

# **Warfighting and Proliferation in the Middle East**

A large, grayscale image of a nuclear mushroom cloud, positioned in the upper right quadrant of the slide, behind the main title.A small, stylized illustration of an olive branch with three leaves, located to the left of the author's name.

**Anthony H. Cordesman  
Arleigh A. Burke Chair in Strategy  
Center for Strategic and International Studies**

**Revised: April 17, 2007**

A large, faint, grayscale illustration of a hand holding an olive branch, positioned in the lower half of the slide, behind the author's name and the revision date.

A grayscale photograph of a nuclear explosion, showing a large, billowing mushroom cloud rising from a dark, flat horizon. The cloud is bright white and yellow at the base, fading to a lighter gray at the top.

# **Acquire, Deploy, Fight, Impact:**

A stylized, grayscale illustration of a dove in profile, facing right. The dove is holding an olive branch in its beak. The illustration is semi-transparent and overlaid on the white background.

## **Future “What if” Options**

# Hypothetical Levels of Proliferation in 2010-2020



# Key Actors in 2010-2020

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

# Iran's Hypothetical Forces

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

# Israel's Hypothetical Forces

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

# US Hypothetical Forces

- Variable yield boosted and fusion weapons.
- Variable yield, 0.1 KT to 5 Megatons
- Ohio-class SSBNs with up to 24 Trident C-4 or D-5 SLBMs.
- B-52, B-1B, and B-2A with nuclear bombs and ALCMs.
- JSF F-35 Lightning II, F-117, F-22, F-15, F-18, F-16 with advanced conventional precision strike capability.
- Ohio, Los Angeles, Seawolf, Virginia SLCNs, with Tomahawk nuclear and conventionally armed missiles.
- High resolution satellite targeting and damage assessment capability.
- Ballistic missile point and (wide?) area defense capability with THAAD, Standard SM-2 and SM-3 (?), and Patriot PAC-3 TMD.
- CW? No. BW? No.
- Meaningful civil defense? Not Applicable.

# Syrian Hypothetical Forces

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



# Gulf Hypothetical Forces

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



# Non-State Hypothetical Forces

- No nuclear weapons (?)
  - Loose nuke from FSU? Proxy transfer
  - Suit case nukes, nuke artillery round, ADM?
- Chemical
  - Mustard, blood agents, non-persistent nerve.
- Biological
  - Dry, coated, Anthrax micropowder equivalent.1
- Radiological
  - Terror weapon capable of contamination, no wide area lethality.
- Crop sprayer UAV level of delivery system; knowledge of “line source” equivalent aerial delivery.
- Sabotage or seizure of state actor weapons?

# Key Deployment Issues in 2010-2020

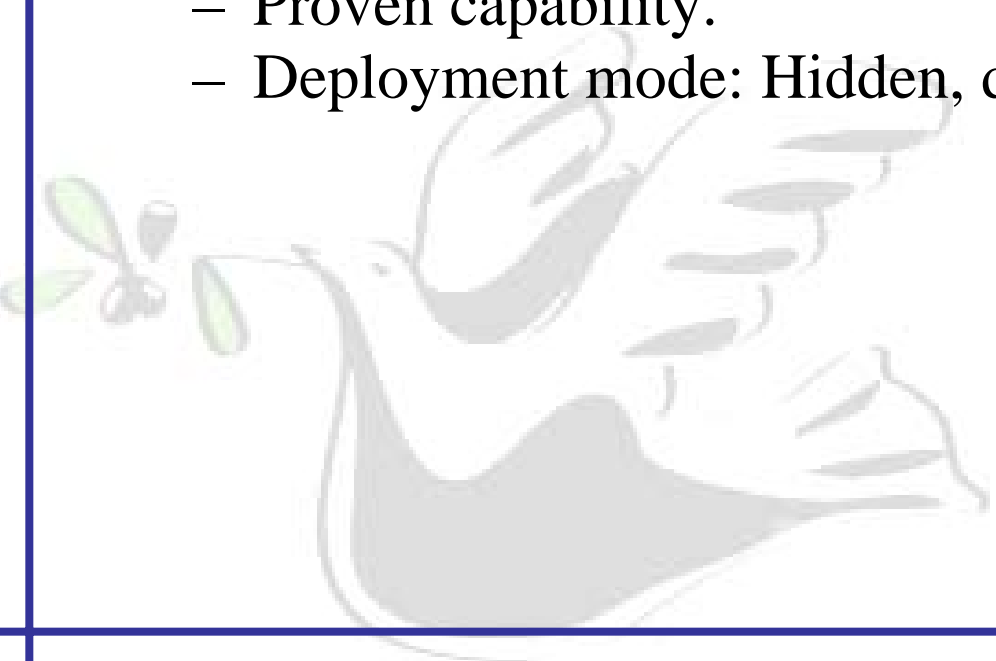
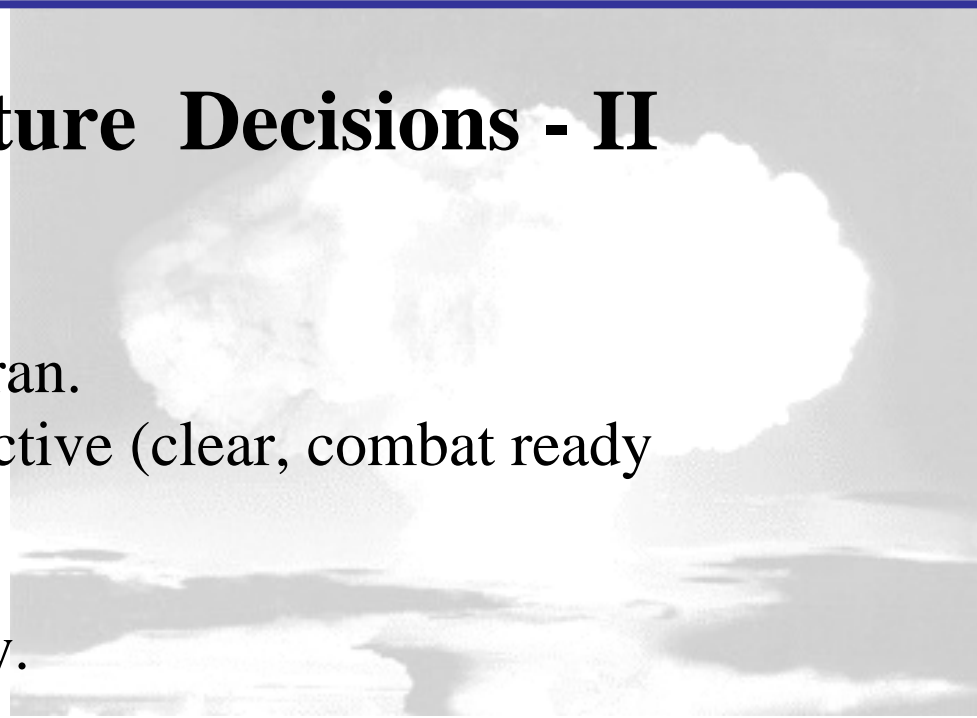


# Key Force Posture Decisions

- **US and/or Israel**
  - Prevent, preempt, contain, deter, retaliate, mutual assured destruction.
- **Iran and Israel:**
  - In reserve (secure storage), launch on warning (LOW), launch under attack (LOA), ride out and retaliate
  - Continuous alert, dispersal
  - Point, wide area defense goals
- **Israel:**
  - Basing mode: sea basing, sheltered missiles.
  - Limited strike, existential national, multinational survivable.
- **US:**
  - Level of defensive aid.
  - Ambiguous response
  - Clear deployment of nuclear response capability.
  - Extended deterrence. Assured retaliation.
- **Gulf:**
  - Passive (wait out), defensive, or go nuclear.
  - Ballistic, cruise missile, air defense.
  - Seek extended deterrence from US

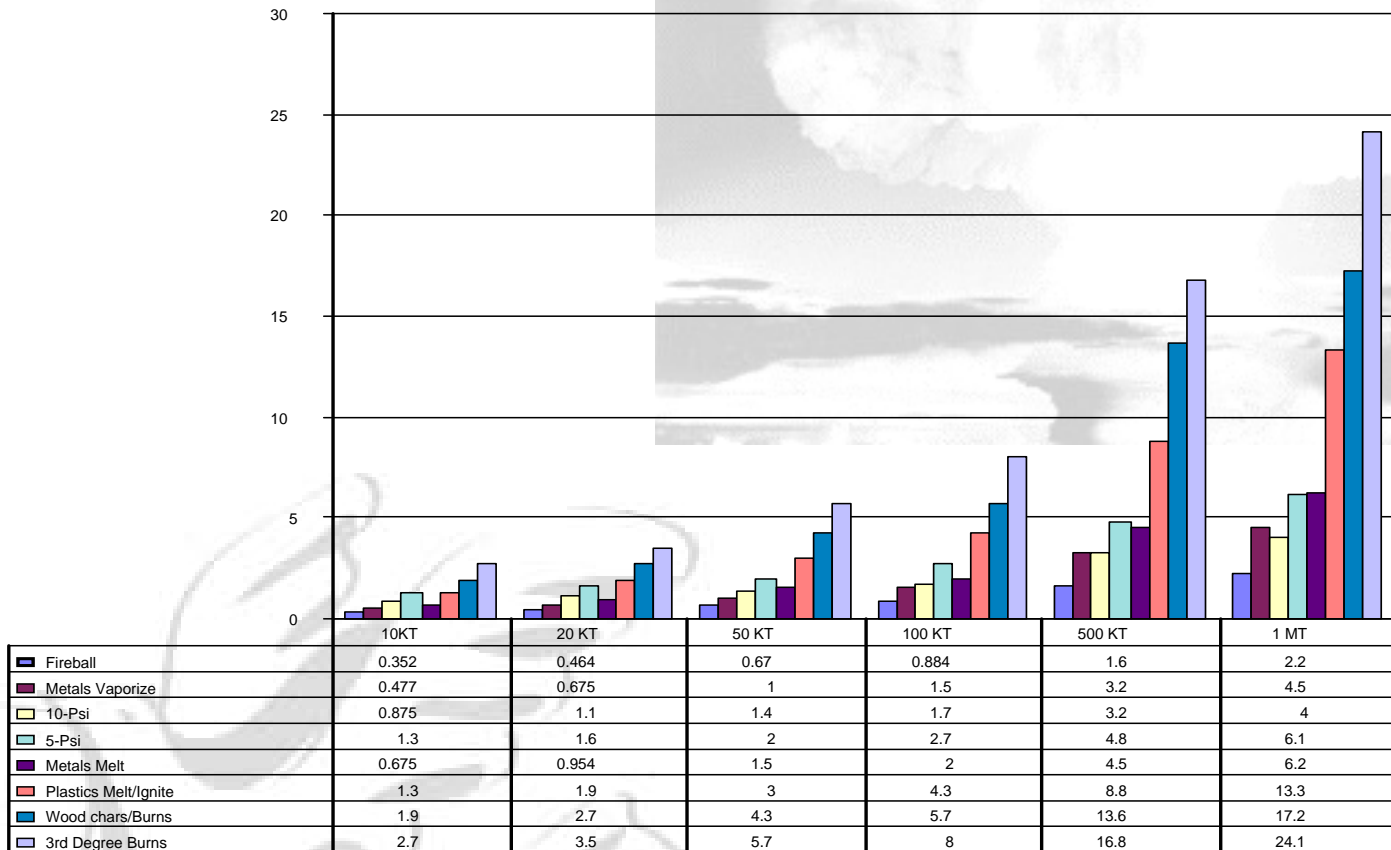
# Key Force Posture Decisions - II

- **Syria:**
  - Link or decouple from Iran.
  - Passive (tacit threat) or active (clear, combat ready deployment).
- **Non-State Actor:**
  - Tacit or covert capability.
  - Proven capability.
  - Deployment mode: Hidden, dispersed, pre-emplaced



# Why Yield Matters

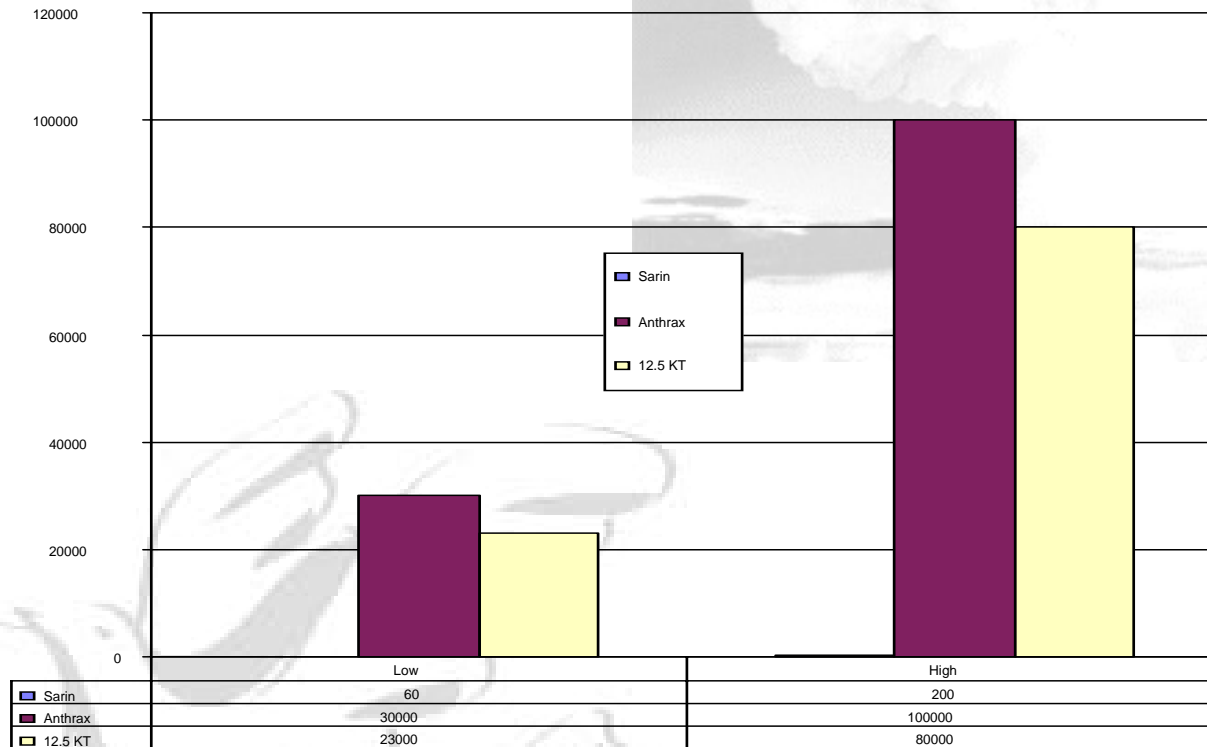
(Seriousness of Effect in Kilometers as a Function of Yield)



Source: Adapted by Anthony H. Cordesman from the Royal United Services Institute, Nuclear Attack: Civil Defense, London, RUSI/Brassey's, 1982, pp. 30-36

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

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



Source: Adapted by Anthony H. Cordesman from Victor A. Utgoff, *The Challenge of Chemical Weapons*, New York, St. Martin's, 1991, pp. 238-242 and Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks*, U.S. Congress OTA-ISC-559, Washington, August, 1993, pp. 56-57.

# **Fight: Hypothetical Exchanges in 2010-2020**



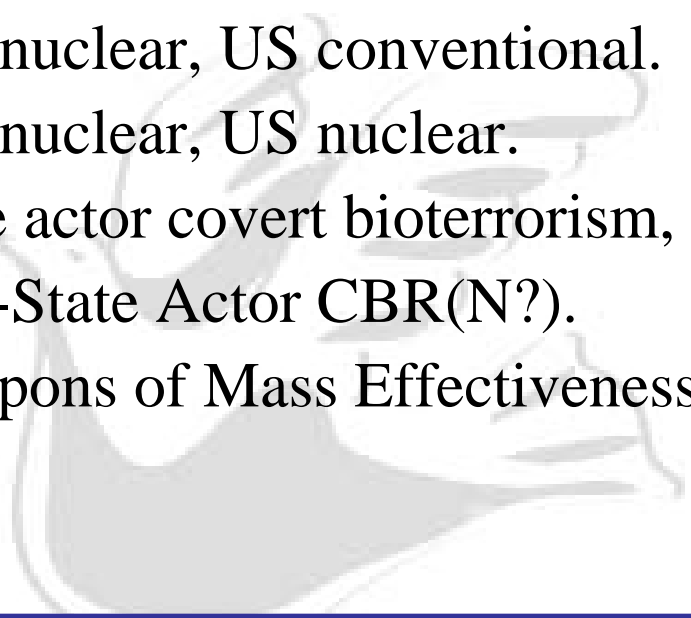


# Introductory Cautions

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

# Possible “Wars:” 2010-2020

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



# Israeli Prevention, Preemption of Iran

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

# Arak 40 MWth Heavy Water Reactor

**Foundation for reactor and containment structure**

**Foundation for reactor ventilation stack**

**Auxiliary building foundation (for Laboratory/Hot cells?)**

# Arak 40 MWth Heavy Water Reactor

Foundation for reactor and containment structure

New excavation

Foundation for reactor ventilation stack

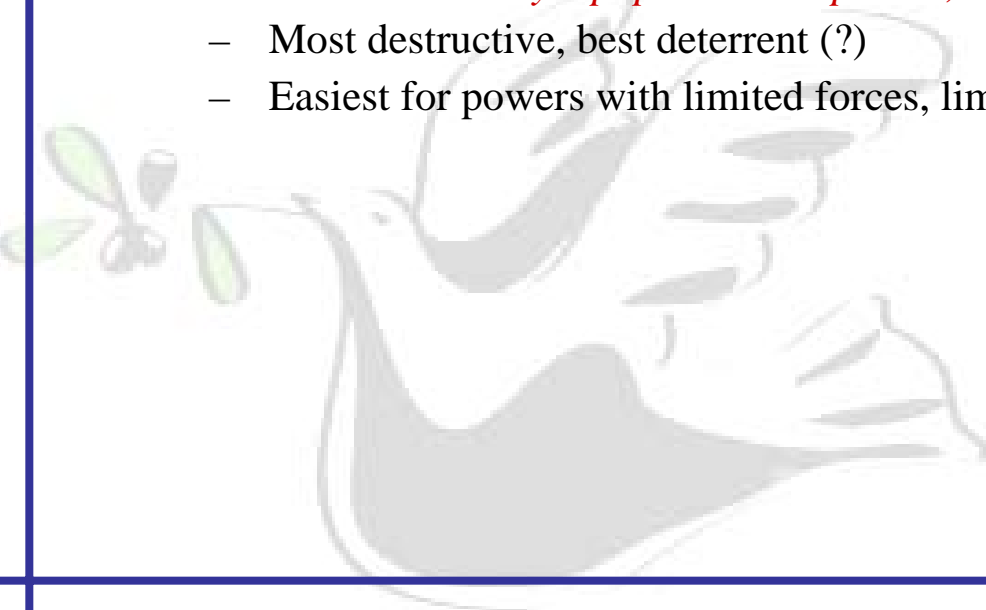
Auxiliary building foundation (for Laboratory/Hot cells?)

# Targeting and Existential Strikes

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

# Counterforce, Countervalue, Counterpopulation

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



# US Prevention, Preemption of Iran

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



# Esfahan Vehicle Entrance Ramp (before burial)

**Bunkered underground  
production halls**

**Admin/engineering  
office area**

*DigitalGlobe Quickbird commercial satellite image*

**20 SEP 02**



# Esfahan Vehicle Entrance Ramp (after burial)

Bunkered underground  
Centrifuge cascade halls

Helicopter  
pads

New security  
wall

Dummy building  
concealing tunnel  
entrance ramp

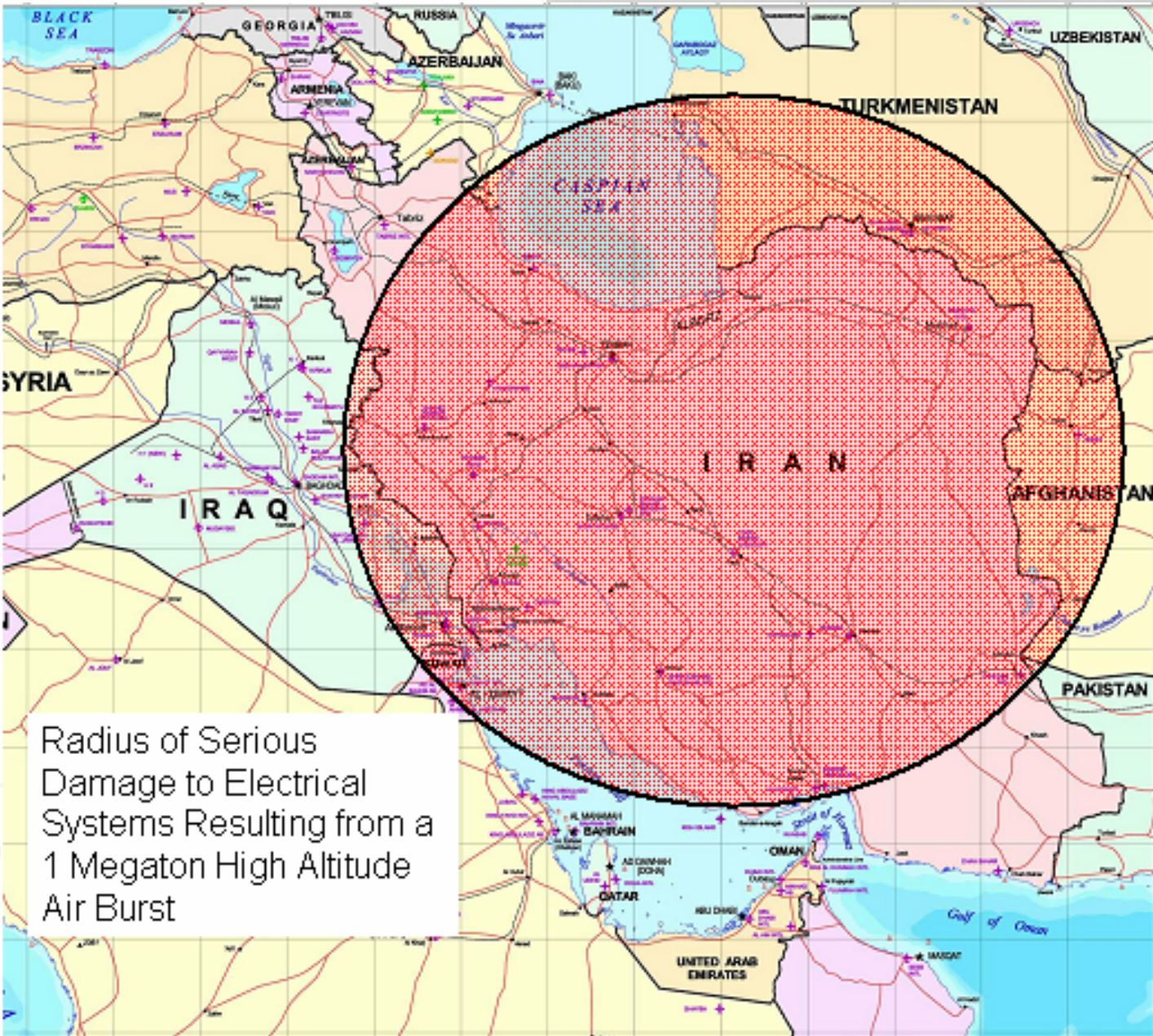
Admin/engineering  
office area

# Arms Race; “War of Intimidation”

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

# Near Use to Warning Shot: Crisis “Management”

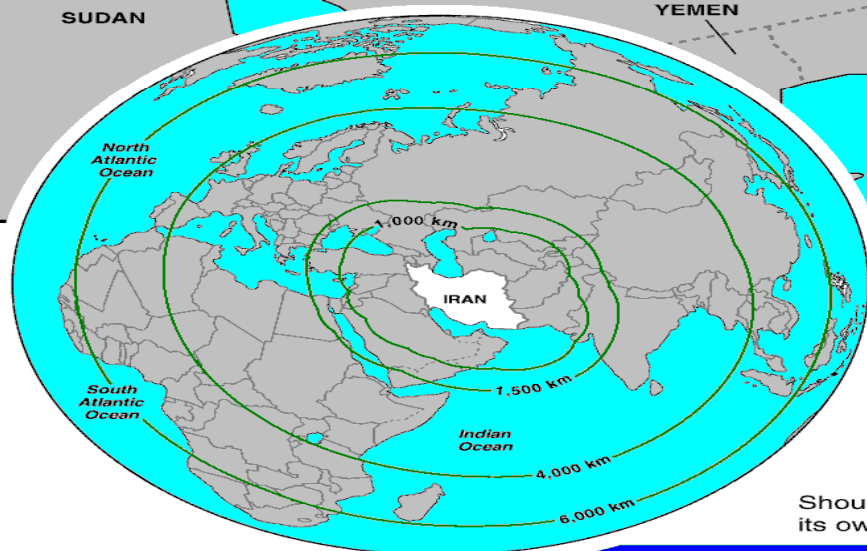
- **Escalatory crises can take on wide range from statements to warning use of weapons. No one scenario dominates.**
  - Test or leak of nuclear/war plan data.
  - Going to new stages of alert.
  - Missile or nuclear tests.
  - Exercises
  - Movement of weapons, deployment of forces, talks of transfer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



# Iranian-Israeli Exchange

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

# Estimated Ranges of Current and Potential Iranian Ballistic Missiles



IRAN		
Current Missile Delivery System	Range (km)	Source
..... CSS-8	150	China
———— SCUD B	300	Libya; North Korea
——— SCUD C	500	North Korea
Potential Missile Delivery System	Range (km)	Potential Source
No Dong	1,000	North Korea
Taepo Dong 1	More than 1,500	North Korea
Taepo Dong 2	4,000–6,000	North Korea

Should Iran receive long range missiles from North Korea, or develop its own, it could threaten a much wider area.

## Iranian Missile Capability



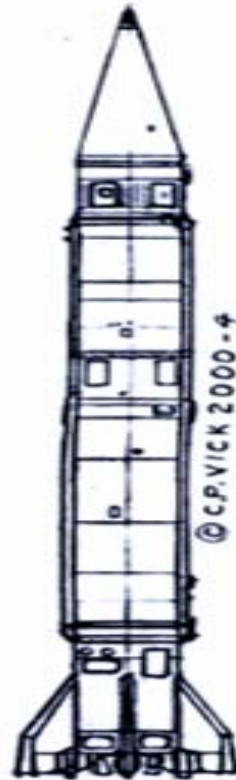


# Iranian Missile Program

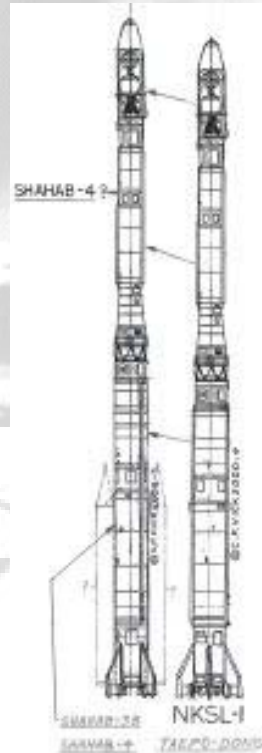
## Shahab-3



## No Dong



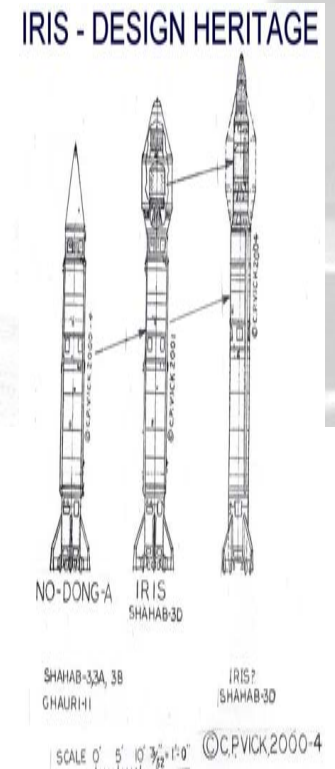
## Shahab-4



## Variant



## IRIS



<u>Range</u>	1,300	1,300	2,000	2,000	3,000
<u>Payload</u>	~1,000	700-1000	?	700	~1,000
<u>IOC</u>	2002	?	?	?	2005

# Stages of Development of Iran's Missiles

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

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

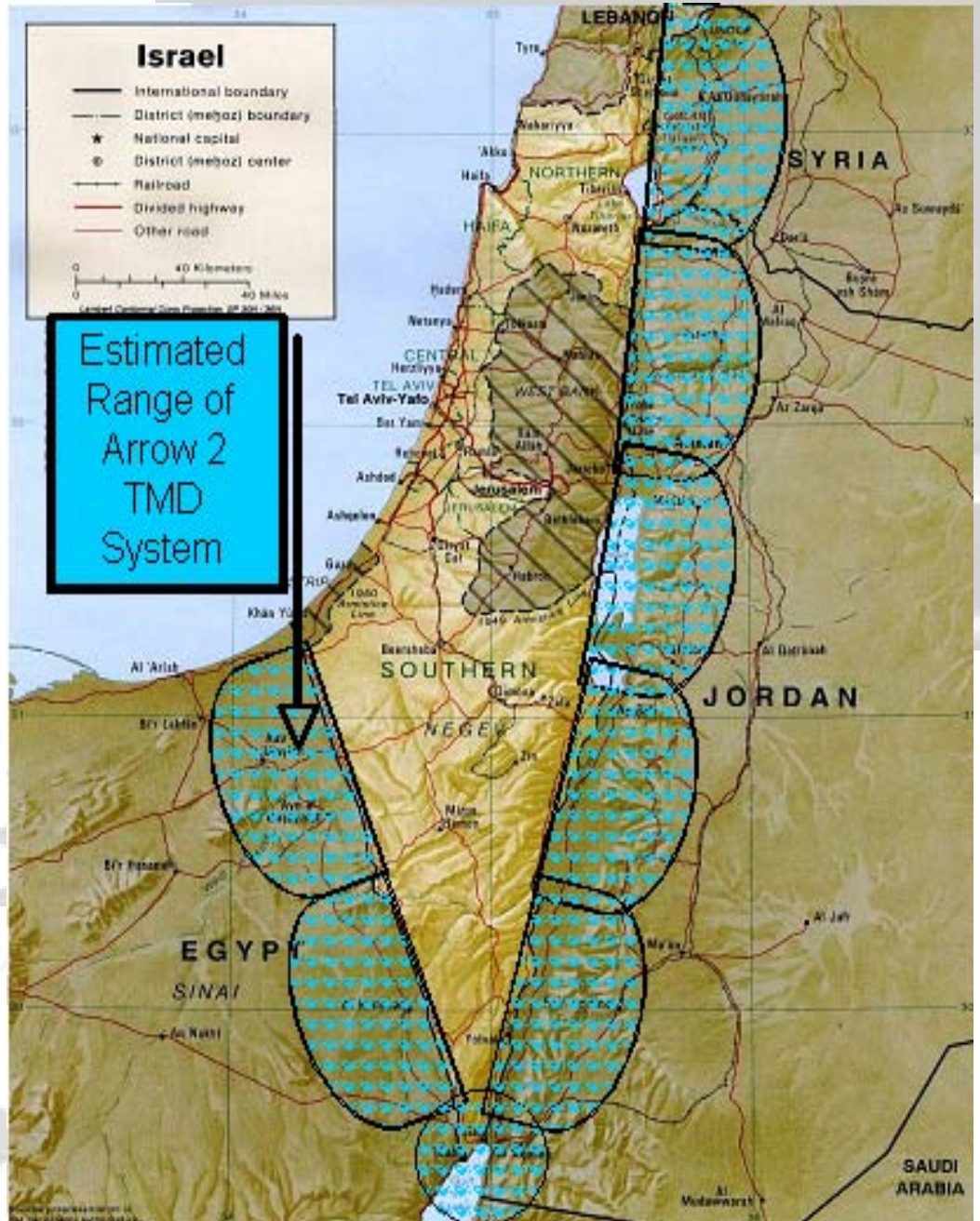
# Israel's Key Cities

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

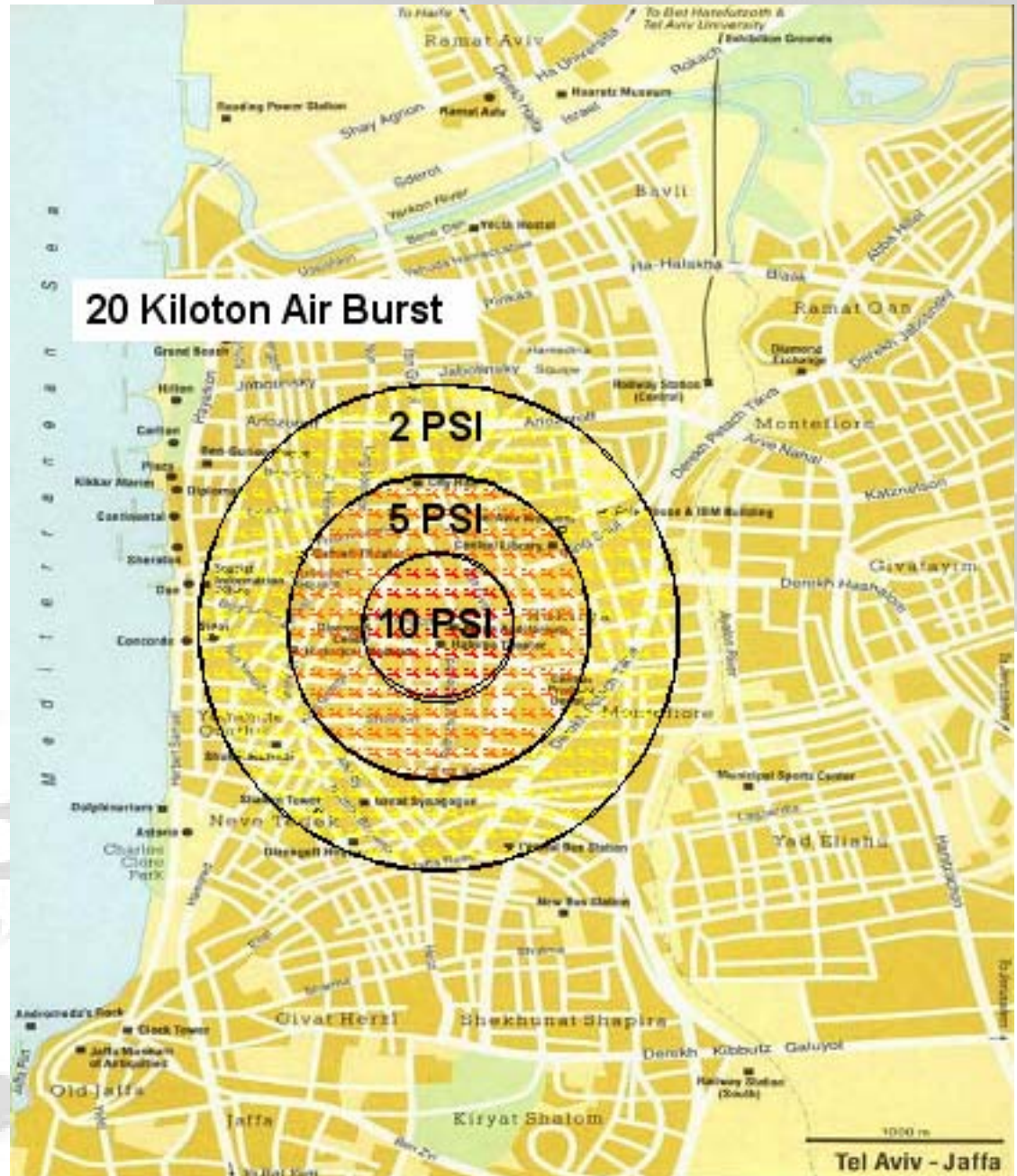
# Israel: High Value Target Areas



# Israel: TMD Coverage with *Existing* Arrow



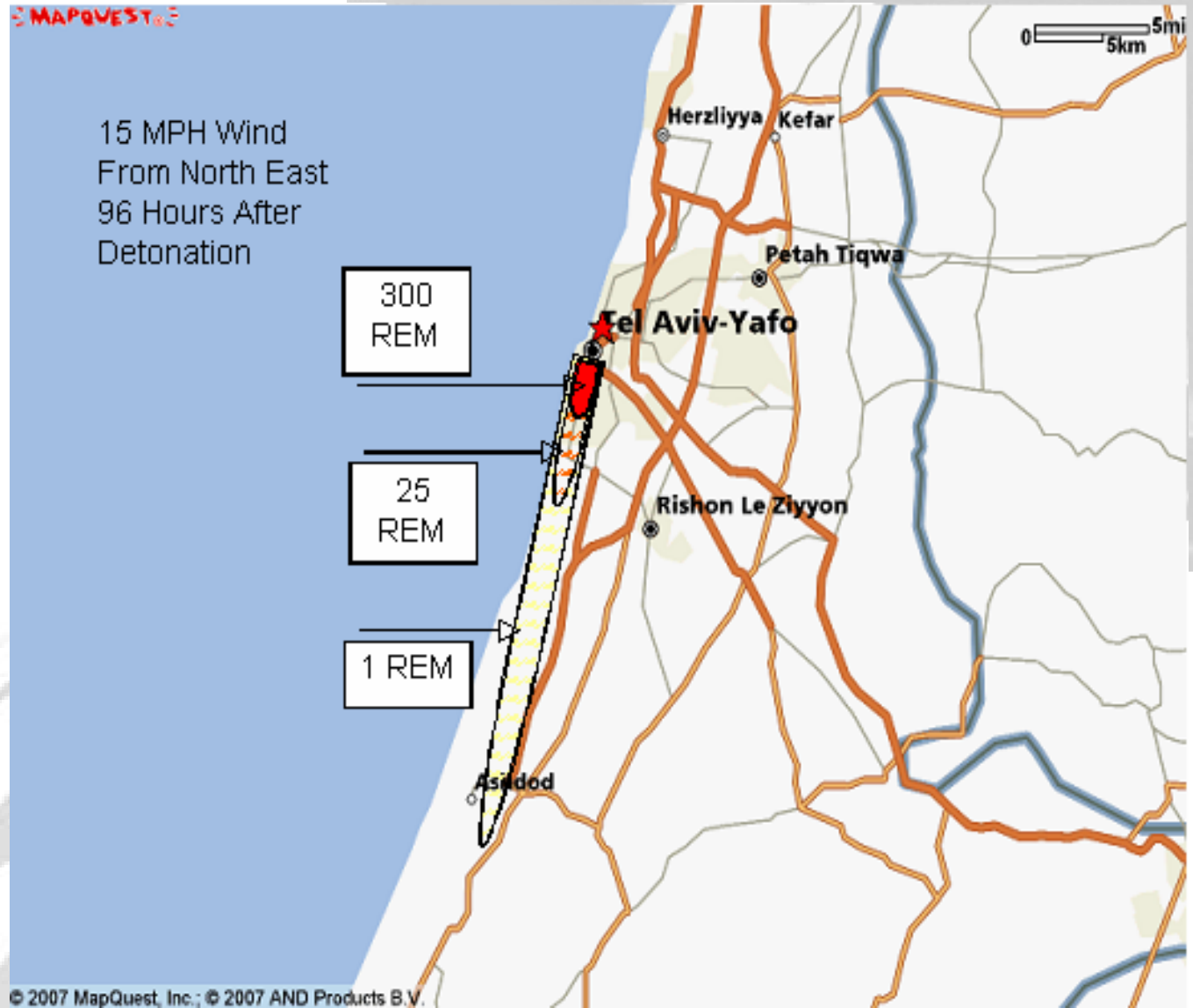
# Israel: Blast coverage of 20KT Iranian Nuclear Weapon



# Fall Out

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

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

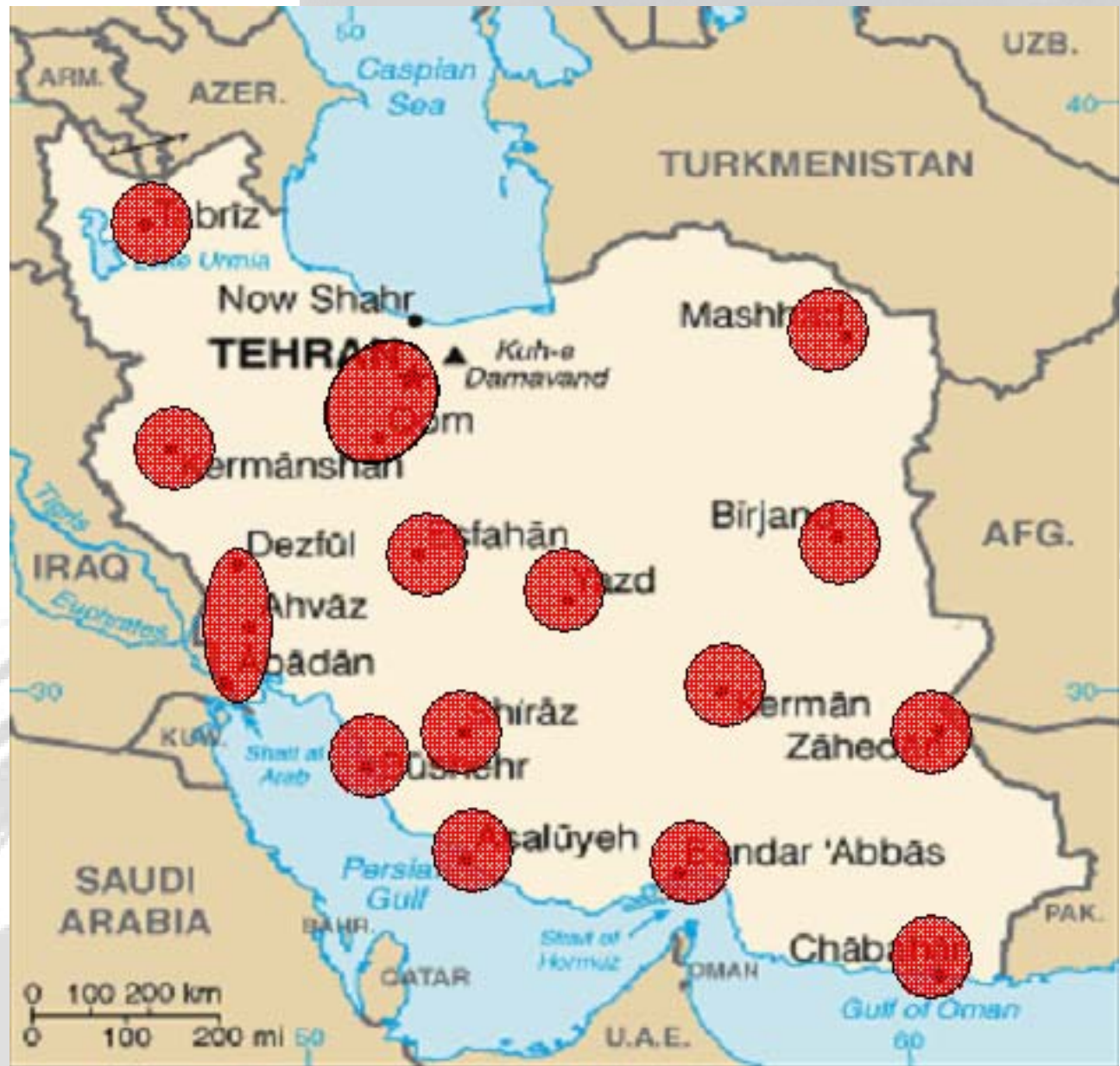




# Israeli Missile Capability



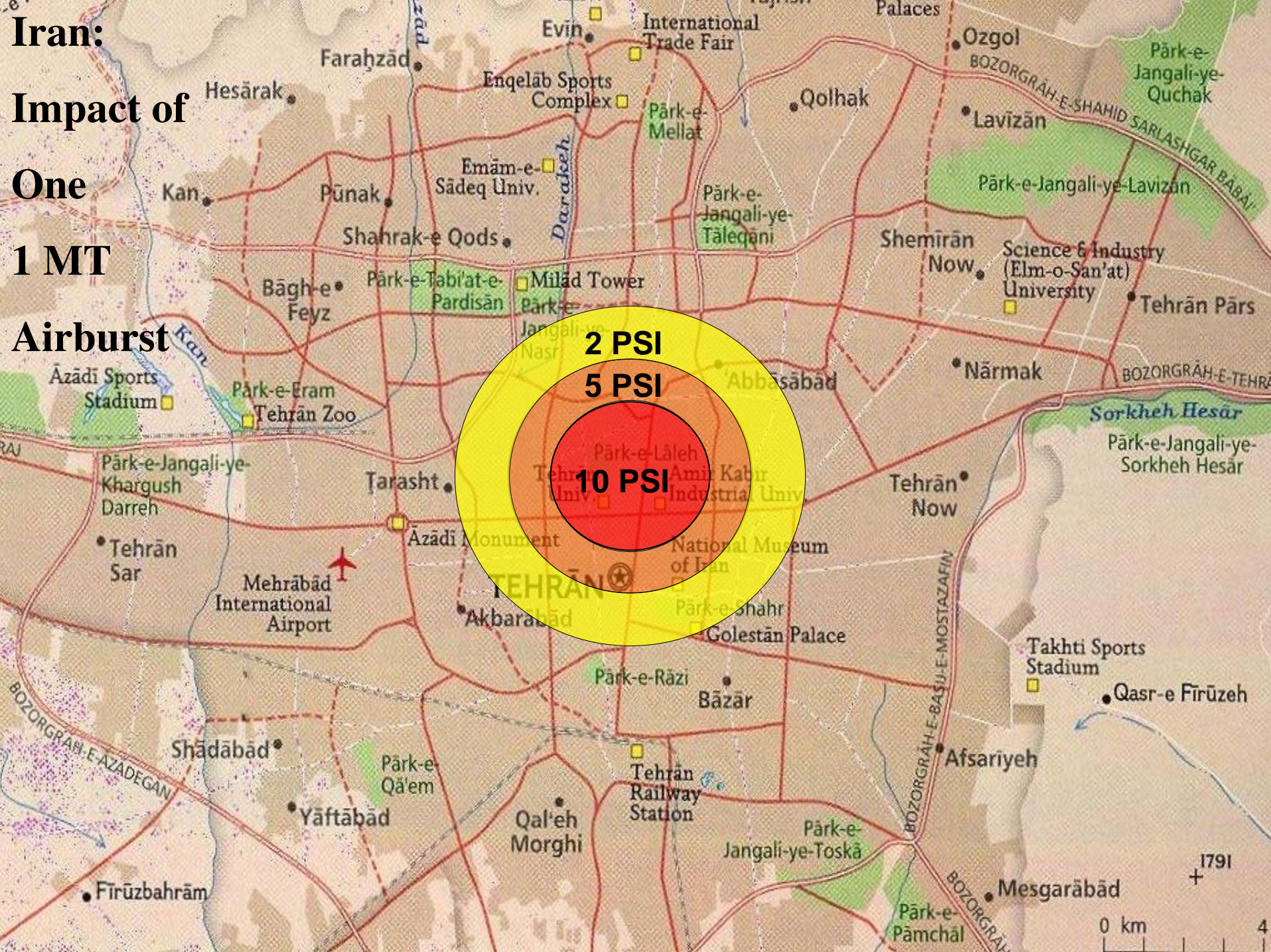
# Iran: High Value Population Centers



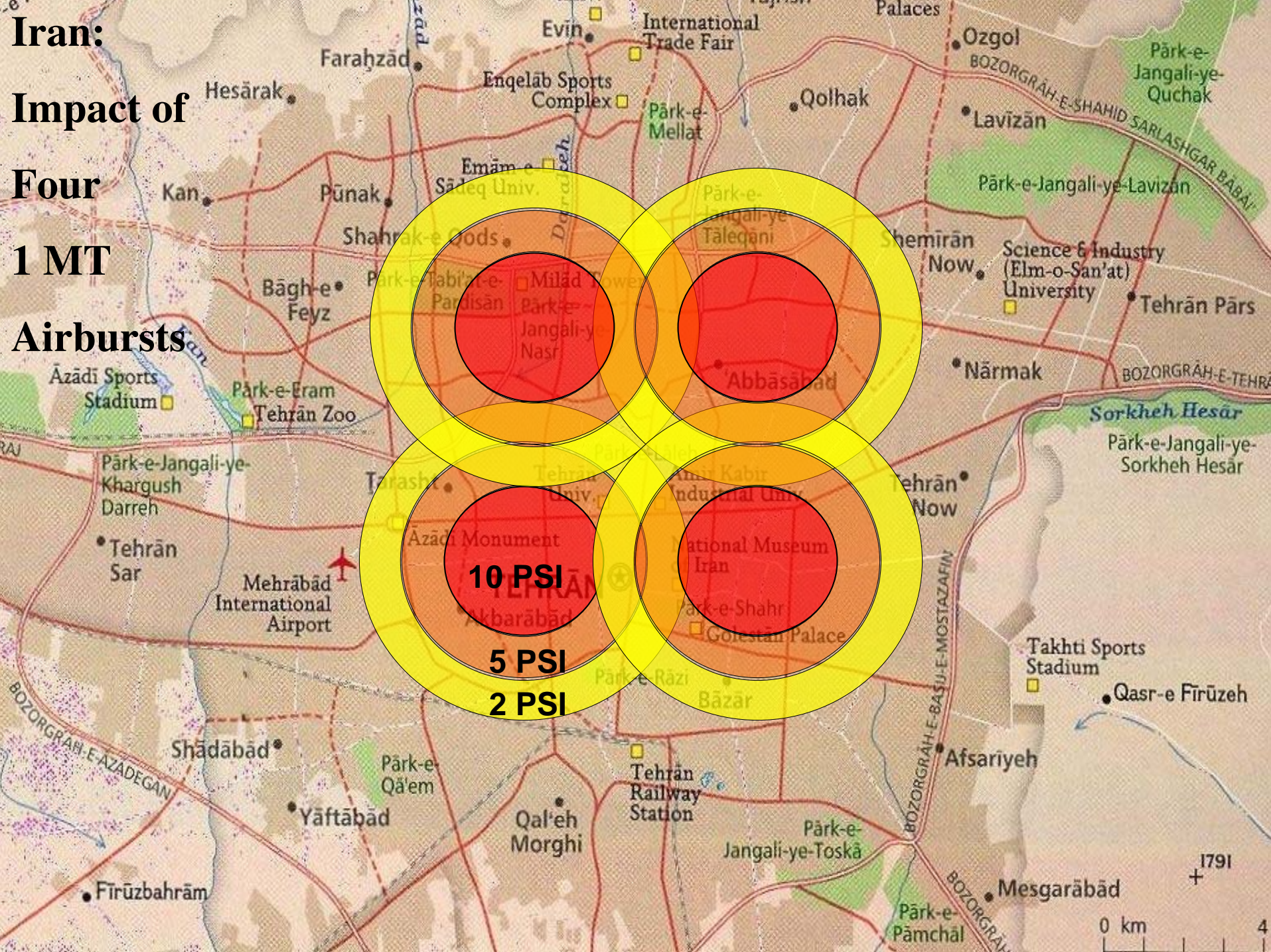
# Tehran

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

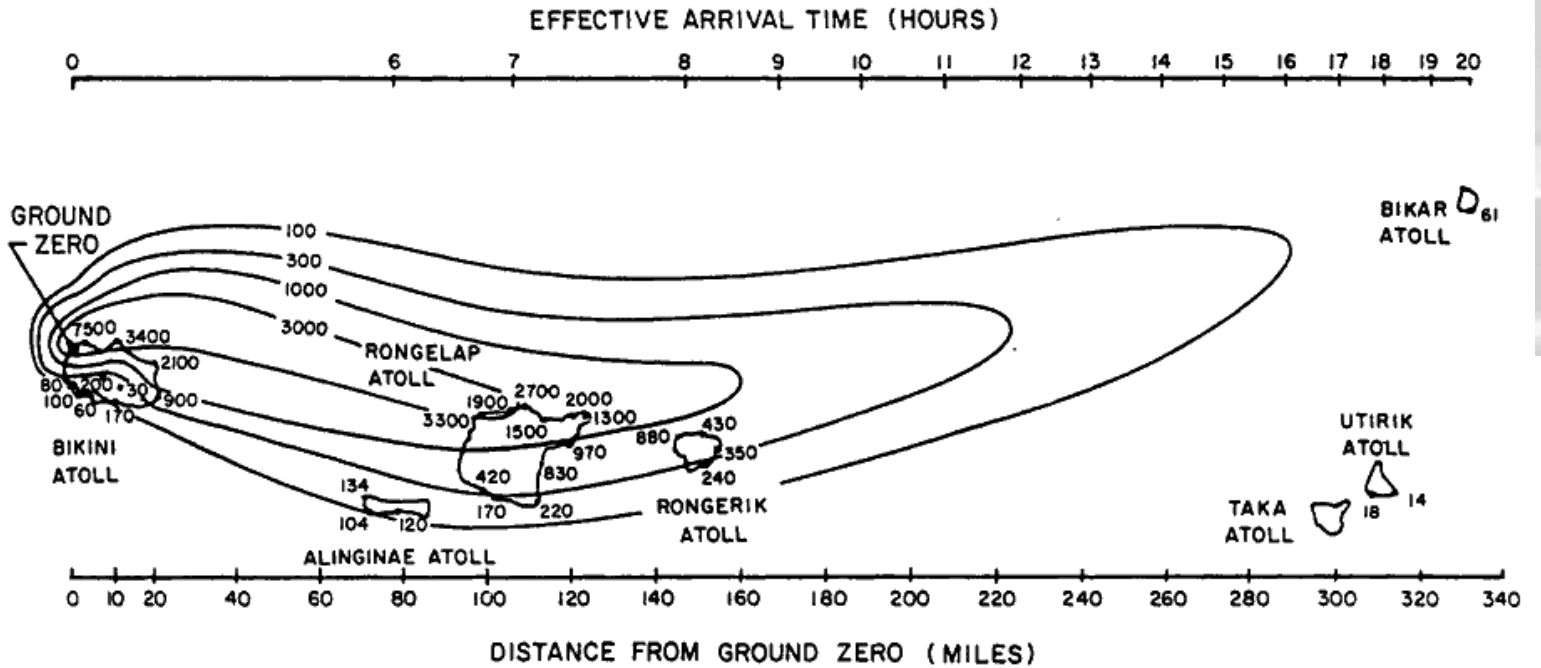
# Iran: Impact of One 1 MT Airburst



# Iran: Impact of Four 1 MT Airbursts

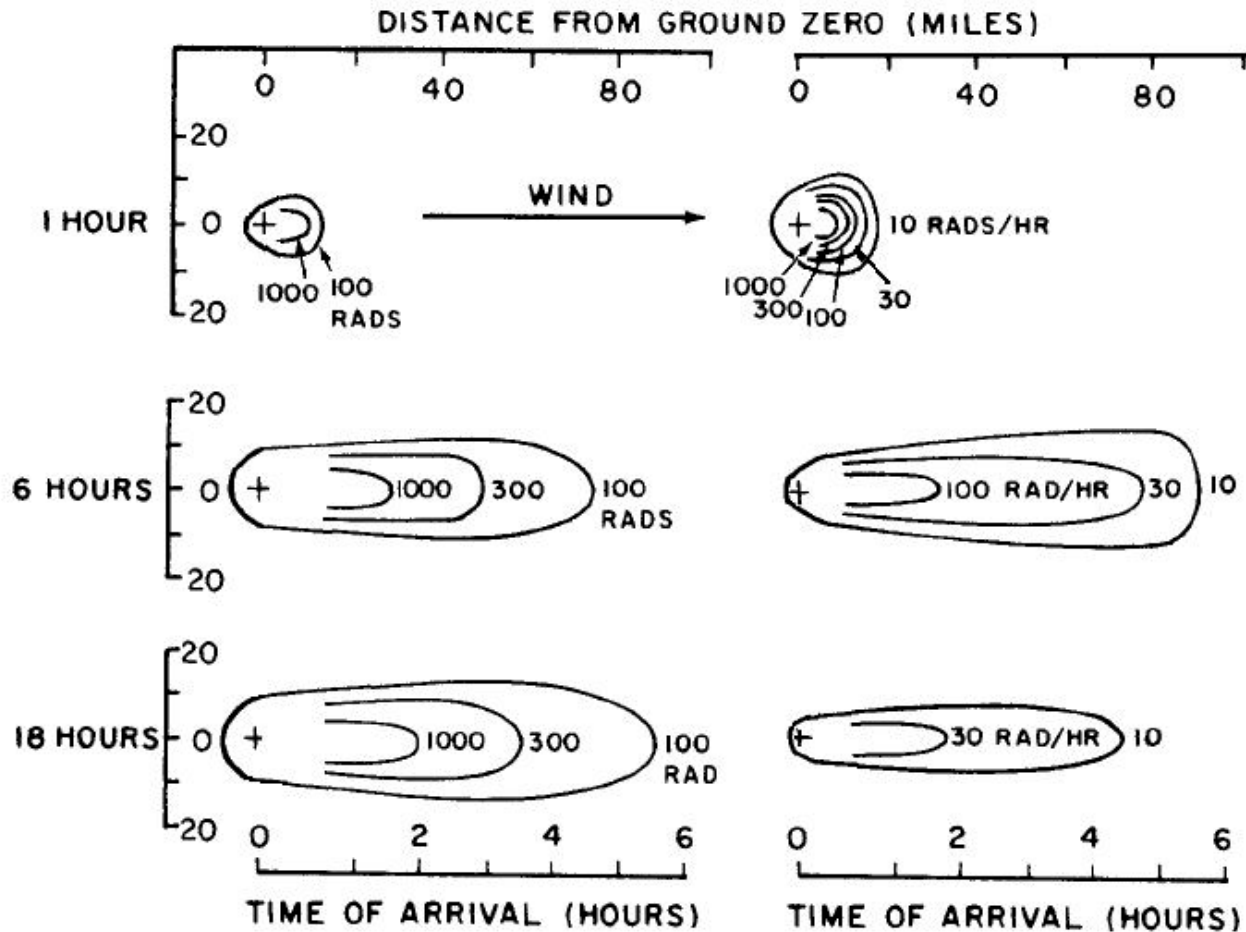


# Tehran: The Fallout Problem



Source: [http://en.wikipedia.org/wiki/Nuclear\\_fallout](http://en.wikipedia.org/wiki/Nuclear_fallout)

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

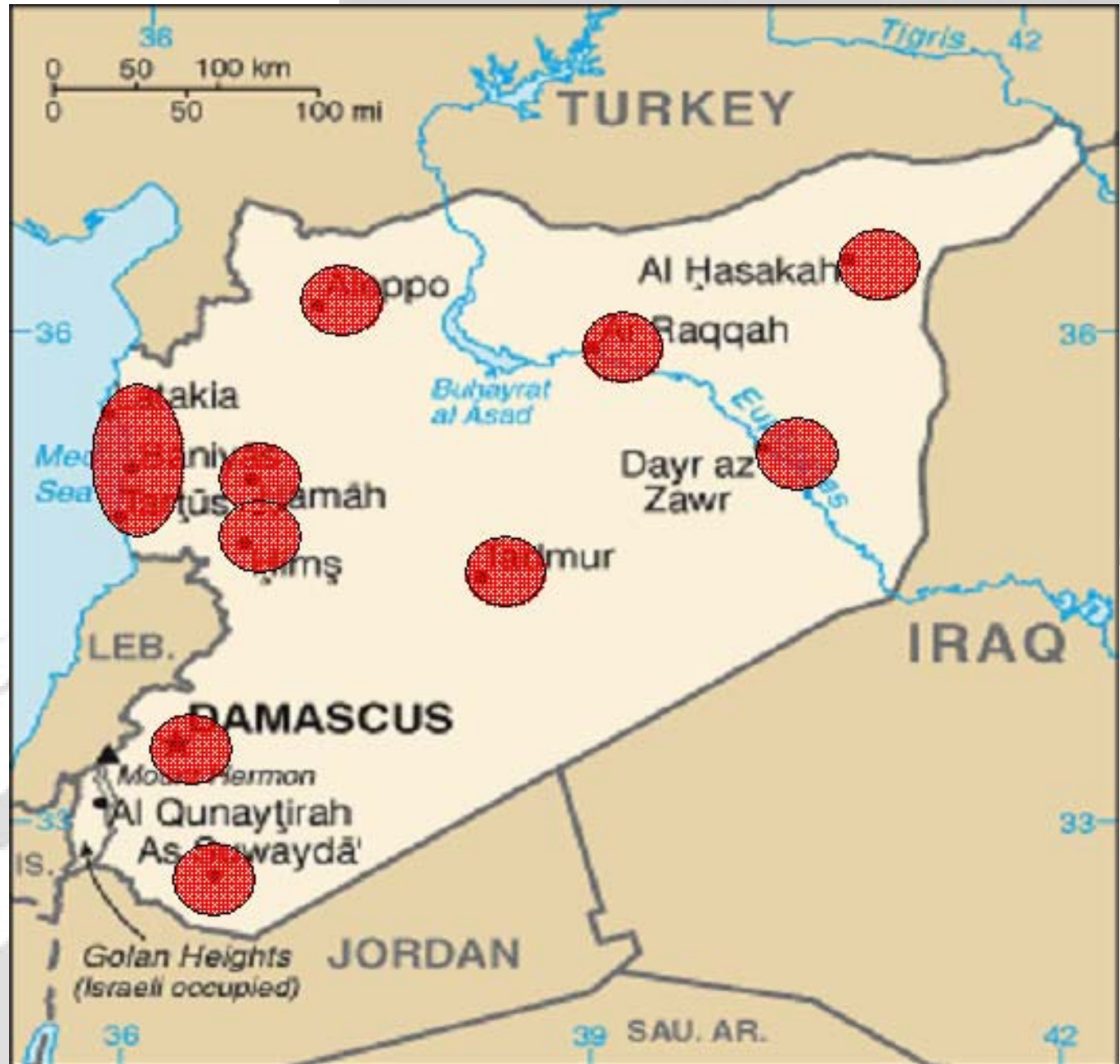


# Syrian “Wild Card”-Israeli Exchange

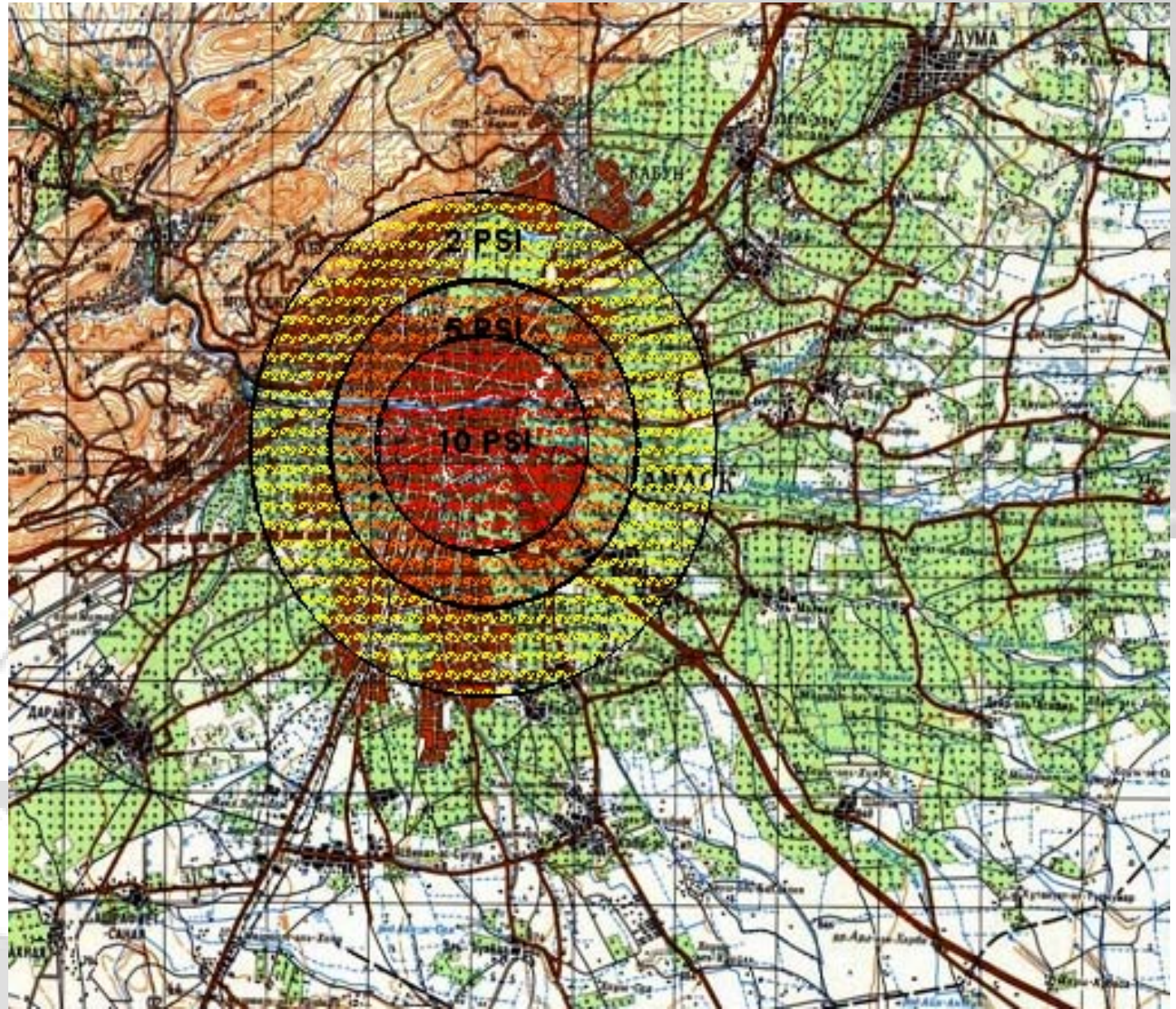
- **Assume dispersed force on both sides. But, Israeli preemption may be a limited option**
- **Assume counterpopulation; counterforce and countervalue not an option.**
- **CBRN versus Thermonuclear retaliation; first strike of at least marginal benefit.**
- **Syrian side:**
  - Have to assume believe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



# Syria: Hugh Value Population Centers



**Syria:  
1 MT  
Strike  
On  
Damascus**



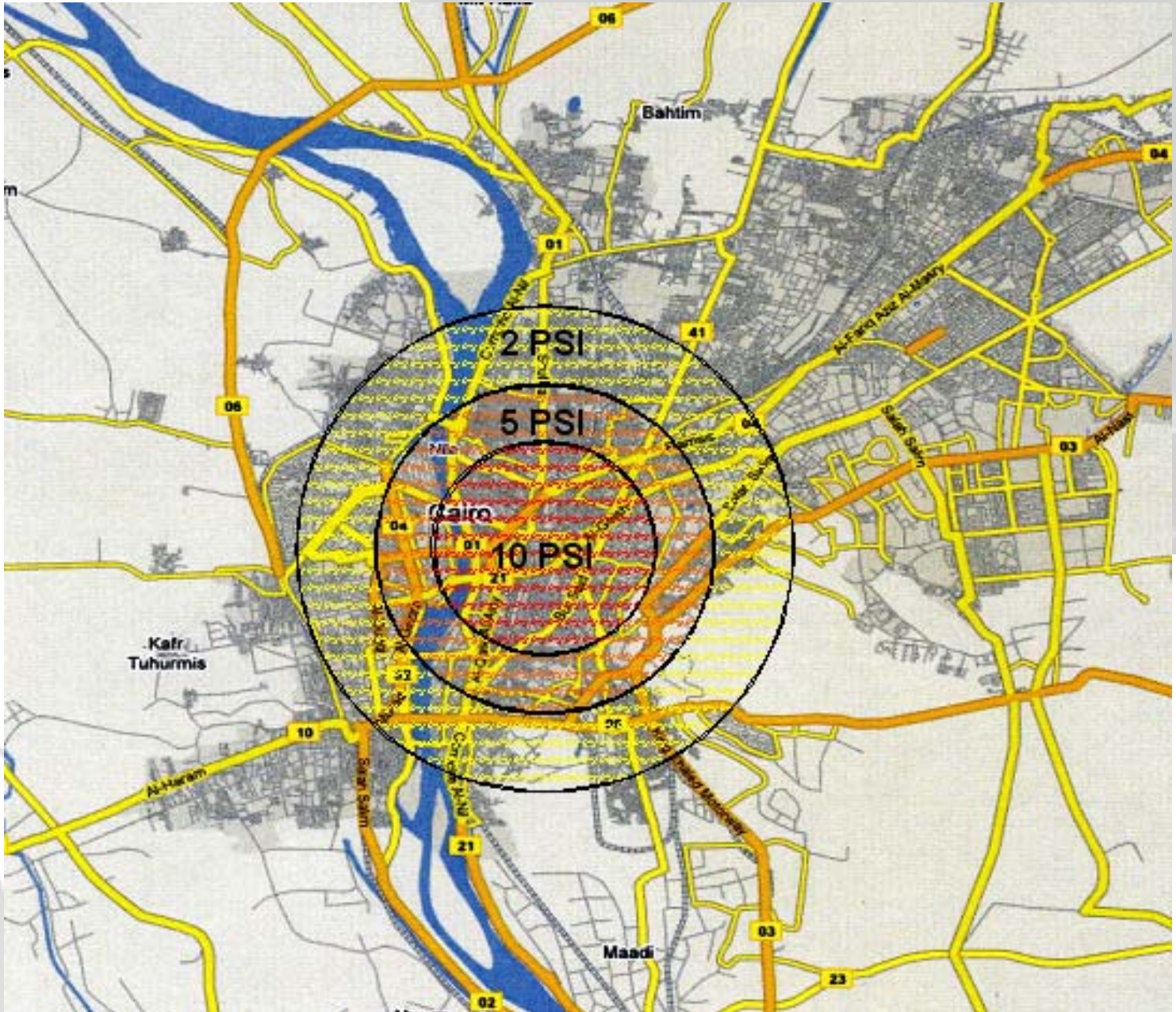
# Syrian Missile Capability



# Egypt: High Value Population Centers



**Egypt:  
1 MT  
Strike  
On  
Cairo**



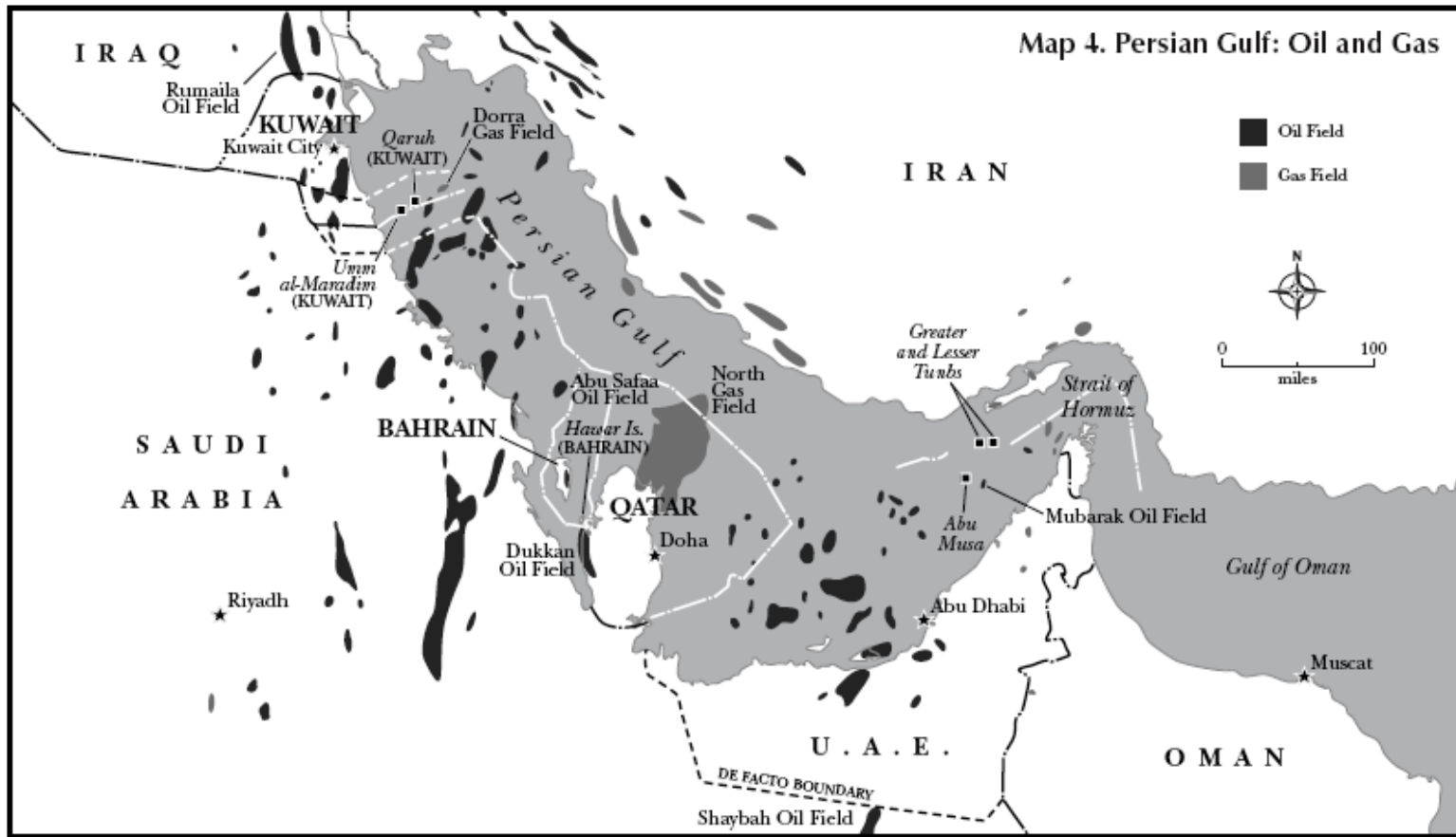
# Iran Nuclear, US Conventional

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

# WME: “Weapons of Mass Effectiveness”

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

# The Gulf Target Base



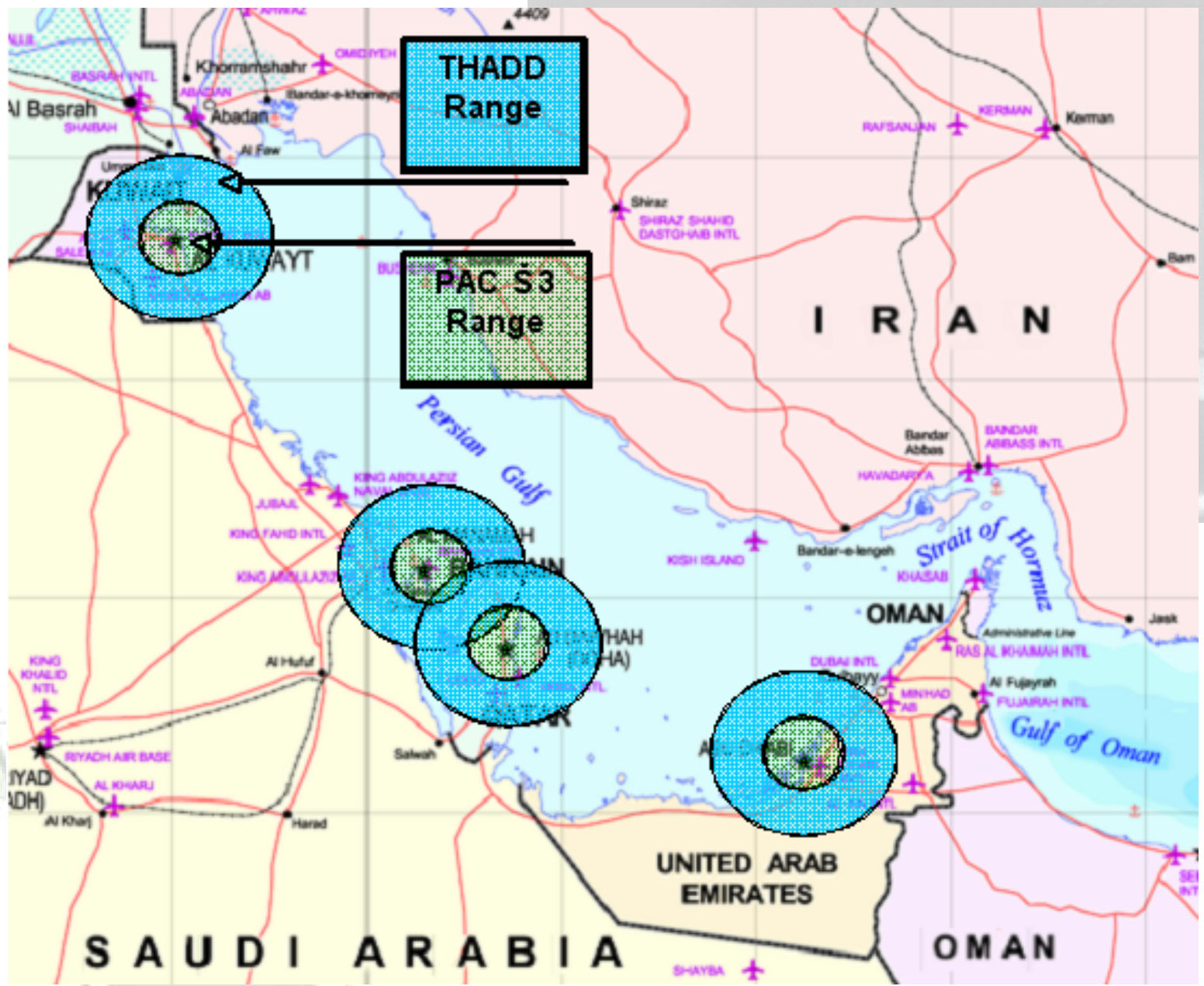


# Iran Nuclear, US Nuclear

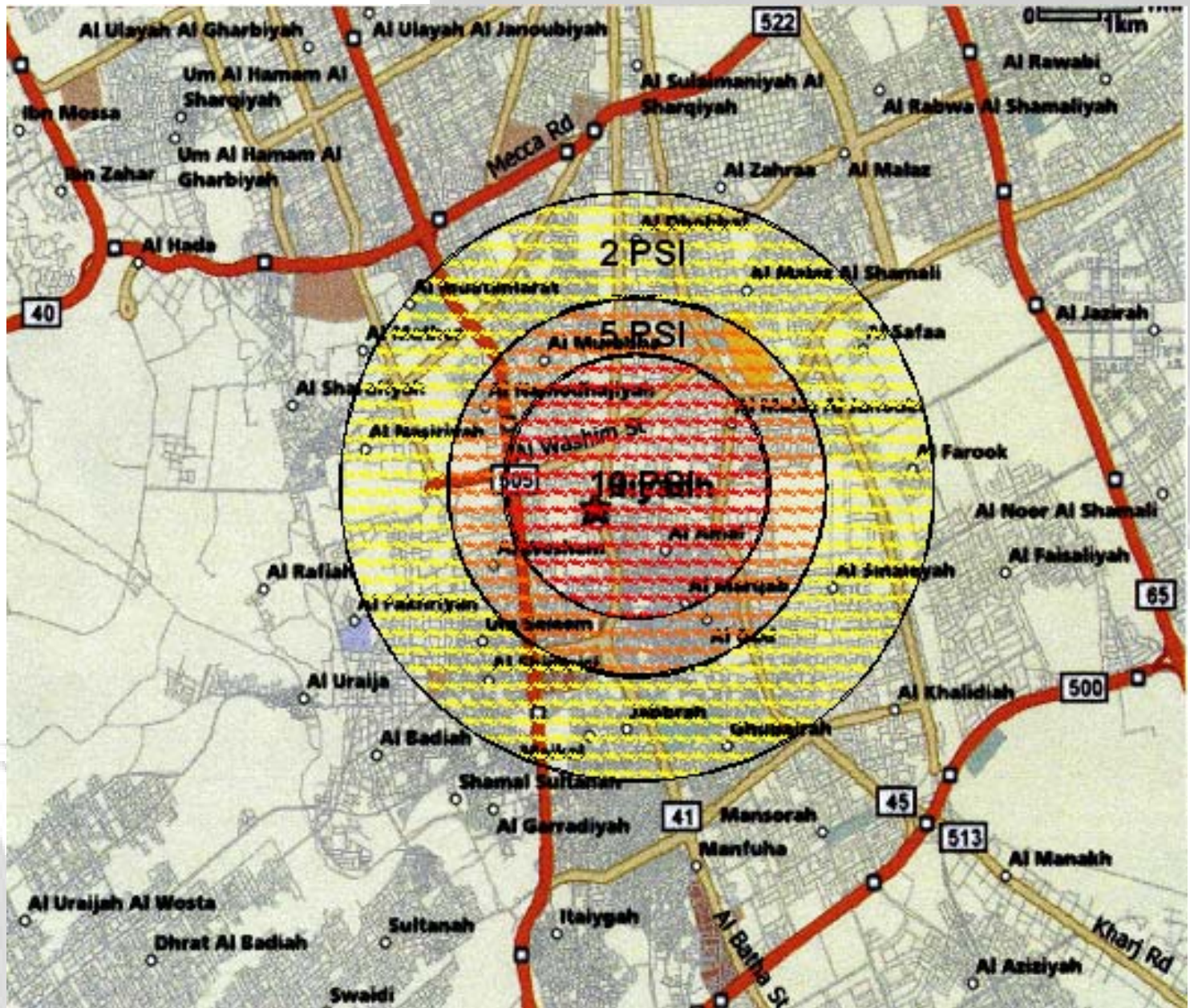
- **Assume mature, dispersed Iranian force. Preemption limited option for US, but face launch on warning, launch under attack option.**
- **Iran cannot threaten US. Can threaten US bases in Gulf, Israel, Europe, GCC allies, Egypt, Jordan, oil export capabilities.**
- **SAD-like environment relying on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

# GCC Options

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



# Saudi Arabia: 1 MT Strike On Riyadh



# State Actor Covert Bioterrorism, Suitcase Nuclear

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

# **Q<sub>50</sub> for Some Types of BW - Open-Air Deployment**

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

# Possible Terrorist Deployment of Biological Weapons

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

# Soviet RBK-type Cluster Bomb for CBR Weapons



Source: Ken Alibeck



# Non-State Actor CBR(N?)

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

# New Types of Biological Weapons

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

# The “War Game” Paradox:

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



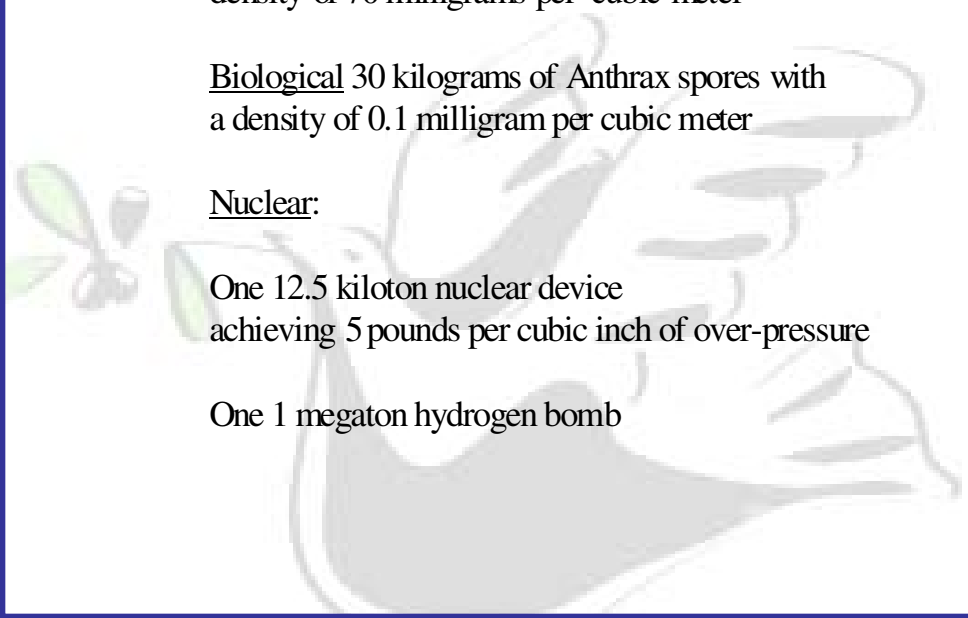
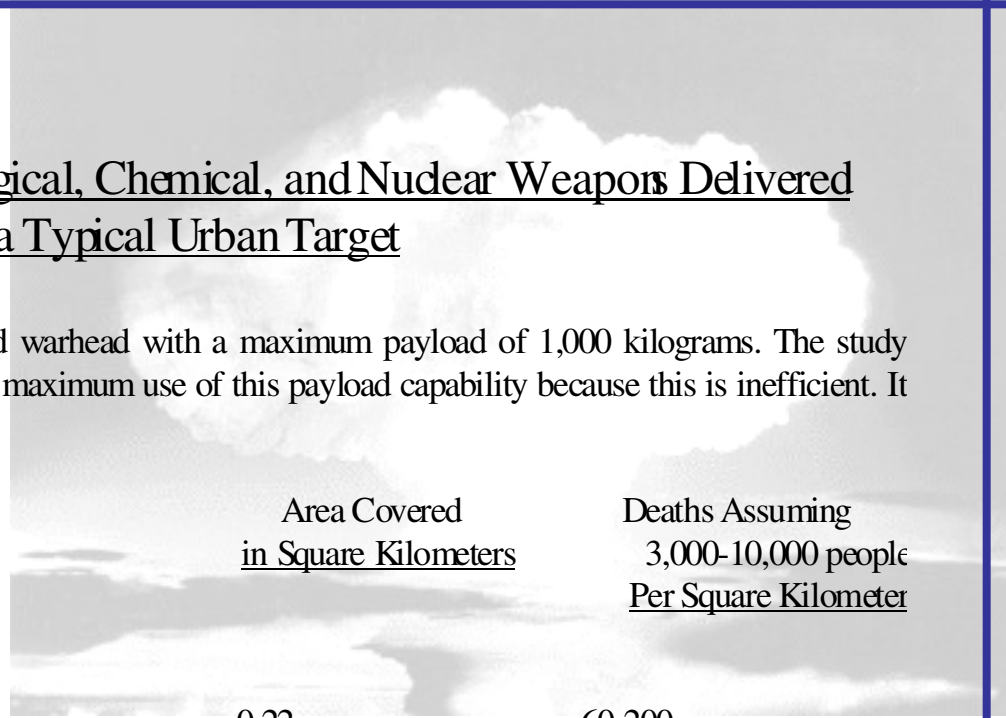
# Back Up Slides



## The Comparative Effects of Biological, Chemical, and Nuclear Weapons Delivered Against a Typical Urban Target

Using missile warheads: Assumes one Scud-sized warhead with a maximum payload of 1,000 kilograms. The study assumes that the biological agent would not make maximum use of this payload capability because this is inefficient. It is unclear this is realistic.

	<u>Area Covered in Square Kilometers</u>	<u>Deaths Assuming 3,000-10,000 people Per Square Kilometer</u>
<u>Chemical:</u> 300 kilograms of Sarin nerve gas with a density of 70 milligrams per cubic meter	0.22	60-200
<u>Biological</u> 30 kilograms of Anthrax spores with a density of 0.1 milligram per cubic meter	10	30,000-100,000
<u>Nuclear:</u>		
One 12.5 kiloton nuclear device achieving 5 pounds per cubic inch of over-pressure	7.8	23,000-80,000
One 1 megaton hydrogen bomb	190	570,000-1,900,000



## The Comparative Effects of Biological, Chemical, and Nuclear Weapons Delivered Against a Typical Urban Target

Using one aircraft delivering 1,000 kilograms of Sarin nerve gas or 100 kilograms of Anthrax spores: Assumes the aircraft flies in a straight line over the target at optimal altitude and dispensing the agent as an aerosol. The study assumes that a biological agent would not make maximum use of this payload capability because this is inefficient. It is unclear if this is realistic.

	<u>Area Covered in Square Kilometers</u>	<u>Deaths Assuming 3,000-10,000 people Per Square Kilometer</u>
<u>Clear sunny day, light breeze</u>		
Sarin Nerve Gas	0.74	300-700
Anthrax Spores	46	130,000-460,000
<u>Overcast day or night, moderate wind</u>		
Sarin Nerve Gas	0.8	400-800
Anthrax Spores	140	420,000-1,400,000
<u>Clear calm night</u>		
Sarin Nerve Gas	7.8	3,000-8,000
Anthrax Spores	300	1,000,000-3,000,000

Source: Adapted by the Anthony H. Cordesman from Office of Technology Assessment, Proliferation of Weapons  
Mass Destruction: Assessing the Risks, US Congress OTA-ISC-559, Washington, August, 1993, pp. 53-54.

## The Thermal and Blast Effects of Nuclear Weapons - Department of Defense Est

### Radii of Effects in Kilometers versus Weapons Yield

Effect	1 KT	20 KT	100 KT	1 MT	10 MT
Nuclear Radiation (1,000 cGY or lethal dose in open)	0.71	1.3	1.6	2.3	3.7
Blast: 50% incidence of translation with subsequent impact on a Non-yielding surface	0.28	1.0	1.4	3.8	11.7
Thermal: 50% incidence of 2 <sup>nd</sup> degree burns to bare skin, Kilometer visibility	0.77	1.8	3.2	4.8	14.5
Duration of Thermal Pulse in Seconds	0.12	0.32	0.9	2.4	6.4

### Ranges in Kilometers for Probabilities of Flying Debris

#### Yield in KT

1  
10  
20  
50  
100  
200  
500  
1000

#### Probability of Serious Injury

1%	50%	99%
0.28	0.22	0.17
0.73	0.57	0.44
0.98	0.76	0.58
1.4	1.1	0.84
1.9	1.5	1.1
2.5	1.9	1.5
3.6	2.7	2.1
4.8	3.6	2.7

### Ranges in Kilometers for Translational (Blast) Injuries

Yield in KT	<u>Range for Probability Blunt Injuries &amp; Fractures</u>			<u>Range for Probable Fatal Injuries</u>		
	-1%	50%	99%	-1%	50%	99%
1	0.38	0.27	0.19	0.27	0.19	0.19
10	1.0	0.75	0.53	0.75	0.53	0.53
20	1.3	0.99	0.71	0.99	0.71	0.71
50	1.9	1.4	1.0	1.4	1.0	1.0
100	2.5	1.9	1.4	1.9	1.4	1.4
200	3.2	2.5	1.9	2.5	1.9	1.9
500	4.6	3.6	2.7	3.6	2.7	2.7
1000	5.9	4.8	3.6	4.8	3.6	3.6

Source: Adapted from Table 2-1 and Table 2-7 of FM 8-10-7 and Table IV of FM-8-9, Part I, and USACHPPM, The Mec Battlebook, USACHPPM Technical Guide 244, pp. 2-2 and 2-3.