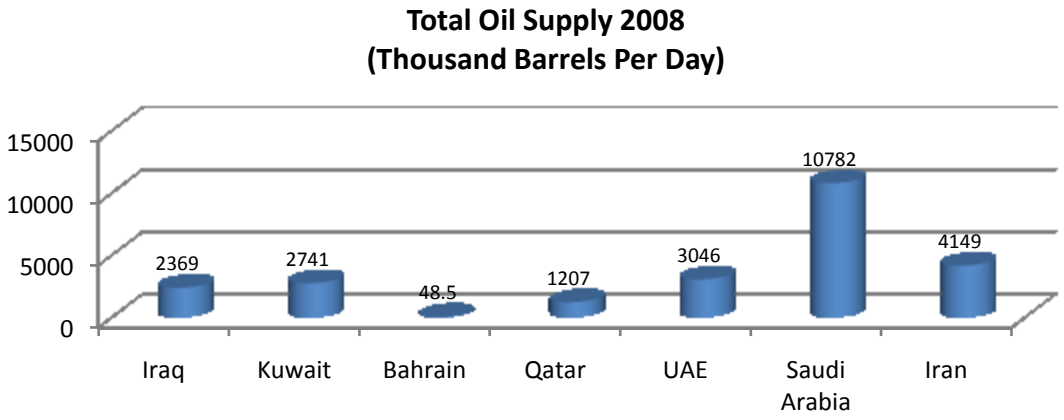
• The Naval System will allow the BMD command to move its defense capabilities close to the enemy sites and serve as a forward deployed sensor and will have the Long Range Engagement and Tracking Capability. This will extend the battle space of the BMDs and contribute to an integrated layered defense.

Enduring Geostrategic Importance of the Gulf

Oil and Gas Fields in the Gulf Region



Gulf States



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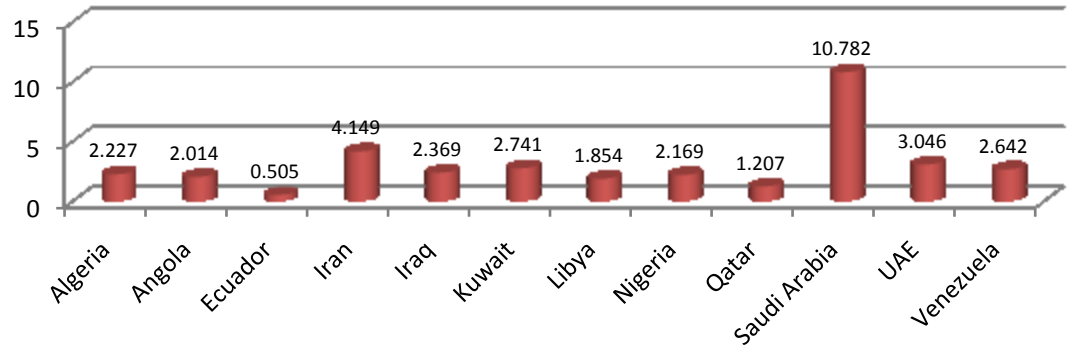
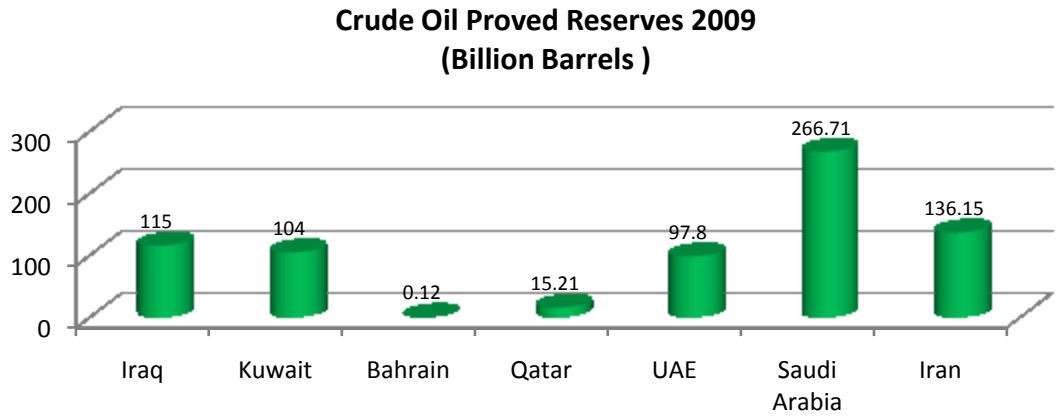


(Source: www.eia.doe.gov)

Gulf States



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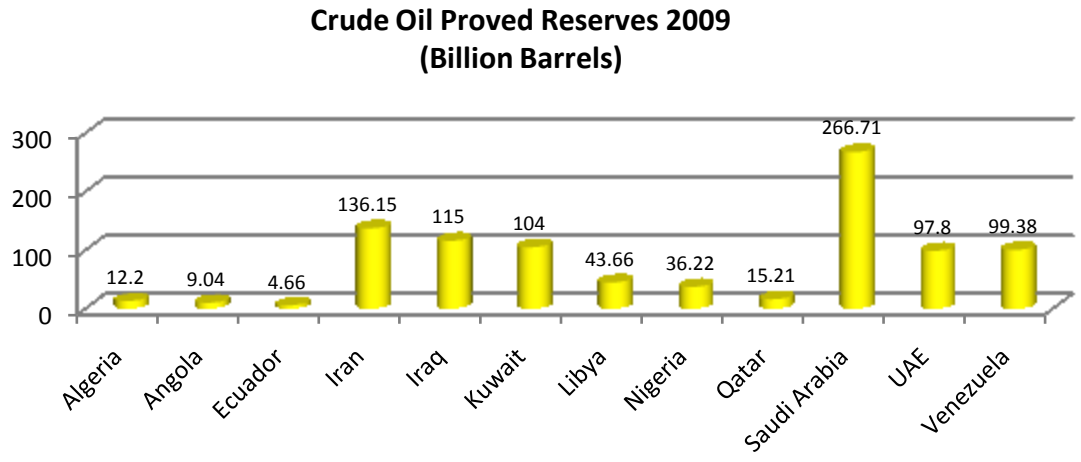
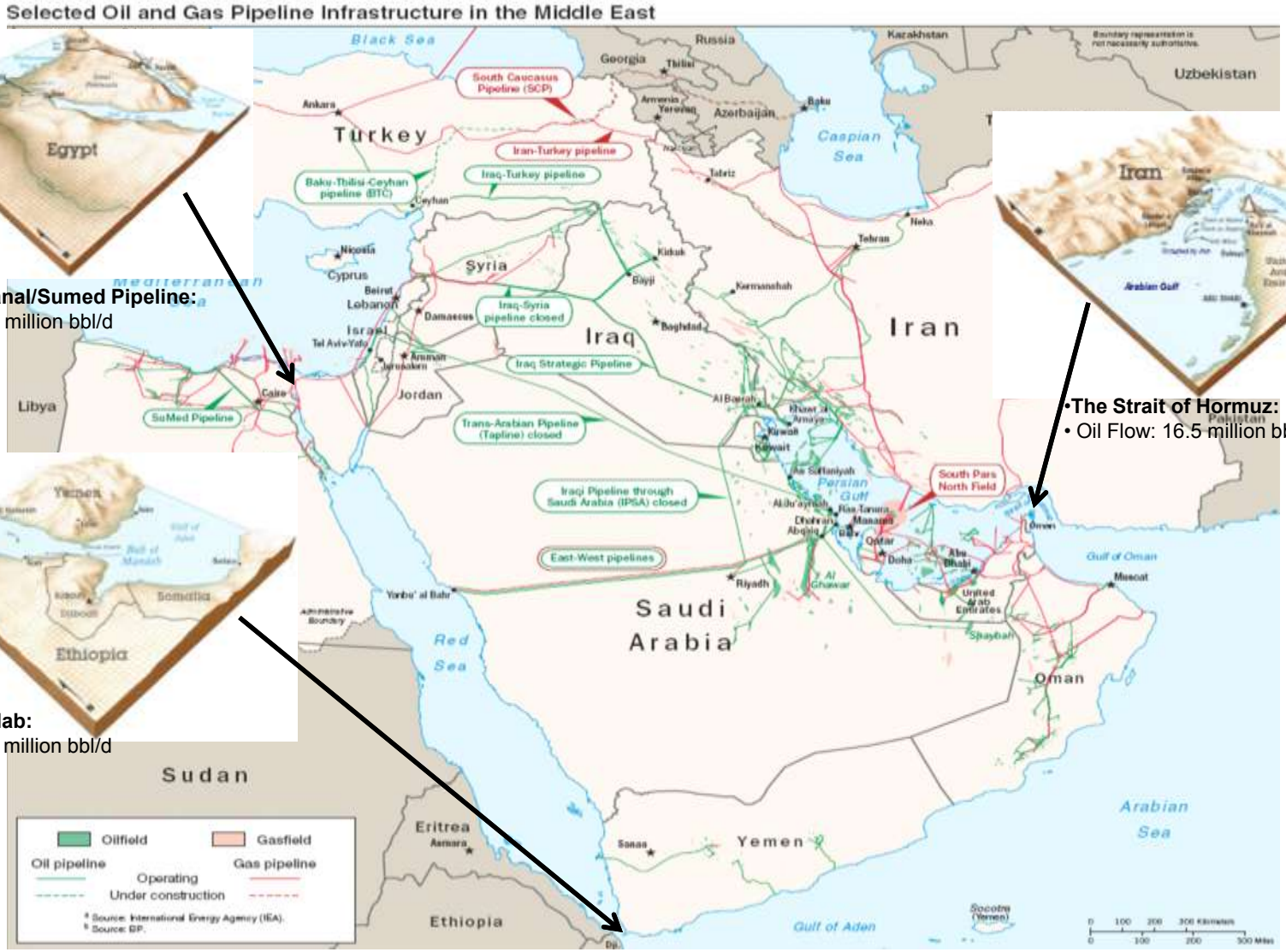


(Source: www.eia.doe.gov)

Gulf Oil and Gas as % of World

	World	Gulf	Gulf % of World	OPEC	OPEC % of World
Crude Oil Proved Oil Reserves (Billion Barrels)	1342	735	55%	940	70%
Total Oil Supply (Million Barrels per Day)	85.5	24.3	28%	35.7	42%
Proved Reserves of Natural Gas (Trillion Cubic Ft)	6,254	2,535	41%	3,110	50%

(Source: www.eia.doe.gov)



•**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

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

Strait of Hormuz

• Strait of Hormuz is the world's most important oil chokepoint due to its daily oil flow of 16.5-17 million barrels (first half 2008E), which is roughly 40 percent of all seaborne traded oil (or 20 percent of oil traded worldwide). Oil flows averaged over 16.5 million barrels per day in 2006, dropped in 2007 to a little over 16 million barrels per day after OPEC cut production, but rose again in 2008 with rising Gulf supplies.

• At its narrowest point the Strait is 21 miles wide, and the shipping lanes consist of two-mile wide channels for inbound and outbound tanker traffic, as well as a two-mile wide buffer zone. The majority of oil exported through the Strait of Hormuz travels to Asia, the United States and Western Europe. Currently, three-quarters of all Japan's oil needs pass through this Strait. On average, 15 crude oil tankers passed through the Strait of Hormuz daily in 2007, along with tankers carrying other petroleum products and liquefied natural gas (LNG).

• Closure of the Strait of Hormuz would require the use of longer alternate routes at increased transportation costs. Alternate routes include the 745 miles-long Petroline, also known as the East-West Pipeline, across Saudi Arabia from Abqaiq to the Red Sea. The East-West Pipeline has a capacity to move five million-bbl/d. The Abqaiq-Yanbu natural gas liquids pipeline, which runs parallel to Petroline to the Red Sea, has a 290,000-bbl/d capacity. Other alternate routes could include the deactivated 1.65-million bbl/d Iraqi Pipeline across Saudi Arabia (IPSA), and the 0.5 million-bbl/d Tapline to Lebanon. Oil could also be pumped north to Ceyhan in Turkey from Iraq.

(Source: http://www.eia.doe.gov/emeu/cabs/World_Oil_Transit_Chokepoints/Hormuz.html)

Bab el-Mandab

• The Strait of Bab el-Mandab is a chokepoint between the horn of Africa and the Middle East, and a strategic link between the Mediterranean Sea and Indian Ocean. It is located between Yemen, Djibouti, and Eritrea, and connects the Red Sea with the Gulf of Aden and the Arabian Sea. Exports from the Gulf must pass through Bab el-Mandab before entering the Suez Canal. In 2006, an estimated 3.3 million bbl/d flowed through this waterway toward Europe, the United States, and Asia. The majority of traffic, around 2.1 million bbl/d, flows northbound through the Bab el-Mandab to the Suez/Sumed complex.

• Bab el-Mandab is 18 miles wide at its narrowest point, making tanker traffic difficult and limited to two 2-mile-wide channels for inbound and outbound shipments. Closure of the Strait could keep tankers from the Gulf from reaching the Suez Canal or Sumed Pipeline, diverting them around the southern tip of Africa. This would effectively engage spare tanker capacity, and add to transit time and cost.

• The Strait of Bab el-Mandab could be bypassed through the East-West oil pipeline, which crosses Saudi Arabia with a 4.8 million bbl/d capacity. However, southbound oil traffic would still be blocked. In addition, closure of the Bab el-Mandab would block non-oil shipping from using the Suez Canal, except for limited trade within the Red Sea region.

• Security remains a concern of foreign firms doing business in the region, after a French tanker was attacked off the coast of Yemen by terrorists in October 2002.

(Source: http://www.eia.doe.gov/emeu/cabs/World_Oil_Transit_Chokepoints/Bab_el-Mandab.html)

Suez/Sumed

• The Suez Canal is located in Egypt, and connects the Red Sea and Gulf of Suez with the Mediterranean Sea. The Canal is one of the world's greatest engineering feats covering 120 miles. Oil shipments from the Gulf travel through the Canal primarily to European ports, but also to the United States. In 2006, an estimated 3.9 million bbl/d of oil flowed northbound through the Suez Canal to the Mediterranean, while 0.6 million bbl/d travelled southbound into the Red Sea.

• Over 3,000 oil tankers pass through the Suez Canal annually, and represent around 25 percent of the Canal's total revenues. With only 1,000 feet at its narrowest point, the Canal is unable to handle large tankers. The Suez Canal Authority (SCA) has discussed widening and deepening the Canal to accommodate VLCCs and Ultra Large Crude Carriers (ULCC).

• The 200-mile long Sumed Pipeline, or Suez-Mediterranean Pipeline, also provides a route between the Red and Mediterranean Seas by crossing the northern region of Egypt from the Ain Sukhna to the Sidi Kerir Terminal. The pipeline provides an alternative to the Suez Canal, and can transport 3.1 million bbl/d of crude oil. In 2006, nearly all of Saudi Arabia's northbound shipments (approximately 2.3 million bbl/d of crude) were transported through the Sumed pipeline. The pipeline is owned by Arab Petroleum Pipeline Co., a joint venture between EGPC, Saudi Aramco, Abu Dhabi's ADNOC, and Kuwaiti companies.

• Closure of the Suez Canal and the Sumed Pipeline would divert tankers around the southern tip of Africa, the Cape of Good Hope, adding 6,000 miles to transit time.

(Source: http://www.eia.doe.gov/emeu/cabs/World_Oil_Transit_Chokepoints/Suez.html)

Important World Oil Transit Chokepoints

Name	2006E oil flow (bbl/d)	Width at Narrowest Point	Oil Source Origin	Primary Destination	Past Disturbances	Alternative Routes
The Strait of Hormuz	16.5 – 17 million	21 miles	Gulf Nations including Saudi Arabia, Iran and UAE	Japan, The United States, Western Europe, other Asian countries	Sea mines were installed during the Iran-Iraq War in the 1980s. Terrorist threats post September 11, 2001	745 miles long East-West Pipeline through Saudi Arabia to the Red Sea
The Strait of Malacca	15 million	1.7 miles	Gulf Nations, West Africa	All Asia/Pacific consumers including Japan and China	Disruptions from pirates are a constant threat, including a terrorist attack in 2003. Collisions and oil spills are also a problem. Poor visibility from smoke haze.	Reroute through the Lombok or Sunda Strait in Indonesia. Possible pipeline construction between Malaysia and Thailand.
The Suez Canal/Sumed Pipeline	4.5 million	1,000 feet	Gulf Nations especially Saudi Arabia, and Asia.	Europe and The United States.	Suez Canal was closed for eight years after the Six Day War in 1967. Two large oil tankers ran aground in 2007 suspending traffic.	Reroute around the southern tip of Africa (the Cape of Good Hope) additional 6,000 miles.
Bab el-Mandab	3.3 million	18 miles	The Gulf Nations	Europe and The United States	USS Cole attack in 2000; French oil tanker in 2002, both attacks off the coast of Aden, Yemen.	Northbound traffic can use the East-West oil pipeline through Saudi-Arabia; Reroute around the southern tip of Africa (the Cape of Good Hope) additional 6,000 miles
The Turkish Straits	2.4 million	0.5 mile	Caspian Sea Region	Western and Southern Europe	Numerous past shipping accidents due to the straits sinuous geography. Some terrorist threats were made after September 11, 2001	No clear alternative; potential pipelines discussed including a 173 mile pipeline between Russia, Bulgaria, and Greece.
The Panama Canal	0.5 million	110 feet	The United States	The United States, and other Central American countries	Suspected terrorist target.	Reroute around Straits of Magellan, Cape Horn and Drake Passage; additional 8,000 miles.

(Source: http://www.eia.doe.gov/emeu/cabs/World_Oil_Transit_Chokepoints/Background.html)

GCC and Iran Order of Battle

Air Bases and Air Force Order of Battle (2009)

Three Main Iranian Nuclear Facilities

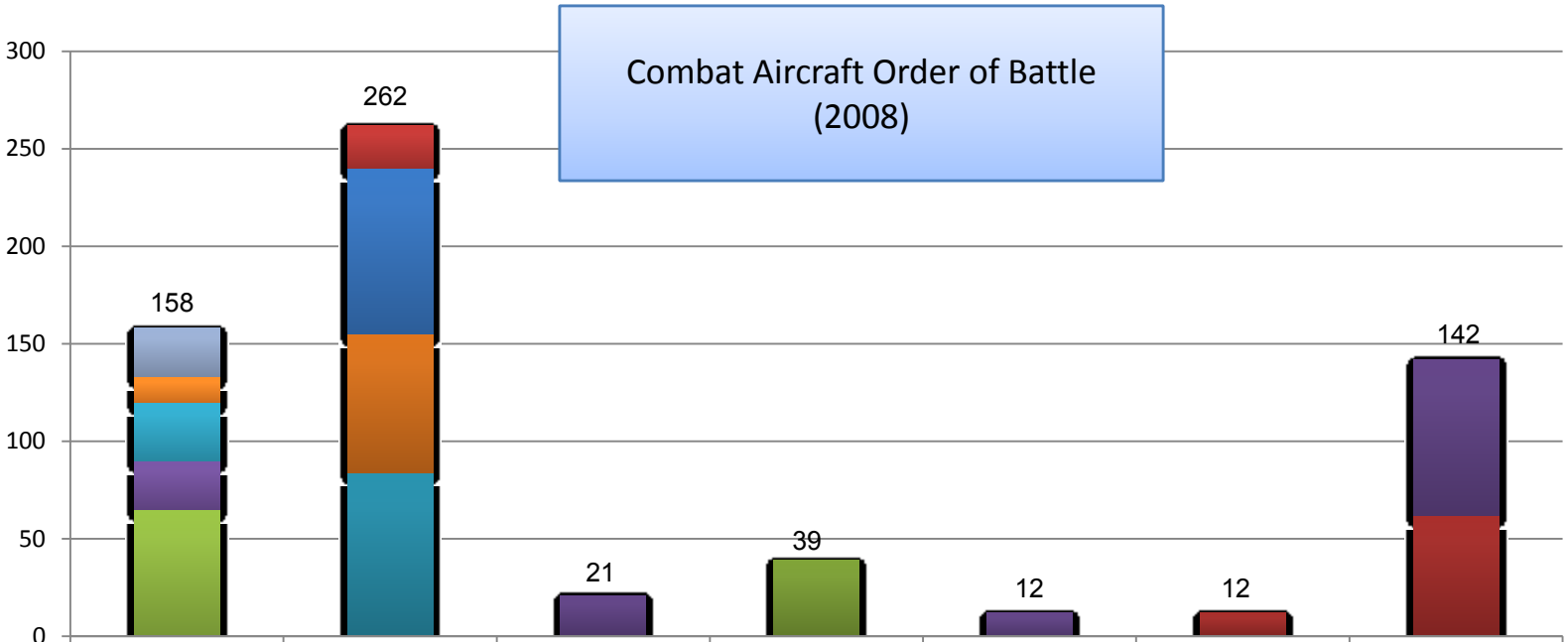
- Natanz: Uranium Enrichment Facility
- Arak: Heavy Water Nuclear Reactor and Possible Future Plutonium Production Reactor
- Esfahan: Nuclear Research Center. Uranium Conversion Facility (UCF)

Air Bases Source: Global Security.org
Order of Battle Source: Anthony Cordesman and Adam Seitz CSIS "Iranian Weapons of Mass Destruction: The Birth of a regional Nuclear Arms Race". Feb 14, 2009.

	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

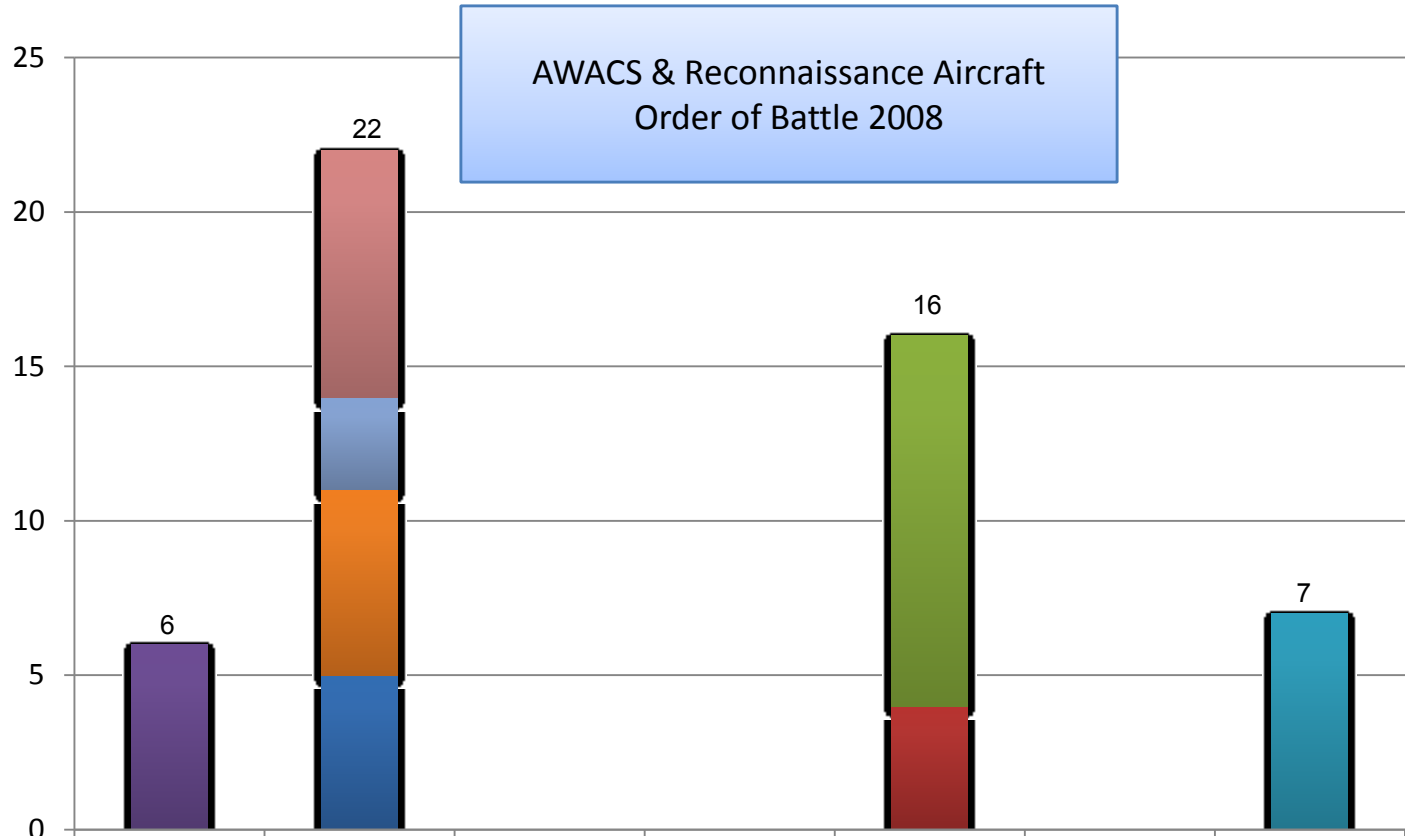
Iran Airbases

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	Saudi Arabia	Bahrain	Kuwait	Oman	Qatar	UAE
MiG-29	25						
Su-25	13						
Su-24	30						
F-14	25						
F-4E/D	65						
Tornado ADV		22					
Tornado IDS		85					
F-15S		71					
F-15C/D		84					
F-16C/D			21		12		80
F-18				39			
M2000						12	62

(Source: Anthony Cordesman CSIS)



	Iran	Saudi Arabia	Bahrain	Kuwait	Oman	Qatar	UAE
SB7L-360		8					
Cessna 208B		3					
CH-2000		6					
M2000 RAD							7
RF-4E	6						
PC-9					12		
Hawk 203					4		
E3A AWACS		5					

(Source: Anthony Cordesman CSIS)

Gulf Land-Based Air Defense Systems in 2008

Country	Major SA	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 SCIS)

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			

States with Nuclear Weapons

Israel	Pakistan	India	Iran (Potential)

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.

Part I
U.S. Air Force Doctrine
Definition of Functions and Missions

• Air Force forces employ air and space power globally through the following specific functions to achieve Strategic-, Operational-, and Tactical – level objectives.

- Strategic Attack
- Counterair
- Counterspace
- Countersea
- Information Operations
- Combat Support
- Command & Control
- Airlift
- Air Refueling
- Spacelift
- Special Operations
- Intelligence
- Surveillance & Reconnaissance
- Combat Search & Rescue
- Navigation & Positioning
- Weather Services

• These battle proven functions can be conducted at any level of war and enable the Air Force to shape and control the battlespace.

(Source: US Air Force Basic Doctrine AFDD 1, 2003)

Strategic Attack

• **Strategic attack is defined as offensive action conducted by command authorities at generating effects that most directly achieve our national security objectives by affecting the adversary's leadership, conflict-sustaining resources, and strategy.**

Military forces are highly interconnected entities. Through strategic attack, military commanders can directly affect adversary leadership perceptions (either by isolation, deception, or exploitation) and cut off their fielded forces from their leadership and societies, as well as directly attack the adversary's capacity to sustain military forces in the field.

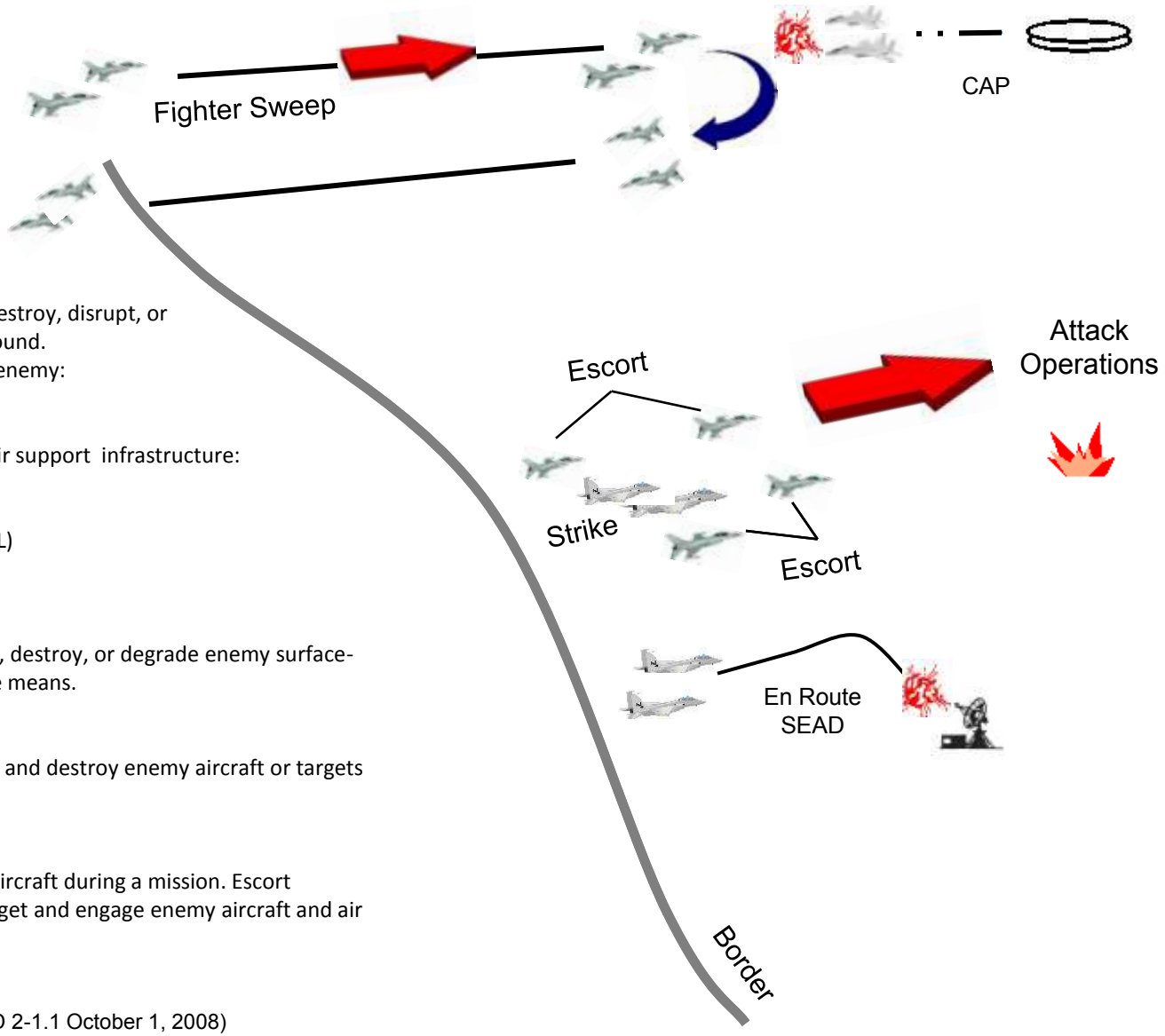
• **Air and space power is inherently a strategic force and an offensive weapon. Unlike other forms of military power, air and space power may simultaneously hold all of an enemy's instruments of power at risk – military, economic, and diplomatic.**

Employed properly, it offers the capability of going to the heart of the enemy sources of strength, avoiding prolonged attrition-based surface combat operations as a precursor.

• **Strategic attack, as envisioned today, is more than just a function—it is also a different approach for thinking about war. It is the manifestation of the airman's perspective: thinking about defeating the enemy as a system.**

(Source: Strategic Attack USAF AFDD2-1.2, June 12, 2007)

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:
  - Missile Sites
  - Airfields
  - Command Control and their support infrastructure:
    - Launch Sites
    - Launchers
    - Fuel Supplies (POL)
    - Runways

❑ 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.

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

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.

Counterland

❑ **Counterland** is defined as air and space operations against enemy land force capabilities.

• The main objectives of counterland operations are to dominate the surface environment and prevent the opponent from doing the same. Counterland provides the Joint Force Commander (JFC) two discrete air operations for engaging enemy land forces:

- **Air interdiction (AI)**, in which air maneuver indirectly supports land maneuver or directly supports an air scheme of maneuver, and

- **Close air support (CAS)**, in which air maneuver directly supports land maneuver.

❑ **Air interdiction is air and space** power's application of interdiction. Air interdiction is a form of aerial maneuver that destroys, disrupts, diverts, or delays the enemy's surface military potential before it can be used effectively against friendly forces, or otherwise achieve its objectives.

AI is directed against enemy land force capabilities and associated infrastructure that contribute directly to or are maneuvering to reinforce the ground battle.

❑ **Close Air Support (CAS):**
CAS provides direct support to help friendly surface forces in contact with enemy forces carry out their assigned tasks.

CAS can halt attacks, help create breakthroughs, cover retreats, and guard flanks.

❑ Counterland Operations require an integrated, flexible, and responsive Command & Control structure to process Air and Space Power requirements, and a dependable, interoperable, and secure communications architecture to exercise control.

(Source: Counterland Operations USAF AFDD 2-1.3 , 11 September 11 2006)

Countersea

❑ **Countersea** operations are those operations conducted to attain and maintain a desired degree of maritime superiority by the destruction, disruption, delay, diversion, or other neutralization of threats in the maritime environment.

The main objective of countersea operations is to secure and dominate the maritime environment and prevent opponents from doing the same.

The countersea function entails Air Force operations in the maritime environment to achieve, or aid in the achievement of, superiority in that medium.

The identified Air Force specialized collateral functions are:

- Surface Sea surveillance and anti surface ship warfare through air and space operations.
- Antisubmarine warfare and anti-air warfare operations to protect sea lines of communications.
- Aerial mine-laying operations
- Air-to-air refueling in support of naval air operations.

Many of these collateral tasks translate to primary functions of air and space forces such as interdiction, counterair, and strategic attack.

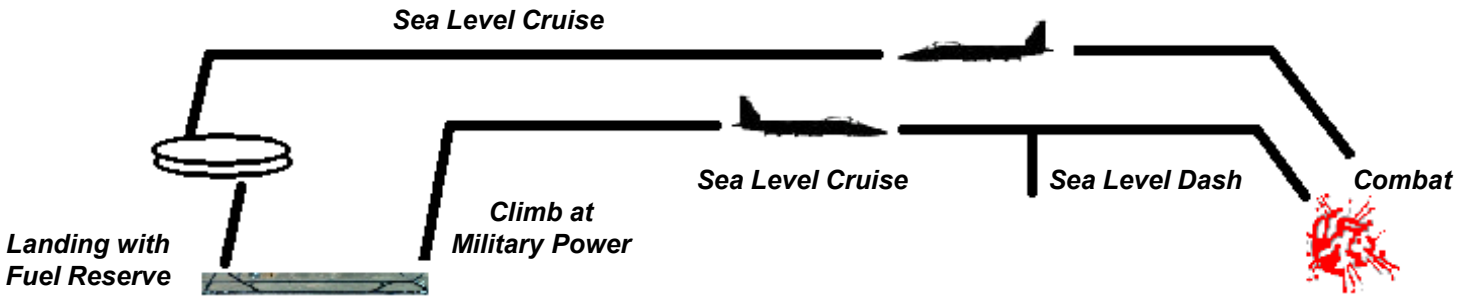
As with the air and space functions, countersea operations are designed to achieve strategic-, operational-, or tactical-level objectives in the pursuit of joint force objectives.

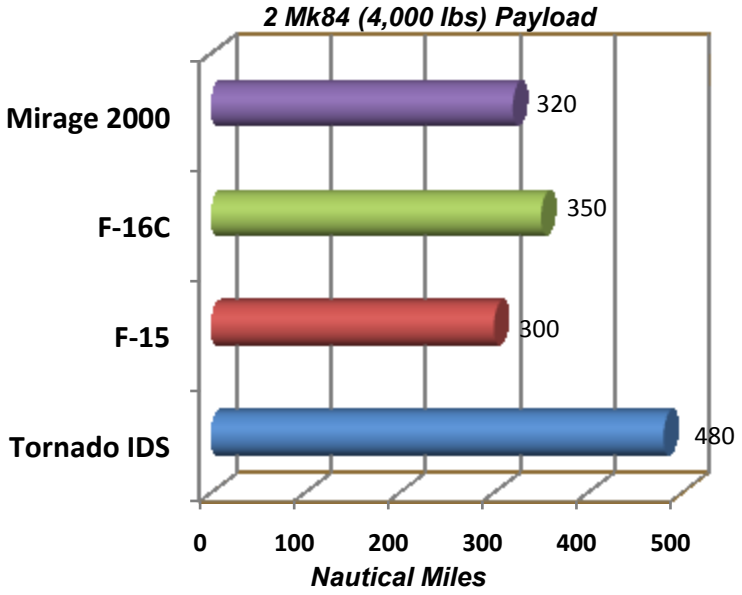
The objective is to gain control of the medium and, to the extent possible, dominate operations either in conjunction with naval forces or independently.

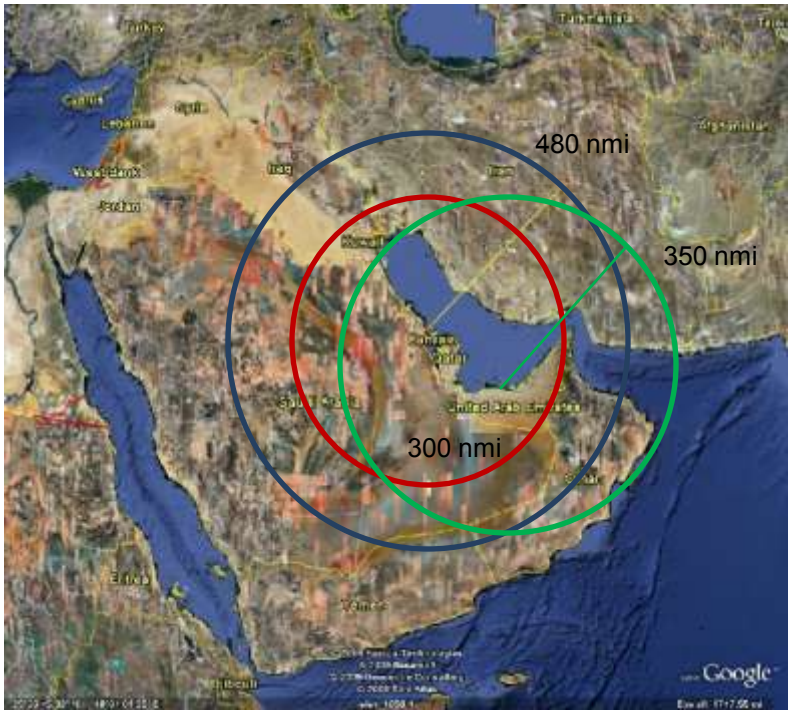
(Source Countersea Operations: USAF AFDD 2-1.4 September 15, 2005)

Air to Ground
Mission Profiles and Weapon Systems

Air to Ground Ranges of GCC Aircraft
Lo-Lo-Lo-Lo Profile
(External Fuel Tanks Dropped on Combat)

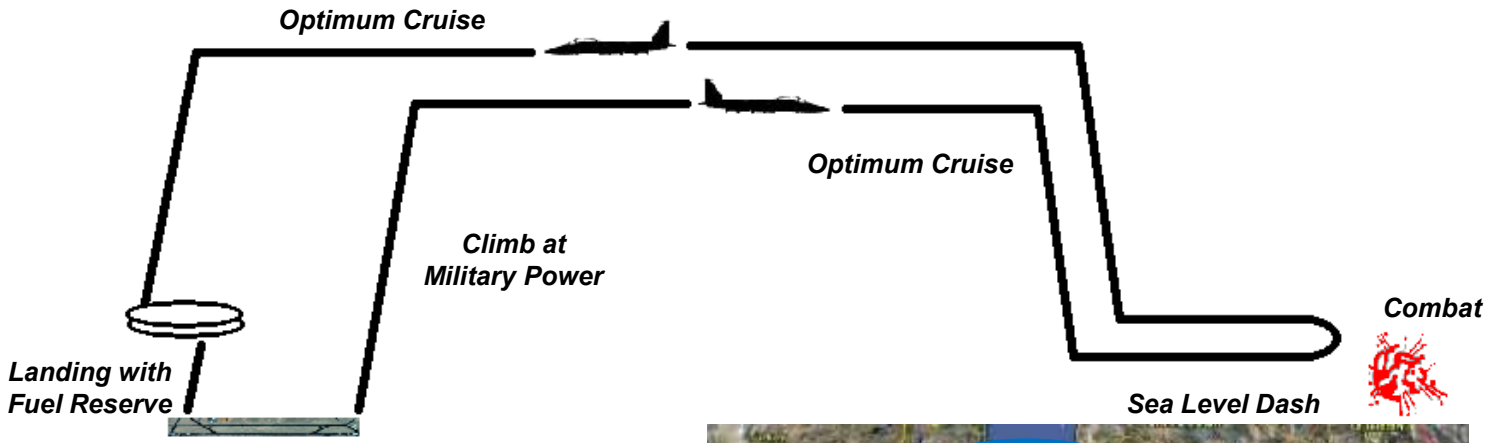


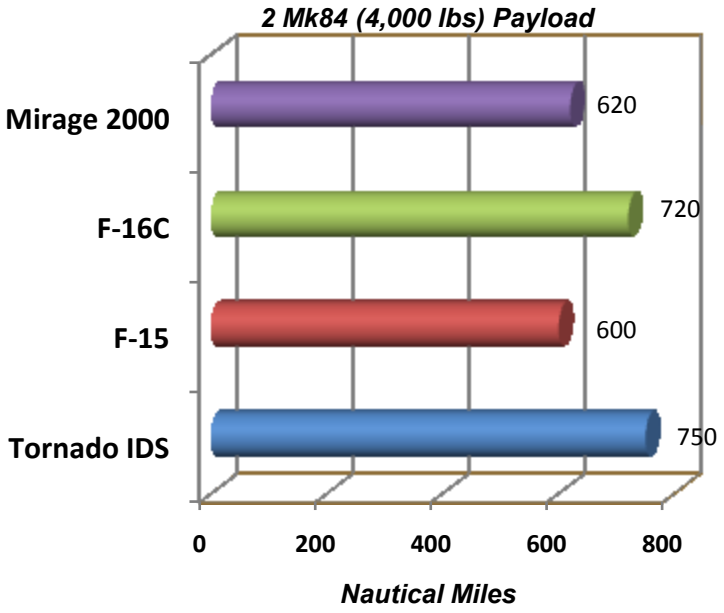


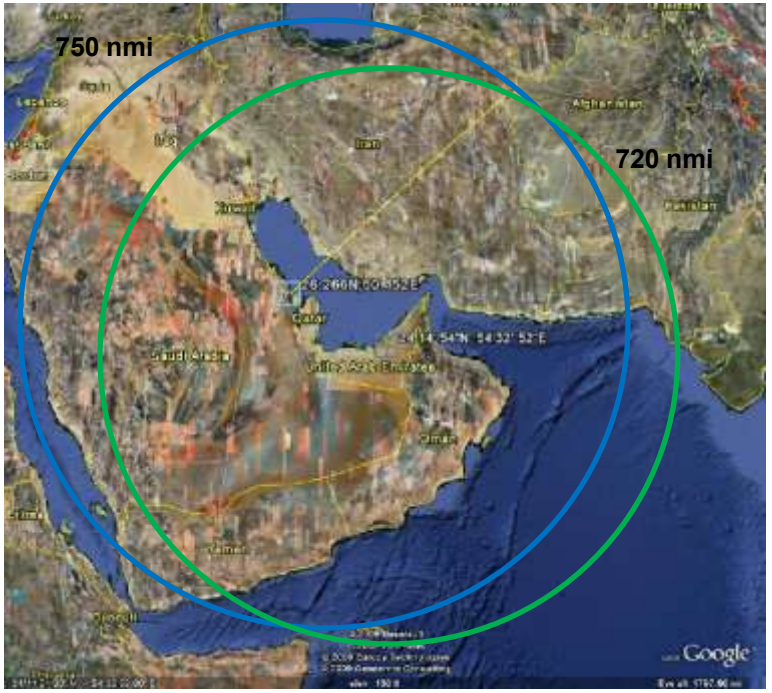


- *Tornado IDS/F-15 Launched from King Abdulaziz Air Base*
- *F-16C/Mirage 2000 Launched from UAE*

Air to Ground Ranges of GCC Aircraft
Hi-Lo-Lo-Hi Profile
(External Fuel Tanks Dropped on Combat)

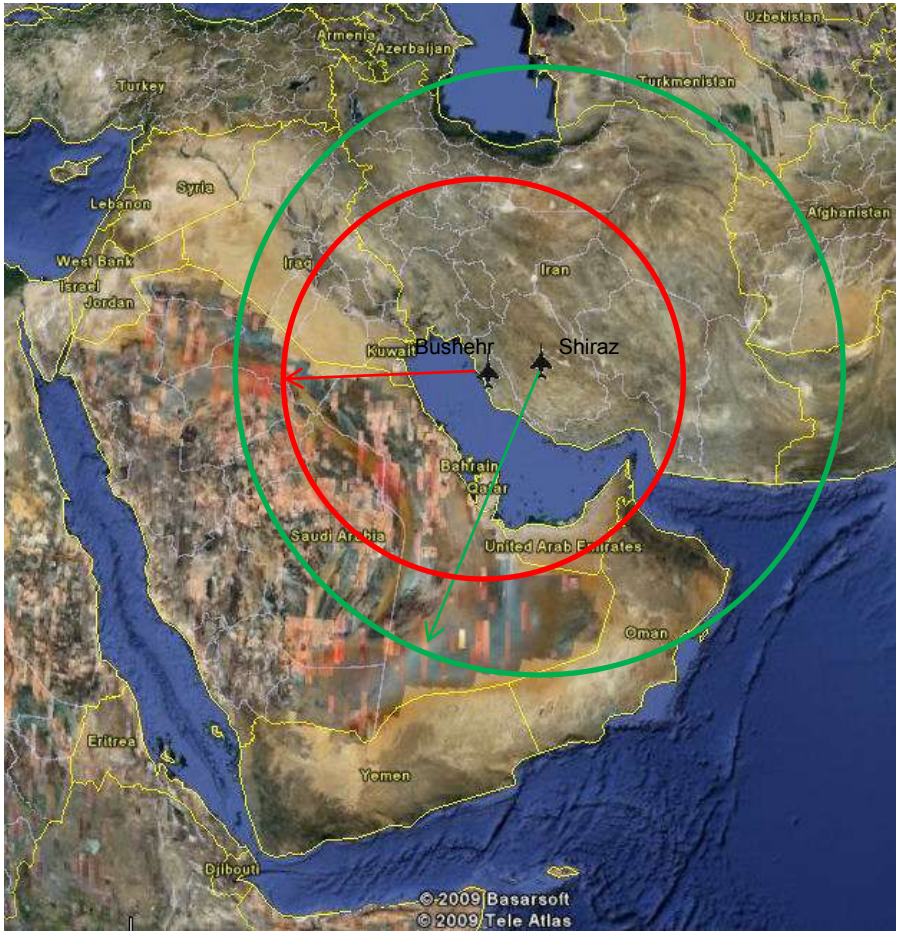






- *Tornado IDS/F-15 Launched from King Abdulaziz Air Base*
- *F-16C/Mirage 2000 Launched from UAE*

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

• Old weapons provided good capability against most targets at moderate cost, particularly with appropriate weapon/target matching and with automated bombing system (5 to 10 mil CEP). Typically the first pass attack is a low altitude run, pop-up to a couple of thousand feet, CCIP delivery at 30 to 45 degrees dive.

•This would increase exposure to ground based SAM/AAA air defense systems in the target area, increasing aircraft loss rate, decreasing survivability thereby lowering number of sorties, eventually target kills.

• Old weapons mainly consist of:

- Conventional Iron Bombs (MK-80 Series Low Drag and Retarded)
- Canister Weapons (Rockeye, CBU's)
- Guided Weapons (TV Maverick)

• Current weapons provide large increases in targets killed per sortie, without dependency on heavy payloads, flexible delivery profile and standoff which also improve aircraft survivability.

- Advanced Canister Weapons (Tactical Munitions Dispensers) with various submunitions including mines for efficient runway cratering and multiple armor kills.
- Improved Guided Weapons, Such as the GPS/INS for mid course navigation and Imaging Infra Red for terminal homing.

Current and Future Weapons Systems Operational Requirements resulting in:

• High single-shot kill probability
• Weapons that serve as an effective force multiplier
• Stand-off capability, Operating from ranges outside enemy point defenses.
• Low and High altitude launch, outside the lethal ranges of current and future SAM systems.
• Preserving crew and aircraft survivability
• Being effective against a wide array of Land and Sea targets
• Weapons that employ Launch and Leave with high accuracy, such as
  - Coupled GPS/INS for mid course navigation
  - Imaging Infra Red and data link for Terminal Homing
• Capable of Day/Night and Adverse Weather conditions

Weapon System	Guidance	Mission	Warhead	Range & CEP
Joint Direct Attack Munition (JDAM) Variants: GBU-29 : 25lb MK80 GBU-30 : 500lb MK81 GBU-31 : 1000lb MK83 GBU-32 : 2000lb MK84 Hard Target penetrators: BLU-109 2000lb Blu-110 1000lb	Accurate delivery of General Purpose Bombs. Guidance consists of an INS/GPS in the tail section. JDAM Product Improvement Plan PIP GPS/INS mid-course with a terminal seeker to provide a CEP of 3m	Close Air Support (CAS) Air Interdiction Offensive Counterair Suppression of Enemy Air Defense (SEAD) Naval Anti-Surface Warfare Amphibious Strike	Warhead: BLU-109 Penetrator MK84; Warhead: 535 lbs Tritonal (BLU-109) 945 lbs Tritonal (MK 84)	Up to 15 nautical miles 13 m using integrated GPS/INS unit 30 m using INS only
GBU-10 Paveway II GBU-10E/B : MK84 2000lb GBU-12D/B : MK82 500lb GBU-16B/B : MK83 1000lb MK13 / 18 : 1000lb	Laser Guided Bomb. The operator illuminates a target with a laser designator and then the bomb is guided to a spot of laser energy reflected from the target.	Air Interdiction Bridges, SCUDS, C4I Nodes and Bunkers	Warhead: BLU-109 Penetrator MK84 lb; Blast/Fragmentation Explosive: 535 lbs Tritonal (BLU-109) 945 lbs Tritonal (Mk 84)	Up to 8 nmi CEP= 9m
GBU-15	Unpowered Glide Weapon. The weapon is remotely controlled by a data link system, and operator locates the target area and the specific aim point by observing the video transmitted from the weapon. Weapon Video is either Electro-Optical (TV Camera) or Infra-Red.	Offensive Counterair Close Air Support Air Interdiction Naval Anti-Surface Warfare	MK84 GP Bombs BLU-109 Penetrating Bombs Explosive: 535 lbs Tritonal (BLU-109) 945 lbs Tritonal (Mk 84)	Greater than 5 nmi
GBU-24 Paveway III LLLGB Developed in response to sophisticated enemy air defenses, poor visibility and to counter limitations in low ceilings.	Low Level Laser Guided	Close Air Support (CAS) Air Interdiction Offensive Counterair Naval Anti-Surface Warfare Mobile Hard, Fixed Hard and Soft Targets.	MK84 GP Bombs BLU-109 Penetrating Bombs Explosive: 535 lbs Tritonal (BLU-109) 945 lbs Tritonal (Mk 84)	Up to 10nmi Designed for low altitude delivery and with a capability of improved standoff ranges to reduce exposure.
GBU-27/28		GBU-27 : Penetrates 1.8 to 2.4 meters of concrete hard targets. GBU-28 : Bunker Buster. Penetrates at least 6 meters of concrete (reinforced) and 30 m of earth.	GBU-27 : BLU-109 2000lb Class warhead. 550 lbs explosive GBU-28 : BLU-113 4000lb Class warhead. 630 lbs of explosive.	

Airfield Attack Current Weapons and Methods

JP 233

The JP 233 was a British submunition delivery system used on the Tornado IDS. Each JP 233 was divided into a rear section with 30 SG-357 Runway Cratering Submunitions and the front section carrying 215 HB-876 anti-personnel mines. Both types were retarded by small parachutes.

The SG-357 weighed 26 kilograms and was a two-stage munition – a shaped charge in the front blasted a hole in the runway's concrete. A second charge fell into the hole and exploded, producing a large crater. The HB-876 (2.4 kg) anti-personnel mines would lie scattered on the surface, making rapid repair of the runways nearly impossible. They would explode at preset intervals or if disturbed were capable of disabling bulldozers or other earth-moving equipment.

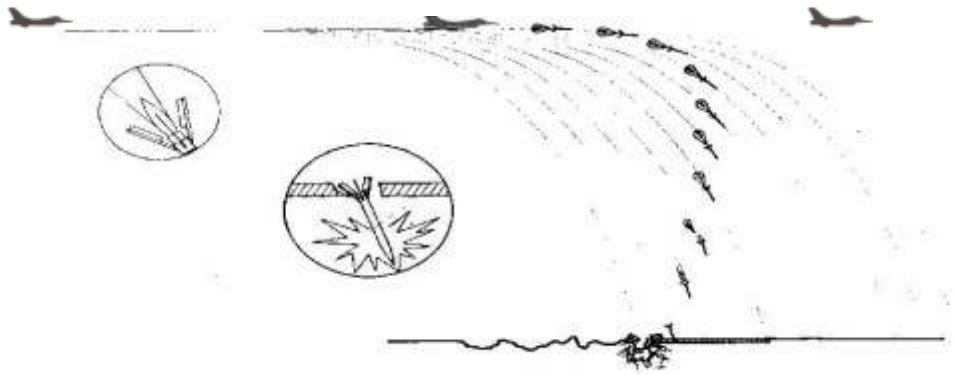
Durandal

- Released in horizontal flight:
    - At very low level of 180 feet with aircraft speed between 280 to 600 knots.
- Terminal Impact Speed: 250 m/sec
- Warhead: 30 lb explosive (TNT Tolite)
- Crater Dimensions:
    - Diameter: 20 ft
    - Depth: 10 ft

BAP 100 mm
MBDA France

BAP 100 is a lightweight air launched runway attack bomb designed in the 1970s as an alternative to the BLU-107 Durandal Antirunway Weapon.

Bomb Length Bomb Weight Adapter of 6: Adapter of 18:	1.8 m 36 kg 240 kg 760 kg
Parachute Dragging For Safety For verticality 45 degrees 70 degrees	 320 m A/C at 560 knots Z = 50m and time = 3.25 seconds Z = 80m and time = 4.25 seconds
Booster Acceleration Penetration Speed Area damaged by one bomb	 220 m/sec 50 square meters
Fuze	Has a fuze delay action allowing an explosion delay after the bomb strikes the target.



Cluster Munitions

Weapon	Targets	Submunitions	Release & Footprint	Notes
CBU-97 Sensor Fuzed Weapon (SFW).	Tanks and Support Vehicles	10 Submunitions which are parachute stabilized. Each of the BLU-108/B submunitions contains 4 armor penetrating projectiles with infrared sensors to detect armored targets, prioviding 40 weapons total.	Weapon can be delivered in all weather conditions, day and night, from altitudes of 200 ft to 20,000 ft at speeds between 250 to 650 knots. Each CBU-97/B can cover an area of about 500 x 1200 ft.	The primary components of this 1,000lb class weapon are the SUU-66/B Tactical Munitions Dispensor, 10 BLU-108/B submunitions, and 40 “hockey puck” shaped skeet infrared sensing projectiles. Wind Corrected Munition Dispensor (WCMD) tail kit on SFW redesigned as a CBU-105, the delivery increases up to 40,000 ft and stand off ranges up to 12 miles can be achieved.
BL 755 Cluster Bomb	Primary targets are Armored Vehicles and Tanks with secondary soft targets (ant-personnel) capabilities.	147 Submunitions	At 200 ft release altitude and 450 knots speed, pattern dimensions 500 length x 100 ft width.	
BLU-97/B Combined Effects Bomb (CEB)	Armor, Personnel and Material.	A total of 202 bomblets are loaded in each dispensor.	Approximately 650 x 1300 ft	
Beluga Grenade Dispensor Bomb	General Purpose (with fragmentation grenades): Convoy of vehicles, POL, Parked Aircraft. Anti Tank (with shaped charge grenades): Tanks (stopped or slowed down), Armored Troop Carriers. Interdiction (with delayed explosion grenades): Port and Harbour areas, Roads.	151 grenades Grenade mass : 1.3 kg Diameter : 66mm	Area Covered: 40 x 120 m short carpet 40 x 240 m long carpet Can be released from altitudes of 60m (200 ft) and above, at speeds between 350 to 550 knots.	In the case of low level release against tanks, the grenade is capable of piercing up to 300mm of steel plates, landing on the top part of the tank thereby enhancing the kill probability.
MK 20 Rockeye	Tanks and Armored vehicles	247 piercing MK 118 bomblets. Each bomblet contains 100lbs of high explosive.	Release from 500ft and speed 550 knots, Dispersal Pattern: 200ft length x 425ft width.	

AGM-65 Maverick Air to Ground Missile

AGM-65 A/B	TV Guidance
AGM-65C	Laser Guidance Specifically designed for Close Air Support
AGM-65D	Imaging Infra Red Seeker Head
AGM-65E	Has a large penetrator warhead 300lb
AGM -65F	Deployed by the Navy. Identical to AGM-65D except that it has a larger 300lb warhead
AGM-65G	Deployed by the USAF, IIR seeker and a 300lb warhead

Anti Ship Missiles

Missile	Guidance	Maximum Range (nmi)	Platform
AM-39 Exocet	Inertial and Active Homing	38	Air Launched
AGM 84D Harpoon	Active Radar	90 +	Air Launched
AS 15TT	Radar & Radar Altimeter	9.2	Helicopter Launched

SAM Air Defense Systems and SEAD

Surveillance Radars:

• An effective surveillance radar system in a conflict environment must have the capability to deal with all types of air vehicles:

- Combat Aircraft and Bombers
- Tankers, AWACS, Signal Intelligence Gathering Platforms….
- Cruise Missiles
- Helicopters
- Unmanned Air Systems/Unmanned Air vehicles
- Tactical Ballistic Missiles
- Civilian Aircraft

• A ground based surveillance radar platform performs the functions of Detection, Tracking and Identification of the Air Vehicle.

• Combat aircraft and bombers are the traditional targets on which the information is required. This can be obtained by a number of ways. For instance if information is required to support Defensive Counterair Operations (Combat Air Patrol and Strip Launched Interceptors CAP/SLI).

• This might require that the radar coverage range extend some distance (usually 100nmi) in front of the friendly combat aircraft. However, this is dependent on how much Early Warning time does the overall Air Defense System of a defending Country need to effectively respond and to maximize the number of scrambled strip launched interceptors.

• Similarly in determining the surveillance-radar system needed to confront Ballistic Missiles and Stand-Off Missiles will depend on the requirement:

- How much National Defense is required to accomplish specific Political and Military Objectives, assuming a given level of technical performance for the defense system / surveillance radar.

- One can imagine several plausible objectives for instance:
    - Completely blocking an attack of a given size.
    - Attenuating an attack by a certain percentage.
    - Protecting some target set so that a specified fraction of the defended targets survive a given attack.

(Source: A Simple Model for Calculating Ballistic Missile Defense Effectiveness. Dean Wilkening. Science and Global Security 1999, Volume 8.2, pp. 183-215)

Iran's Current Air/Missile Defenses

- U.S. never delivered integrated system before fall of Shah.
- Only modern short-range point defense system is TOR-M.
- Other short-range systems mix of older Russian system, SHORADs, and aging – possible inactive British and French systems.
- Medium to long-range systems are low capability or obsolescent.
- HAWKS and IHAWKs do not have capable ECM. Date back to 1960s and 1970s.
- Various versions of SA-2 obsolete.
- Radar sensor and battle management/C4I systems have major limitations.
- Less than 30 export versions of MiG-29, some not operational.
- F-14s do not have ability to use primary air defense missile since 1979-1980.

(Source: Anthony Cordesman Security Challenges and Threats in the Gulf: A Net Assessment. September 2008)

TOR-M Short Range Air Defense

• Russia has delivered an undetermined number –- possibly 29 --Tor-M1 systems (originally built for Greece) to the Islamic Republic of Iran, along with service contracts with an approximate value of $700,000,000.

• The Tor is low- to medium-altitude, short-range surface-to-air missile system designed for engaging airplanes, helicopters, cruise missiles, precision guided munitions, unmanned aerial vehicles and ballistic targets. NATO reporting names are SA-15 Gauntlet and SA-N-9 Gauntlet. It is designed to protect targets from attack day or night in any weather, not only by shooting down attacking aircraft but also by destroying any munitions before they reach their target.

• From the start the Tor system was designed to provide air defense against modern and future threats equipped with precision guided weapons like the AGM-86 ALCM.

• Tor missile system was accepted into service on the 19th March 1986. The Tor-M1 air has an additional fire control channel allowing two targets to be engaged at once, an improved optical channel, computer, ECM protection and warhead The Tor-M1-1 or Tor-M1V has improved network connectivity and ECM functions. The latest variant -- the Tor-M2E—has improved fire control radar coverage and four guidance channels allowing four missiles to be guided at any one time, plus a new wheeled chassis as well as a new digital computer system and a new all weather optical tracking system.

• Each 9K331 vehicle is a completely autonomous transporter, launcher, and radar unit TLAR that carries a modern phased array radar and 8 missiles stored vertically, ready to fire.

• Target tracking range is 24 km (15 miles), engagement range is up to 12 km (1-7.5 miles) with minimum range varying between 100-2000 m (328-5,621 feet), depending upon version. Effective Altitude is 10-6000m (33-20,000 ft).

• The digital computers allow for a high degree of automation, similar to the US Patriot missile system. Target threat classification is automatic. The system can be operated with little operator input, if desired. It is equipped with NBC (nuclear, biological and chemical) protection.

• The missiles utilize command guidance and their detonation is via a radar proximity fuze. The missiles can maneuver at up to 30Gsand can engage targets flying at up to Mach 2.

(Source: Anthony Cordesman Security Challenges and Threats in the Gulf: A Net Assessment. September 2008)

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

• For SAM kill envelopes See Appendix II

AS 37
Air to Ground Anti Radar Missile

Mission	Suppression of Enemy Air Defense (SEAD)
Target	Surveillance, Tracking, Fire Control Radars. L, S and C Bands L : 900 – 1400 MHz S : 2700 – 3300 MHz C : 5000 – 5800 MHz Fire and Forget
Warhead	140 kg Blast Type capable of putting antennas or structures out of action from distance up to 16m. Blast pressure between 40 to 50 psi.
Accuracy	CEP up to 12 meters
Range	Maximum Firing Distance at M 0.9 = 30 km Minimum Firing Distance at Low Altitude = 15 km At 9,000 meters altitude: M 0.9 Range = 70 km M 1.2 Range = 80 km 12,000 meters altitude: M 1.2 Range = 95 km

Western Anti - Radar Missiles

Missile	Guidance	Maximum Range (nmi)
AGM-88 HARM	Passive Radar Homing	60 +
SHRIKE 45A (ARM)	Passive Radar Homing	7 to 9
AGM 780 Standard ARM	Passive Radar Homing	13.5 to 30

AS 30 L
Air to Ground Laser Guided Missile (MBDA France)

Propulsion	2 Stage Mach 09 Supersonic on Target
Navigation	Proportional Navigation in Final Guidance
Guidance	Laser reflection from target
Warhead	Blast Fragmentation.
Range	Maximum Range 10 km Stand off maneuver 7.5 km 4 G with illuminator Minimum Range 3.5 km

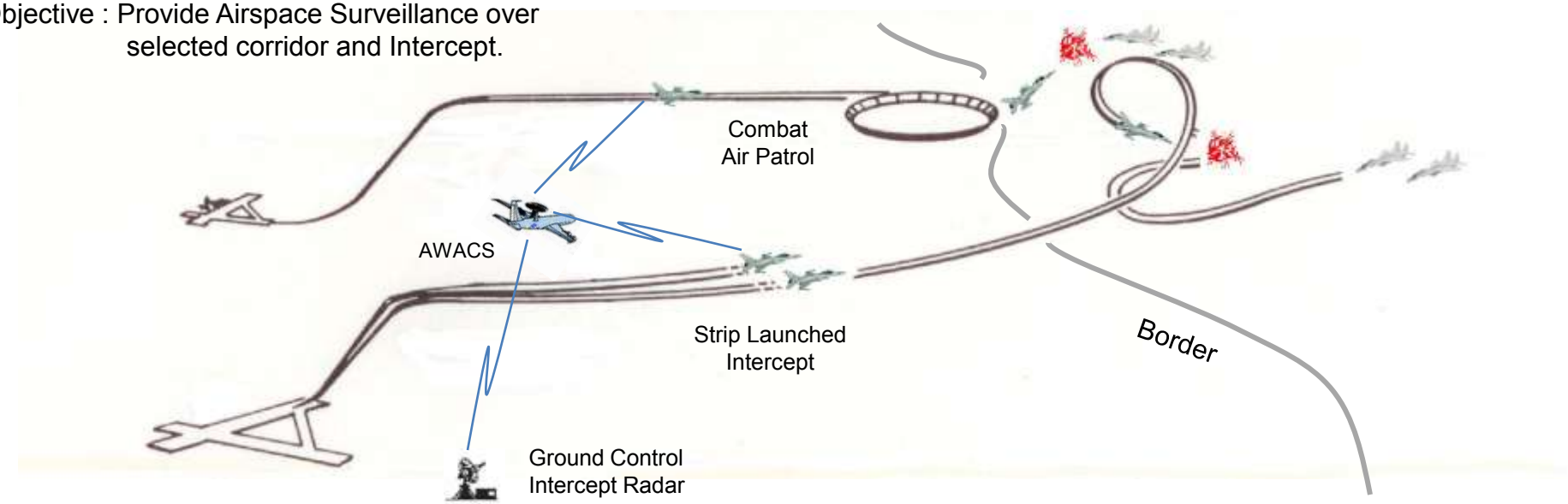
Russian Air To Surface Missiles

Missile Designation	Guidance System	Range (km)	Platform
Zvezda / AA-7	Radio Command	10	MiG-23
Raduga / AS-9	Anti-Radiation Homing (Anti – Radar)	120	Su-24
Zvezda / AS-10	Radio Command / Anti Radiation Homing	20	MiG-23 / Su-24M
Raduga / AS-11	Anti-Radiation Homing	120	MiG-23 / Su-24M
Zvezda Kh-27 / AS-12	Anti-Radiation Homing	60	MiG-23
Molinya / AS-14	Semi Active Laser Guidance / Electro Optical	10	MiG-23 / Su-24M

Defensive Counterair Operations DCA

Defensive Counterair Operations

Mission : Defense of Border from Enemy Intrusion.
Objective : Provide Airspace Surveillance over selected corridor and Intercept.



❑Active Air and Missile Defense

Active defense is defensive action taken to destroy, nullify, or reduce the effectiveness of air and missile threats against friendly forces and assets. It consists of two broad categories:

- Air Defense

  Defensive measures designed to destroy attacking enemy combat aircraft or unmanned air vehicles, or to nullify or reduce the effectiveness of such an attack.

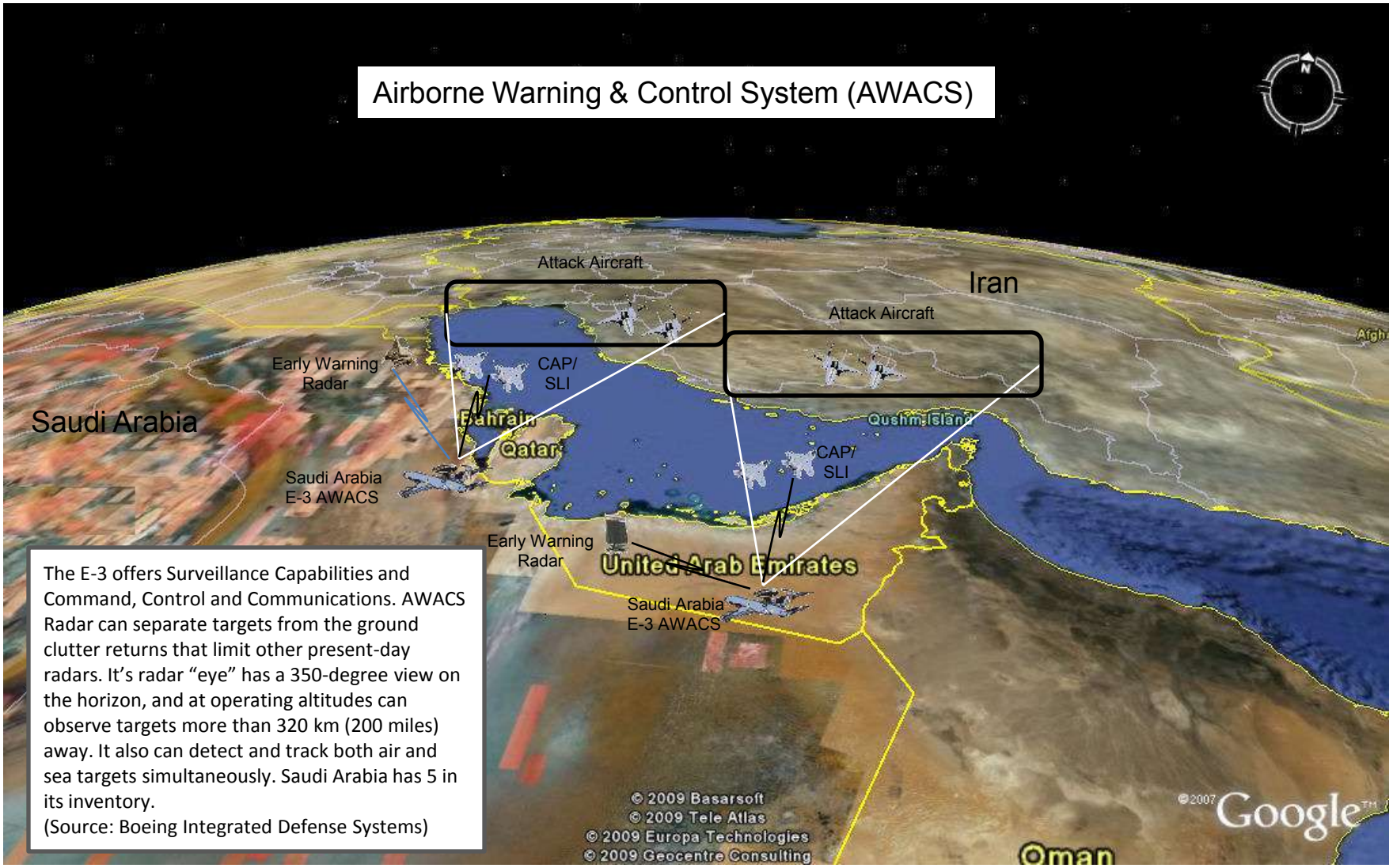
- Missile Defense

  Defensive measures designed to destroy attacking enemy missiles, or to nullify or reduce the effectiveness of such attack.

❑Passive Air and Missile Defense

- Detection and Warning
- Chemical, Biological, Radiological and Nuclear (CBRN) Defenses
- Camouflage, Concealment & Deception
- Hardening
- Reconstitution
- Dispersion
- Redundancy
- Mobility
- Electronic and Infrared Countermeasures
- Low Observable (Stealth) Technology

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


Airborne Warning & Control System (AWACS)
Attack Aircraft
Iran
Attack Aircraft
Early Warning Radar
CAP/ SLI
Saudi Arabia
Bahrain
Qatar
Qushm Island
CAP/ SLI
Saudi Arabia E-3 AWACS
Early Warning Radar
United Arab Emirates
Saudi Arabia E-3 AWACS
The E-3 offers Surveillance Capabilities and Command, Control and Communications. AWACS Radar can separate targets from the ground clutter returns that limit other present-day radars. It's radar "eye" has a 350-degree view on the horizon, and at operating altitudes can observe targets more than 320 km (200 miles) away. It also can detect and track both air and sea targets simultaneously. Saudi Arabia has 5 in its inventory.
(Source: Boeing Integrated Defense Systems)
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© 2009 Geocentre Consulting
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Oman

	Saudi E-3 Specifications	E-2C+
Primary Function	Airborne Surveillance and Command, Control and Communications	Early Warning and Control Aircraft
Power Plant	Four CFM-56-2 turbofan engines, 24,000 lb thrust	Two Allison T56-A-427 engines-each has approximately 5,1000 horsepower
Dimensions	Airframe: span 44.43 meters; Length 46.62 meters; height 12.5 meters; Rotodome 9.1 meters diameter; w.8 meters thick; 3.35 meters mounted above fuselage.	Wing Aspect Ratio: 8.94m; Length overall:17.54; Height Overall: 5.58 m; Diameter of Rotodome: 7.32m; Propeller Diameter: 4.11m; Wings Gross Area: 5.76 square meters.
Speed	More than 800 km/hour	Max 350 knots, 650 km/hr
Endurance	More than 11 hours (without refueling)	4 hr 24 minutes at 175 nmi from base
Aircraft Ceiling	More than 10,670 meters (35,000 ft)	11,275 / 37,000 ft
Range	More than 9,250 km (5,000 nmi)	1,500 nmi
Crew	17 (four flight crew, 13 AWACS specialists)	5, 2 pilots and 3 operators
Maximum takeoff weight	151,955 kg	5,624 kg / 54,426 lbs

• Any lack of coordination and cooperation between friendly firing units, the distribution of the fired salvos over targets is a Random Process i.e. many may fire at a single target so in effect we might have two aircraft firing on the same target rather than distributing themselves between the targets.

• E-3 AWACS with it's Command, Control, and Communications can ensure that there is a more uniform distribution between weapons and targets thereby avoiding a random distribution.

•The AWACS serves as a Force Multiplier in this role.

Saudi Arabia E-3 AWACS

• The Peace Sentinel program for Saudi Arabia began in 1981. It included five AWACS aircraft and six E-3 derivative (KE-3) inflight refueling tanker aircraft, along with spare parts, trainers and support equipment. In 1984, the Saudi government exercised an option to increase the tanker order to eight. The first Saudi E-3 was delivered in June 1986, with deliveries of the remaining E-3s and tankers completed by September 1987.

• In August 2001, Boeing began installing new mission computers and other hardware and software on the Royal Saudi Air Force (RSAF) AWACS fleet, as part of a contract worth $60 million. Under the contract, Boeing upgraded the aircraft's mission computer and software to the same level currently in use by the U.S. AWACS fleet and provide RSAF operator training. Upgrading the five AWACS aircraft was completed in 2003.

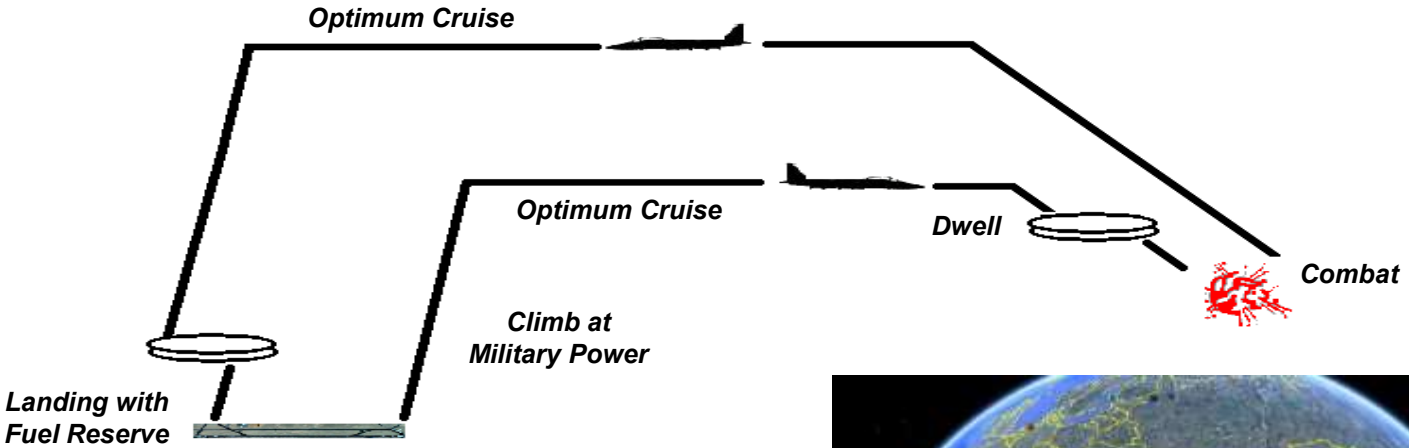
• In 2008, Boeing completed a major communications upgrade on the first of five Saudi E-3 Airborne Warning and Control System (AWACS) aircraft. Installation and checkout of the aircraft were performed at the Boeing Military Flight Center in Seattle. The enhancement, known as Link 16, is a secure, jam-resistant, digital data link that allows military aircraft, ships and ground units to exchange tactical pictures in near real time. Link 16 also supports the exchange of text messages and imagery data and provides additional channels for digital voice. The Link 16 AWACS upgrade is the first in a series of anticipated technology upgrades to the Saudi AWACS fleet.

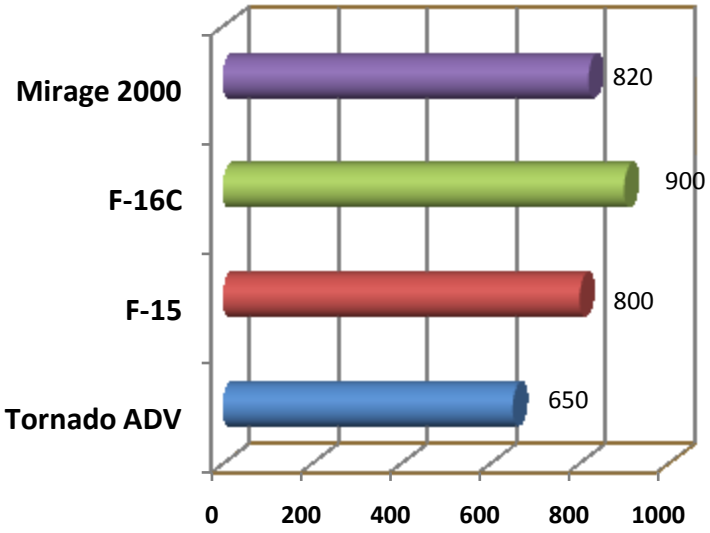
• This powerful capability provides the Saudi fleet with a secure data and voice link, allowing direct communication between their AWACS aircraft and forward-positioned fighter aircraft. The fleet upgrade is scheduled to be completed in December 2009. The Royal Saudi Air Force is also pursuing a multi phase Radar System Improvement Program (RSIP) similar to other AWACS users. Phase 1 is the design and long lead parts initiative with Phase 2 as the production program. The Phase 1 contract was awarded in 2008. A Phase 2 contract will be awarded in the 3rd quarter of 2009. This will bring the Saudi AWACS configuration in line with the rest of the world-wide AWACS fleets for secure data links and radar enhancements.

(Source: Boeing Integrated defense Systems – AWACS)

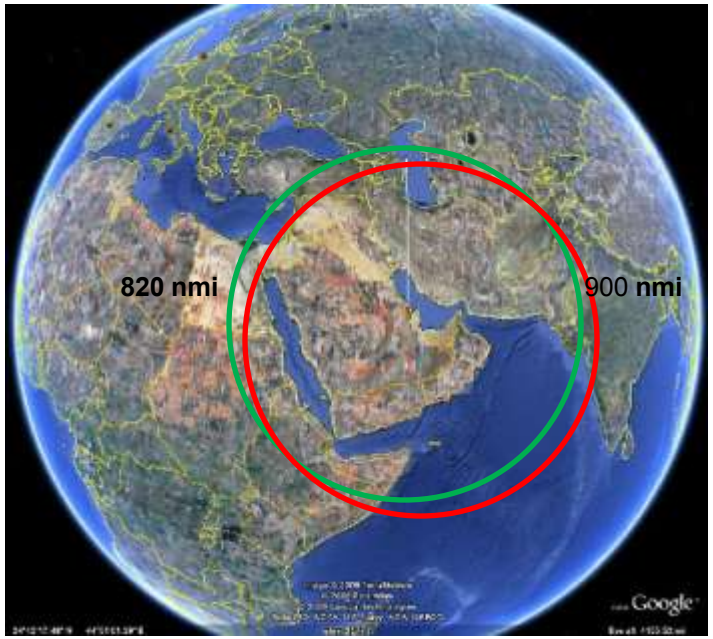
Air to Air
Mission Profiles and Weapon Systems

Air to Air Ranges of GCC Aircraft
Air Superiority Mission
(External Fuel Tanks Dropped)



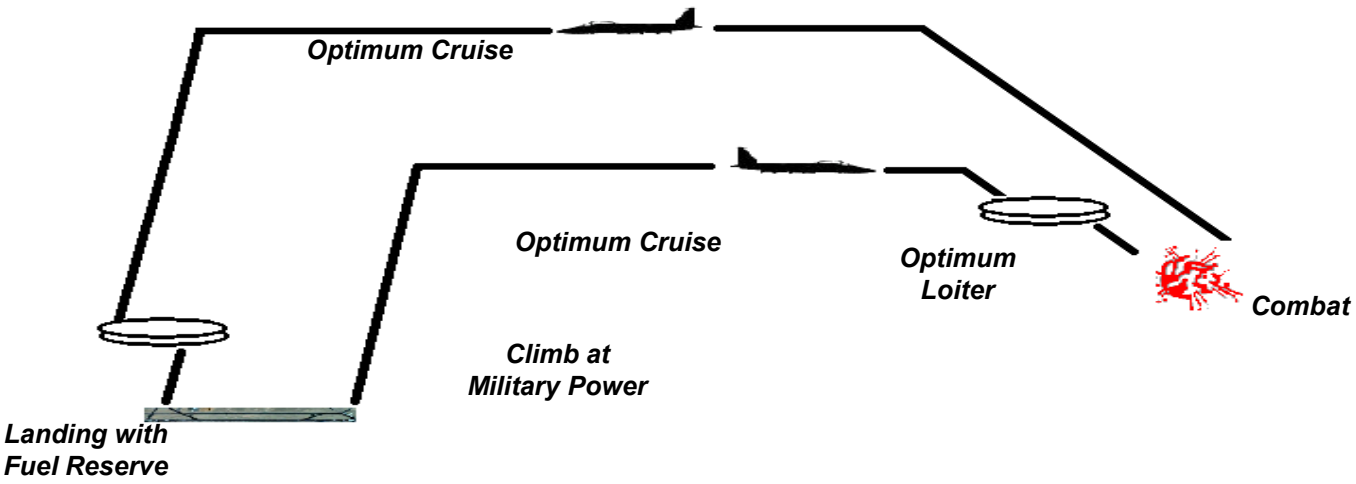


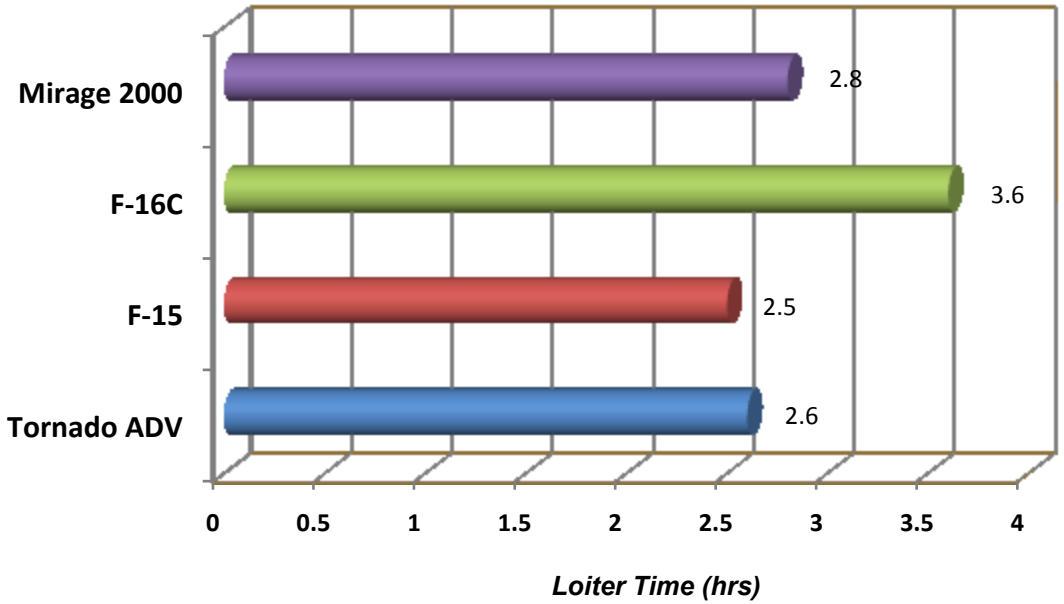
4 AAMs Payload
Zero Dwell Time



- *Tornado ADV/F-15 Launched from King Abdulaziz Air Base*
- *F-16C/Mirage 2000 Launched from UAE*

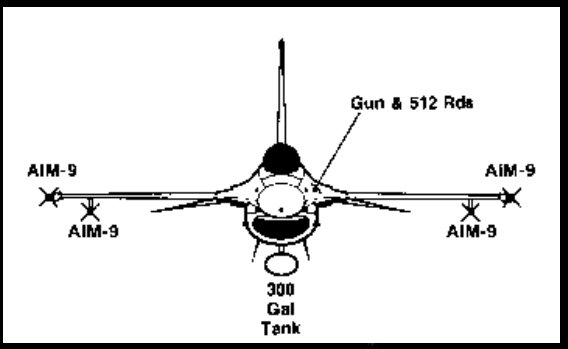
Air to Air for GCC Aircraft
Combat Air Patrol Mission
(External Fuel Tanks Dropped on Combat)





4 AAMs Payload
Range 200 nmi

F-16C Supersonic Intercept From Brake Release



Mission Configuration
(300 Gal Tank Retained)

Time to Climb From Brake Release
Maximum Thrust
40,000ft, 1.8 Mach

Aircraft	Payload	Time in Minutes
F-15C	4 AIM 7 2 AIM 9	2.5
Tornado ADV	2 SRAAM	2.7
Mirage 2000	2 Magic	3.7
F-16C	2 AIM 9	3.6

180 nmi
@ 1.4M
14.9 min

140 nmi
@ 1.6M
11.1 min

215 nmi
@ 1.2M
20.1 min

200 nmi
@ 1.3M
17.2 min

160 nmi
@ 1.5M
12.8 min

Jordan
Iraq
Kuwait
Saudi Arabia
Qatar
Iran
Ethiopia
Djibouti
Yemen
United Arab Emirates
Turkmenistan
Oman
Afghanistan

Air Superiority/CAP Ranges of Iranian Air Force

F-4E (Bushehr):
(2) AIM-7E
(4) AIM-9
(2) 370 Gallon Fuel Tank
30 Minutes loiter time
Range = 300 nmi
80 Minutes loiter time
Range = 100 nmi

MiG-29 (Bushehr
(2) R-27 (AA-10)
(4) R-73 (AA-11)
(1) 400 Gallon Fuel Tank
15 Minutes Loiter Time
Range = 350 nmi

Air Bases Source: Global Security.org
Order of Battle Source: Anthony Cordesman CSIS

Current AAMs
Operational Requirements

Within Visual Range AAMs (SRAAM)

- IIR Seeker head capable to discriminate the target even in the presence of strong counter-measures.

- When Interlaced to a Head Mounted Sight (HMS) the new all aspect high off-bore sight capability for engagement can reach +/- 90 degrees, plus high maneuverability.

- The ASRAAM to be cued by not only the sensor on board the fighter aircraft (fire control radar or infra-red search and track IRST), but also mainly by the pilot via the HMS.

- ASRAAM to be fully compatible with all the interface of the AIM-9 missile family.

Beyond Visual Range AAMs (MRAAM)

- Capable of multiple target engagement when linked to a track-while-scan radar.

- Guidance system:
  - Inertial Navigation + Update Command via data link during the mid-course phase
  - Active radar homing in the terminal phase.

- Good target discrimination and enhance resistance to countermeasures.

- Increase in Range while also Shortening the flight time to the target.

- More details on Current Air to Air Missiles can be found in Appendix I

Russian Air To Air Missiles

Missile Designation	Guidance System	Range (km)	Platform
K-13 / AA-2D	Infra Red	7.5	AIM-9 Equivalent
R-40TD / AA-6	Semi Active Radar Homing	50	MiG-25 / 31
K-23 / AA-7	Semi Active Radar Homing	50	MiG-23 ML
R-60 / AA-8	Infra Red	10	MiG -23/29/31 SU-24 / 27
K-60 / AA-10	Semi Active Radar Homing	80	MiG-29, Su-27/35
R-73 / AA-11	Infra Red	30	Replacement of the current AA-2. on MiG-23ML/MiG-29/Su-27

Short Range AAMs

Missile	Country	Guidance	Warhead	Fuze Type	Range (km)	In Service
Kentron A-Darter	South Africa	IIR	17 kg Fragmentation	Laser	20	2008
B GT IRIS-T	Germany	IIR	11.4 kg	Laser	25	2005
MBDA ASRAAM	U.K.	IIR	Blast Fragmentation	Laser	20	2002
Raytheon AIM-9X	USA	IIR	10.2 kg Fragmentation	Laser	10	2003
Rafael Python-5	Israel	IIR	11 kg Fragmentation	Laser	30	2005
Vympel R-73 M2	Russia	IR + Inertial	7.4 kg Fragmentation	Laser	30	1996

IIR: Imaging Infra Red
IR + I: Infra Red + Inertial

(Source : Military Technology MILTECH 7/2006)

Medium Range AAMs

Missile	Country	Guidance	Warhead	Fuze	Range (km)	In Service
MBDA MICA	France	R (J Band) IR (Dual Band)	12 kg Blast Fragmentation	Contact/Radar	60	1998
MBDA Meteor	International	R (Ku-Band)	Blast Fragmentation	Contact/Radar	>100	2012
Vympel R-77 (RVV-AE)	Russia	R (J Band)	22.5 kg Blast Fragmentation	Contact/Radar	80	2002
Raytheon AIM-120C-5	USA	R (I Band)	20 kg Directed Fragmentation	Contact/Radar	>50	1991
CATIC PL-12	China	R(I Band)	Blast Fragmentation	Proximity	70	2007
Rafael Derby	Israel	R	11 kg Blast Fragmentation	Proximity	>60	2002
Kentron R-Darter	South Africa	RI	-	Proximity	> 60	-

Guidance Type:
R: Inertial Guidance with Mid-Course Updating + Active Radar Terminal Seeker
IR: Inertial Guidance with Mid-Course Updating + Imaging Infra Red terminal Seeker
RI: Inertial Guidance + Active Radar Terminal Seeker

MICA is available in two versions:
MICA EM with terminal active pulse Doppler Radar Seeker
MICA IR with terminal imaging dual-band infrared seeker

(Source : Military Technology MILTECH 7/2006)

Counterspace

❑ US Air Force counterspace operations are the ways and means by which the Air Force achieves and maintains space superiority. Space and Air Superiority are crucial first steps in any military operations

❑ Effective counterspace operations depend on space situational awareness to provide an understanding of global space operations and is derived from C2, ISR, and Environmental Information. Like counterair, counterspace operations have an offensive and a defensive component.

Offensive Counterspace (OCS) Operations	Defensive Counterspace (DCS) Operations
Consist of operations that deny, degrade, disrupt, destroy, or deceive an adversary's space capability or the service provided by a third-party's space asset(s) to the adversary at a time and place of our choosing through attacks on the space nodes, terrestrial nodes, or the links that comprise a space system. These operations range from dropping ordnance on terrestrial nodes of space systems to jamming enemy satellite uplink or downlink frequencies. OCS operations initiated early in a contingency can result in an immediate advantage in space capabilities and control of the space medium.	Consist of operations that preserve space capabilities, withstand enemy attack, restore/recover space capabilities after an attack, and reconstitute space forces. DCS operations should be proactive in nature to protect our capabilities and prevent the adversary from disrupting overall friendly operations. Suppression of threats to friendly space capabilities is a key of DCS operations. An example of DCS operations from Operation IRAQI FREEDOM was the destruction of adversary, ground-based global positioning system (GPS) jammers to preserve freedom to employ GPS-aided munitions by friendly forces.

(Source: Space Operations USAF AFDD 2-2, November 27, 2006)

Information Operations

Information operations (IO) are actions taken to **influence, affect, or defend information, systems, and/or decision-making to create** effects across the battle space. IO must be integrated into air and space component operations in the same manner as traditional air and space capabilities. IO can create effects across the entire battle space and provide advantages to a commander assigned an operational mission.

- **Electronic warfare operations are those military actions involving the** use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy across the electromagnetic battle space.

- **Network warfare operations are the integrated planning and employment** of military capabilities to achieve desired effects across the digital battle space. Network warfare operations are conducted in the information domain, which is composed of hardware, software, data, and human components.

(Source: Information Operations USAF AFDD 2-5, January 11, 2005)

Intelligence, Surveillance & Reconnaissance (ISR):

Intelligence, surveillance, and reconnaissance (ISR) is defined as an activity that synchronizes and integrates the planning and operation of sensors, assets, processing, exploitation, and dissemination systems in direct support of current and future operations. This is an integrated intelligence and operations function.

Goal:
The goal of ISR operations is to provide accurate, relevant, and timely intelligence to decision makers. Intelligence, surveillance, and reconnaissance (ISR) are often referred to as a collective whole, though the capabilities are distinctive and each fulfills a different purpose. These distinctive capabilities are defined below:

❑ **Intelligence** is the product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas; it is the information and knowledge about a topic obtained through observation, investigation, analysis, or understanding. (JP 1-02)

❑ **Surveillance** is the systematic observation of aerospace [sic], surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means. (JP 1-02).

❑ **Reconnaissance** is a mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. (JP 1-02).

The information derived from surveillance and reconnaissance, converted into intelligence by exploitation and analysis, is used to formulate strategy, policy, and military plans; to develop and conduct campaigns; guide acquisition of future capabilities; and to protect, prevent, and prevail against threats and aggression aimed at the US and its interests. Air Force surveillance and reconnaissance assets are not inherently strategic, operational, or tactical in nature; they can be used to gather information to meet requirements at all levels of warfare. ISR operations are conducted across the range of military operations from peace, to war, to conflict resolution.

(Source: Intelligence Surveillance and Reconnaissance Operations USAF AFDD 2-9, July 17 2007)

❑ STRATEGIC, OPERATIONAL, AND TACTICAL ISR

ISR supports strategic, operational, and tactical operations by providing intelligence and services to a diverse set of consumers, to include national agencies; geographic, functional, or Service components; and unit-level decision makers.

❑ ISR PRINCIPLES

ISR operations provide intelligence information to commanders and decision makers at all levels, helping them reduce uncertainties in the decision-making process. To be effective, ISR products must be responsive to the commander's or decision maker's needs. Intelligence products must enable strategic, operational, and tactical users to better understand the operational environment systematically, spatially, and temporally, allowing them to orient themselves to the current and predicted situation to enable decisive action. By adhering to the principles listed below, ISR personnel and systems can maximize intelligence support to consumers.

- Integrated
- Accurate
- Relevant
- Timely
- Fused
- Accessible
- Secure
- Survivable, Sustainable, and Deployable
- Unified Effort
- Persistent and Global Reach
- Network Centric

UAS’s / UAV’s

Unmanned Air Vehicles/Systems (UAVs/UAS's)

• UAV's/UAS's where initially employed in a range of conventional missions such as:

- Intelligence, Surveillance & Reconnaissance (ISR)
- Target Acquisition
- Signal Intelligence (COMMINT and ELINT)

• UAV's/UAS's where further developed with the capability to carry Air to Surface missiles, and to attack targets autonomously. This gave the UAV's/UAS's the ability to carry out Strategic and Tactical Missions:

- Strategic Missions which require more endurance and weapons payload
- Tactical Missions which require a reduction in size.

• Both missions require a weaponization capability for the destruction of enemy forces and Air Defense systems. UAV's/UAS's have the advantage of being low risk for the missions and have become an indispensable weapon of war. UAV's/UAS's survivability against heavily defended targets is higher than that in manned aircraft

• Tactical UAV/UAS Missions cover:

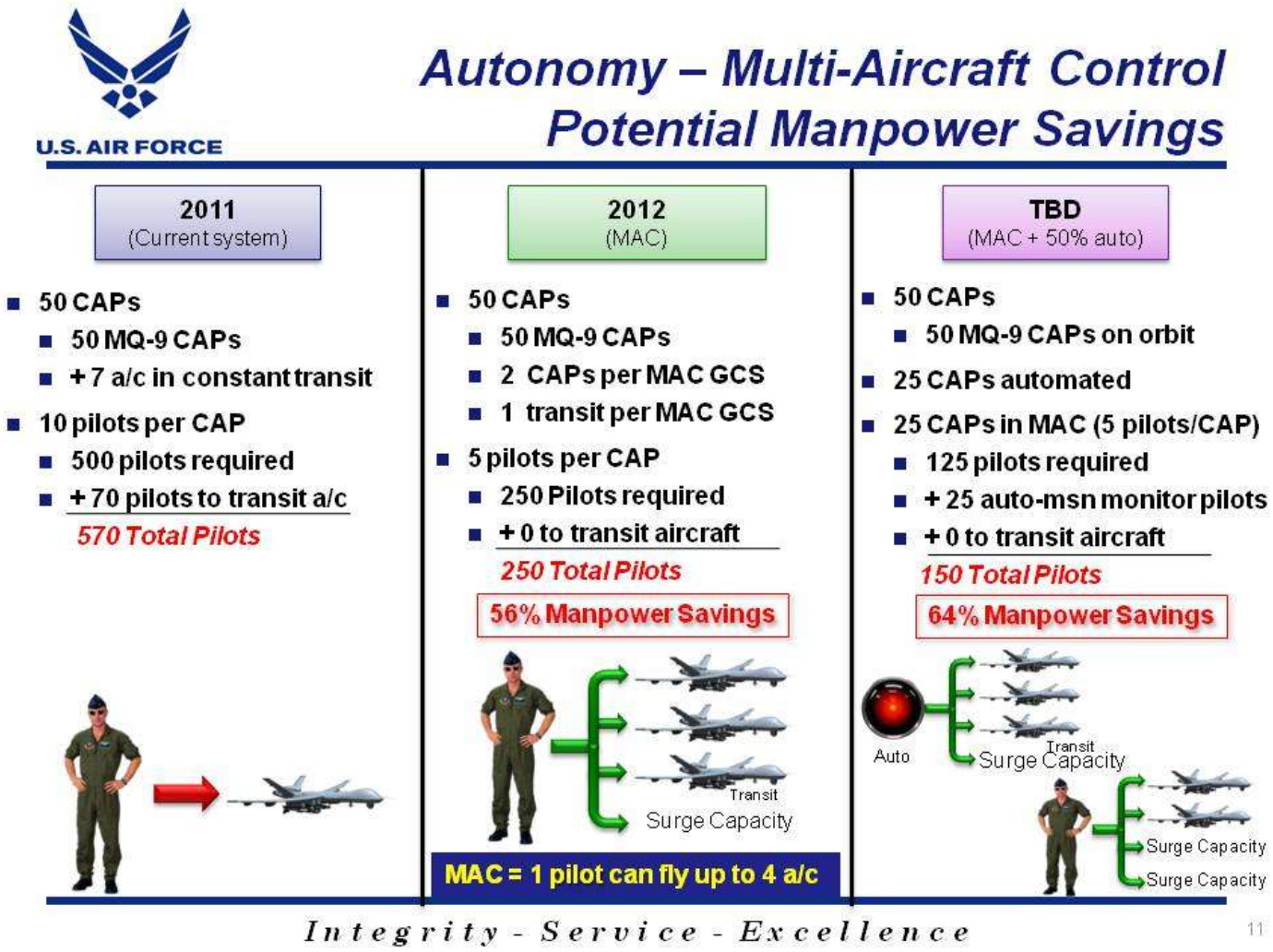
- ISR
- SEAD
- Electronic Attack (Deception/Jamming….)
- Mobile Network Node/Communications Relay. UAV's/UAS's can be utilized as nodes in a mobile communications network for the maneuvering forces.

What do UAS's Bring to Operations?

U.S. AIR FORCE

- Persistence—ability to loiter over a target for long time periods for ISR and/or opportunity to strike enemy target
- Undetected penetration / operation
- Operation in dangerous environments
- Can be operated remotely, so fewer personnel in combat zones—projects power without projecting vulnerability
- Integrates "find, fix, finish" sensor and shooter capabilities on one platform

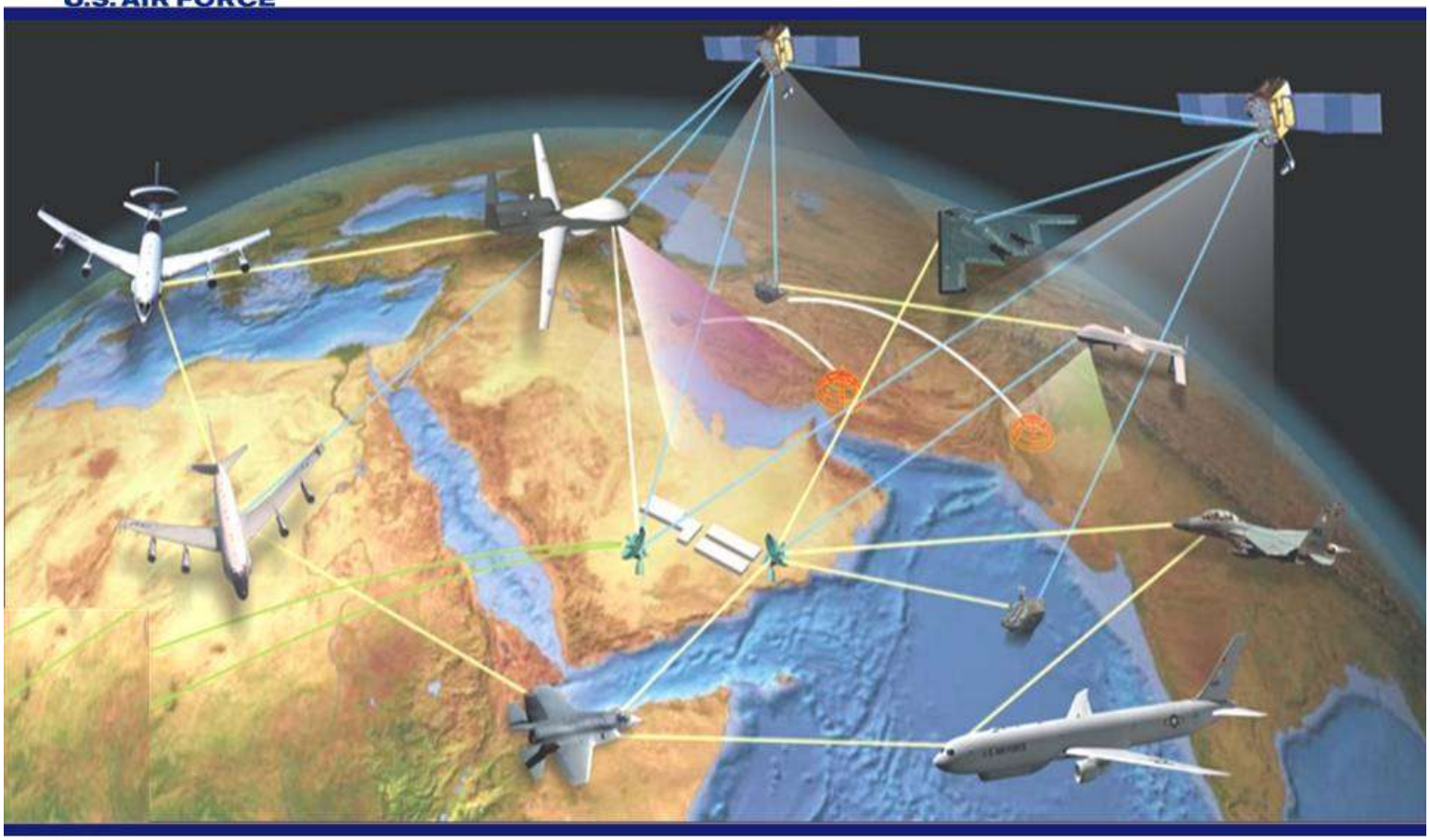
(Source: Headquarters U.S. Air Force. Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047. Lt. Gen Dave Deptula, Deputy Chief of Staff Intelligence, Surveillance and Reconnaissance; Colonel Eric Mathewson AF UAS Task Force).



(Source: Headquarters U.S. Air Force. Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047. Lt. Gen Dave Deptula, Deputy Chief of Staff Intelligence, Surveillance and Reconnaissance; Colonel Eric Mathewson AF UAS Task Force).

U.S. AIR FORCE

Air Force ISR Surge



Integrity - Service - Excellence

(Source: Headquarters U.S. Air Force. Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047. Lt. Gen Dave Deptula, Deputy Chief of Staff Intelligence, Surveillance and Reconnaissance; Colonel Eric Mathewson AF UAS Task Force).

Iranian UAV Projects / Assets 2009

Prime Manufacturer	Designation	Development / Production	Operation	Payload Wt.	Endurance (hr)	Range	Ceiling (ft)	Mission
Unknown	Stealth	Underway / Underway	Deployed			700 km		R/S*
HESA	Ababil (Swallow)	Complete / Underway	Deployed	45 kg	1.5+	150 km	14,000	Multiple variants for R/S* - attack – ISR**
Shahbal Group, Sharif Univ.	Shahbal	Underway		5.5 kg		12 km	4,500	R/S*
Asr-e Talai Factories	Mini-UAV	Underway						Surveillance
FARC	Sobakbal	Underway / Underway	Deployed	0.35 kg	2	2.7 - 13.5 mi	19,686	Surveillance
Qods Aeronautics Industries	Mohajer II/III (Dorna); Mohajer IV (Hodhod); Saeqeh I/II; Tallash I/Endeavor; Tallash II Hadaf 3000	Complete / Underway	Deployed					Multirole aka Lightning Bolt Target drone - aka Target 3000

Source: Adapted by Adam C. Seitz from AIAA Aerospace 2009 Worldwide UAV Roundup; available at: http://www.aiaa.org/Aerospace/images/articleimages/pdf/UAVs_APR2009.pdf.

*R/S: Reconnaissance / Surveillance; **ISR: Intelligence / Surveillance / Reconnaissance

Defensive Counterair Operations

Combat Air Patrol (CAP)
and
Strip Launched Interceptors (SLI)

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 total available combat aircraft at the start of a conflict is the:
(Total Assets) – (Number of Aircraft not Operational Ready)

In the Alert Phase of air operations, the combat ready assets are assigned to the Ground Launched Intercept and Combat Air Operations (CAP).

Maximum Strip Launched Interceptors

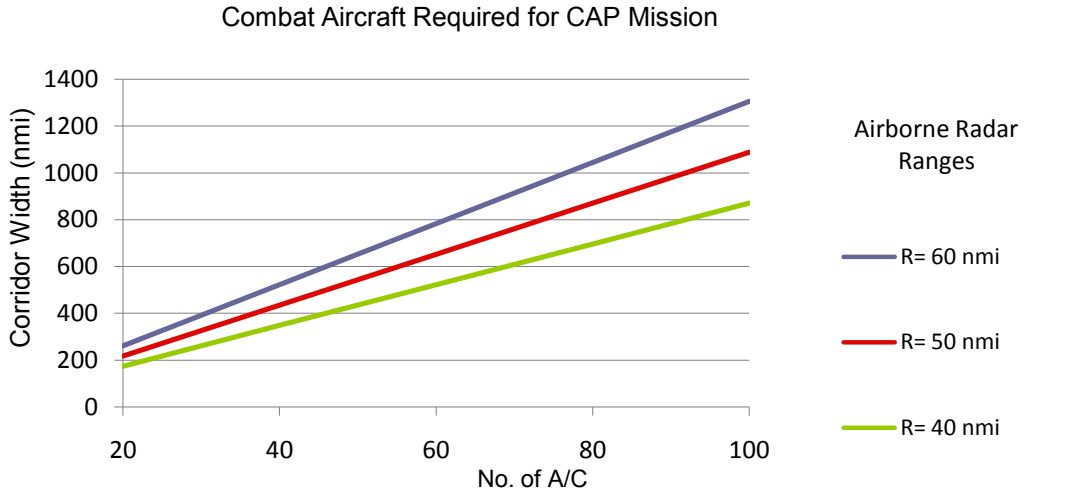
• C4I delay time is assumed to be the time taken by the Early Warning Radars in detecting the Intruders, threat assessment and transmission of the data/ information to the various Air Defense sectors and airbases. This time interval has to be minimized and optimized and is dependent on the type of C4I hardware and software that are in place.

• The response time is assumed to begin after airbases are put on alert, and is the scramble time for combat aircraft to be in the air (wheels up). This time interval has also to be minimized and is very dependent on aircraft type.

• At the end of the response time we assume two interceptors are launched and two more are launched every 30 seconds after until the interceptors can no longer intercept the intruders outside of the “keep out range”.

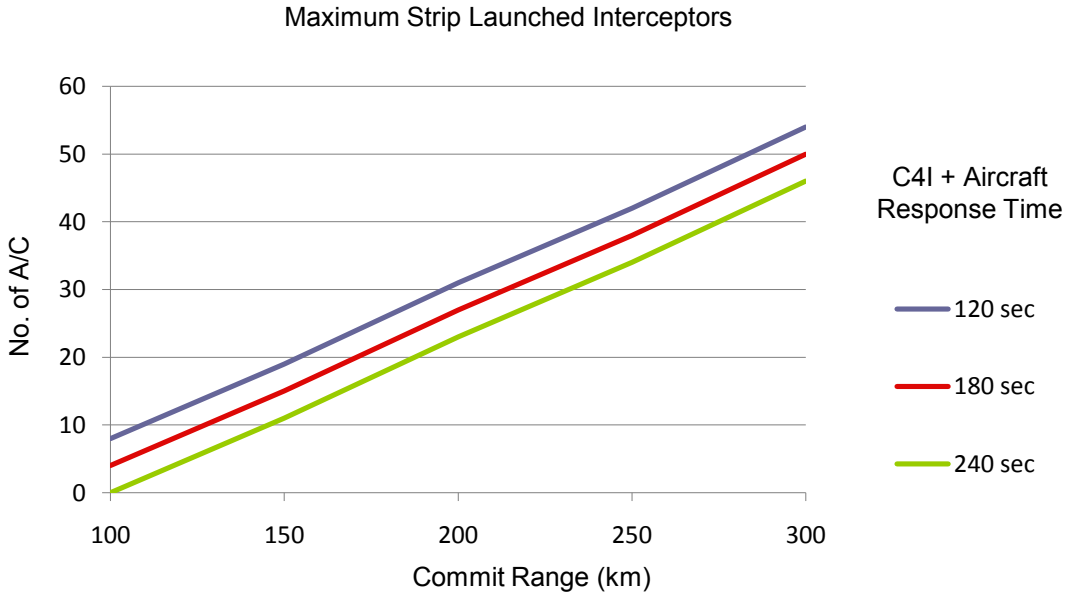
• The Maximum Strip Launched Interceptors is highly sensitive to the C4I time delay and the response time.

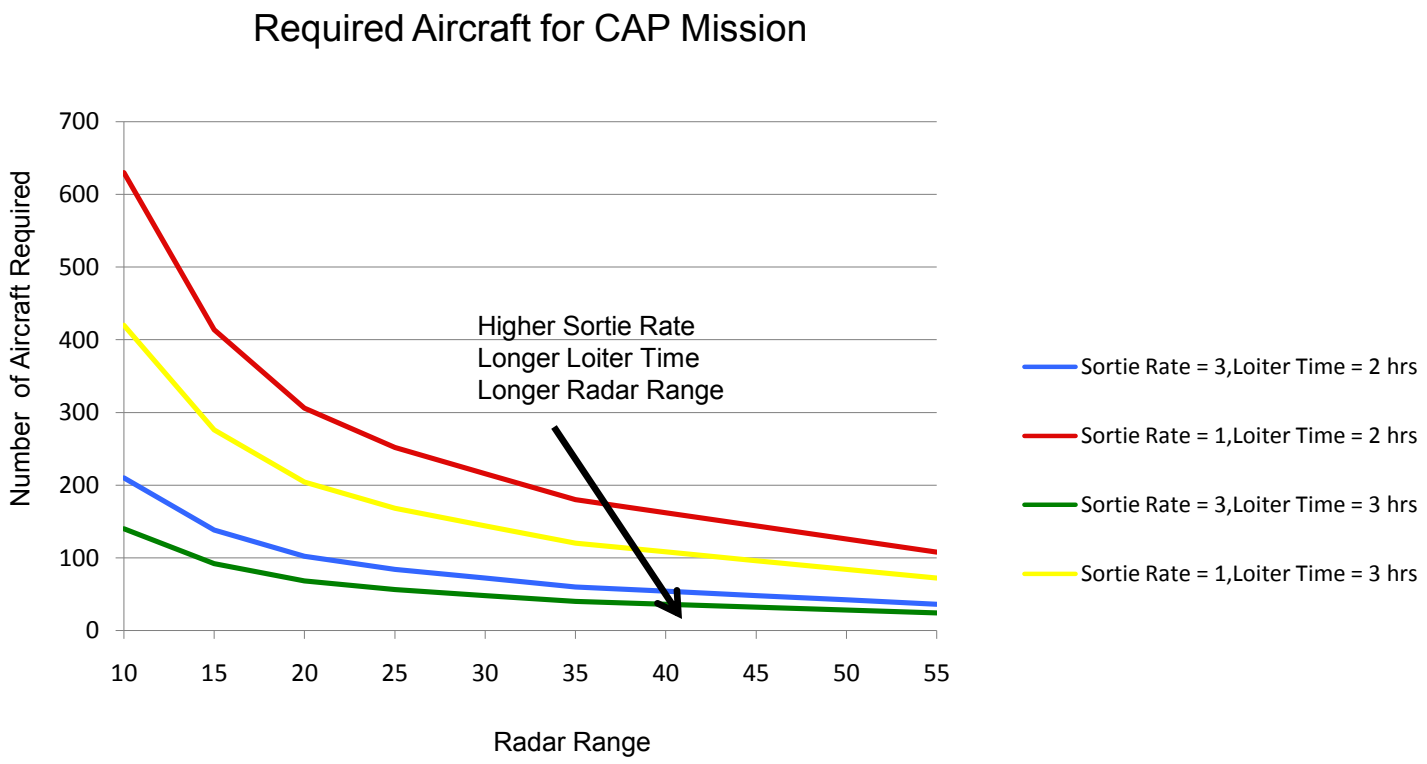
- A/C Sortie Rate : 3
- Length of Operational Day : 18 hours
- Airborne Radar Search Sector = 120 degrees
- 50% Overlap between two CAP Aircraft
- R : Airborne Radar Range in Search Mode (nmi)



- Keep out Range from Airbase : 40 km
- Strike Aircraft Speed : 0.85 Mach at Sea Level
- 2 A/C launched in pairs every 30 seconds
- C4I + Response Time : 120 sec, 180 sec, 240 sec.

Increase SLI Interceptors by:
- Minimizing C4I Time
- Minimizing Aircraft Scramble Time





Decreasing the Number of A/C required for CAP:

- High Sortie Rate in return higher Operational Readiness is required
- Longer Loiter Time capability
- Longer Radar Range with high probability of detection

Assumptions regarding Iranian Aircraft:

CAP:	SLI (Strip Launched Intercept):
Aircraft Sorties Rate : 2 per day 18 hour operational day Airborne radar sector search : 120 degrees Radar Range : 60nmi	Keep out range : 40 km Strike A/C Speed : 0.85 Mach Response Time : 360 seconds

Aircraft Allocated	CAP	Maximum SLI
GCC	60 (Corridor Width:800 nmi)	55
Iran	24 (Corridor Width: 200 nmi)	38

Weakness in the Operational Performance of the Iranian Air Force

- Long C4I Early Warning delay time due to antiquated System, semi-automated man in the loop.
- Long Response / Scramble Time by Combat Aircraft
- Low Operational Readiness Rate of Combat Aircraft
    - Need Improvement in maintenance operations
    - Need Improvement in supply of spare parts
- Low Combat Aircraft Sortie Rates, Sustained and Surge.
- High Loss Exchange Ratio in a Closing / BVR Environment and Visual Engagement Environment.
- Centralized Battle Management

Missions and Air Force Effectiveness
Force Allocation Analysis

GCC Airforce Tactical Fighter Capabilities - 2009

Type	Order of Battle	Operational Ready %	Force Available	Force Sorties per Day	Postulated Employment
Tornado ADV	Saudi Arabia: 25	75	19	57	Deep Strike
Tornado IDS	Saudi Arabia: 85	75	64	192	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
Total	**491**		**368**	**1,105**	

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

Iran Airforce Tactical Fighter Capabilities - 2009

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
Total	158		95	190	

BAS: Battlefield Air Superiority

CAS: Close Air Suport

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

Airfield Attack
Offensive Counterair Operations Analysis

Runway Attack Operational Requirements:

• Pilots at the airbase under attack will try to take-off in the shortest possible Take-off Length (TOL) and Minimum Clear Width (MCW) required. For modern aircraft such as the F-16 it is safe to assume a a minimum TOL of 3,000 ft and a MCW of 50 ft.

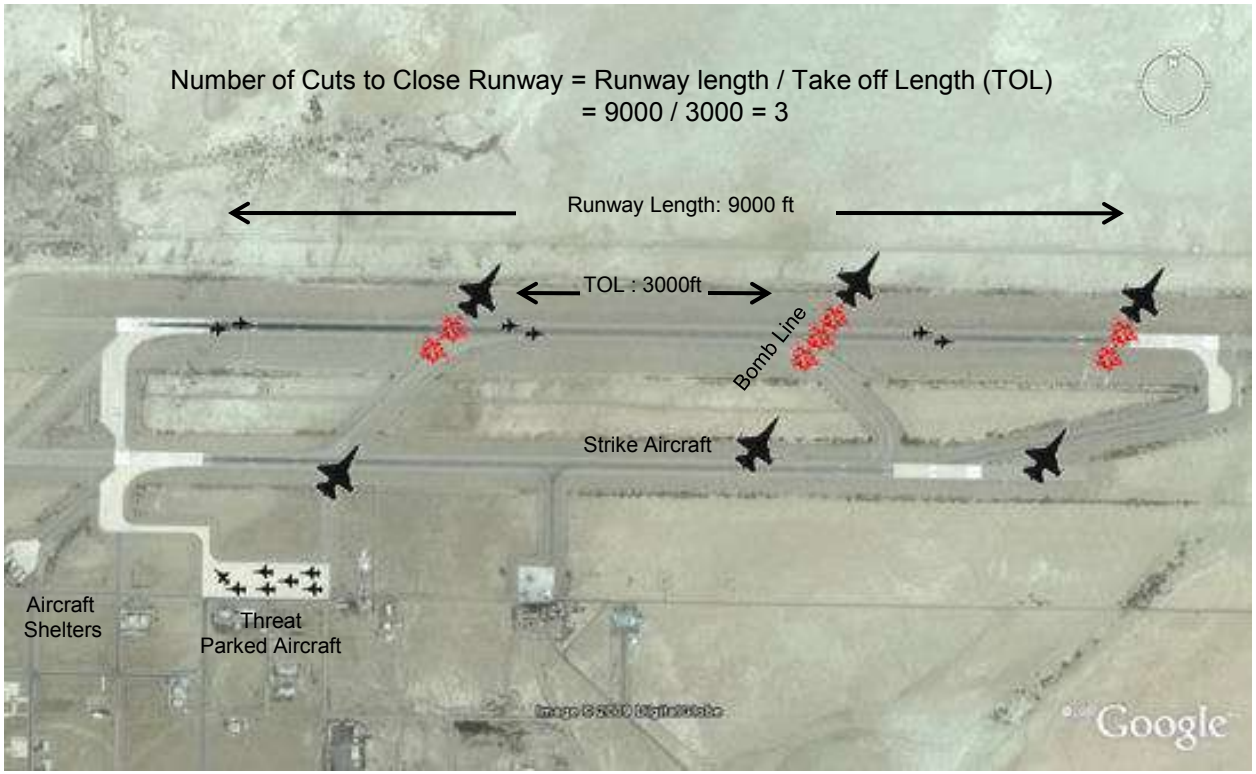
• For runways that are 9,000 ft in length, it would then take 3 cuts each 3,000 ft long and 50 ft MCW to stop combat aircraft from taking off.

Runway Attack
Old Weapons and Methods

Unguided Bombs	• High altitude horizontal bombing or Diving attack • Large Dispersions
Guided Bombs	• Laser guided bombs, requiring high altitude approach and weapon release. • The target must be illuminated: ○ By the same target ○ By another aircraft
Retarded Bombs	• Military runways have hard concrete surfaces. • Retarded bombs usually arrive at end of flight with a very low Kinetic Energy. • Attack aircraft must: ○ Keep a high altitude or ○ Climb and then perform a dive attack with stabilized aiming. This would increase the overall exposure of the aircraft to enemy point air defense systems.

The number of aircraft sorties required to attack a given airbase is determined by:

- The number of surfaces to be closed i.e. a runway or both a runway and taxiway.
- The aircraft payload
- The number of required passes per cut
- Criteria for the probability of closing a runway.



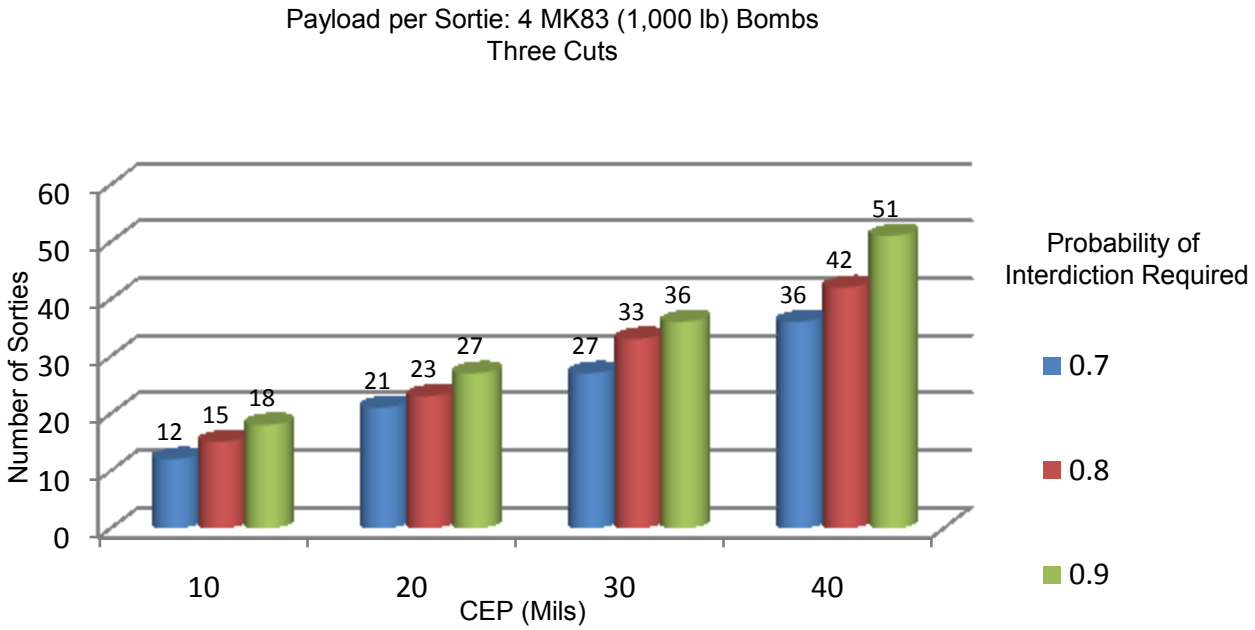
Air Base Runway Attack

- Survivability not taken into consideration from possible Ground SAM/AAA Air Defense Systems.
- Required Probability of Interdiction = 0.8

Current Weapons Effects and Payload Comparisons

	Durandal	BAP-100	JP 233
A/C Weapon Load / Munitions per Cut per pass	8	36	60
Crater Damage Diameter (ft)	24	14	16
Probability of cut per pass	0.55	0.75	0.7
A/C Sorties per cut	2	1	1
Total Sorties per Airbase Strike	6	3	3

Runway Unguided Weapon Attack



Old Weapons Effects and Payload Comparisons

- First Pass Attack: Low Altitude Run, Pop-Up to 8,000 ft AGL, CCIP Delivery at 30 to 45 Degrees Dive.
- Survivability not taken into consideration from possible Ground SAM/AAA Air Defense Systems.
- Low Drag MK83 Bombs

Runway Closure
Mission Planning Assumptions

Mission	Target(s)	Desired Objective	Aircraft	Payload Configuration
Runway Closure	(5) Airfields, each with runways 9000ft by 200 ft	• Closure with 70% Confidence. • Closure for 3 days. • Minimum Clearing Width:20 ft • Minimum clearing Length:3000ft	TORNADO IDS F-15S	BAP 100
Enroute SEAD	(3) Corridors each with 3 SAM Sites (5) Airfields with Short Range SAM and AAA Guns	• Engage on H Hour • Neutralize prior to Strike	F-15E F-16C MIRAGE 2000	AS-37 HARM
Fighter Sweep	CAP Aircraft	Engage and Neutralize	F-15E/C F-16C MIRAGE 2000 TORNADO ADV	AIM-120 AMRAAM SRAAM
Fighter Escort	Point and Area Defense Interceptors	Protect the Strike Force	F-15E/C F-16C MIRAGE 2000	AIM -120 AMRAAM SRAAM

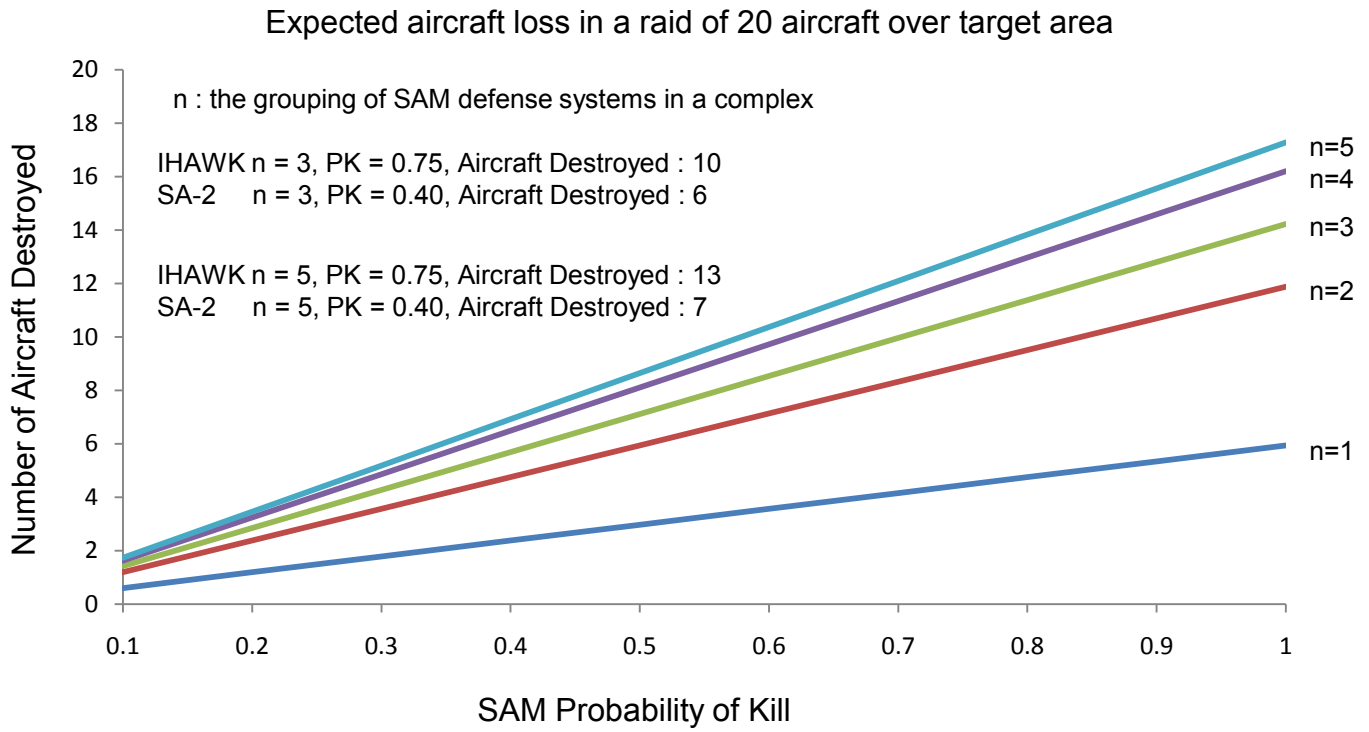
Aircraft Required for Airfield Closure

Payload	Required Sorties per Airbase Strike	Number of Aircraft Required to close 5 Airfields for 3 days	Number of Aircraft Required to close 5 Airfields for 7 days
Bap-100 (36)	3	27	56
Durandal (8)	6	55	112
JP-233 (60)	3	27	56
MK-83 (4) CEP = 10 mils	12	110	225
MK-83 (4) CEP = 20 mils	21	192	393

Bases attacked per Sortie = 1
Attrition per Sortie = 1.5%
Probability of Closure Criteria = 70%
Estimated Closure Time of Runway = 12 hours
Strike Aircraft Operational Readiness = 85%
Sorties per Aircraft per Airfield Closure Time = 3

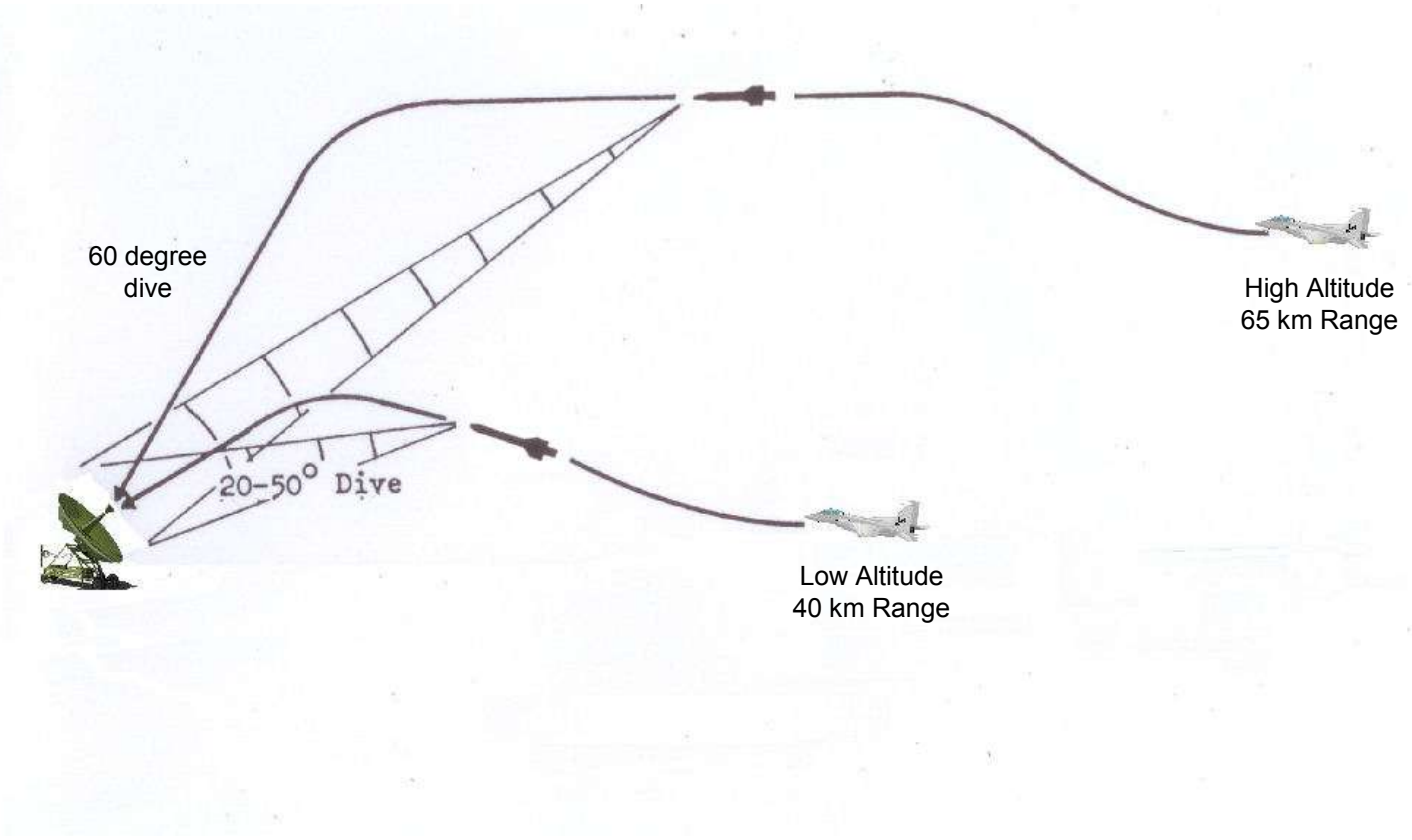
Air Defense and SEAD Operations Analysis

•Criteria for evaluating SAM systems:
- SAM defense system completely destroying all attack aircraft, with a required probability, or
- Attenuating an attack by a certain percentage.

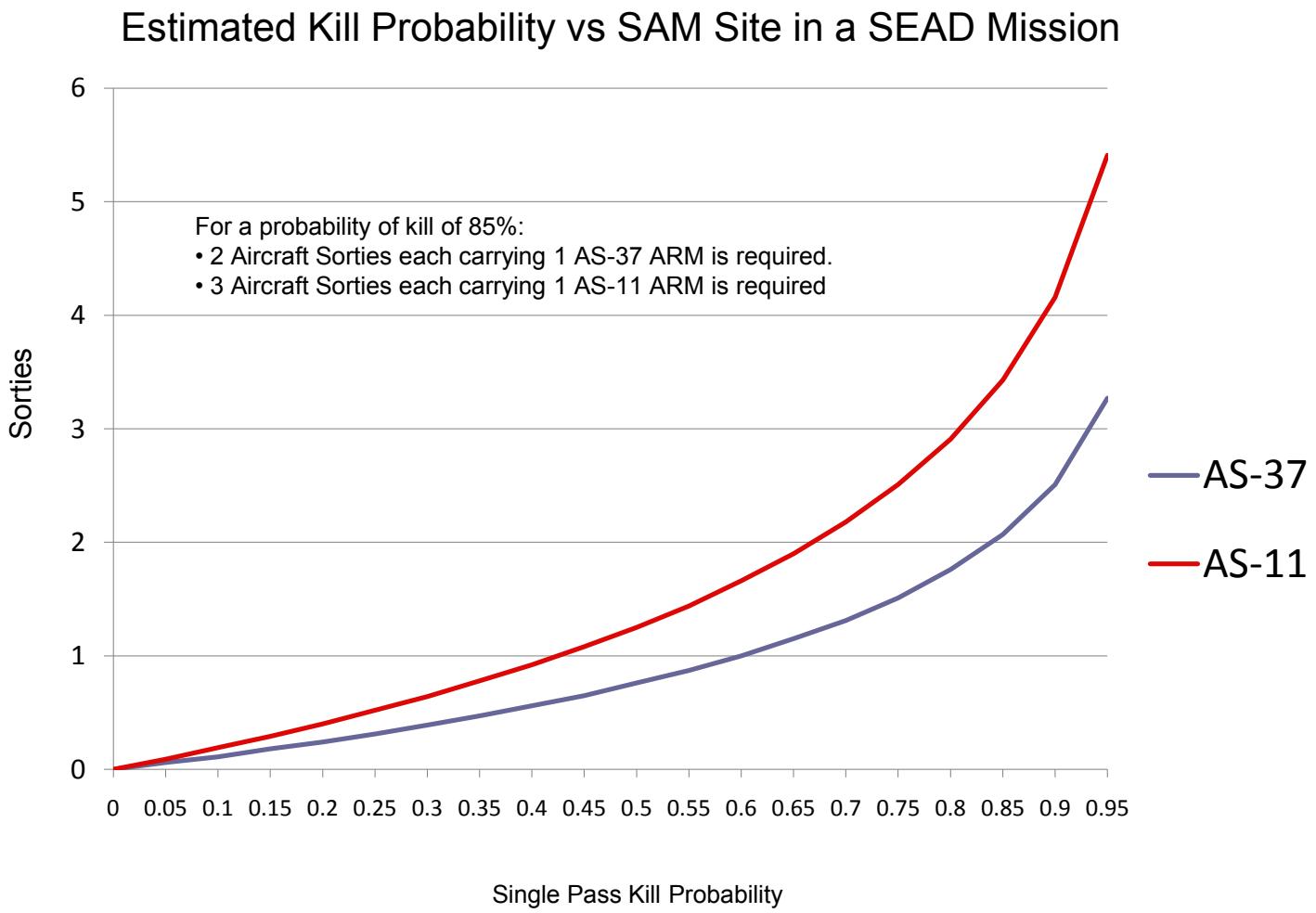


- Aircraft Raid Density: 4 A/C per Minute
- Average value of the time required by the AD system to fire (1 or 2 missiles) on a single target = 0.5 minutes
- Probability of target detection prior to the time when the missile complex is still in a position to fire on the target = 0.9
- Rules of Engagement: 1 or 2 missiles launched per target

Typical Suppression of Enemy Air Defense Mission Profiles
(SEAD)



AS-37 Anti-Radiation Missile (ARM)



Payload: (1) Anti-Radiation Air to Surface Missile per Aircraft Sortie

Maverick AGM-65B Kill Probability vs SAM site
Standard Maverick Release Envelope

Payload	Probability of Kill
1 Maverick / pass	0.67
2 Mavericks / pass	0.88
3 Mavericks / pass	0.95

AS-7 Kerry Anti-Radar Missile vs SAM site

Payload	Probability of Kill
1 AS-7 / pass	0.42
2 AS-7 / pass	0.66
3 AS-7 / pass	0.81

Short Range Surveillance System Survivability vs ARM Attack

	GCC	Iran
Desired Probability of destruction of ground target:	0.85	0.85
Probability of single target kill by aircraft:	0.75	0.4
Probability of Aircraft Kill by Air Defense System with Cueing:	SA-2: 0.4	IHAWK: 0.75
In the absence of any Air Defenses the Sortie Size needed to achieve a desired Probability of target destruction is:	1	4
The effective result of the defense is to reduce the strike kill probability per sortie to:	0.45 from 0.75	0.10 from 0.4
When A/D system responds (no ARM attack yet) the necessary strike sortie rate size becomes:	3 from 1	18 from 4
Probability of a single ARM to destroy a sensor it is attacking (from slide 104):	0.70	0.55
Number of Aircraft attacking each Radar Site:	2	3
Probability of damage on each radar site by aircraft attacking:	0.91	0.91
Number of Radar Sites:	5	5
Effective kill probability of the Defense with No Cueing:	0.20	0.40
Resulting Defense Effectiveness Reduced to:	0.30 From 0.40	0.58 From 0.75
Therefore total Aircraft Sorties required for Air to Ground Mission resulting from the defense effectiveness and ARM attack.	2 from 1	9 from 4

(Reference: Mathematical Model based on Air Defense Artillery. Summer 1983. “SHORAD Surveillance System Survivability vs Enemy ARM Strategies”)

Effectively what we have is the following for a single target attack, and 5 radars along the route:

	Without Air Defenses Present		With Air Defenses Present		With Air Defenses and ARM Attack	
	GCC	Iran	GCC vs SA-2	Iran vs IHAWK	GCC vs SA-2 (AS-37)	Iran vs IHAWK (AS-11)
Number of Sorties Required for Counterland Operation (CAS & AI)	1	4	3	18	2	9

GCC will have to allocate 10 Aircraft for SEAD Operation and 2 Aircraft for single target attack in Counterland Operation to produce a 91% probability of overall damage to the target. For 10 targets then require 20 aircraft,

Iran will have to allocate 15 Aircraft for SEAD Operation and 10 Aircraft for single target attack in Counterland Operation to also produce a 91% probability of overall damage to the target. For 10 targets then require 90 aircraft.

Counterland Operations Analysis
CAS and AI

Number of Sorties Required with an 85% Desired Probability of Kill For various Ground Targets

Target	Payload	PK	Number of Sorties	Number of Weapons
POL Storage Tank (60 ft radius, 40 ft high)	4 MK 83	0.5	3	12 MK 83
	4 GBU-31 JDAM	0.7	1.5	6 GBU-31
Aircraft Shelters (100x50x25 ft) Shelter Dimensions	4 LDGP MK 830	0.35	4.5	18
	4 GBU-31 JDAM	0.85	1	4 GBU-31 JDAM
Aircraft Parked Dispersed over an area 1500 x 500 ft.	8 MK 82 Snakeye	0.6	2	16 MK 82 Snakeye
	8 GBU-30	0.85	1	8 GBU-30
Highway Bridge	8 MK 82	0.38	4	32 MK 82
	8 GBU-30	0.62	2	16 GBU-30
Frigate Patrol Boat Missile Patrol Boat	8 MK 82	0.65	2	16 MK 82
	8 GBU-30	0.85	1	8 GBU-30
Column of Tanks (10 tanks in 2000ft by 70ft)	8 MK 82 Snakeye	0.25	6.6	53 MK 82 Snakeye
	8 GBU-30	0.50	3	24 GBU-30

Old Conventional Weapons Delivery:
Survivability not considered from possible ground SAM/AAA environment
First Pass Attack: Low altitude run, pop-up to 8000 ft AGL, CCIP delivery at 30 to 45 degrees dive.

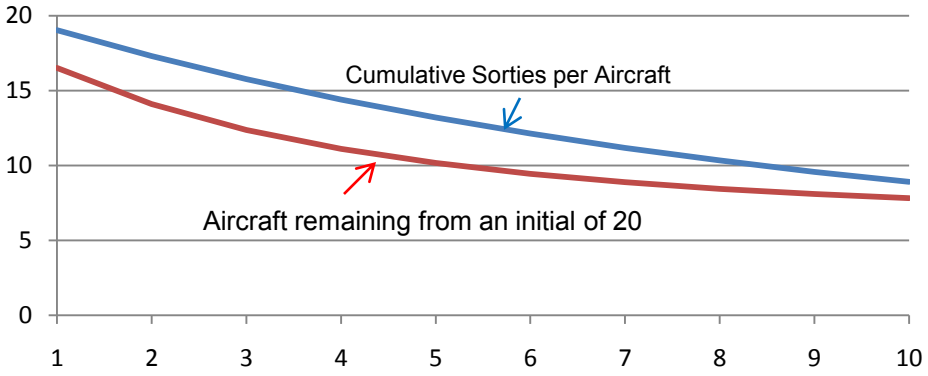
AGM-65C/D Maverick Effectiveness

	Tank	APC	ZSU (AAA)
5,000 ft	0.75	0.80	0.85

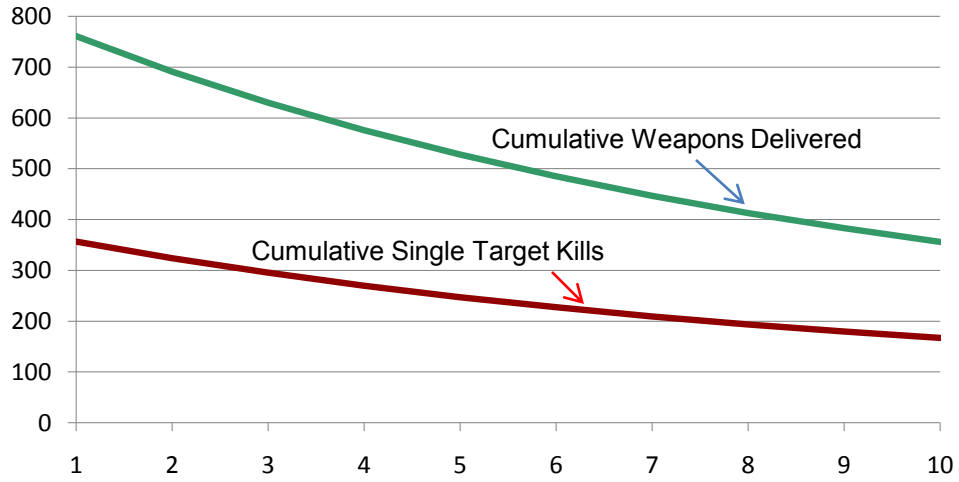
Expected Tank Kills
Column of 10 Tanks, 50 meters Spacing
(Total Area: 2000 ft x 60 ft)

Weapon	Number of Weapons	Targets Attacked	Tank Kills	Passes per Sortie
TV Maverick	4	4	3	4
ROCKEYE	4	1 Tank Column	2	4

Counterlad Operations
Sortie Rate / Survivability relationship through Day 7 GCC Air Force

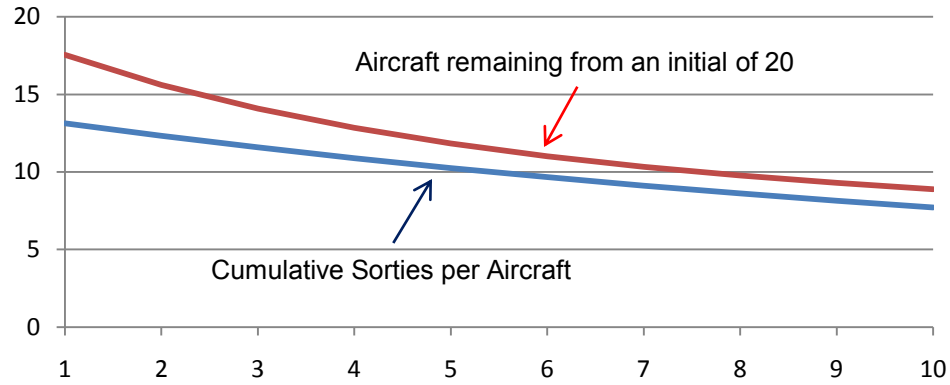


20 Combat Aircraft:
Loss Rate : 1.5%
Cumulative Sortie Rate : 360
Cumulative Single Target Kills : 340
Aircraft Remaining : 15



Number of Aircraft : 20 F-15S
Sortie Rate: 3 per Aircraft per Day
Payload : 2 GPU-10 or 2 GPU-24 Paveway II/III (2,000 lb Bombs)
Hi-Lo-Lo-Hi Mission Profile Range : 600 nmi
Probability of Target Kill = 75%

Counterland Operations
Sortie Rate / Survivability relationship Through Day 7 Iran Air Force



20 Combat Aircraft:
Loss Rate : 5%
Cumulative Sortie Rate : 200
Cumulative Single Target Kills : 131
Aircraft Remaining : 12

Number of Aircraft : 20 F-4E/SU-24
Sortie Rate: 2 Sorties per A/C per Day
Payload : (2) 2,000 lb Bombs
Hi-Lo-Lo-Hi Mission Profile Range 380 nmi
Probability of Target Kill = 40%

MRAAM Engagement Analysis

• When analyzing a Medium Range Air to Air Missile (MRAAM) Engagement, the expected kills are limited by the number of weapons and by the number of firing opportunities.

• Firing opportunities depend on:
  - o Maximum launch range (and hence on launch aircraft energy),
  - o Weapon guidance system (Semi-active radar (SAR), or Launch and Leave),
  - o Retargeting delays (single target track (SST) or Track While Scan (TWS)),
  - o Target size and formation.

• Typical inputs are:
  - o Airborne radar detection capability
  - o Missile Time – Distance Data
  - o Missile Probability of Kill
  - o Firing Doctrine
  - o Altitude and Airspeed

• The Outputs are:
  - o Friendly Aircraft Probability of Kill
  - o Adversary Aircraft Probability of Kill
  - o These then give us the Loss Exchange ratio which is the number of Adversary Aircraft Losses to the number of Friendly Aircraft Losses.

• Appendix III displays the Head-On Intercept Dynamics

Combat Aircraft Radars

Aircraft	Radar	Range (nmi)	Search Scanning Azimuth +/- Degrees
MiG-29A	Saphir 29 (Slot Back)	Search: 54 nmi Track: 38	67
F-16A	Westinghouse APG-66	Search: 38 Track: 29	60
F-16C	Westinghouse IAPG-66	Search: 50 Track: 40	60
Mirage 2000	Thomson RDM	Search: 50 Track: 35	60
F-15E	AN/APG-70	Search: 80 Track: 40	60

Air-to-Air Combat Effectiveness
BVR Combat

F-16C

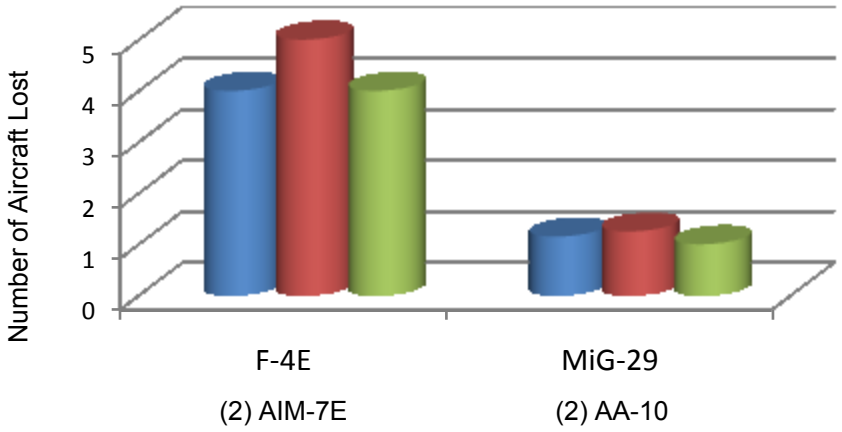
(Mach 1.2)

40 NMI

Altitude : 15,000 ft

MiG-29

(Mach 1.2)



Loss Exchange Ratio =

(4) F-4E for (1) F-16C	(1.15) MiG-29 for 1 F-16C
(5) F-4E for 1 F-15C	(1.25) MiG-29 for (1) F-15C
(4) F-4E for (1) M2000	(1) MiG-29 for (1) M2000

GCC Fighter Sweep vs Iran CAP

		Loss Exchange Ratio
(5) F-18	(6) F-14	(6) F-14 Loss vs (4) F-18
(10) Tornado ADV	(6) F-14	(6) F-14 vs (3) Tornado
(20) F-15C vs	(12) MiG-29A	(12) MiG-29 Loss vs (10) F-15C

GCC Escort vs Iran Max SLI

		Loss Exchange Ratio
(20) F-15C vs	(3) MiG-29	(3) MiG-29 vs (2) F-15C
(10) F-16C vs	(32) F-4E	(32) F-4E vs (8) F-16C
(10) F-18 vs	(3) F-14	(3) F-14 vs (3) F-18

Total Estimated Losses in Air to Air Combat

GCC	**Iran**
27	62

Estimated Aircraft Losses Over a 7 day conflict during Counterland Operations

GCC (1.5% Loss Rate)	**Iran (5% Loss Rate)**
5	8

GCC – Iran
Force Allocation Matrices

GCC Force Allocation Matrix

Combat Aircraft	Country	Order of Battle	Force Available	Total Sorties	CAP	SLI	Airfield Closure	SEAD	Escort	Fighter Sweep	Left for other Mission
Tornado ADV	Saudi Arabia	25	19	57						10	9
Tornado IDS	Saudi Arabia	85	64	191			27				37
Mirage 2000	Total	74	56	167							11
	Qatar	12	9	27	5					5	4
	UAE	62	47	140	20	20					7
F-18	Kuwait	39	29	88	10				10		4
F-16 C/D	Total	113	85	254							10
	Bahrain	21	16	47	5	5			5		1
	Oman	12	9	27	5						4
	UAE	80	60	180	15	15		20	5		5
F-15 C/D	Saudi Arabia	84	63	189		15			20	20	8
F-15S	Saudi Arabia	71	53	160			29				24
Total		491	368	1,106	60	55	56	20	40	35	102

Aircraft Operational Readiness Rate: 75%
Sorties per Aircraft per Day: 3
Closure of 5 airfields for 7 days.

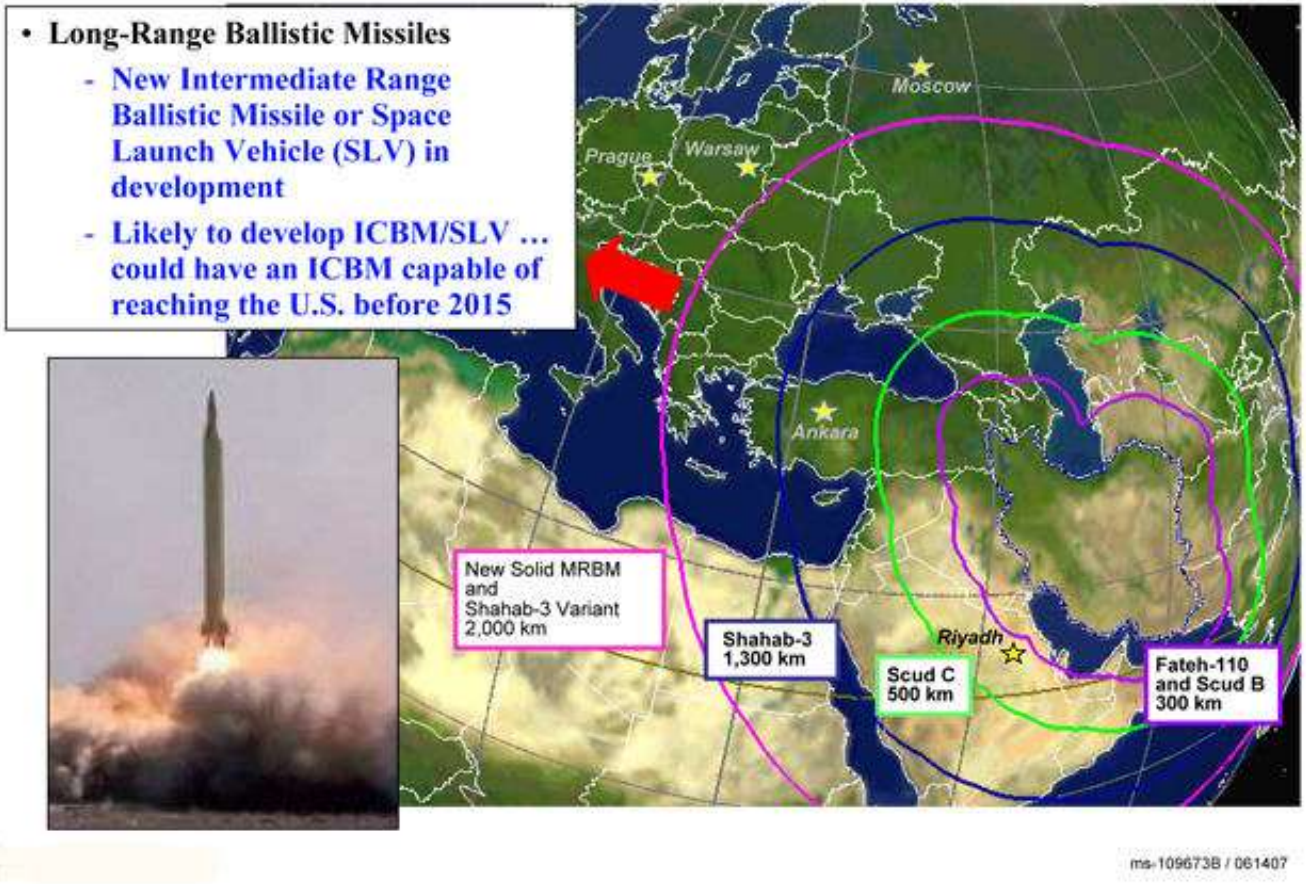
Iran Force Allocation Matrix

A/C	Order of Battle	Force Availabl e	Total Sorties	CAP	Maximum SLI	Runway Strike	SEAD	Escort	FS	Left for other Mission
MiG-29	25	15	30	12	3					0
SU-25	13	8	16							8
SU-24	30	18	36				8			10
F-14	25	15	30	12	3					0
F-4E/D	65	39	78		32		7			0
Total	158	95	190	24	38		15			18

Aircraft Operational Readiness Rate: 60%
Sorties per Aircraft per Day: 2

Theater Ballistic Missiles

Iranian Ballistic Missile Threat



Shehab 3/3A

Range (km)	Payload (kg)
1,350	1,158
1,400	987
1,500	760
1,540	650
1,560	590.27
1,580	557.33
1,600	550
1,780	240
2,000	-

(Source: Missile Defense Program Overview for the European Union, Committee on Foreign Affairs, Subcommittee on Security and Defense. Dr. Patricia Sanders. Executive Director. Missile Defense Agency)

Utilizing Ballistic Missiles with 500 – 1000kg warheads and ranges up to 300 km in:

- Runway Closure
- SEAD Mission (Radars)

Runway Closure:

- For runways that are 9,000 ft in length and 200 ft in width, it would take 3 cuts each 3,000 ft in length and Minimum Clear Width of 50 ft to stop any modern day aircraft, such as an F-16 from taking off.

- With a CEP of 300m minimum, and a warhead of 600 – 700 kg a unitary missile would cause, in a 6 to 12 in Concrete Runway, a crater of 50 ft in width and 15 ft in depth. It would take around 80 Shehab II type missile with 80% confidence to produce 1 cut. Therefore for an airfield it would take some 240 missiles.

- Even if Iran had the capability of developing warheads with 3 to 5 submunitions, and each capable of producing a 50 ft shallow crater, which should prove to be more effective than a unitary warhead which would create one large crater, the following table was calculated:

CEP (m)	P (damage)	No of Missiles per cut	Airfield Closure with 3 cuts
50	0.219	12	36
100	0.132	21	63
150	0.089	32	96
250	0.046	64	192
300	0.035	84	252

(Source: Brining Prithvi Down to Earth: The Capabilities and Potential Effectiveness of India's Prithvi Missile. Science & Global Security, 1998, Volume 7, pp, 333-360).

The number of missiles required is definitely very large and not cost effective. For 5 airfields for instance, up to 1,160 missiles would be required just for the first day of a conflict. The airbase can be fixed within a 24 hour period and back to being operational for aircraft to land and take-off. This number of missiles of the Shehab II class could be very much higher than the present Iranian inventory of Ballistic Missiles.

SEAD Missions (Radars):

We can assume that the same missile carrying submunitions, a 5 psi blast pressure would be required to damage a typical radar, and with a desired probability of damage of 75% the required missiles to damage 1 radar would be:

CEP (m)	Rd (radar dispersal radius)	P (damage)	N (missiles)
50	90	0.7856	2
100	125	0.4385	3
150	155	0.2648	6
250	195	0.1237	13
300	220	0.0918	18

(Source: Bringing Prithvi Down to Earth: The Capabilities and Potential Effectiveness of India's Prithvi Missile. Science & Global Security, 1998, Volume 7, pp, 333-360).

A Comparison between Aircraft and Ballistic Missiles Required for the Missions

Mission	Number of A/C Required	Number of Missiles Required (Shahab II)
Airfield Closure (Payload Bap 100)	3 (see slide 100)	252
SEAD Anti-Radar (Payload AS-37 ARM)	2 (see slide 104)	18

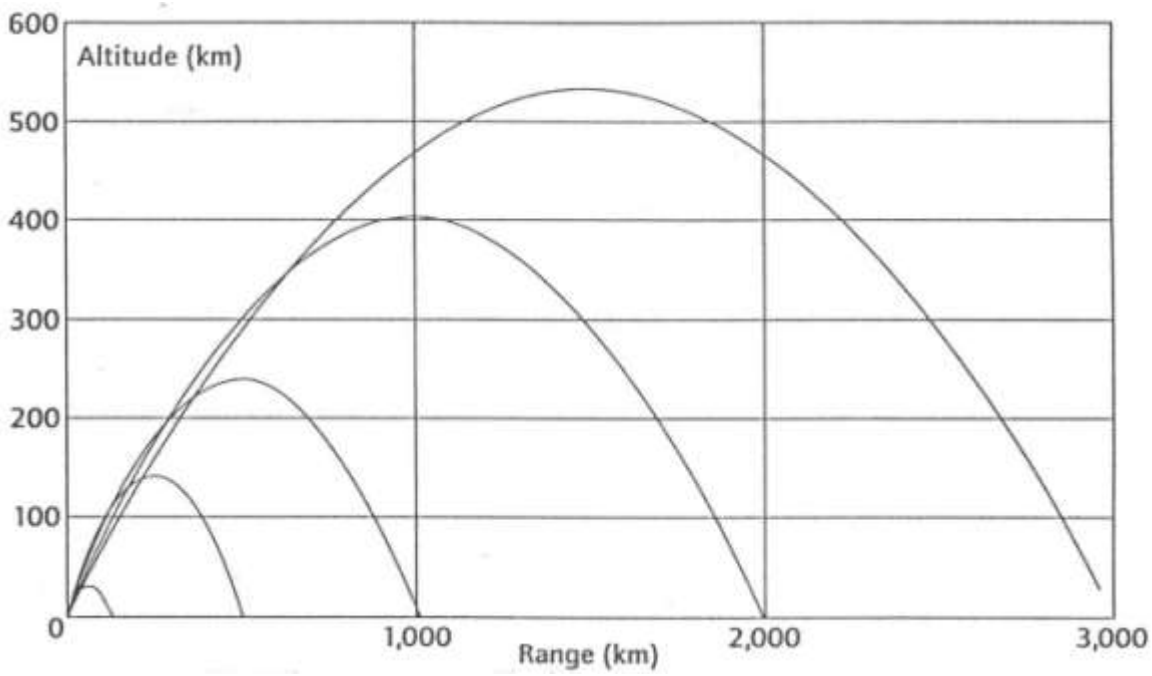
Iran has also been heavily investing in:

- 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.
- Nuclear Program

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 against soft targets such as cities, in essence a major component for Asymmetric Warfare in the form of high attrition and defenses in depth.

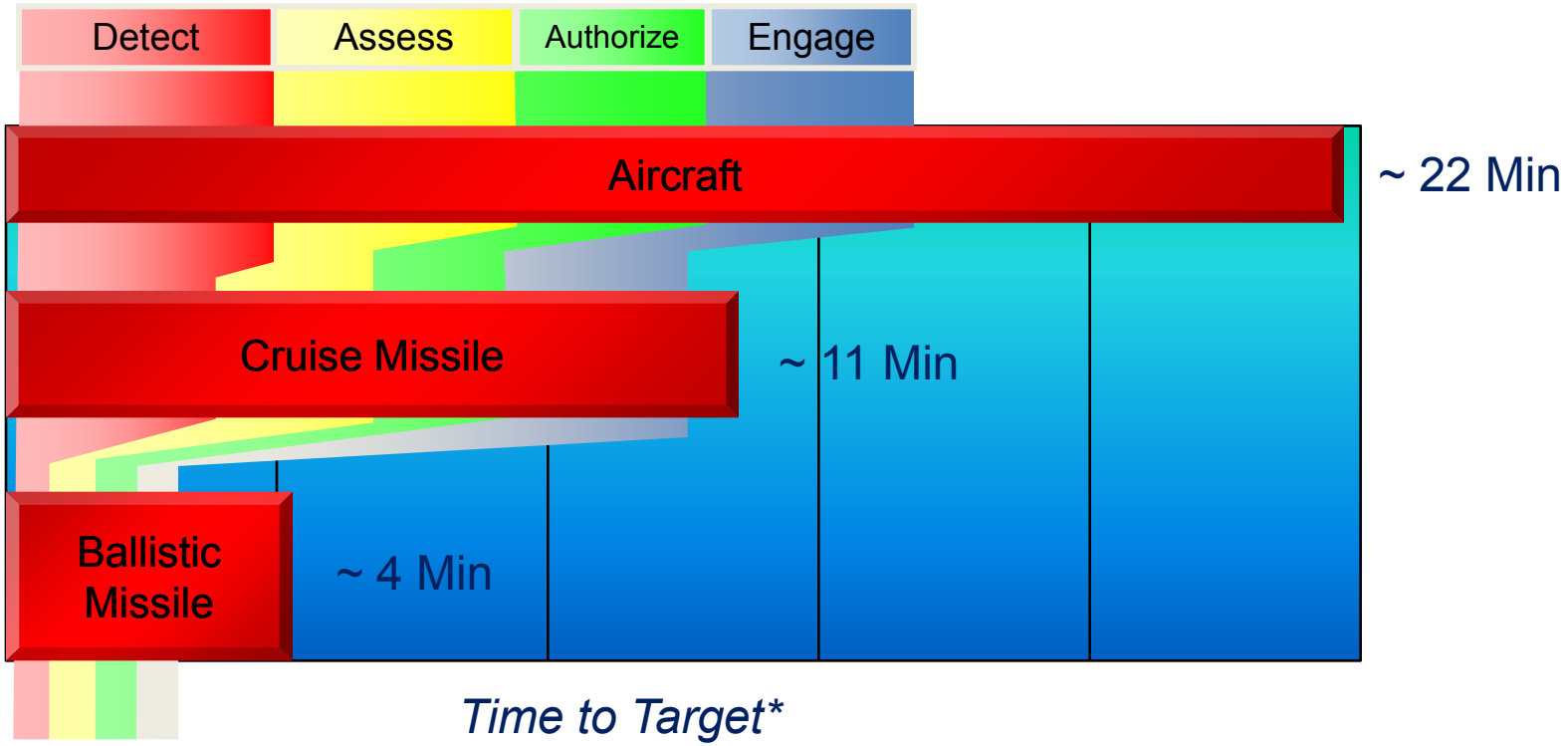

The Arabian Gulf will turn into the front line in the event of an Iranian conflict with Israel and the U.S.
Space Sensor
Defense Support Program in Boost Phase
Iranian Shahab 3 Launched against Israel
Early Warning & Long Range Search & Track Capabilities against Iranian MRBMs
IRAQ
IRAN
KUWAIT
Midcourse & Terminal Missile Defense
Arabian Gulf
BAHRAIN
QATAR
SAUDI-ARABIA
Sea-Based EW & Terminal Defense
Gulf of Oman
Air Defense
UAE
OMAN
PAC-3 THAAD
Early Warning Radar
AWACS
Google

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



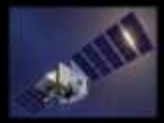
** Based on Approximate Range of 320 Km*

Responsive Missile Defense System is Crucial

(Dennis Cavin, "Counterforce Capabilities Against Cruise and Ballistic Missiles". MEMAD 14 & 15 December, 2008)

Components of a multi-layered integrated Ballistic Missile Defense System

Sensors



Space Tracking and Surveillance System

In Mid - Course Phase

Sensors

Defense Support Program in Boost Phase

Vehicles & Decoys

Mid-Course Phase

Reentry Vehicles & Decoys

Terminal Phase

Boost Phase Vehicles

Sea Based Radar

Sea Based Radar

Forward-Based Radar

Midcourse Radar

- Boost Phase short in time duration limiting interception opportunities.
- Missile destruction occurs before dispersal of payload.
- Debris from missile, including warheads, may fall on the launching country.

- Speed of warhead and short duration of terminal phase are challenges.
- Warheads can maneuver.

- Longer flight duration
- Exoatmospheric (above atmosphere)
- Must be able to discriminate between weapons and decoys.

- Threat most vulnerable.
- Destroy many RVs with single shot.

Ground Based Interceptor

Early Warning Radar

THAAD
"Hit to Kill" Technology
Direct hit of incoming ballistic missile.

Sea Based Terminal

Patriot Advanced Capability PAC-3

Ground Based Radar

U.S. Aegis Ballistic Missile Defense

Standard Missile-3

Ground Based Midcourse Defense

Multiple Kill Vehicle

Arborne Lasers

Kinetic Energy Interceptors

Counterforce Operations

Air Launched Concepts

C4I and Battle Management

Russian ANTEY-2500 Mobile System/S-300VM (SA-12 Giant)

The Russian Antey-2500 Mobile SAM system is considered as the progressive development of the S-300V (SA-12, Giant) long range SAM system. It was designed to protect against air-strikes, including combat aircraft and ballistic missiles of short and medium range. It has been reported that Iran has been negotiating with Russia over this air defense system and the upgraded model the S-200PMU2 for some time.

Radar Detection Unit:

- Range of up to 320 km.
- Targets with speed 4500 km/sec.
- Tracking the trajectories of up to 70 destructive prioritized targets.
- The Antey-2500 can operate either under the Command and Control of higher level command post or autonomously.

- Area protected by one fire unit against:
  - Medium range Ballistic Missiles with 2500 km range: 1000-1750 square km
  - Theater Ballistic Missiles with 1100 km range : 2000-2500 square km
  - Tactical Ballistic Missiles with 600 km range: 2500 square km
  - Piloted air strike up to: 12,500 square km

- Number of Targets simultaneously engaged by one fire unit: 6
- Number of missiles guided at one target:
- One launcher fires: up to 2
- Number of launchers firing: up to 4
- Launching rate from one launcher: 1.5 sec.
- The standard combat crew of an Antey-2500 SAM battalion consisting of four SAM sites (6 launchers, 3 loader/launchers) is 139 personnel. The full crew complement for a SAM battalion is 180.

- Command Post of Antey-2500 SAM System
  - The Command Post provides for the Command and Control of all combat assets of the SAM system. It also prioritizes and distributes the targets among the SAM batteries.
  - Number of targets processed : 200
  - Number of target trajectories tracked simultaneously : 70
  - Number of target designations simultaneously transmitted to fire units: 24

- Launcher Vehicle
  - Number of missiles on a launcher : 4
  - Pre-launch prepara2on of SAM : 7.5 sec
  - Interval between launched : 1.5 sec
  - Weight with missile : 47.5 tons
  - Crew : 2 to 3

- Surface-To-Air Missiles
  - The 9M83ME SAM is designed for destroying aerodynamic targets, including low-flying ones, and those maneuvering up to 12-g loads, in addition to intercepting aero-ballistic and tactical missiles in a heavy
    ECM environment.
  - The 9M82ME SAM is designed for destroying of medium range, theater, tactical and aero-ballistic missiles, as well as all aircraft types operating at ranges of up to 200 km.
  - The design of both missiles is highly unified, and they differ only in the starting boosters (initial firing stage).
  - Type of engine: solid propellant
  - Launching mode: vertical
  - Weight of missile 9M83ME: 2345 kg
  - Weight of warhead: 150kgType of warhead: HEF with direct blast
  - Type of fuse: proximity, semi-active radar
  - Maximum speed:
    - 9M83ME SAM: 1700m/sec
    - 9M82ME SAM: 2600m/sec

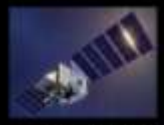
Combat Characteristics Vs Attacking Ballistic Missiles	S-300PMU2 "Favorit"	Antey 2500 S-300V
Number of SAM complexes to one firing unit	6	4
Missile Guidance	Illumination & Radar Command	SAR during last leg of flight
Maximum Range (km)	40	40
Minimum Range (km)	5	5
Minimum Altitude (meters)	20	25
Maximum Altitude (km)	25	30
Rate of Fire (sec)	3	1.5
Reaction Time (sec)	7 to 8	7.5
Missile Maximum Speed (meters/sec)	2,000	2,600
Number of Guided Missiles by one Launcher	4	2
Missile Warhead (kg)	180	150
Illumination and Guidance Radar:		
• Maximum Tracking Range (km)	200	200
• Number of simultaneously tracked BM targets	36	24
• Number of simultaneously guided missiles	72	70
• Maximum Speed of Tracked Target (meters/sec)	2,800	4,500
Time to deploy launcher (minutes)	5	5

Comparative Chart between PAC-3 and the S-300 BMD Systems

	PAC-3	S-300
Maximum Firing Range (km)	150	200
Maximum Range for Destruction of BM (km)	40	40
Maximum Launching Range of BM Destroyed (km)	1,000	2,500
Upper Limit of Destruction Zone (km)	30	30
Area Covered Against BM Strike (km^2)	1,200	2,500
Maximum Speed of Destroyed Target (meter/sec)	3,000	4,500
Maximum Scattering RCS of Destroyed Target (m^2)	0.05 - 1	0.02

A Multi - Layered Integrated Ballistic Missile Defense System

Sensors



Space Tracking and Surveillance System

(Option II)
Vehicles & Decoys

Sensors

Space Tracking and Surveillance System

Mid-Course Phase

Reentry Vehicles & Decoys

Terminal Phase

Sea Based Radar

Sea Based Radar

Boost Phase Vehicles

- Boost Phase short in time duration limiting interception opportunities.
- Missile destruction occurs before dispersal of payload.
- Debris from missile, including warheads, may fall on the launching country.

Forward-Based Radar

Midcourse Radar

Iran BMD

- Speed of warhead and short duration of terminal phase are challenges.
- Warheads can maneuver.

- Longer flight duration
- Exoatmospheric (above atmosphere)
- Must be able to discriminate between weapons and decoys.

- Threat most vulnerable.
- Destroy many RVs with single shot.

Ground Based Interceptor

Jericho III

Early Warning Radar

Antey 2500 / S-300PMU2 "Favorit"

Potentiality of Antey 2500 System in Destruction of Air Targets

Maximum launching range of BM engaged 2500km
Area protected by one fire unit against:

Medium Range BM with 2500 km range : 1000 - 1750 km^2
Theater BM with 1100 km range : 2000 - 2500 km^2
Tactical BM with 600km range : 2500 km^2

Arborne Lasers

Kinetic Energy Interceptors

Counterforce Operations

Ground Based Radar

C4I and

Battle Management

Part II
Iran Asymmetric Warfare

Iranian Response to an Israeli or US Attack

The following is what has been written by analysts regarding Iran's possible response to an attack by Israel or the United States or both:

• Immediate retaliation using its ballistic missiles on Israel. Multiple launches of Shahab-3 including the possibility of CBR warheads against Tel Aviv, Israeli military and civilian centers, and Israeli suspected nuclear weapons sites.
• Using proxy groups such as Hezbollah or Hamas to attack Israel proper with suicide bombings, covert CBR attacks, and rocket attacks from southern Lebanon.

• Give rise to regional instability and conflict as well as terrorism.
• Destabilizing Iraq through the Shia against US occupation, further arming insurgency groups when possible.
• Support and upgrade Taliban capabilities in Afghanistan.
• Increase the threat of asymmetric attacks against American interests and allies in the region.
• Target U.S. and Western shipping in the Gulf, and possibly attempt to interrupt the flow of oil through the Gulf. Danger not simply a cut-off in the supply of oil from Iran, the GCC, or the closing of the Strait of Hormuz, but a prolonged threat to the wider Gulf region.

Operational Readiness Rate

•In estimating the Operational Readiness it can be assumed that a conflict can initiate with relatively short warning. Under such conditions, it can be further assumed that the Armed Forces would not have sufficient time to boost Operational Readiness Rate of it's Combat Forces much higher than Peacetime or Training Operations.

▪ How is Iran preparing for any conflict with Israel and the United States, and what will its fighting doctrine and Operating Readiness be?

▪ One can get a fair idea by analyzing large scale Peacetime Military Exercises over the past couple of years.

(Source: Israeli and US Strikes on Iran: A Speculative Analysis. Anthony Cordesman CSIS. March 5, 2007)

Iranian Military Exercises

Date	
January 27, 2006	Iran completes major military exercise that testes Teheran's ability to attack Gulf shipping and Arab oil facilities. The exercise was meant to show the West that Iran could stop all oil shipments in the Gulf and destroy numerous oil facilities in Gulf Arab countries
August 19, 2006	Iran launches a series of large-scale military exercises aimed at introducing the country's new defensive doctrine: Ballistic Missiles and Asymmetric Warfare (Defiance, Deception, Deterrence, Demonstration).
November 3, 2006	Iran began the 10 days of maneuvers in the Gulf by test firing dozens of missiles, including the long-range Shahab-3 (estimated range: 2000 km or 1,240 miles), and the Shahab-2, which Iran says can carry a cluster warhead that can deliver 1,400 bomblets at once. Aim is to show our deterrent and defensive power to trans-regional enemies.
March 23-30, 2007	Iran's regular Navy launches week-long war-games on its southern shores. The military exercises are being carried out in the Gulf by Iran's regular Navy
January 7, 2008	US ships harassed by Iran. Iranian boats approach three U.S. Navy ships in the strategic Strait of Hormuz, threatening to explode the American vessels. U.S. forces are reported to be on the verge of firing on the Iranian boats, when the boats - believed to be from the Iranian Revolutionary Guard's navy - turn and move away.
July 7, 2008	Iran's elite Islamic Revolutionary Guards Corps launch large-scale, five-day war-games, dubbed "Exercise Stake Net", was carried out in the Straits of Hormuz and the Sea of Oman, where an assortment of new weapons were brought into play. Iran later test-fires nine missiles including what is claims is an upgraded version of Shahab-3 ballistic missile with a one-ton warhead capable of destroying targets within a 2,000-kilometer (1,245- mile) range

(Source: Anthony Cordesman , CSIS "Threats, Risks and Vulnerabilities: Terrorism and Asymmetric Warfare")

Iranian Military Exercises

Date	
October 10, 2008	The Islamic Republic Air Force tests Iran's domestic-made warfare in a joint military exercise with the IRGC, the Defense Ministry says. The joint aerial maneuver is aimed at boosting Iran's defensive capabilities and operational tactics.
December 2-7, 2008	Iran says it will seek to accomplish objectives that include defense against an Israeli and US threat, closing the Strait of Hormuz to local and international shipping, and the testing of new and improved military equipment and tactics.
December 1-7, 2008	Kayhan quotes Admiral Habibollah Sayyari, commander of the navy as saying "In this six-day long maneuver there will be more than 60 combat vessel units," and it will include destroyers, missile-equipped battleships, submarines, special-operations teams, helicopters, and fighter planes. An Iranian naval commander says a week earlier that the country's navy could strike an enemy well beyond its shores and as far away as Bab al-Mandab, the southern entrance to the Red Sea that leads to the Suez Canal. Iran test-fires a new surface-to-surface missile from a warship in a strategic shipping route, as part of the war games in the Sea of Oman and the Gulf region: State radio reports, "The surface-to-surface Nasr-2 missile was tested in the (Sea of) Oman operational region,". IRNA reports that, "The Nasr-2 was fired from a warship and hit its target at a distance of 30 km (19 miles) and destroyed it," adding it was the first test of the new, medium-range missile.

(Source: Anthony Cordesman , CSIS “Threats, Risks and Vulnerabilities: Terrorism and Asymmetric Warfare”)

IRGC Commander and Asymmetric Strategy

• On September 1, 2007, Khamenei promoted Mohammad Ali Jafari, then coordinator of the IRGC Research and Command Center, to the rank of major general and the post of commander in chief of the IRGC. Jafari has outlined the strategy he means to promote as IRGC commander, reiterating his commitment to developing Iran's ballistic missile capabilities and the asymmetrical warfare capacities of the IRGC:

• Asymmetrical warfare... is [our] strategy for dealing with the considerable capabilities of the enemy. A prominent example of this kind of warfare was [the tactics employed by Hizbullah during] the Lebanon war in 2006... Since the enemy has considerable technological abilities, and since we are still at a disadvantage in comparison, despite the progress we have made in the area of equipment, [our only] way to confront [the enemy] successfully is to adopt the strategy [of asymmetric warfare] and to employ various methods of this kind."

Some Tangible Examples

- Iranian tanker war with Iraq
- Oil spills and floating mines in Gulf.
- Use of Quds force in Iraq.
- Iranian use of UAVs in Iraq.
- Missile and space tests; expanding range of missile programs (future nuclear test?).
- Naval guards seizure of British boat, confrontation with US Navy, exercises in Gulf.
- Development of limited “close the Gulf” capability.

Iranian Asymmetric Doctrine

- Iran sends signals about its use of asymmetric warfare through its military parades and exercises.

- The IRGC often claims to conduct very large exercises, sometimes with 100,000 men or more. The exact size of such exercises is unclear, but they are often a small fraction of IRGC claims.

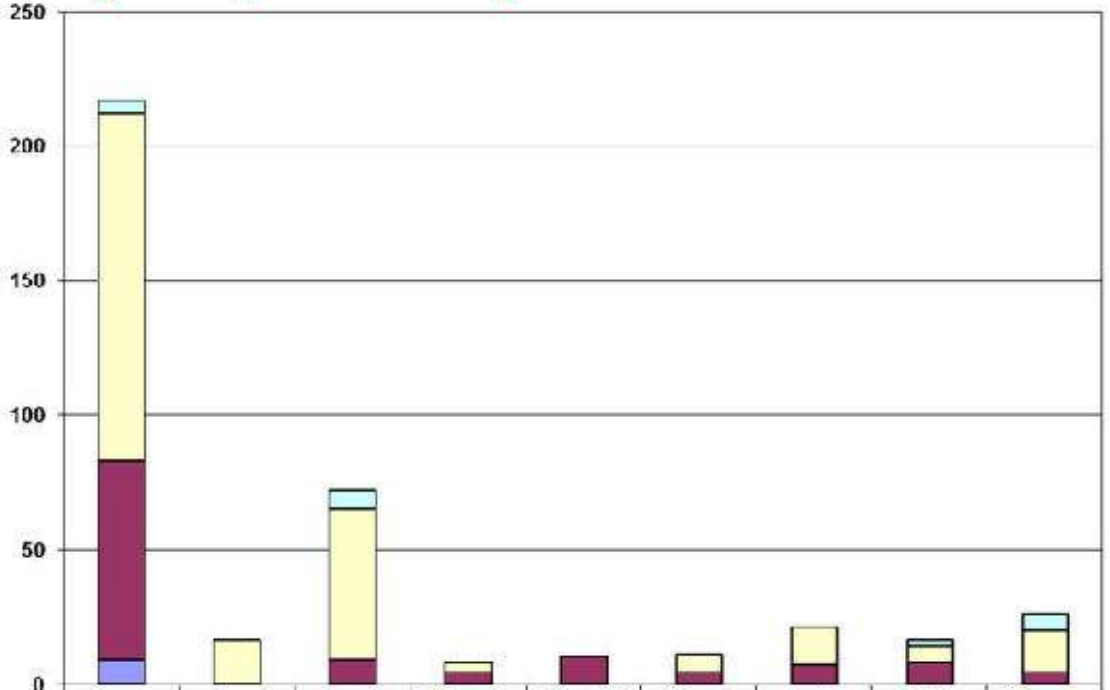
- One important aspect of the exercise was the almost total absence of the regular Iranian navy, whose functions are more oriented towards the classical tasks of sea denial and power projection ashore in the Gulf and the Straits of Hormuz.

- By displaying both its real and virtual military (e.g. naval) fighting capabilities through electronic, printed and network media, and through endless official statements, Iran tends to achieve the following politico-diplomatic and propaganda ends (4Ds):

  - Defiance (to maintain a course of resistance, targeting primarily the Western political will and system).
  - Deception (on the real state of Iranian warfighting capabilities, targeting the Western military establishments).
  - Deterrence (with the IRI military "might", targeting Western public opinion, delivered through the media).
  - Demonstration (of the outreach of its own power, targeting the Iranian people and the Moslem world).

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

Key Ships for Asymmetric Warfare



	Iran	Iraq	Saudi	Bahrain	Kuwait	Oman	Qatar	UAE	Yemen
Mine Warfare	5		7					2	6
Other Patrol	129	16	56	4		7	14	6	16
Missile Patrol	74		9	4	10	4	7	8	4
Submarines	9								

Source: Adapted by Anthony H. Cordesman from IISS, The Military Balance, various editions; Jane's Sentinel series; Saudi experts

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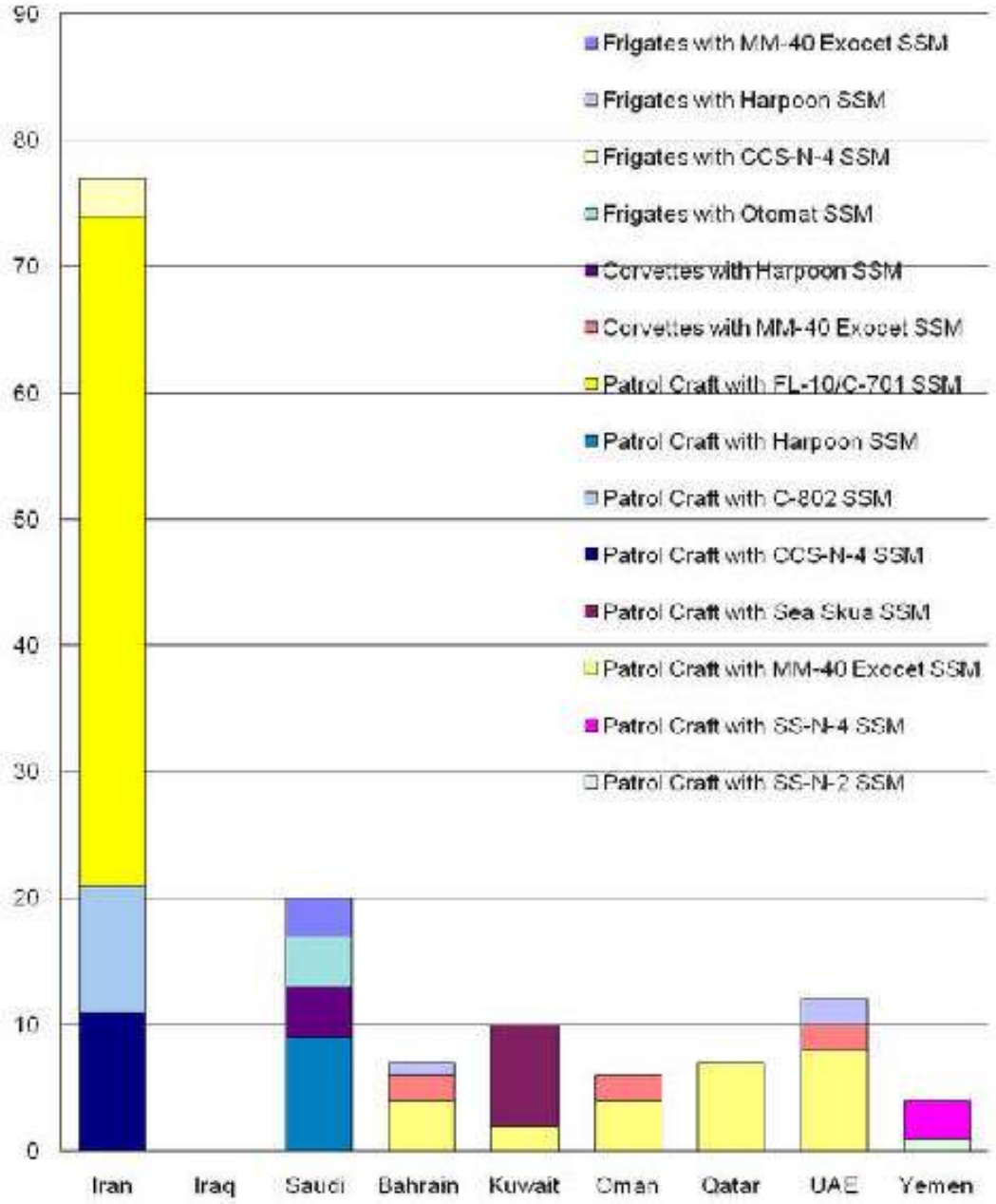
Gulf Warships with Anti-Ship Missiles, 2009



Source: Adapted by Anthony H. Cordesman from IISS, The Military Balance, various editions and material provided by US and Saudi experts.

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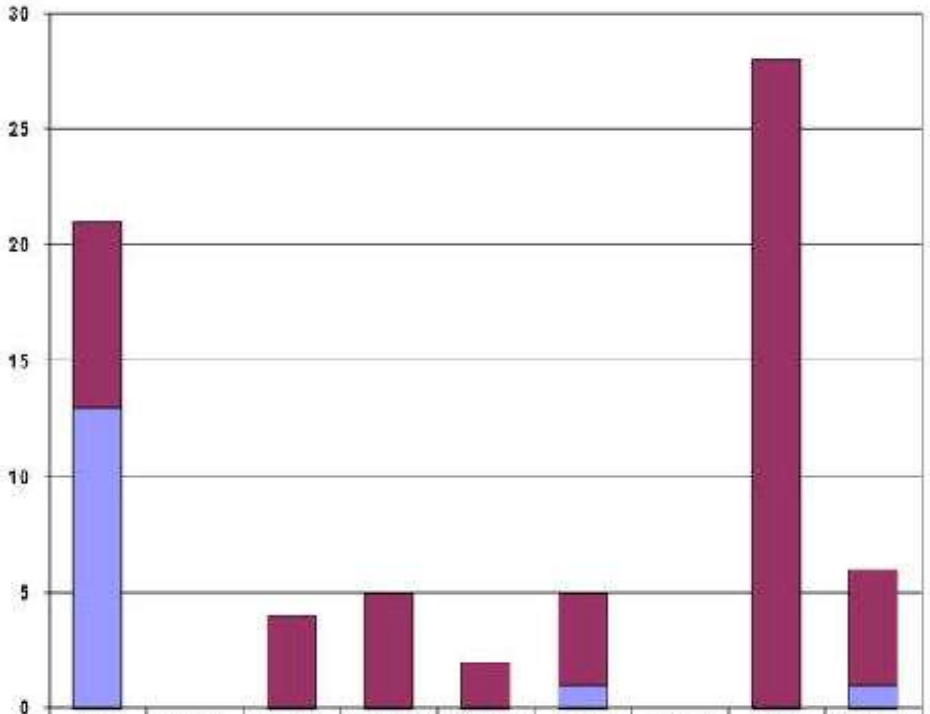
Amphibious Ships & Landing Craft, 2009



	Iran	Iraq	Saudi	Bahrain	Kuwait	Oman	Qatar	UAE	Yemen
Landing Craft	8		4	5	2	4		28	5
Amphibious Ships	13		0			1			1

Source: Adapted by Anthony H. Cordesman from IISS, The Military Balance, various editions, Jane's Sentinel series, and material provided by US and Saudi experts. Estimates differ on Saudi landing craft, because of different ways to count operational status. Some experts put the figure at 6 LCMs and 2 LCUs.

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Planning for Asymmetric Warfare

- Deterrence and conflict prevention as critical as defense.
- Need integrated GCC force planning and war planning efforts.
- Must show GCC will act together. Threats cannot divide or exploit weakest link.
- Exercise realistic "red-blue" war games to determine common options and requirements.
- Follow-up with realistic CPXs and FTXs.
- Emphasize joint warfare approaches that tie in paramilitary and security forces.
- Demonstrate have exercised a retaliatory capability.
- Interoperability with other Gulf states and with US, UK, France.
- Defend against strikes at critical nodes and infrastructure.

76

(Source: Anthony Cordesman CSIS)

Appendix I
Air to Air Missiles

Sparrow AIM-7F	Matra Super 530	
Guidance: Semi Active Radar Homing (SAR) Minimum Range : 1,000ft Maximum Range: 21 nmi for 2 meter squared target 29 nmi for a 5 meter squared target 53 nmi Aero Range at 40,000ft Mach 2.0 40,000 ft, ML=0.9 Mach, MT=0.9 Mach, Heading Zero Degrees, Head On Range = 37 nmi 90 lbs warhead Multiple Target Capability Reliability 95%	ZF (Fighter Altitude) : 20,000 ft ZT (Target Altitude) : 10,000 ft MF: 1.2 Mach MT: 0.9 Mach NT: 1g ZF (Fighter Altitude) : 30,000 ft ZT (Target Altitude) : 30,000 ft MF: 1.4 Mach MT: 1.2 Mach NT : 1g	Minimum Range: 3 km Maximum Range: 22 km Minimum Range: 3 km Maximum Range: 24 km

Magic 550 AAM

Magic 550 AAM

- Seeker look angles +/- 30 degrees and 3 to 4 microns
- Lateral Acceleration close to 35g
- Maximum Guided Flight Time: 25 secs
- Minimum closing speed : 80 m/sec
- Homing Head Passive Infra Red

Altitude (ft)	ML	MT	Range (km)
0	0.8	0.5/0.8/1.05	4.35/2.3/1.45
	0.9	0.6/0.9/1.05	3.6/2.12/1.6
20,000	0.9	0.6/0.9/1.2	6.8/4.2/2.6
	1.2	0.9/1.2/1.45	5.1/3.35/2.25

Magic 550 II AAM (Improved)

- Range, Gimbal, and Sensitivity are the only factors that the Magic 550 II is different from the Magic 550.
- Seeker is a multi-element detection giving all aspect firing capability (4 to 4.5 microns)
- Propulsion is 10% greater than Magic 550
- Gimbal +/- 45 degrees
- Lateral acceleration 35 g
- Fuze changed from IR to Proximity (EM) Active Radar.
- Lock on time less than 1.3 seconds

ZL=ZT=15,000 ft
MT=0.8 Mach, ML=0.9 Mach, NT=1G Head-on
Maximum Range: 17.5 km
Minimum Range: 1.5 km

With No Target Afterburner (Military Thrust):
NT=1G

Altitude (ft)	Rear Range (km)	Frontal Range (km)
1,000 ft	3	6
10,000 ft	9	14

Medium Range Skyflash

• Threat: Low level Multiple Targets ECM Environment
• Missile: Medium Range Air to Air Radar Guided all Weather Capability day and night.
• Warhead Weight: 32 kg Continuous Rod
• Missile Lateral Acceleration up to 25 g's.
• Seeker: Semi-Active Radar (SAR) design of the Monopulse type, uses angle tracker 45 degrees from axis.

• Snap-Down
Launch Altitude 15,000 ft, M=0.9
Target Altitude 500 ft, M=0.95
Range: 12.5 km

Altitude (ft)	ML	MT	G	Range (km)
Sea Level	0.9	1.2	1	17
10,000	0.9	1.4	1	22
20,000	0.9	1.7	1	25

AMRAAM Skyflash II

• Airframe retains key features of Skyflash to minimize the aircraft interface changes and the integration tasks.
• New Features:
  - Multiple target Engagement and Multi-Shot Capability
  - ECCM in a high threat Counter Measures Environment
  - Increase in Range and higher average velocity which will reduce missile flight time.
  - Off-Boresight Capability, seeker +/- 60 degrees.
  - Guidance: Mid-course up-dated Inertial Navigation & Fire and Forget.
  - Terminal: Active Pulse Doppler Radar
  - All Weather capability, day and night.
• Lateral Acceleration up to 37g's
• Range up to 50 km.

• Snap-Up (Launch Aircraft Sea Level):
Target Altitude 20,000 ft, ML=0.9, MT=0.9, Range= 45 km

• Snap-Down (Target Aircraft Sea Level):
Launch Altitude 20,000 ft, M=0.9, MT=0.9, Range = 30 km

Altitude (ft)	ML	MT	G	Range (km)	Fire & Forget Boundary (km)
300	0.9	0.9	1	50	30

British Aerospace
Short Range Air to Air Missile
(SRAAM)

SRAAM was developed as a close combat air-to-air missile with the capability to intercept highly maneuverable targets. Designed to have the following operational characteristics:

All aspect day and night capability
Fire and forget
Performance within the launch and target envelope of 50 meters to 15km altitude and between 0.9 to M2.0 speeds.
Launcher and Target aircraft maneuvers greater than 7g
Lock before launch
Fast reaction time (< 1 sec)
Has high ECCM capability
High reliability and lethality

Gimbal seeker : +/- 60 degrees
Fuze: Passive IR Proximity Fuze which triggers at ranges up to 3 meters.
Warhead: 6.9kg with a lethal radius of 3m.

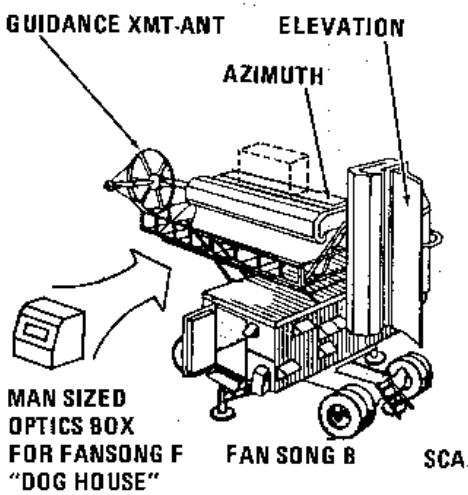
	Maximum Range			Minimum Range		
	Head On (km)	Beam On (km)	Tail On (km)	Head On (km)	Beam On (km)	Tail On (km)
Low Altitude 100 ft	3.2 (i) 7.5 (ii)	3.5	2.2	1	1	0.3
Medium Altitude 10,000 ft	3.2 (i) 7.9 (ii)	4.1	2.5	1	1.2	0.3
High Altitude 35,000 ft	3.2 (i) 8.2 (ii)	5.2	3.6	1.5	1.5	0.5

(i) : Head On Military Power
(ii) : Head On Full Thrust

Appendix II
Medium Range SAM Systems

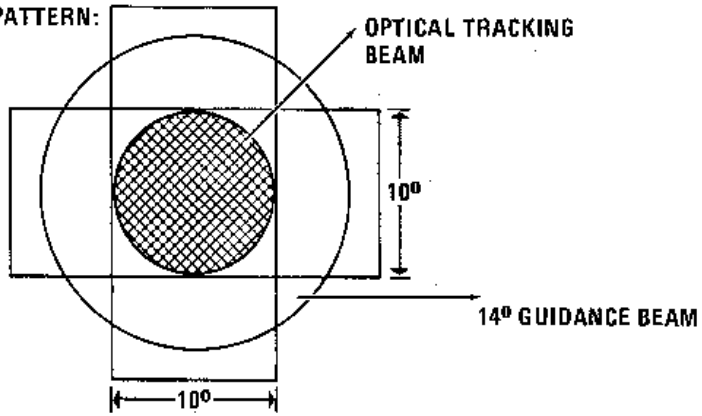
SA-2 Guideline

SA-2b/f FANSONG B/F



ACQUISITION RADARS:	SPOON REST & FLAT FACE A/C BAND DETECTION 100-125 NM
FANSONG B/F:	ACQUISITION E/F BAND TRACK E/F BAND MISSILE BEACON E/F BAND COMMAND UPLINK C BAND
MAXIMUM RANGE:	ACQUISITION 60-75 NM TRACK LOW PRF 50-60 NM HI PRF 30-40 NM OPTICAL 15-20 NM
GUIDANCE:	AUTOMATIC – LEAD ANGLE MANUAL/OPTICAL – THREE POINT

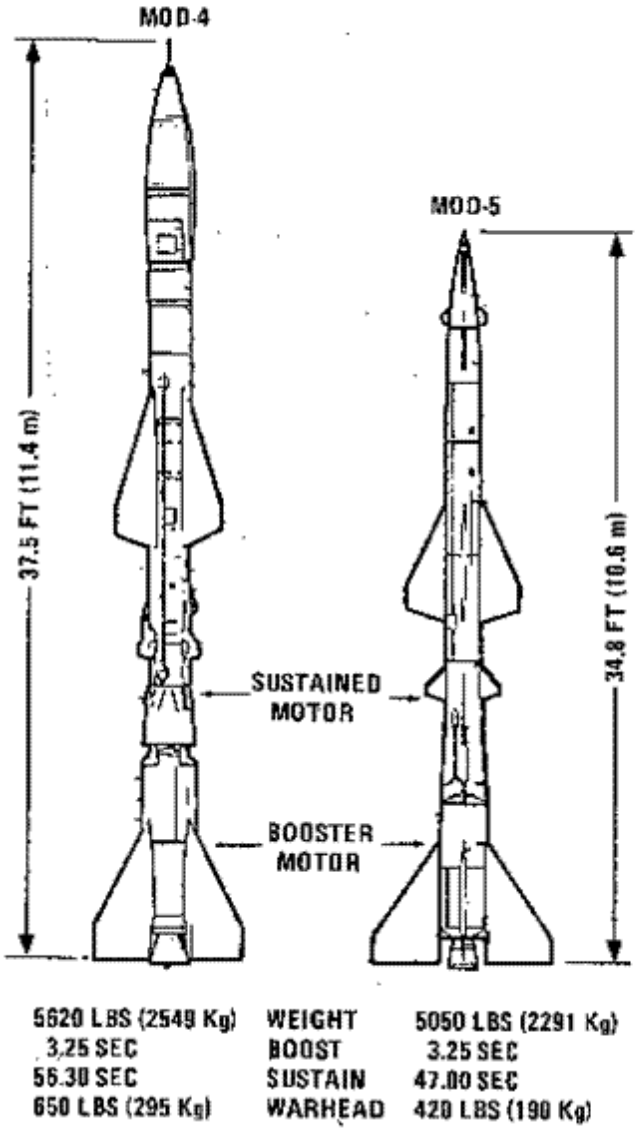
SCAN PATTERN:

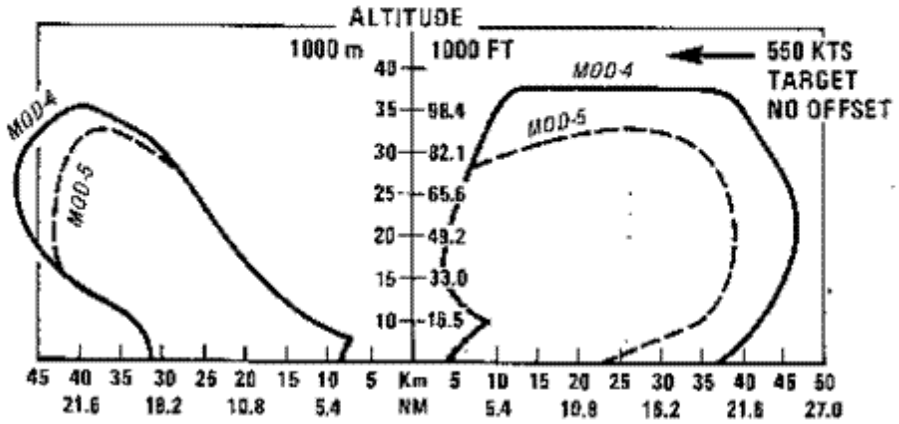


SA – 2 (Guideline) SAM

Associated Radar	Frequency (MHz)	PRF (pps)	Pulse Width (microsecond)	Power (KW)	Radar Range
Spoon Rest D (P-18)	150 - 157	300 – 400	4 – 7	200 per beam	185 – 231 km
Tracking/Guidance (1) Fansong A/B	2950 – 3065	1000 – 1250	0.3 – 1.0	600	Acquisition: 120 km (2 sq m) Tracking: Low PRF 92 – 110 km Tracking : High PRF 55 – 75 km Optical Range: 28 – 37 km
Missile Uplink Command	705 – 850	2260 – 2660	0.3 – 0.5		
Missile Beacon	2950 – 3065				
(2) Fansong C/E	4950 – 5050	900 – 1020 1750 – 2070	0.4 – 1.2 0.2 – 0.9	600	Acquisition: 160 km (2 sq m) Tracking: Low PRF 130 km Tracking : High PRF 110 km Optical Range: 28 – 37 km
Missile Uplink Command	715 – 820	1720 - 2070	0.3 – 0.5		
Missile Beacon	4950 – 5050				

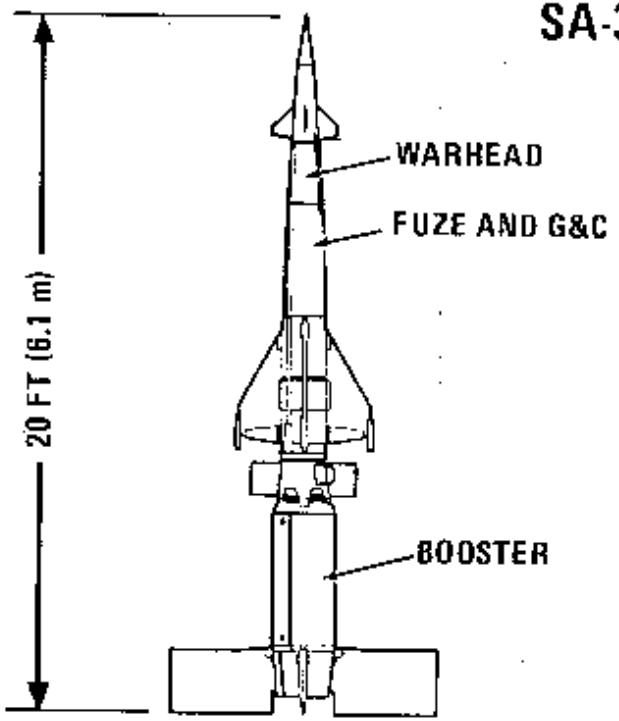
GUIDELINE MISSILE FOR THE SA-2 SYSTEM

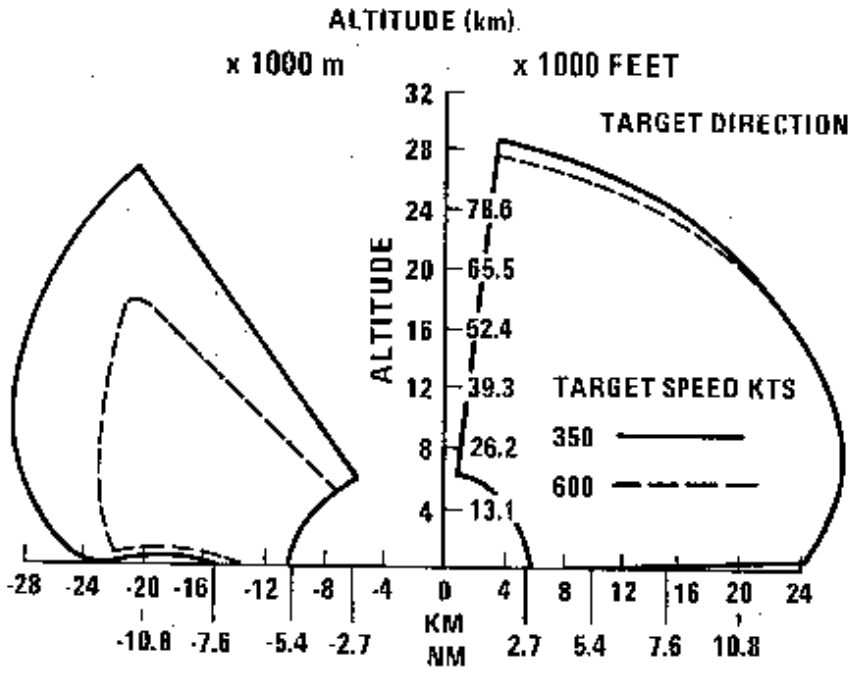




SA-2 Target Intercept

SA-3 GOA MISSILE





MISSILE WEIGHT (Modified Booster)	2000 LB
BOOSTER: THRUST	40,500 LB
BURN TIME:	2.6 SEC
SUSTAINER: THRUST	4,600 LB
BURN TIME:	18.7 SEC
WARHEAD WEIGHT	160 LBS

MINIMUM RANGE	1.5 - 2.0 NM
MAXIMUM RANGE	15 - 18 NM
MINIMUM ALTITUDE	200 - 300 FT
MAXIMUM ALTITUDE	70,000 - 80,000 FT

The SA-5 Gammon (Soviet Designator S-200)

- At each SA-5 the following radars are deployed:
  - For Early Warning: Backtrap Radars, Tall King Radar
  - Height Finders: Odd pair (PRV-13)/Odd Group (PRV-16)
  - Acquisition: Spoon Rest D Radars/ Clam Shell Radar
  - Tracking & Guidance: Square Pair Radars

- Because the SA-5 is essentially a long range high altitude system (250 km), each site has a combination of SA-6/8/9/7 surface to air missiles and ground troops with AAA guns to protect the site from very low altitude penetrating targets.

- Two Soviet Command and Control Centers were integrated into the system:
  - Vozdukh – 1M
  - Vector System. A semi-automated system, with the man in the loop design.

SA-5 (Angara/Vega) SAM

Associated Radar	Frequency (MHz)	PRF (pps)	Pulse Width (micro-second)	Power (kw)	Radar Range
Early Warning: Back Trap (P-80) Tall King C (P-14)	 2050 – 2550 162 – 177	 366 185 – 210 93-100	 1 – 15	 2000 2000	 480 km 550 – 750 km
Height Finder: Odd Pair (PRV – 13)	2620 – 2625 2710 – 2712 2823 – 2830	278 - 366	2.8 – 4.2	-	350
Guidance/Tracking: Square Pair	6800 - 6950	-	-	2.0	-

Command & Control:

• Vozdukh -I M System:
This is an improved version of the system, it is less vulnerable to jamming.

• Vektor System:
This is a more up-to-date Command & Control Center. The Vektor system is apparently not fully automated, i.e. is a semi-automated system, still with the man in the loop design. The roles and rules of the man in the loop are unknown.

The system gives a projected video of speed, azimuth, direction, and altitude to the operator who in return determines the optimum intercept zone of the target. It is understood that besides the high power early warning radars that pass data to the center, the Vektor system obtains data from the SA-5/ SA-2/SA-3 systems.

▪ The SA-5 is essentially a long range high altitude system (250 km), each site should have a combination of SA-6/8/9/7 surface to air missiles and ground troops with AAA guns to protect the site from very low altitude penetrating targets. Deployed mostly to protect its major ports and oil facilities along the coast of the Gulf.

▪ What is known about the Iranian Air Defense system clearly shows how it has become largely obsolescent even though some SA-2 upgrade has been reported to have taken place. So it has become easy to apply ECM against them and destroying them using anti-radiation air to surface missiles.

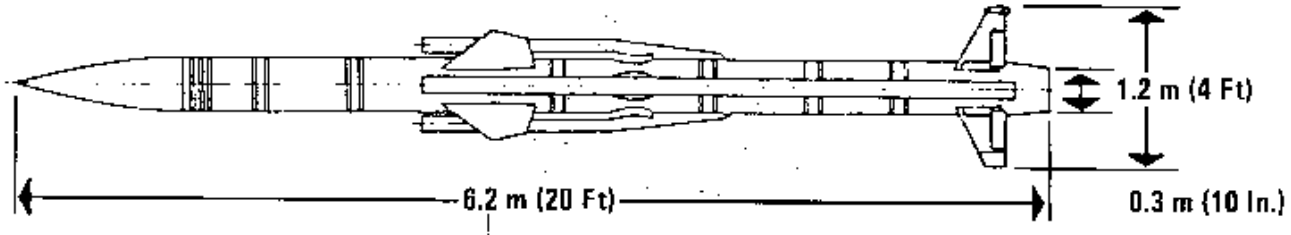
▪ Iran lacks the modern weapon systems, integration and C4I Battle Management to reduce the potential destructive effectiveness of any offensive interdiction missions by the GCC. One can predict a very low attrition rate to an GCC Strike.

▪ Long C4I Early Warning delay time due to antiquated system, semi-automated man in the loop.
▪ Long Response / Scramble Time by Combat Aircraft
▪ Low Operational Readiness Rate of Combat Aircraft
▪ Need Improvement in maintenance operations
▪ Need Improvement in supply of spare parts
▪ Low Combat Aircraft Sortie Rates, Sustained and Surge.
▪ High Loss Rates in a Closing / BVR and Visual Engagement Air to Air Combat Environment.
▪ Centralized Battle Management

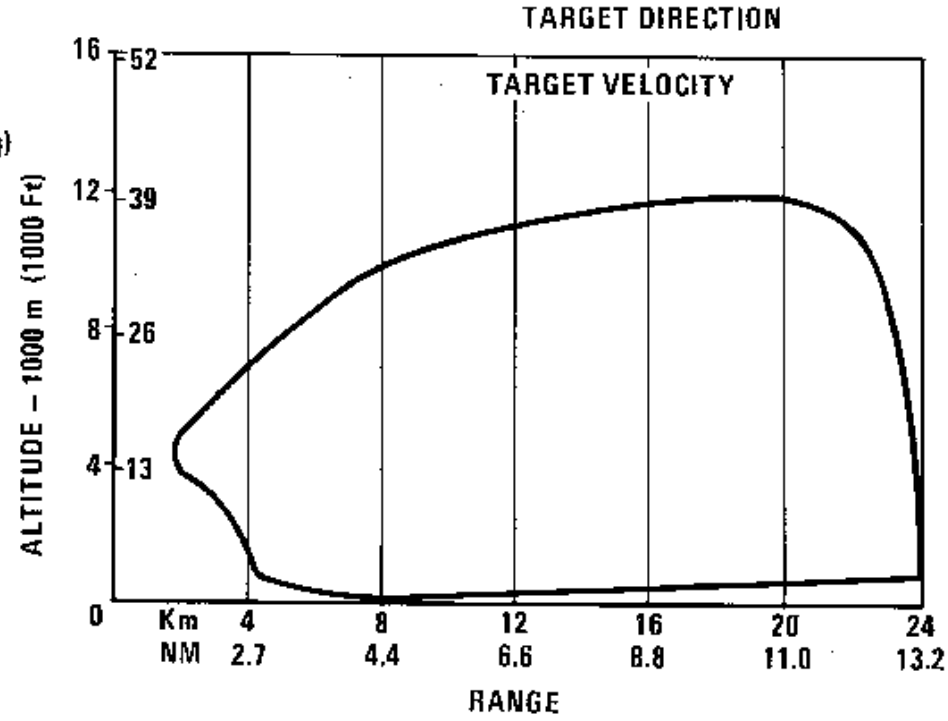
▪ There have been reports that Russia secretively supplied Iran with the ANTEY-2500 Mobile SAM System/ S-300V (SA-12 Giant). If this is the case then the whole analytic model beginning from C4I Early Warning to Response and Scramble times in the engagement of GCC combat aircraft with this integrated mobile air defense system will have to be recalculated.

(Source: Israeli and US Strikes on Iran: A Speculative Analysis. CSIS. March 5, 2007)

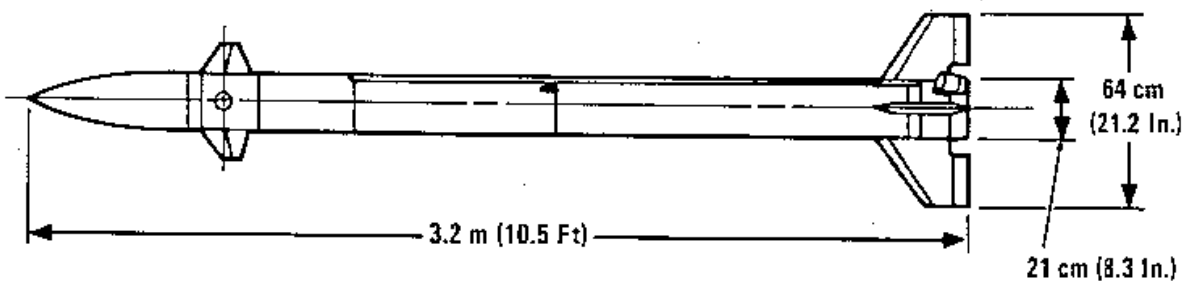
SA-6 GAINFUL MISSILE



MISSILE WEIGHT:	1,320 LBS (599 Kg)
BOOSTER THRUST:	19,000 LBS
BURN:	4.1 SEC
SUSTAINER THRUST:	3,400 LBS
BURN:	22.5 SEC
WARHEAD:	130 LBS (59 Kg)

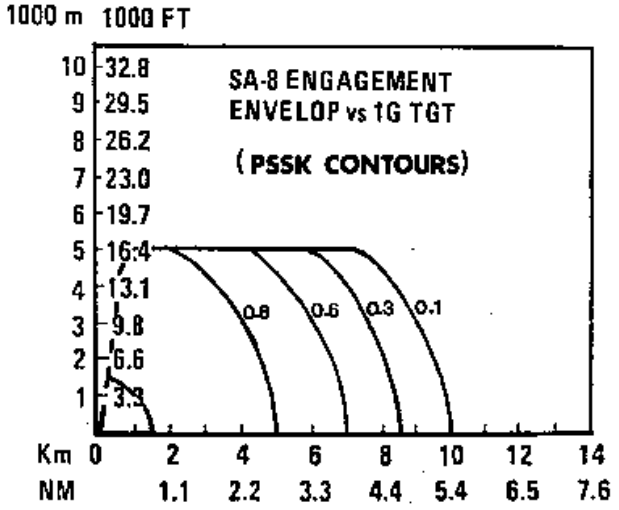


SA-8

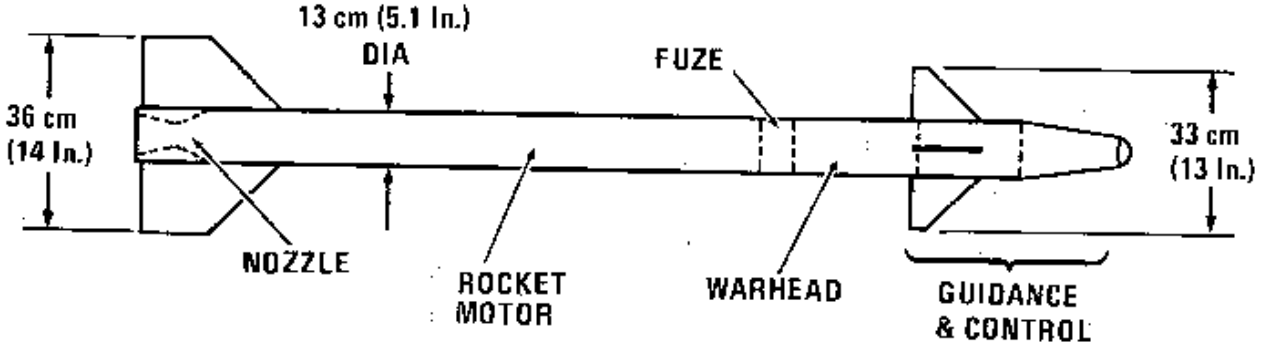


SA-8 (OSA-AK) MISSILE

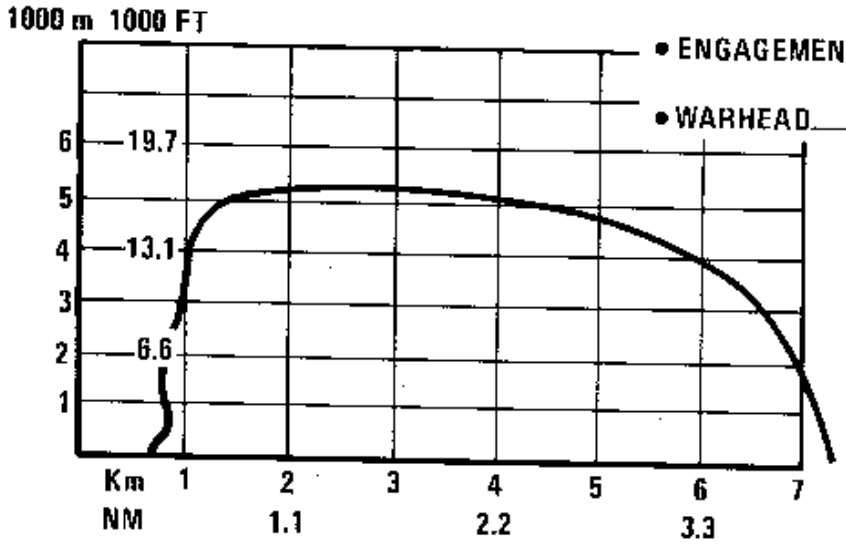
NO OF MISSILES ON COMBAT VEHICLE	: 6	
MAXIMUM SPEED OF INCOMING TARGETS	: 500 M/SEC	
MINIMUM SPEED OF INCOMING TARGETS	: 0 M/SEC (HELICOPTER HOVERING)	
MISSILE WEIGHT AT LAUNCHING	: 126 KG	
WARHEAD WEIGHT	: 14.3 KG	
1 TARGET ENGAGED BY 2 MISSILES ON DIFFERENT COMMAND FREQUENCIES		
TARGET SPEED (M/SEC)	300	500
MISSILE ALTITUDE (M)	25-5000	100-5000
MISSILE DOWNRANGE (M)	1500-10000	1500-8000
CROSSRANGE(M)	6000	4000



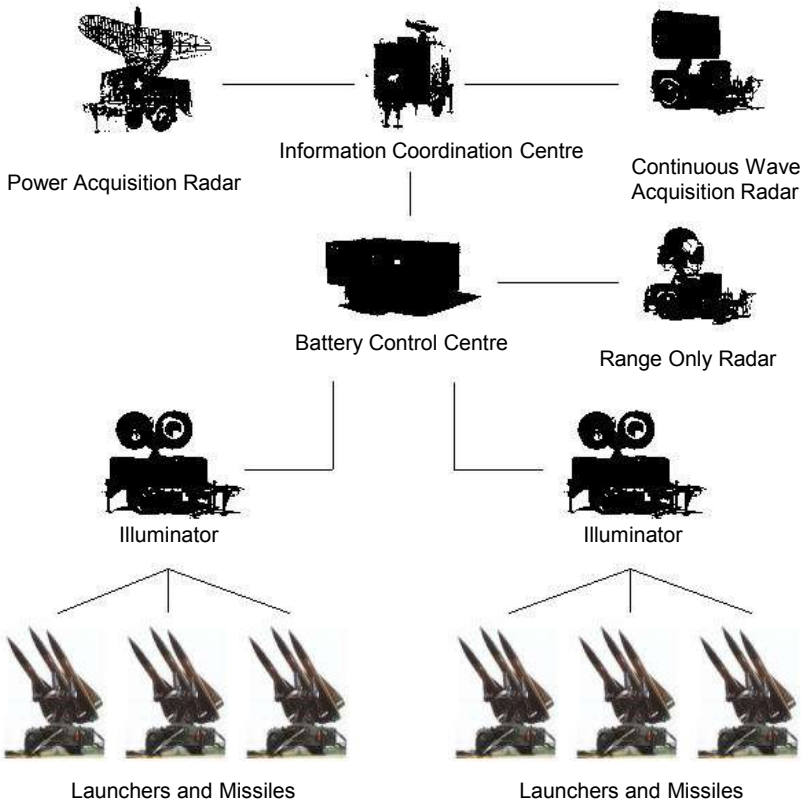
SA-9 GASKIN IR SAM



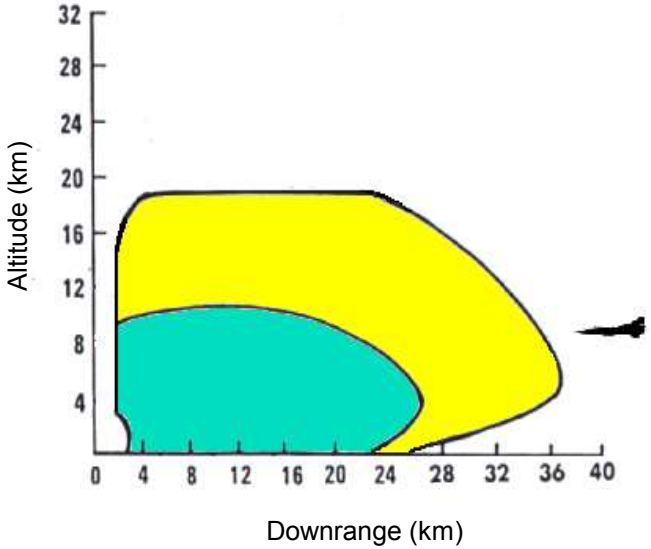
- SEEKER HEAD ____ PbS (1.9-3.0μ) UNCOOLED
- HEAD-ON ACQUISITION ____ NONE BUT EXPECTED
- TAIL-ON ACQUISITION ____ A/B ____ 11-15 Km (6-8 NM)
  MIL ____ 5-10 Km (3-5 NM)
- ENGAGEMENT ENVELOPE ____ MIN ____ 1 Km (.5 NM) 50 FT
  MAX ____ 7.5 Km (4 NM) 15 FT
- WARHEAD ____ 14.8 LBS (6.7 Kg)

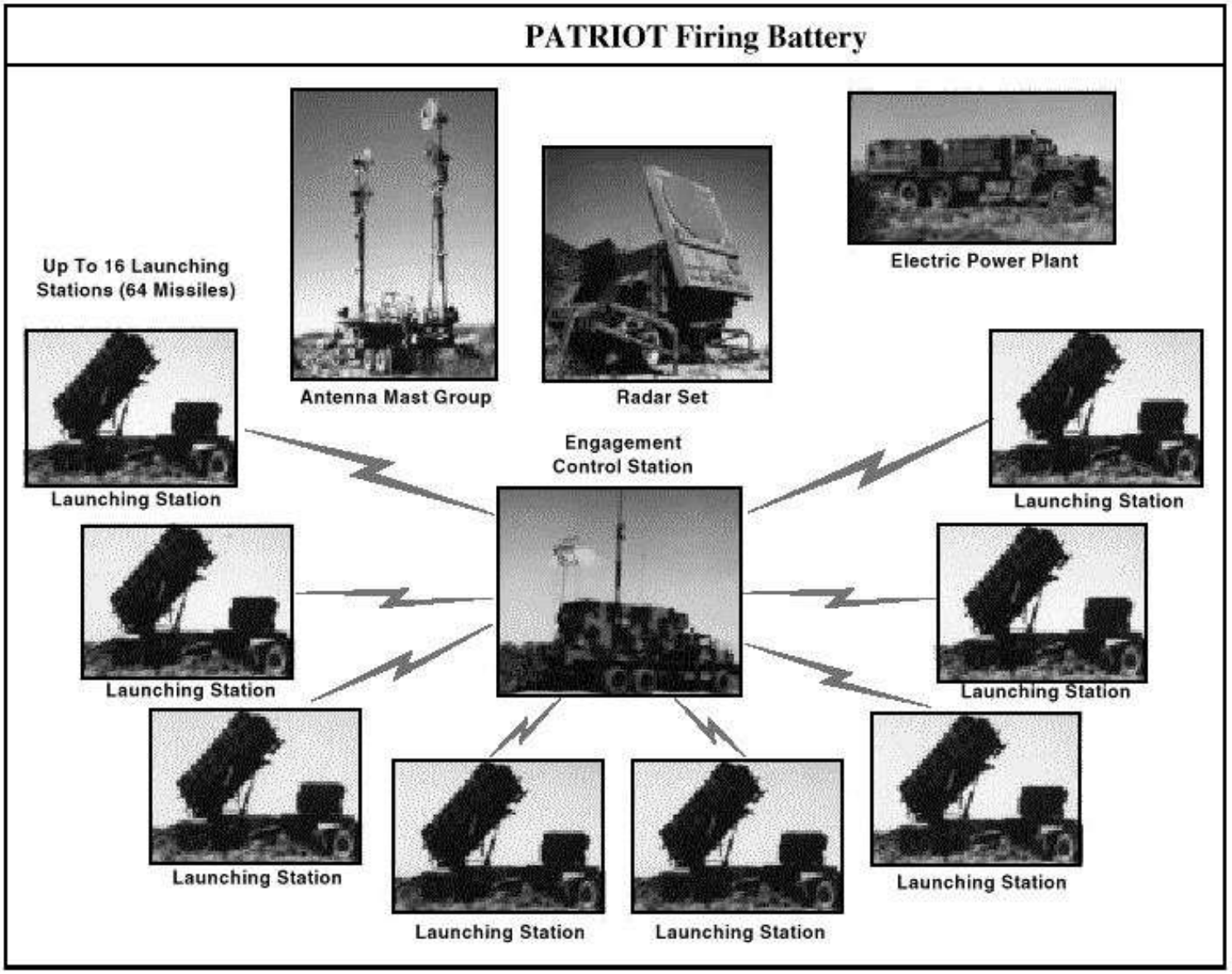


Improved Hawk Battery



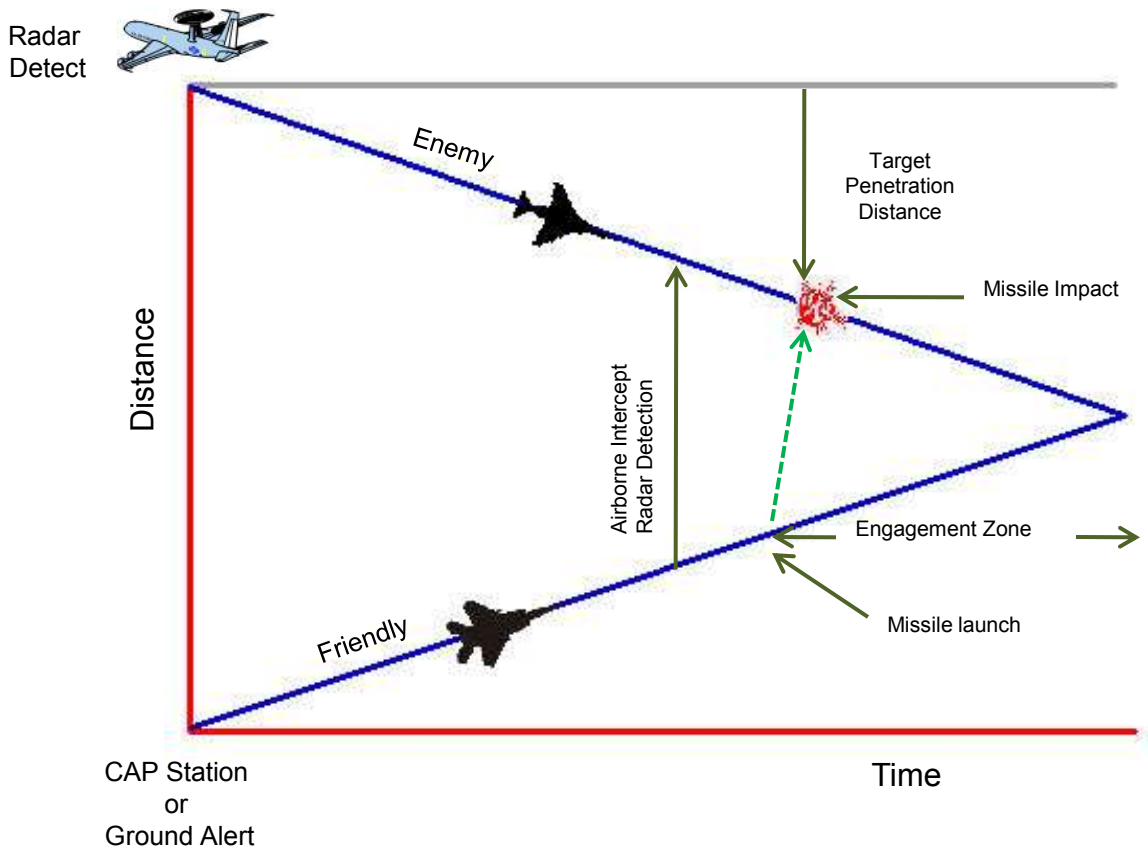
IHAWK SSPK Intercept Contours



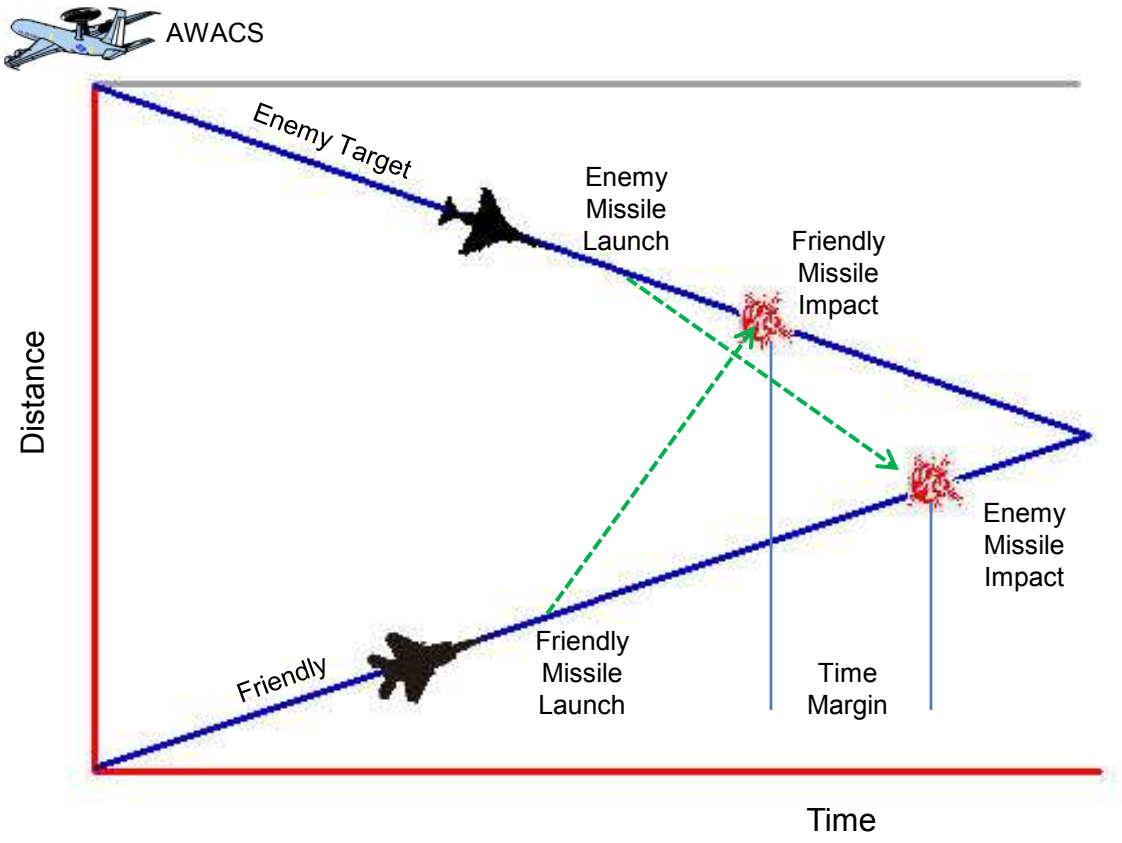

PATRIOT Firing Battery
Up To 16 Launching Stations (64 Missiles)
Antenna Mast Group
Radar Set
Electric Power Plant
Launching Station
Engagement Control Station
Launching Station
Launching Station
Launching Station
Launching Station
Launching Station
Launching Station
Launching Station
Launching Station

Appendix III
Air to Air BVR Analysis

Head-On Intercept Dynamics



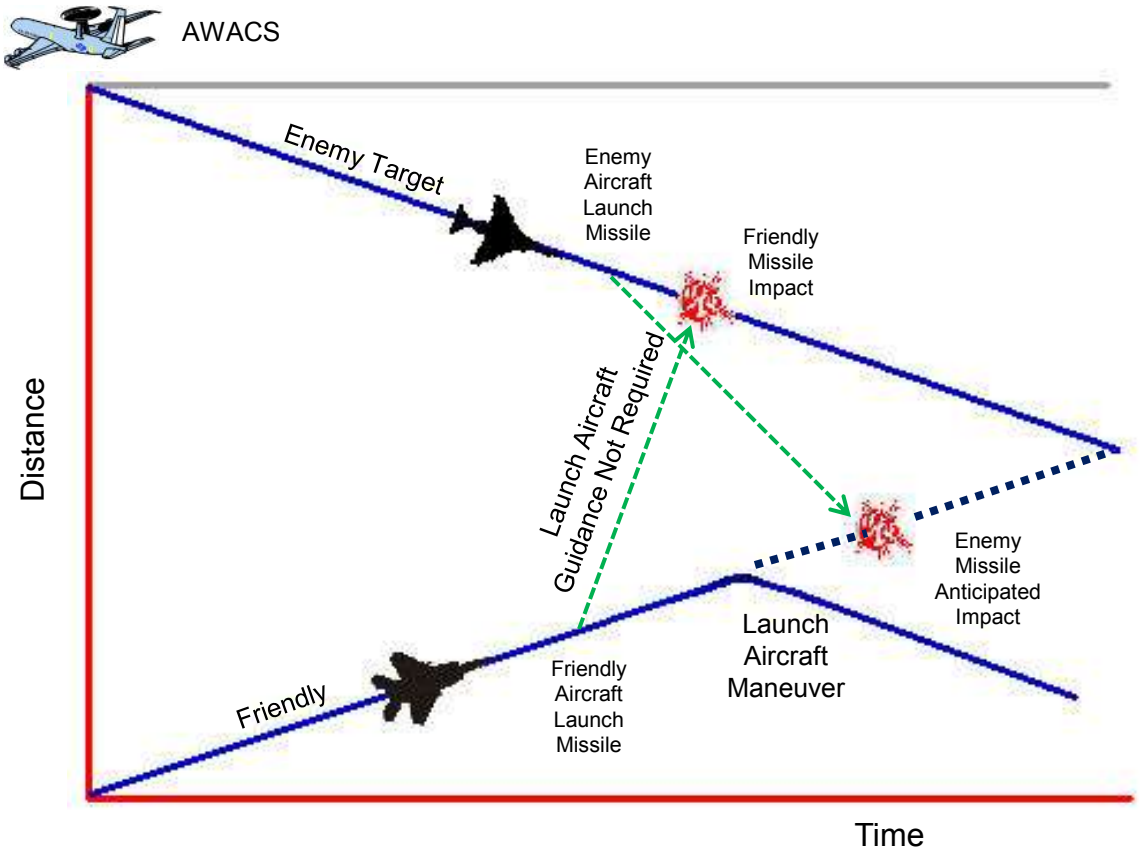
Missile Duel Kinematics



Time Margin: Time for AA-10 missile to impact at friendly missile impact.

Killing Enemy Aircraft terminates AA-10 Semi Active Radar (SAR) Guidance.

Effect of Launch and Leave BVR Missile



Appendix IV
Characteristics of High Explosives

The curve in Fig. 3.72 shows the variation of peak overpressure with distance for a 1 KT free air burst in a standard sea-level atmosphere.

Scaling. For targets below 5,000 feet and for burst altitudes below 40,000 feet, the range to which a given peak overpressure extends for yields other than 1 KT scales as the cube root of the yield, i.e.,

$$D = D_1 \times W^{1/3},$$

where, for a given peak overpressure, D_1 is the distance (slant range) from the explosion for 1 KT, and D is the distance from the explosion for W KT.

Source: The Effects of Nuclear Weapons. Compiled and edited by Samuel Gladstone and Philips J. Dolan. 3rd Edition.

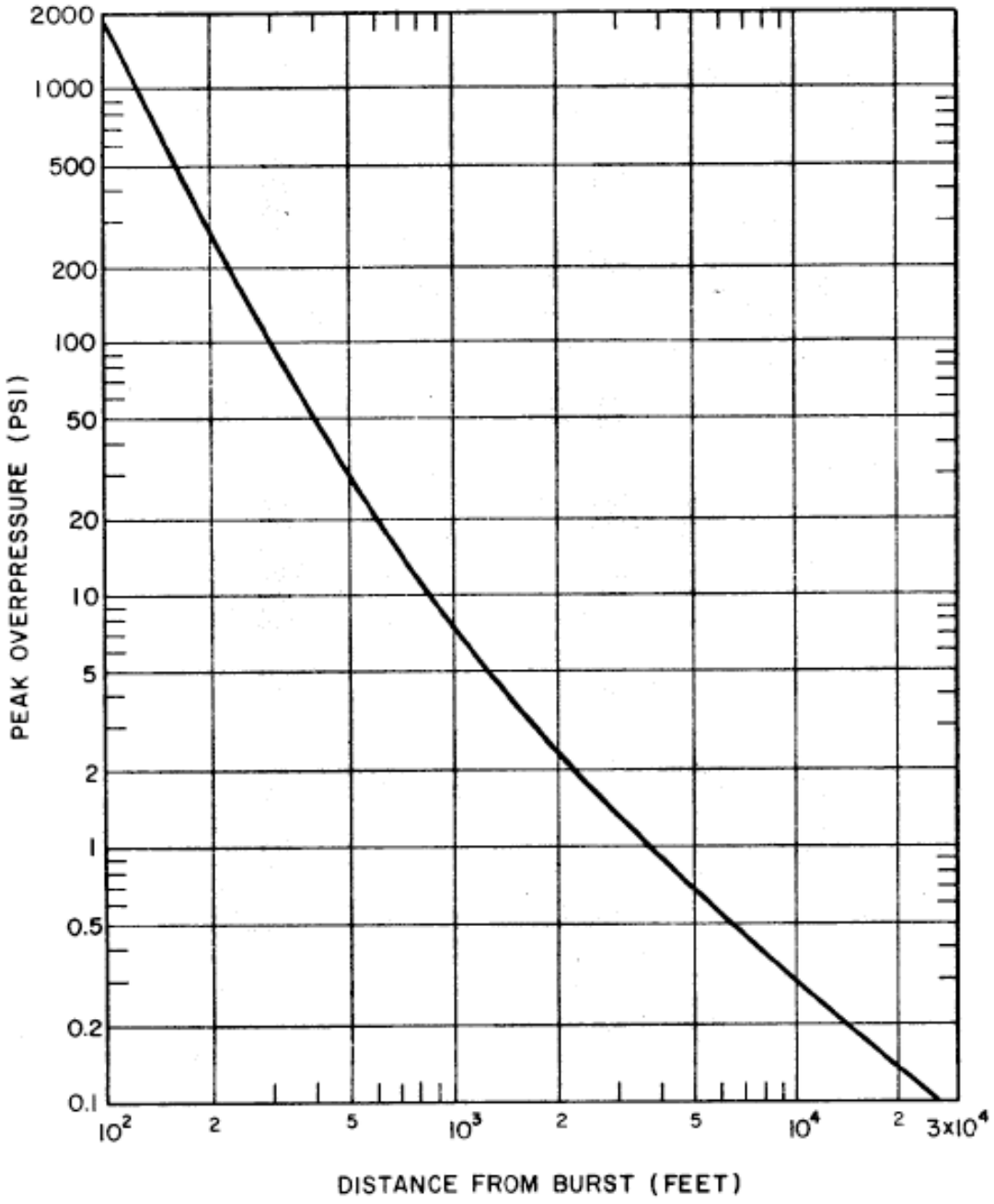


Figure 3.72. Peak overpressure from a 1-kiloton free air burst for sea-level ambient conditions.

High Explosive Bombs
Physical Characteristics

Munition	Type	Operational Weight (lbs)	High Explosive Filling Type	High Explosive Filling Weight (lb)
250 lb Mk 81 Mod1	Unretarded GP	260	H-6 or Tritonal	139.00
500 lb Mk 82 Mods 1,2	Unretarded GP	531	H-6 or Tritonal	277.00
750 lb M117 Series	GP	799	H-6 Minol 2	562.00
1000 lb Mk 83 Mods 3,4	Unretarded GP	985	H-6 or Tritonal	607.00
2000 lb MK 84 Mods 1,2	Unretarded GP	1970	H-6 or Tritonal	1395.00
GBU-27 2000 lb BLU-109	Penetrating	2000	Tritonal	800.00
GBU-28 5000 lb BLU-113	Penetrating	5000	Tritonal	1000.00
GBU-10 2000 lb	Non-Penetrating	2000	Tritonal	1400.00

Military Targets Blast Effects

Peak Overpressure	Typical Blast Effects
5 psi	Light Housing Destroyed
10 psi	Brick Housing/Commercial Building Destroyed
20 psi	Reinforced Concrete Structures Destroyed
100-500 psi	Nuclear Weapon Storage Bunkers
100-1,000 psi	Command Bunkers
500-10,000 psi	Missile Silos
1,000 – 10,000 psi	Deep Underground Command Facilities

(Source: Alexander Glaser Princeton University February 12, 2007. Adapted from Physical Vulnerability Handbook)

Lethal Miss Distance

(meters)

Warhead kg	3 psi	5 psi	7 psi	10 psi	15 psi	20 psi
10	11	8	6.5	5.35	4.35	3.77
50	19	13.71	11.2	9.15	7.45	6.45
100	24	17.1	14.1	11.6	9.35	8.1
150	27	19.65	16.1	13.2	10.7	9.3
200	30	21.5	17.6	14.5	11.75	10.2
350	36	26	21.2	17.5	14.2	12.35
500	42	29.5	24	19.75	16	13.9
750	47	33.74	27.5	22.75	18.3	15.9
1000	51	37	30.4	24.9	20.15	17.5
1500	59	49	35	28.5	23	20
2000	65	46.5	38.3	31.35	25.4	22

Lethal Miss Distance: Is The maximum distance from the periphery of the target at which a weapon detonation will inflict the necessary damage for a kill for that weapon-target combination.

Appendix V
Probability of Kill vs CEP and Lethal Range

In any encounter the Kill Probability is dependent on:

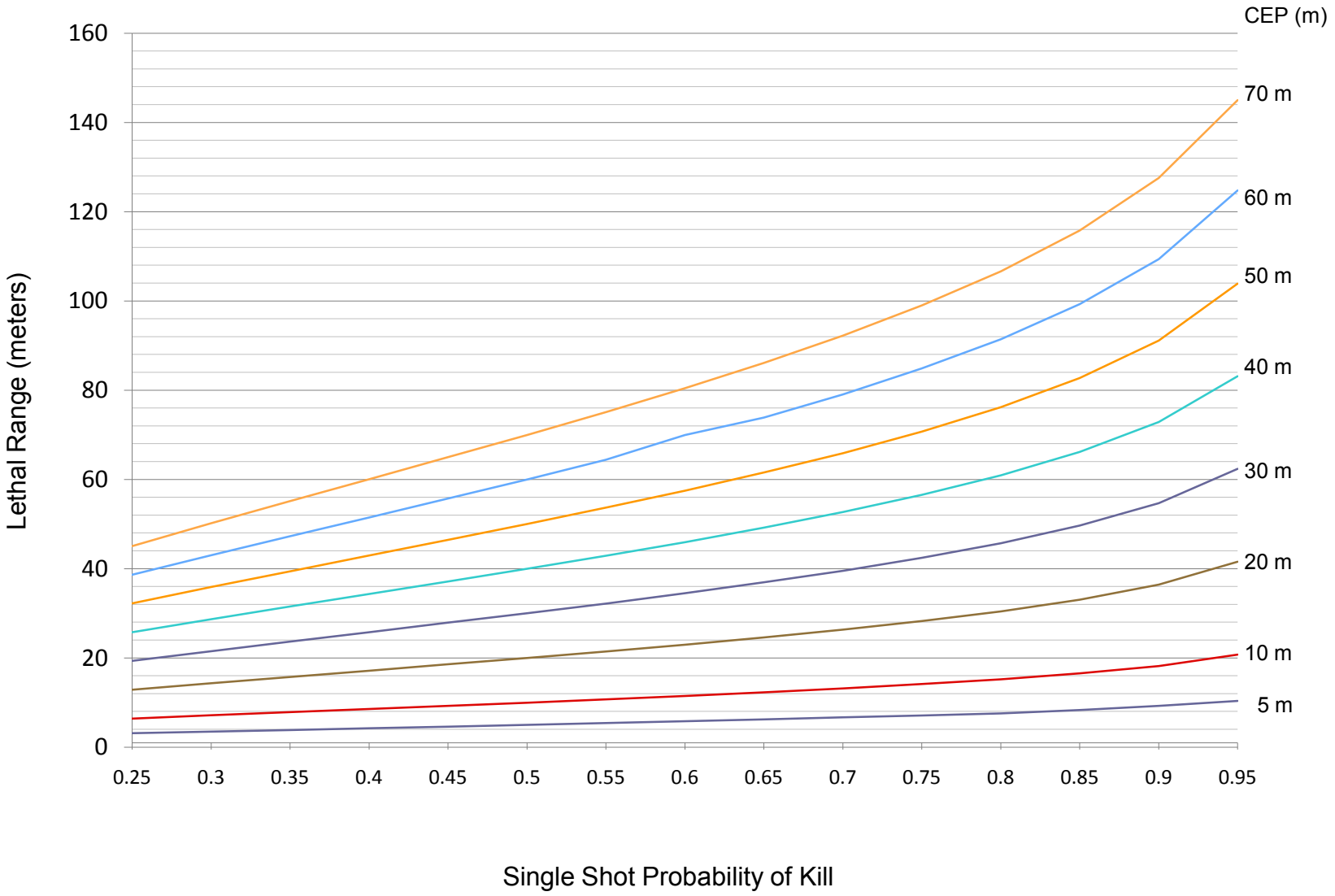
- Probability of mission survival going to target and egress.
- Probability of target acquisition
- Probability of weapon reliability
- Probability of target single shot kill probability (might need more than 1 missile to destroy the target)

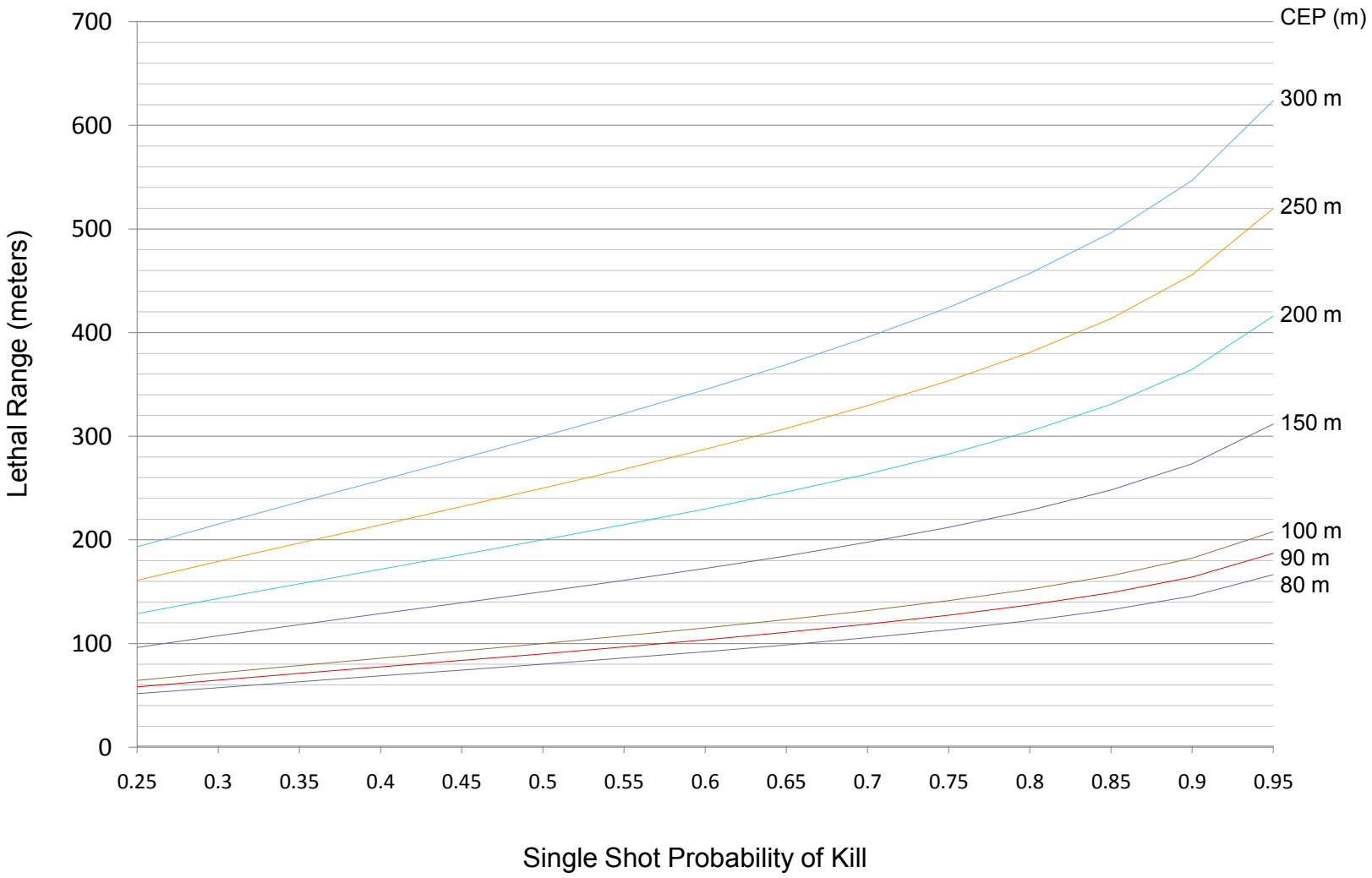
•Probability of mission survival depends on:
  - ISR
  - Location of target
  - Self Protection Electronic Equipment
  - Aircraft has a self escort defense capability
  - Successful SEAD operations along the way to target
  - C4I

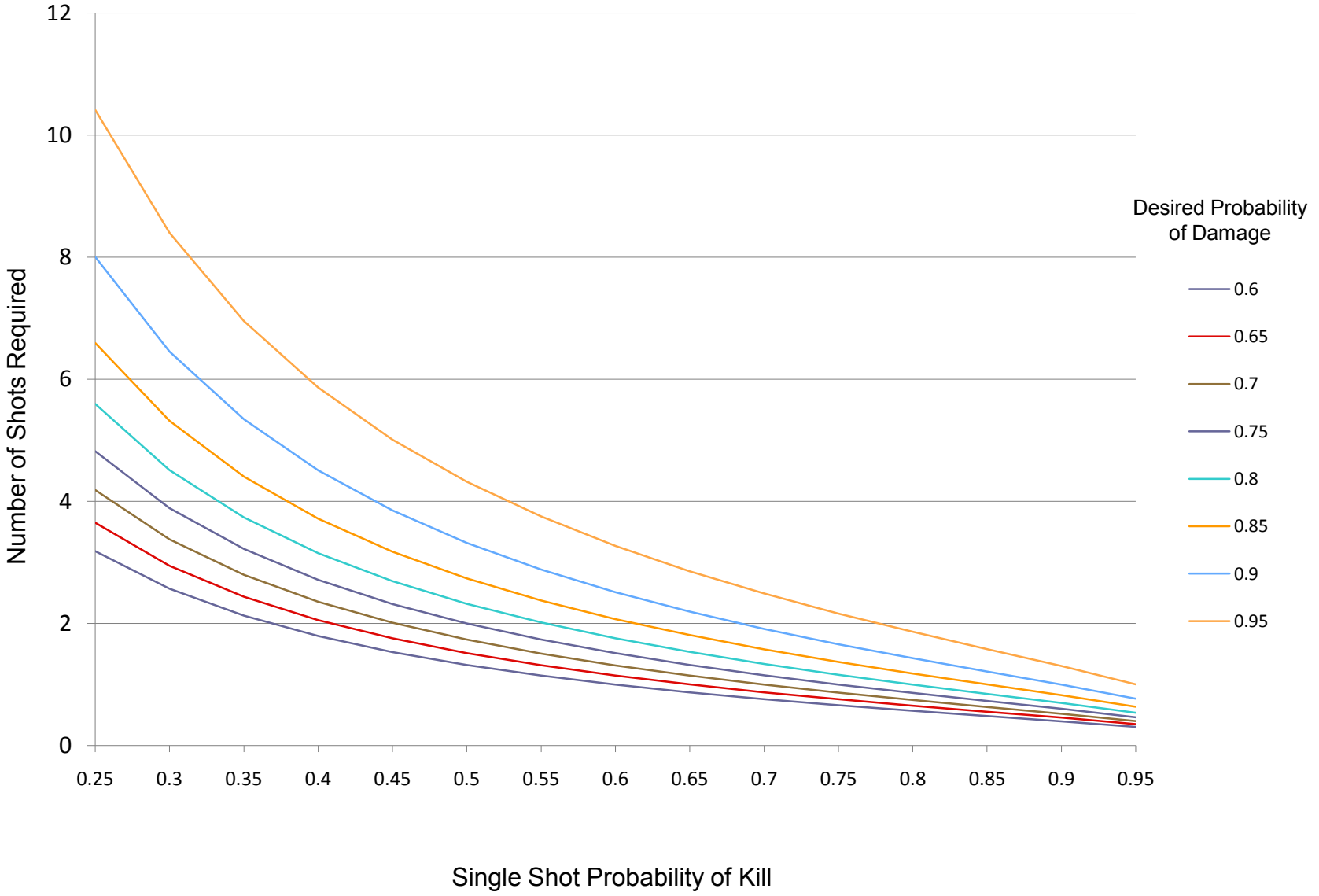
- Probability of Target Acquisition depends on:
  - Radar and other sensors on Aircraft.

- Probability of weapon reliability depends on:
  - Technology involved in weapons design and Aircraft systems reliability.

- Probability of single shot kill probability depends on:
  - Accuracy of targeting system on weapon (CEP)
  - Lethal range of weapon warhead.


CEP (m)
70 m
60 m
50 m
40 m
30 m
20 m
10 m
5 m
Lethal Range (meters)
160
140
120
100
80
60
40
20
0
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
Single Shot Probability of Kill

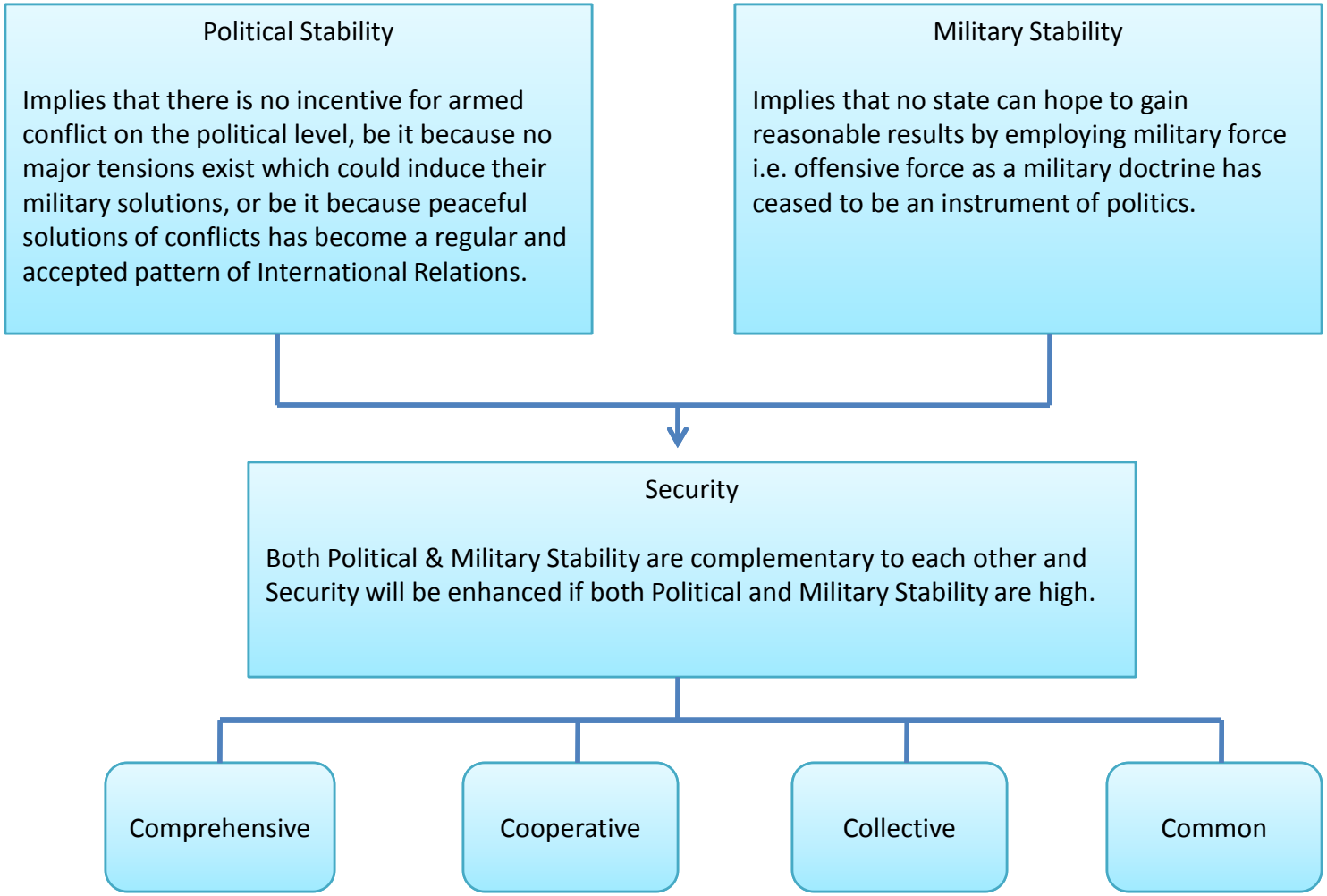

Lethal Range (meters)
700
600
500
400
300
200
100
0
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
Single Shot Probability of Kill
CEP (m)
300 m
250 m
200 m
150 m
100 m
90 m
80 m



(Number of Shots Required : Number of Aircraft Passes, Sorties, or Missiles Fired)

Appendix VI
Notes on Security Arrangements (Common, Collective, Cooperative, Comprehensive)

SECURITY
"Absence of the Threat of War"



Common Security:

Seeks security with other countries rather than against them. It is predicated on the assumption that States share a common interest in avoiding war, and that war avoidance is best pursued through strategies which emphasize cooperation and reassurance and reduce the emphasis on confrontation and deterrence.

Common Security attempts to find an appropriate and stable balance between the requirements of deterrence and reassurance.

Collective Security:

Directed against an aggressor coming from outside. Participation in a Collective Security organization entails a commitment by each member to join a coalition, being based either on defense in its traditional sense, or upon deterrence.

Collective Security is relevant because it helps generate the domestic support to go to war and the international legitimacy to win the peace.

Cooperative Security:

Refrains from the very idea of enforcing stability in a confrontational way. It exclusively aims at promoting cooperation in order to prevent:

- The emergence of conflicts in a political sphere, or
- To reduce the danger of armed confrontation.

More specifically, Cooperative Security Policy aims at preventing emerging conflicts from escalating into larger proportions – in this sense it depends on the cooperation of all.

Comprehensive Security:

Emphasizes on non-military means of achieving and maintaining security. Comprehensive security stresses the importance of the non-military instruments of security policy.

Security Assurances

Positive Security Assurances:

U.N. Security Council whose Nuclear Weapon States will provide assistance to any non-nuclear weapons state (party to the NPT) that is a victim of an act of aggression or an object of a threat of aggression in which nuclear weapons are used.

Negative Security Assurances:

A commitment by Nuclear Weapons States that they would not use or threaten to use nuclear weapons against non-nuclear weapon states.