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***HOMA*: ISRAEL'S NATIONAL MISSILE  
DEFENSE STRATEGY  
(ABRIDGED VERSION)**

by

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In Partial Fulfillment of the Graduation Requirements

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## *Acknowledgements*

Missile defense has been a high interest topic for both Israel and the US since President Reagan's Strategic Defense Initiative, the Gulf War and even more so as a result of the *Report of the Commission to Assess the Ballistic Missile Threat to the United States* (15 July 1998) chaired by the current Secretary of Defense, The Honorable DONALD H. RUMSFELD.

The missile threat is one of Israel's main strategic threats and I hope this paper adds to the intellectual discussion of the issues involved in missile defense. I would like to thank many people for helping me. First, Major Gregory Stanley, an instructor at Air Command and Staff College (ACSC's Theater Missile Defense expert), was willing to step up to the plate of being my research advisor, even while taking care of his responsibilities and simultaneously pursuing his own doctorate. Second, the people that I met and discussed this topic with were extremely helpful in helping a neophyte conceptualize the various issues involved. These helpful people (not in any particular order) included Dr. Mark D. Mandeles (The J. De Bloc Group-Historical and National Security Policy Analysis), Dr. W. Seth Carus (National Defense University), Colonel Jerry Warner (DoD Office of Net Assessment), Mr. Michael Eisenstadt (Washington Institute for Near East Policy), Mr. James Colbert (Jewish Institute for National Security Affairs), Mr. Charles Perkins (Senior Military Analyst of the American Israel Public Affairs Committee), Ms. Diana Simpson (Air University Librarian extraordinary), Dr. Yehudit Barsky (American Jewish Committee), and Israeli experts. I have to thank the advent of the Internet and the various research tools available to me on the Net for providing a plethora of information that

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### *Abstract*

This paper is written to answer a research question posed by the USAF's Institute for National Strategic Studies (INSS). The desired general objective of the research is to discuss the strategic needs and military objectives in a particular region or country of how theater missile defense (TMD) supports or jeopardizes US National Missile Defense (NMD) strategy. This research examines, in detail, Israel's national missile defense program, called *Homa* (Hebrew for Fortress Wall).

Chapter 1 discusses the fundamentals of missile defense and the reason why Israel's missile defense system affects US national security interests. Chapter 2 describes Israel's missile defense program, *Homa*, and explains why Israel's TMD program is, effectively, the first active two-tier National Missile Defense system. This description includes Israel's current, planned, and desired capabilities. Chapter 3 describes the confrontation (Iraq, Iran, Syria, and Libya) and potential confrontation states' (Pakistan, Egypt, Sudan, Saudi Arabia, and United Arab Emirates) ballistic missile threats to Israel. Continuing the discussion of threats and other perspectives, Chapter 4 discusses the views of other countries and an academic discussion of the implications of presented information through observations and recommendations. The countries discussed include regional non-confrontation states (Jordan and Turkey), western-friendly countries, and (3) hegemonic and proto-hegemonic countries. The final chapter, Chapter 5, concludes with a short discussion on the importance of missile defense, especially the cooperation between Israel and the US. The paper also includes appendices that describe current Israeli missile defense

systems as well as future threats facing Israel such as Palestinian artillery and Katyusha rocket ranges.

From all the research conducted for this paper and after examining all the costs, risks, and benefits of an Israeli NMD, the author strongly recommends that the US and Israel, along with other friendly countries, continue to work hard against the missile threat and overcome its tactical, operational, strategic effects. Some possible abuses of missile defense could occur; however, the gain of working together against a common enemy is far greater than the risks. Furthermore, these risks can be identified and monitored to minimize their effects. The Israeli NMD gives the US a unique opportunity to work closely with a friendly nation that faces similar threats as US forces and other allies face in the region. By working closely with the US, Israel can accelerate its NMD program and potentially create another means to deter potential aggressors in the region.

## Chapter 1

### Chapter 1: Introduction to Missile Defense and the Israeli Example



Nations of the Middle East and North Africa

**Figure 1 Map of the Middle East**

*...we received a report that a Scud fired at Dhahran had struck a US barracks. The explosion killed twenty-eight of our troops and wounded many more. It was a terrible tragedy—this terror weapon launched into the sky that by sheer fate happened to fall where we had a concentration of troops—and it brought home once again to our side the profanity of war. I was sick at heart.*

— General H. Norman Schwarzkopf  
(Referring to the single greatest cause of US troops killed during the Gulf War)<sup>1</sup>

This paper is written to answer a research question posed by the USAF's Institute for National Strategic Studies (INSS). The desired general objective of the research is to discuss the strategic needs and military objectives in a particular region or country and how theater missile defense (TMD) supports or jeopardizes US National Missile Defense (NMD) strategy. This research examines, in detail, Israel's missile defense program, called *Homa* (Hebrew for Fortress Wall, Fence, Barrier, Barrier Wall, or Citadel).<sup>2</sup>

**Why Care?** Why should anyone care about Israel's missile defense plan? First, Israel has created the world's first two-tier NMD.<sup>3</sup> Israel's experiences will help the US struggle with its own NMD, which appears to be a high priority in President George W. Bush's administration and especially with Secretary of Defense Donald H. Rumsfeld who was a member of the *Commission to Assess the Ballistic Missile Threat to the United States*, published on 15 July 1998.

Another reason for high interest in Israel's NMD program development is the turbulent Middle East. Not only do ballistic missile threats to Israel concern the US (because we are concerned about helping democracies in the world—from *the National Security Strategy Dec 2000*), but also because our troops are stationed in the Middle East facing the same threats. During the Gulf War, General Schwarzkopf's most significant threat to US and coalition forces was missile attacks from Iraq—they were the single greatest cause of US casualties. The importance of dealing with this threat could be shown by the number of sorties that were flown by coalition aircraft against Iraqi Scuds:

Approximately 4,750 anti-Scud sorties were planned throughout the war, including the change or addition of 553 sorties. Daily Scud hunting sorties numbered between 75 and 160, or about 5 percent of planned daily sorties. The anti-Scud strategy had essentially three parts: first, pre-planned attacks against production, storage, and fixed sites; 24-hour patrols to disrupt pre-launch activities; and, 24-hour patrols to attack launch sites after they fired their missiles.<sup>4</sup>



**Figure 2 Iraqi Scud Attack Areas During the Gulf War**

The effectiveness of these efforts was extremely poor. It is questionable if Israel or the US could do any better today against Iraqi Scud attacks than the poor performance that occurred during the Gulf War.

US troops continue to be stationed in the Middle East for a variety of reasons including maintaining the uninterrupted flow of oil to our main business partners in Europe and Asia as well as to the US. During the year 2000, the US imported 55% of its crude oil and its imports will continue to increase to 61% by 2010 according to the Department of Energy.<sup>5</sup> Furthermore, the Middle East, particularly the Persian Gulf, is a declared vital US interest since President Carter's State of the Union speech in January 1980.<sup>6</sup>

Besides our concern for regional stability in the Middle East (ME), the ballistic missile threat that Israel faces is the same that many other democracies and our friends all over the world fear now or will fear in the future. These countries include South Korea, Japan, Taiwan, Australia, India as well as our European allies. Many of the countries developing ballistic missiles are looking to extend their ranges from short to medium to even intercontinental ranges (see Definitions for distances at the end of paper) and that is precisely the reason the US is seriously considering developing it's own National Missile Defense (NMD).

In effect, Israel is on the frontline against the rogue states—“recalcitrant and outlaw states that not only choose to remain outside the family [of democracies] but also assault its basic values.”<sup>7</sup> Most of these states are in the Middle East and also happen to support terrorism—Iraq, Iran, Syria, Sudan, Libya (North Korea and Cuba are the only other countries identified by the US Department of State as state sponsors of terrorism).<sup>8</sup> Even North Korea, another rogue state, continues to be directly involved in assisting the rogue Middle Eastern states with their growing missile programs by selling them Scud missiles and other more advanced systems such as the No Dong. Additionally, non-rogue states such as Russia, China and even some European companies have admitted to providing support and selling missile technology to these Middle Eastern rogue states.<sup>9</sup>

With the proliferation of weapons of mass destruction (WMD), especially in the ME, a future confrontation with any of the missile capable countries could affect the entire world—via the disruption of the oil flow, WMD contamination, environmental disasters, loss of markets or loss of access to markets, and other destabilizing effects.

**What is missile defense?** According to *Doctrine for Joint Missile Defense* (Joint Publication 3-01.5, 22 February 1996), the following definitions will assist clarifying the

landscape of missile defense. Other similar terms are defined at the end of the paper under the Definitions.

**Theater Missiles (TM)** are ballistic missiles, cruise missiles, and air to surface missiles whose targets are within a given theater of operation.

**Theater Missile Defense (TMD)** is composed of four operational elements: passive defense, active defense, attack operations, and command, control, communications, computers, and intelligence (C4I).

**National Missile Defense (NMD)** is an expanded version of TMD that covers a country's entire territory.

**Passive defense** - measures taken to posture the force to reduce vulnerability and minimize the effects of a TM attack.

**Active defense** - operations taken to protect against a TM attack by destroying TM airborne launch platforms and/or destroying TMs in flight.

**Attack operations** - operations taken to destroy, disrupt, or neutralize TM launch platforms and their supporting structures and systems.

**Command, control, communications, computers, and intelligence (C4I)** - systems used to coordinate and integrate the joint force capabilities to conduct and link passive defense, active defense, and attack operations.

**Anti-Ballistic Missile (ABM) Limitations:** The ABM treaty delineates four main areas that the US and USSR agreed to in 1972:

The first restriction is that no more than 100 interceptors can be fielded at only one site. The designated site for the United States is Grand Forks, ND. Prior to the addition of a protocol to the original ABM Treaty (added at U.S. insistence), each party was permitted to deploy its defensive missiles at two locations. A few defense strategists are now advocating that the U.S. negotiate a termination of the ABM Treaty's protocol, thus re-establishing the ABM Treaty's original provision which allowed two deployment sites. Others would either abrogate the ABM Treaty entirely or negotiate some major revisions to that agreement to allow for missile defenses at multiple sites.

The second restriction of note is that each ABM interceptor missile can only be equipped with a single warhead/kill vehicle. This provision makes it impossible to develop cost effective missile defenses, defenses that are not disproportionately more expensive than offensive forces. For example, a single Chinese missile with a 9-MIRV warhead would require a minimum of nine U.S. interceptor missiles to eliminate the threat. In reality, considering China's reported work on penetration aids and the probability that some number of U.S. interceptors would miss their targets, the number of actual interceptors required to prevent nuclear disaster would be considerably higher than nine.

The third difficulty is the limitations on ABM radars. Essentially, the ABM radar must be within 150 kms of the ABM site at Grand Forks, ND. Since the NMD radar is expected to have a range of about 4000 kms, this means that the potential for intercepting offensive missiles launched against Alaska or Hawaii will be very fragile. Although early warning

radars are allowed to be deployed on the periphery of each country, the radar handling the intercept must be located within 150 kms of the ABM launch site.

The fourth difficulty is that it makes a number of potential theater missile defense systems legally questionable (e.g., airborne lasers and fast intercept missiles deployed on ships). Essentially, this fourth point revolves around the issue of what systems are subject to being counted against the Treaty's limits and which can be considered theater-level assets.<sup>10</sup>

These four areas determined how the US and USSR agreed to define the difference between TMD and NMD in 1996:

The agreement specified the limitations on the *Theater High Altitude Area Defense* (THAAD) system. The **interceptor** will be restricted to a speed of **3 kilometers per second or less**; it also cannot be tested against **targets** traversing ranges greater than **3500 kilometers or at velocities in excess of 5 kilometers per second**. Of perhaps greater significance, THAAD will **not receive targeting data from satellites or adjunct radar systems**, a restriction that could reduce the system's protective footprint by roughly half. Although the status of the Navy theater wide system and the Air Force's boost phase intercept systems have not yet been negotiated, and the U.S. administration reportedly opposes limitations on these systems, Russia is expected to try to have those two systems restricted as well. Russia is linking its continued participation in the START treaties to the ABM Treaty.<sup>11</sup>

Regardless of these definitions, the ABM Treaty was signed between the US and USSR and does not involve Israel. Israel does not define the threat nor its ability under these terms. These terms affect Israel only when it deals with issues of US technology transfer because the US, for the time being, has agreed to abide by the ABM Treaty.

**What purpose does missile defense serve?** Since the beginning of their use in World War II, missiles continue to pose a difficult problem because of their military, political, and psychological effects. US military doctrine, *Doctrine for Joint Theater Missile Defense*, (Joint Pub 3-01.5), describes the impact of ballistic missiles during war:

The Scud missiles used by Iraq and Iran in the “War of the Cities,” and the Iraqi use of Scud missiles against coalition forces and Israel in the 1991 Gulf War were the first uses of ballistic missiles since the use of the V-2 in World War II. Though relatively primitive in nature, these Soviet and Iraqi variant Scud missiles had a psychological impact and forced operational and tactical changes.<sup>12</sup>

Missile defense attempts to prevent an enemy missile from attacking friendly areas. A variety of methods can be used to deal with a missile attack.

**How does missile defense work?** Experts from the Union of Concerned Scientists describe missile defense as like shooting a bullet to stop another bullet.<sup>13</sup> Possible methods of stopping a missile are usually described as various phases of interception: boost phase intercept (BPI), mid-course intercept (MCI), and terminal intercept (TI). BPI occurs when an enemy's missile is intercepted while the missile is accelerating from the rocket booster. MCI occurs after the boost phase when a ballistic missile is intercepted at the mid-point of its trajectory. Finally, TI occurs when an enemy missile is accelerating towards the earth.

During the first phase, a missile is most vulnerable to attack because all of its parts are still attached.<sup>14</sup> The most difficult part of destroying a ballistic missile is during its terminal phase since the warhead and the rest of the missile are all jumbled up. Also, the enemy could use a variety of deception techniques (see footnote for a list and description of various types of missile defense counter-measures) could be used during this phase to deceive anti-missile defenses.<sup>15</sup> Israel is trying to develop a missile defense program that tries to target ballistic missiles during the boost phase for similar reasons:

One, the lethality challenge is greatly simplified – destruction of the TBM can be achieved by direct hits on the target warhead or sending interceptor warhead fragments into the target booster fuel tanks, guidance system or rocket motor. Two, a successful BPI campaign eases the requirement placed on terminal missile defense system and provides an answer to many of the measures an enemy can adopt in order to counter terminal defenses, including the use of decoys, penetration aids, and advanced submunitions. And three, the TBM boost phase of flight takes place over enemy territory.<sup>16</sup>

Besides these methods, other defense analysts and experts discuss the notion of attacking missiles before or after launch or at fixed facilities (storage, production, deployment sites, etc) as was attempted by the Coalition Forces during Desert Storm. Israel calls attacking missile

launchers before/after the missiles are fired as Boost Phase Launcher Intercept System (BPLI). Another source refers to another concept of Before Launch Phase Intercept (BLPI) which is a system that “would require an advanced combination of on-location intelligence by satellite, air surveillance and possibly ground observation by special forces to detect, identify, warn and then point the aerial platform UAV to launch its [Kinetic Kill Vehicle] KKV at the target – the missile launcher Transporter Erector Launcher (TEL).”<sup>17</sup>

Currently, debate is occurring in the missile defense community on what tactic to take. Israel favors the BPLI while the US favors BPI. BPI is ideal because it destroys missiles during their launch phase while the missile is most vulnerable, while the warhead is still attached and explosion occurs over enemy territory. The problem with BPI is the requirement to maintain surveillance over enemy territory in order to target missiles by more assets when they launch. A more aggressive program, BPLI could destroy missile launchers before they launch or attack the launcher after the missile was launched. BPLI also requires surveillance and a method to destroy launchers, but the decision to attack is not determined when the enemy launches their missiles. BPLI allows decision-makers the option of a pre-emptive attack. BPLI actually could be argued to be more effective than BPI because

BPLI proponents maintain that destroying the TELs, whose number is necessarily limited, is a much more effective approach than trying frantically to intercept dozens of missiles in flight. Furthermore, the destruction of the missiles on the ground has an even greater psychological impact on both the enemy armed forces as well as the local population.<sup>18</sup>

Although both countries agree on the importance of the BPI concept, the debate on BPLI appears to be ongoing. This debate is called the battle over the “L” as in the “L” or launcher in BPLI.<sup>19</sup> Whatever the end result of this debate, both BPI and BPLI coincide with Israel’s preference to fight wars on its enemies’ territories since it has very little room to maneuver on its own.

Why should any country develop a defense system against missiles? Isn't a counter-force option enough to deter a potential enemy? After all, this worked for the US and the USSR during the Cold War. First, Israel and its enemies are not super-powers. Second, the consequences of a worst case scenario exchange of weapons in the Middle East will not destroy the entire world. Third, Israel and its enemies have fought many wars in the last several decades; the US and USSR/Russia have never fought directly except for a few skirmishes. Fourth, the US and the USSR/Russia have a sense of being world hegemonies; the Muslim countries facing Israel do not like to see Israel as a regional hegemon because of Israel's size (similar in area as New Jersey or 1/6 the size of Alabama) and population (approximately 5.5 million). Finally, Israel's Principal Assistant for Strategic Affairs to the Minister of Defense, Major General (reserve) David Ivri sees Israel's counter-force capability ineffective against the threat of ballistic missiles--this fact was proven during the Gulf War.

The looming threat from proliferating ballistic missiles requires us to look at Israel's defense doctrine. Deterrence is no longer a sufficient policy, not when Israel's civilian population becomes exposed to long-range missile attacks.<sup>20</sup>

How does Israel intend to solve the problem of the ballistic missile threat? Again, Major General Ivri states his vision of Israel's missile defense system:

I want our enemies to be concerned that any missile launched against us will explode in low orbit, over their own territory and their own civilian population," Ivri said. To accomplish this, Israel must develop a multi-layered response to the missile threat, he explained. The defense package would include the Arrow anti-missile system that Israel is now deploying for point defense, as well as a system yet-to-be fully developed that would identify and destroy enemy missiles in their boost phase, shortly after being fired.<sup>21</sup>

The next chapter will describe Israel's concept of national missile defense; it is called *Homa* or Fortress Wall.

## Notes

<sup>1</sup> *Doctrine for Joint Theater Missile Defense*, Joint Pub 3-01.5, 22 February 1996: I-1.

<sup>2</sup> Arie Egozi, "Israel Arrow in on Defence," *Flight International* Reed Business Publishing, 15 February 1995. Available from Lexus-Nexis. Various translations are found throughout the literature. I have consolidated all the different references into the list provided.

<sup>3</sup> Amnon Barzilai, "Israel's response to the Ballistic Missile Threat," *Military Technology* Bonn, Germany, March 2000, Vol 24:3, p. 30 and "Arrow 2 to be Linked to US Radar Detection," *Israel Line*, 12 February 1999, Available from <http://sun00781.dn.net/news/israel/990212-il.htm>. Accessed 4 November 2000.

<sup>4</sup> Mark E. Kipphut, Lt Col, USAF, *Crossbow And Gulf War Counter-Scud Efforts Lessons From History*, Air War College, Maxwell Air Force Base, Alabama, April 1996. Data referenced came from the *Gulf War Air Power Survey, Volume. I, Part II, Command and Control*, p. 247.

<sup>5</sup> Tom Doggett, "Senate bill aims to cut US oil imports to 50 pct." *Reuters*, 31 January 2001. Available from <http://www.climateark.org/articles/2001/1st/senbilla.htm>. Accessed 11 March 2001.

<sup>6</sup> Sheldon L. Richman (senior editor at the Cato Institute), "'Ancient History': U.S. Conduct In The Middle East Since World War II And The Folly of Intervention." Policy Analysis No. 159 August 16, 1991. Available from <http://www.cato.org/pubs/pas/pa-159.html>. Accessed 12 February 2001.

<sup>7</sup> *Strategic Assessment 1999: Priorities for a Turbulent World*. Institute for National Strategic Studies, National Defense University, June 1999: 220. On 19 June 2000, the Department of State re-designated rogue states as "states of concern" to help warm relations with North Korea and make broader changes to how the U.S. views all countries through the glasses of democratization (see Nicholas Berry, *State Department Classifies Foreign States: "States of Concern" Only One of the Categories*, Available from <http://www.gn.apc.org/cndyorks/caab/articles/concern.htm>, 6 July 2000, accessed 13 February 2001). However, I use this term because it best describes our attempt to isolate and apply various forms of pressure for these countries to change their policies.

<sup>8</sup> *Patterns of Global Terrorism: 1999*. May 2000. Available from [http://www.fas.org/irp/threat/terror\\_99/sponsor.html](http://www.fas.org/irp/threat/terror_99/sponsor.html). Accessed 13 February 2001.

<sup>9</sup> This information is culled from a variety of sources:

- Bates Gill, "Chinese Arms Exports to Iran," *Middle East Review of International Affairs* (MERIA) Volume 2, No. 2 - May 1998, Available from <http://www.biu.ac.il/Besa/meria/journal/1998/issue2/jv2n2a7.html>. (China related)

- George Tenet, "Weapons of Mass Destruction: A New Dimension in U.S. Middle East Policy," *Middle East Review of International Affairs* (MERIA) Volume 4, No. 2- June 2000, Available from <http://www.biu.ac.il/Besa/meria/journal/2000/issue2/jv4n2a4.html>. (Russia, China, and North Korea)

- W. Seth Carus, "Iran and Weapons of Mass Destruction," *Middle East Review of International Affairs* (MERIA) Volume 4, No. 3 - September 2000, Available from

## Notes

<http://www.biu.ac.il/Besa/meria/journal/2000/issue3/jv4n3a5.html>: “Iran has acquired additional missiles from North Korea and China, and has received assistance for indigenous development from China, North Korea, and Russia.”

- Jasjit Singh (Director, IDSA), “India, Europe and Non-Proliferation: Pokhran II and After,” *Institute for Defence Studies and Analyses* (India), November 1998 Vol XXII NO.8, Available from <http://www.idsa-india.org/an-content.htm>: “Nuclear delivery systems, especially ballistic missiles, have been transferred by China and North Korea to Pakistan, Saudi Arabia and Iran.” Footnoted from General K.M. Arif, *Working with Zia: Pakistan's Power Politics 1977-1988*, (Karachi: Oxford University Press, 1995), p. 341.

- Anthony H. Cordesman, “Weapons of Mass Destruction in Iran: Delivery Systems, and Chemical, Biological, and Nuclear Programs,” *Center for Strategic and International Studies* 28 April 1998, Available from <http://www.csis.org/mideast/reports/WMDinIran4-28-98.html>. Mentions numerous countries and companies including those from South America, Europe, and others that assisted Iran in its pursuit of a WMD capability.

- Anthony H. Cordesman, “Weapons of Mass Destruction in the Middle East,” *Center for Strategic and International Studies* 4 October 1999, Available from <http://www.csis.org/mideast/reports/WMDinMETrends.pdf>. Also refers to several countries assisting Iran, Iraq, Egypt and others with their WMD and delivery programs.

<sup>10</sup> Robert L. Pfaltzgraff, Jr., “Exploring U.S. Missile Defense Requirements in 2010: What Are the Policy and Technology Challenges?” *Institute for Foreign Policy Analysis* April 1997. Available from [http://www.fas.org/spp/starwars/advocate/ifpa/report696\\_ch5.htm](http://www.fas.org/spp/starwars/advocate/ifpa/report696_ch5.htm). Accessed 16 March 2001.

<sup>11</sup> Robert L. Pfaltzgraff, Jr., “Exploring U.S. Missile Defense Requirements in 2010: What Are the Policy and Technology Challenges?” *Institute for Foreign Policy Analysis* April 1997. Available from [http://www.fas.org/spp/starwars/advocate/ifpa/report696\\_ch5.htm](http://www.fas.org/spp/starwars/advocate/ifpa/report696_ch5.htm). Accessed 16 March 2001.

<sup>12</sup> *Doctrine for Joint Theater Missile Defense*, Joint Pub 3-01.5, 22 February 1996: III-4.

<sup>13</sup> Bob Dietz, Steve Fetter, Richard L. Garwin, Kurt Gottfried, Lisbeth Gronlund, George N. Lewis, Theodore A. Postol, Andrew M. Sessler, and David C. Wright UCS/MIT report "Countermeasures: A Technical Evaluation of the Operational Effectiveness of the Planned US National Missile Defense System" Available from [http://www.ucsusa.org/security/CM\\_ch4-5.pdf](http://www.ucsusa.org/security/CM_ch4-5.pdf). April 2000. Accessed 15 December 2000. According to Scott Peterson in “High Hopes for Foolproof Missile Defenses Fizzle,” *Christian Science Monitor*, 30 July 1997, Available from <http://video.csmonitor.com/durable/1997/07/03/intl/intl6.html>. Accessed 6 January 2001. Dwight D. Eisenhower used the same metaphor: “hitting a bullet with another bullet.”

<sup>14</sup> “A New Threat to the Arrow,” *Ha’Aretz* 15 October 1995, p. B1. Available from <http://www.fas.org/news/israel/nes95199.htm>. Accessed 1 November 2000.

<sup>15</sup> Robert L. Pfaltzgraff, Jr., “Exploring U.S. Missile Defense Requirements in 2010: What Are the Policy and Technology Challenges?” *Institute for Foreign Policy Analysis* April 1997. Available from [http://www.fas.org/spp/starwars/advocate/ifpa/report696\\_ch1.htm](http://www.fas.org/spp/starwars/advocate/ifpa/report696_ch1.htm). Accessed 16 March 2001:

“**Stealth.** All countries are working on reducing the radar cross section of their missiles and warheads. This is being done by use of radar absorbing paints/materials and use of radar non-

## Notes

reflecting designs. In addition, there is some possibility that future efforts could include such actions as putting re-entry vehicles (RVs) inside of plastic balloons filled with radar absorbing foam (available on the commercial market) to camouflage the RVs from the ground-based radar systems.

**Decoys.** Decoys are already deployed by some other countries, such as Russia and the U.K. These are designed to look like RVs and provide defenses with a higher number of targets to interdict. Decoys also provide potential platforms for radar jammers.

**Maneuver.** Almost all countries are working on maneuvering their missiles and warheads to make them more difficult to intercept. At this time, only Russia is believed to be working on an exoatmospheric maneuvering missile system (maneuvering outside the atmosphere consumes large quantities of fuel and is limited to gentle turns measuring 2-3 Gs). Most other countries with ballistic missile capabilities are currently limiting their efforts to maneuver their missiles to the endoatmospheric segment of the trajectory (once the missile leaves the vacuum of space and regains aerodynamic maneuverability from the earth's atmosphere). Maneuvering can cause the intercepting missile to deplete its fuel as it constantly readjusts its intercept vector (burning fuel) or to be unable to make the vector correction fast enough to make a successful intercept.

**Coning** (also called corkscrewing). Coning is an example of a maneuvering warhead. If a RV or warhead wobbles as it reenters the atmosphere (accidentally or deliberately caused) a spiraling maneuver can be introduced consisting of 10-15 G turns which corkscrews the RV in a 30-40 meter diameter circuit. An interceptor would need a vector and range to target (and on-board computational capability) to plot a successful intercept against a warhead engaged in this type of maneuver.

**MIRVs and Submunitions.** By placing multiple warheads or submunitions on each offensive missile, the offense can overwhelm the defense unless the defense develops a cost-effective way of dealing with multiple munitions from a single missile. Complicating the problem for national missile defense is the limitation in the ABM Treaty against putting multiple intercept capabilities on defensive missiles. (That limitation would not apply to theater missile defenses.) It should also be noted that the Chinese, for example, reportedly plan to salvo fire their offensive missile attacks in order to saturate missile defenses.

**Reducing Infrared Signature.** Infrared warhead signatures might be nearly eliminated by the addition of a double shroud (inter-shroud insulated), since much of the heat signature will be eliminated by simply jettisoning the hot shroud(s) since the frigid temperature of space would soon cool the outer skin of the warhead or RVs to near ambient temperature. (The discarded shroud would also act as a decoy.) In addition, IR altering paints can be applied to the exterior of the warhead to change the nature of the IR signature. These counter measures could make it very difficult for the IR seeker on the intercepting missile to find the target against the background coldness of space.

**Radar Jammers.** Small microwave antennas can be mounted on the RVs and decoys and equipped to receive frequency-hopping radar signals, amplify them, and rebroadcast them, and, in the process, elongate the radar signal in a way that creates a dead space in the coverage (i.e., a volume masker). In addition, simple chaff clouds and metallic balloons can also be released with the RVs and used to scatter the radar signal or to hide the RVs. In the vacuum of space, these simple devices would continue to travel with the warheads until stripped off by the atmosphere during re-entry.

## Notes

**Simple Masking.** Warheads can be difficult for an infrared seeker to identify due to simple masking. For example, when China's *Dong Feng* 15 is launched (the type fired near Taiwan in March 1996), the warhead trajectory is trailed by the missile body. The missile body is a hot object and creates a large infrared signature that helps mask the signature of the much smaller warhead. In addition, in the case where a missile breaks up as Iraq's Scuds were prone to do, the resulting hot metal may give off an IR signal larger than that of the warhead, making it difficult to pick out the target. Similarly, in the case where a missile tumbles (easily triggered when staging occurs exoatmospheric where there are no aerodynamic forces to help stabilize the missile's flight), there is no way that the current sensor technology can determine which end of the missile should be targeted to hit the warhead."

<sup>16</sup> "Boost-Phase Intercept," *Federation of American Scientists Space Policy Project Special Weapons Monitor*, Available from <http://www.fas.org/spp/starwars/program/bpi.htm>. Accessed 21 November 2000.

<sup>17</sup> David Eshel, "Examining Israel's BMD Options," *Jane's Intelligence Review* 1 September 2000. *Jane's Online*.

<sup>18</sup> Amnon Barzilai, "Israel's response to the Ballistic Missile Threat," *Military Technology* Bonn, Germany, March 2000, Vol 24:3.

<sup>19</sup> Amnon Barzilai, "Israel's response to the Ballistic Missile Threat," *Military Technology* Bonn, Germany, March 2000, Vol 24:3.

<sup>20</sup> David Ivri, "Deterrence is not enough. Israel needs a multi-layered response to the ballistic missile threat." *Begin-Sadat (BESA) Center for Peace Studies*, Available from <http://www.biu.ac.il/SOC/besa/bulletin/no8art1.htm>, 28 December 1998. Accessed 13 November 2000.

<sup>21</sup> David Ivri, "Deterrence is not enough. Israel needs a multi-layered response to the ballistic missile threat."

## Chapter 2

### Chapter 2: Israel's Grand Military Strategy & NMD Plan

*There is another threat in the Middle East, the threat is ballistic missiles. Our strategy, as well as our politics and tactics have to be changed to be adaptive [to these threats]. The number is growing and the ranges of these missiles is getting longer.*

—Major General Eitan Ben-Eliahu  
Press conference at the Asian Aerospace 2000 Trade Show<sup>1</sup>

What are Israel's strategic security concerns, what threatens Israel, and how does the *Homa* plan fit in? A variety of sources point to Israel's strategic threats summarized below:

Israel's security is conditioned by a number of historical and strategic factors which can be summarized as follows: first, Arab hostility to the establishment of the Jewish state; second, the small size of the country, which has no strategic depth protecting it from this hostile environment; third, its dependence on outside sources of energy (whereas Arab states have ample oil reserves to sustain war financing); fourth, a high population density and industrial concentration that makes it vulnerable to attack; fifth, a relatively small pool of manpower compared to its potential and actual enemies; and sixth, a domestic political inability to sustain drawn-out conflicts and take high levels of casualties. As a result, its national security strategy has tried to compensate for these drawbacks by developing a qualitative edge over regional powers; deterring attack with conventional and unconventional threats (including the presumed possession of nuclear weapons); adopting an offensive military doctrine and force structure; and relying on universal conscription (including women).<sup>2</sup>

According to Uzi Rubin, the former head of *Homa* and now a key member of the Israeli National Security Council (INSC), stated that Israel faces three strategic threats: terrorism, long-range missiles, and unconventional weapons.<sup>3</sup> In addition to the three strategic threats described by Mr. Rubin, two more should be added: Islamic radicalism and internal instability. Israel faces the long-term strategic threat of Islamic radicalism which is both an internal ( Hamas, Islamic Jihad,

etc) and external threat (Iran, Hizballah, Sudan, etc). Internal instability refers to the tensions not only between Israeli Muslims, Jews, and Christians, but also other categories within the Israeli population: secular and religious Jews; Russian, North African, European, American, and native Israelis; and between the rich and the poor. However, these other strategic issues do not greatly affect the focus of this paper, which is the missile threat.

David Ivri, former aide to the Defense Minister and now the Israeli Ambassador to the US, stated that missiles were the greatest threat to Israel:

As a result of the loss of our deterrent power in this area [as demonstrated in the Gulf War], surface-to-surface missiles have become the top strategic threat to Israel. Not only Syria, but also by Iran, Egypt and Iraq are either developing or retaining their capabilities.<sup>4</sup>

**Assumptions:** This paper is concerned with the threat to Israel of weapons delivered by missiles. This paper will examine the threat of missiles only with both conventional and non-conventional warheads.<sup>5</sup> This paper does not take into consideration the various treaties<sup>6</sup> that any nation in the Middle East is a party to because this is a *real politick* paper.

**The Threat:** Threat, in military parlance, means having the capability and intent to cause a danger to a particular country. Capability, in this case, means having the technology and demonstrated use of missiles and related warhead technology. Intent is determined by expressing or communicating (overt or covert) a desire to attack or to harm. The following countries in the Middle East have the capability and the intent to use missiles against Israel: Iraq, Iran, Syria, and most recently Libya. The countries that have the capability and the possible intent (countries who have involved themselves in wars against Israel) are Egypt, Saudi Arabia, Pakistan, and possibly the United Arab Emirates. For more details on their capabilities see Chapter 3.

**Israeli Five Tiered System:** How does Israel deal with all of these various threats? Former Israeli Defense Minister Yitzhaq Mordechai, speaking at the Galili Center for Strategy and National Security, describes Israel's five tiered strategic defense system that is set up to deal with the threats:

The first is prevention of war through greater peace efforts. The second is building a reliable deterrent capability. The third component is active defense based on the Arrow missile...[T]he fourth defense component is the need to carry out a preemptive attack on the missiles and the ballistic missile launchers inside their bases...he qualified these remarks by adding that this component is limited by political considerations. The fifth tier, the Defense Minister said, is passive defense, which consists of the procurement of protective kits and the construction of bomb shelters.<sup>7</sup>

A few comments on the above five tiers is required before delving into the missile threat and Israel's missile defense system. This paper will explore the last three tiers, since they are all related to the missile threat. The author assumes these tiers are how Israel's defense and political establishments view the threats and the tools they have to deal with them. It is important to note that the tiers reflect a world-view of political realism—the tiered system works well in the context of nation states.<sup>8</sup> However, these tools fall short when viewed through political liberalism which “portrays the world in terms of individuals seeking more freedom and better living conditions, as well as physical security and other values” or communitarianism

portrays the world in terms of communities rather than states or individuals. Ethnic or national groups define identity for and attract the intense loyalty of many people. Religious groupings command similar devotion from many others. Some community members believe states that either arbitrarily divide their identity group or that combine it with others to be the enemy.<sup>9</sup>

It is only noted here that Israel's tiered system does not address other sets of worldviews, which arguably are more prevalent in the Middle East which is mainly a Muslim dominated region and tends to be anti-Western.



**Figure 3 Israeli with a gas mask in anticipation of Iraq attack (December 1998)<sup>10</sup>**

Israel views the last three tiers by defining defense into three categories: passive, active, and responsive. Passive defense occurs where the population uses shelters, gas masks, etc to protect themselves from an attack—nothing is done to stop the actual attack. active defense is the measures taken to prevent a missile from landing on friendly territory such as using the Israeli Arrow and/or Patriot missiles to shoot down the incoming missile. The proposed THAAD or AEGIS missile defense systems would be US versions of Active defense. Responsive defense is attacking the enemy missile system while it is still over enemy territory. The systems that would conduct this kind of action would be Boost Phase Intercept, Boost Phase Launcher Intercept, and attack operations like preemptive air strikes.<sup>11</sup>

**What is the Missile Threat?** According to the former head of *Homa* (Israel's NMD project) and now a key member of the Israeli National Security Council (INSC), Uzi Rubin stated that within the context of the missile threat, Israel faces approximately 2,000 ballistic missiles from eight Middle Eastern countries.<sup>12</sup> Countries in the ME with a missile capability

include Iraq, Iran, Syria, Pakistan, Egypt, Libya, and possibly Saudi Arabia and the Sudan. These threats will be discussed in greater detail in chapter 3, but one example of the threat will help explain the need for a missile defense.

Rick Francona, a former USAF military attaché to Baghdad (prior to the Gulf War) and General Schwarzkopf's Arabic interpreter during the Gulf War, stated in his book *Ally to Adversary*, that

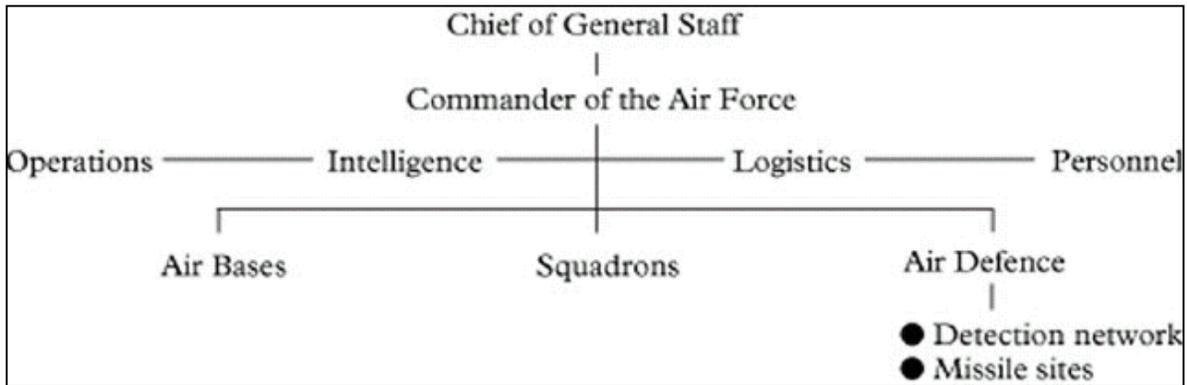
computer models of the detonation of just one Al-Husayn chemical warhead over Tel Aviv postulated as many as eight thousand deaths. Use of biological warheads would be even more lethal. Israeli planners now had to face the reality that attacks on Iraq could result in a chemical or perhaps a biological warfare response.<sup>13</sup>

What is the significance of this fact? Just one Al-Husayn missile would have killed more Israelis than any single war that Israel fought since its establishment in 1948 or the warhead could kill more people than all acts of terrorism since the establishment of the state of Israel.<sup>14</sup> The *Homa* Project is designed to meet this threat head on.

### **THE *HOMA* PROJECT**

*Homa* is a “layered, active defense based on three elements: endo-atmospheric interception – or close to the target defense; exo-atmospheric interception – or mid-trajectory attack; and interception at the launch phase – boost or ascent phase intercept.”<sup>15</sup> Israel's *Homa* Project is part of longer term plan to expand its capabilities. Its current capabilities focus on endo-atmospheric interception or point defense. Future systems are looking at boost phase interception.

The three parts of the *Homa* Plan could be described as the current systems deployed in Israel against ballistic missiles, planned systems, and desired systems. As was mentioned at the end of Chapter One by Major General (res.) David Ivri, Israel is developing a multi-layered response to the missile threat.<sup>16</sup> It is important to note that the *Homa* Plan is considered to be part of the Israeli Air Force, under Air Defense. Unlike the US, Israel placed its Air Defense under the Israeli Air Force (IAF). Furthermore, the IAF also controls all rotary-winged aircraft such as the AH-64A, Bell AH-1F/S, Bell AH-1, CH-53, etc. A basic chart of the IAF is pictured below:<sup>17</sup>



**Figure 4 Israeli Air Force and Air Defense**

Next, a description of the current, planned and desired missile defense systems in Israel is briefly discussed.

### **CURRENT SYSTEMS DEPLOYED IN ISRAEL**

Israel has three current systems deployed to destroy ballistic missiles: Hawk, Patriot Advanced Capability Level 3 (Patriot PAC-3), and the Arrow Weapon System (AWS). These systems can also be used against other air targets such as aircraft or cruise missiles. All of these Air Defense systems are briefly described below. A more detailed description can be found in Appendix A. A table of the current Air Defense surface to air systems is provided:<sup>18</sup>

<i>Type</i>	<i>Role</i>	<i>Quantity</i>	<i>In Service</i>
Arrow 2	Anti-Missile Defense System	3 batteries ordered	1
HAWK	Low-to-Medium Altitude SAM	n/a	n/a
MIM-23B Improved HAWK	Low-to-Medium Altitude SAM	17 bty	17 bty
MIM-104 Patriot	Medium-to-High Altitude SAM	4 bty	4 bty
MIM-72A Chaparral	Low-Altitude SAM	50 <sup>(1)</sup>	50 <sup>(1)</sup>
<b>Note:</b> 1. Estimated. The weapons, outlined in the above table, are deployed by the two active air defense brigades of the IAF.			

**Table 1 Israeli Air Defense Assets**

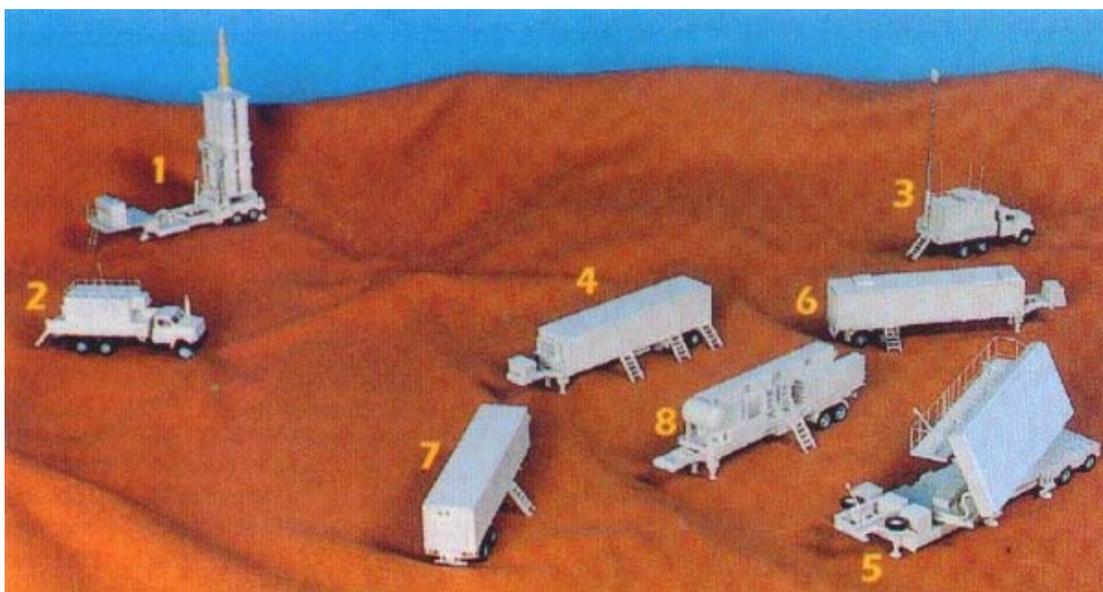
**Improved HAWK (I-HAWK):** According to *Jane's*, Israel deploys I-Hawks along with its three Patriot batteries—one Patriot battery for every three I-Hawk batteries.<sup>19</sup> There are 17 batteries of the Raytheon I-HAWK in the two active Air Defense brigades.<sup>20</sup>

**Patriot (Phased Array Tracking Radar Intercept On Target) Advanced Capability Level 3 (Patriot PAC-3):** Raytheon's Patriot is a point defense missile system, originally designed to shoot down aircraft.<sup>21</sup> Initially, US forces used the original Patriot system during Desert Storm in a variety of locations including Israel. PAC-3 is now deployed in Israel and other high threat areas of the world including South Korea, Taiwan, and Saudi Arabia. Other countries are interested in the Patriot including Greece and the Netherlands.<sup>22</sup>

**Arrow Weapon System (AWS):** In Israel, the Arrow missile is called "Hetz" (Hebrew for Arrow). The AWS was designed to intercept SS-1 SCUD and SS-21 SCARAB Short-Range Ballistic Missiles (SRBMs) as well as Iraqi Al Hussein and Saudi Arabian Chinese CSS-2.<sup>23</sup> Israel declared on 12 March 2000, that the Arrow 2 system was fully operational.<sup>24</sup> After eight tests (seven successful),<sup>25</sup> Israel plans to stand up three batteries throughout Israel. The first two are to defend Tel Aviv and Haifa regions.<sup>26</sup> Each system will have the following equipment associated with each battery: approximately 50 Arrow missiles, an "undisclosed number of six-round" launchers,<sup>27</sup> Green Pine early warning and tracking radar (manufactured by Israel

Aircraft Industries' Elta Electronic Industries), Citron battle management system responsible for launching the Arrow (developed by Tadiran Electronics Systems), and the Hazelnut Tree launcher control center.<sup>28</sup> Each battery is designed to track and counter "14 enemy missiles simultaneously."<sup>29</sup> The range is the Arrow 2 is as follows: maximum intercept altitude ~50 km, with a maximum range of 90 km.<sup>30</sup> According to *Jane's*, unconfirmed reports state that 350 missiles are planned for completion by 2010.<sup>31</sup>

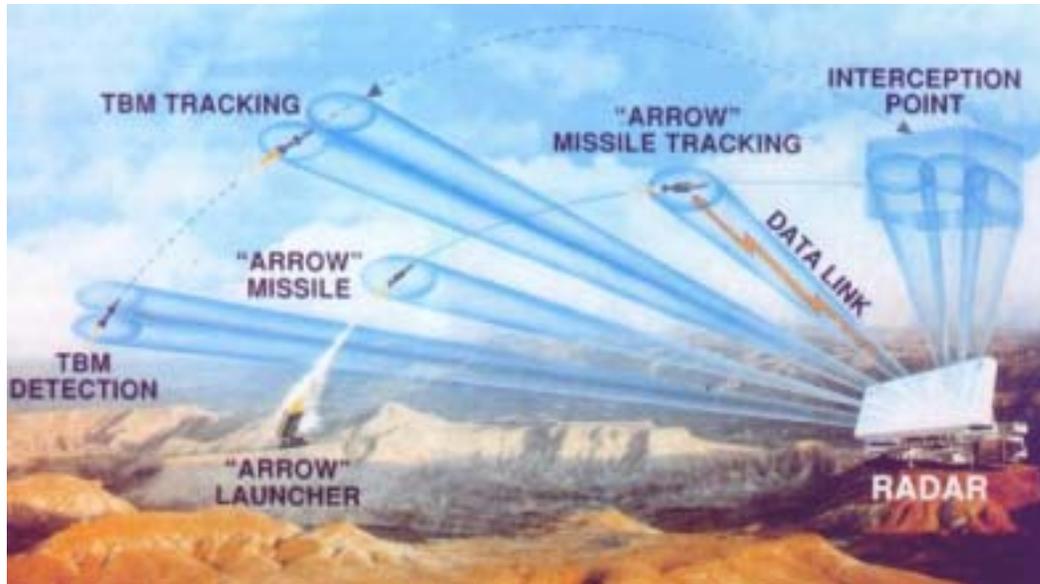
The following countries have shown an interest in purchasing the AWS: Turkey (*Jane's Procurement* Turkey 5 February 2001), Singapore (*Jane's Procurement* Singapore 5 February 2001), United Kingdom, South Korea, India and Japan.<sup>32</sup>



**Figure 5 Arrow missile battery notional deployment**

(1) Launcher (six canisters), (2) CITRON TREE launch control center, (3) Communications center, (4) HAZELNUT TREE fire control center, (5) GREEN PINE radar antenna, (6) Radar control center, (7) Radar power unit, (8) Radar cooling unit.

A battery has four launch vehicles with six ready missiles each, a Tadiran Citron Tree launch control centre, a Hazelnut Tree fire control centre which can handle 14 simultaneous intercepts, one Elta Green Pine radar which tracks targets up to 500 km away with one trailer with a radar control centre, one with its power unit and one with its cooling unit.<sup>33</sup>



**Figure 6: Key components of the Arrow Weapon System (AWS) Concept<sup>34</sup>**



**Figure 7 Elta L-Band EL/M-2080 Green Pine radar system: heart of the Arrow Weapon System (AWS)<sup>35</sup>**



**Figure 8 Inside view of the Citron Tree fire Control system (Tadiran 2000)<sup>36</sup>**

## **PLANNED SYSTEMS**

**Missiles:** ADAMS (Israeli modified SAM) also called “Relampago” is a vertically launched Barak Surface to Air Missile (SAM) that has the following characteristics: 2.17m length, 0.17 diameter, 98 kg launch weight, high explosive (HE) fragmentation warhead, solid propulsion, 10 km range, development status, and in-service 1996.<sup>37</sup> It is unknown if this system is deployed in Israel since it is produced for the export market. According to *Jane’s*, Relampago is an

Israeli self-propelled SAM produced by Rafael for the export market in association with IAI. Based on the naval, vertically launched Barak SAM, the Relampago is mounted on a 6X6 or 8X8 cross country truck that carries 12 missiles (ready to launch) and associated radars.<sup>38</sup>

**Unmanned Aerial Vehicles (UAVs):** Israel has employed UAVs since at least the October 1973 War (Yom Kippur War). Some of the highlights of Israeli innovation in UAVs include:

Israel's earliest reported employment of UAVs was the operation of drones in the 1973 Yom Kippur war on the Syrian and Egyptian fronts as reconnaissance and surveillance platforms. They were also used as decoys to draw the fire of Arab SAMs and thus deplete their missile inventories. In 1982, innovative UAV developments led to the highly successful air operations over the Bekaa Valley in Lebanon. Israeli Scout and Mastiff mini-RPVs conducted reconnaissance and surveillance of Syrian airfields, SAM sites and troop

movements. Reportedly, UAVs simulating the radar returns of Israeli aircraft preceded the main force to draw Syrian SAM fire and to stimulate the Syrian radars for strikes by Israeli anti-radiation missiles; UAVs were also reported to have electronically suppressed Syrian radars. The Israeli success was complete with only one aircraft lost against the Syrian loss of 86 combat aircraft and 18 SAM batteries. The watershed, however, was the provision to commanders, for the first time in war this century, of real-time video imagery of enemy dispositions beyond the line-of-sight.<sup>39</sup>

In the near future, Israel plans to deploy unmanned aerial vehicles that will be used to detect and destroy ballistic missiles during all deployment phases.<sup>40</sup> Several interesting reports indicate that Israel is working on UAVs that can even fly supersonic.<sup>41</sup> Currently, Israel has UAVs that are used as anti-radiation weapon.



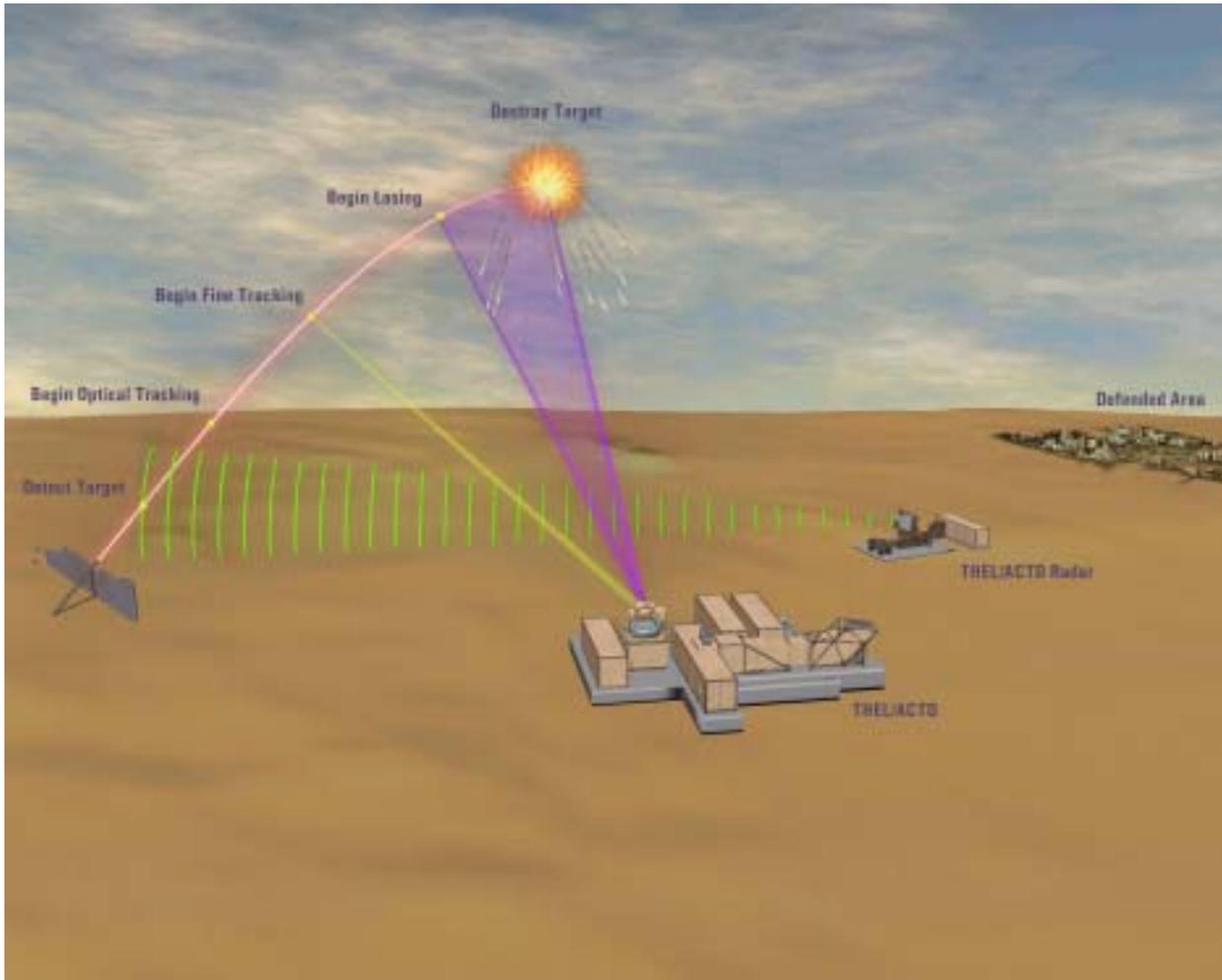
**Figure 9 Picture of a Harpy UAV destroying a radar site<sup>42</sup>**

Other Drones/UAVs include: IAI Samson; IAI Delilah – UAV, Firebee 147 (Shadmeet/Plover), Teledyne 324 (Siksak/Peregrine), Chukar III (Telem/Hillock), IAI Scout (Zahavan/Oriole) – UAV, IAI Searcher (Chugla/Pheasant) – UAV, TRW/IAI Hunter (Cachlileet/Magpie) – UAV, IAI Harpy Silver Arrow (Meyromit/Petrel) – UAV, and Elbit Systems/Silver Arrow Hermes 450S – UAV.<sup>43</sup>

**Figure 10 (below) Hunter - Israeli UAV**

Hunter  
Source: TRW Inc.





**Figure 11 Tactical High Energy Laser (THEL)**

**Tactical High Energy Laser (THEL):** The concept of a ground based laser destroying rockets, missiles (medium range Scuds, Iranian Shihab, and the North Korean Taopo-dong)<sup>44</sup>, and even possibly aircraft and cruise missiles has been proven at least against Russian-made Katyusha rockets.<sup>45</sup> However, due to the fact that the current system is not mobile, the Israeli government has requested the THEL be deployed to Israel once it is mobile, probably in five to seven years (2005-2007). Lt General John Costello, commander the Army’s Space and Missile Defense Command said that the THEL “demonstrator still could go to Israel if that nation wants

it for an emergency” and “Israeli sources also expressed concern that a fixed THEL would become a difficult target to defend from attacks.”<sup>46</sup>

## **DESIRED SYSTEMS**

In the future, Israel would like to have other weapon systems to increase the effectiveness of its layered defense (whether it designs them itself or acquires them from other nations).

**Israeli Boost Intercept System (IBIS):** The focus of IBIS is to attack TBM during their boost phase. The system depends on four elements for mission success: “high-altitude long-endurance (HALE) unmanned aerial vehicles (UAV); small, lightweight agile interceptor missiles (kill vehicles); passive electro-optical sensors; and communications links.”<sup>47</sup> This system proposes using modified air-to-air (AA) missiles such as the Python 3 or 4 against tactical ballistic missiles during boost phase.<sup>48</sup> These missiles would have extended ranges and would be used from aircraft or UAVs. The modified missiles would be called Missile Optimized Anti-Ballistic (MOAB) and will have the following profiles:

**UAV:** Will cruise at an altitude of 7-10 km., carry IRST, laser range-finder, datalinks, and 2-4 MOAB missiles, and will loiter up to 24 hours on station.

**MOAB:** Adds a boost motor assembly to the Python 4 missile giving it a velocity of 1.5-2.0 km/s and a range of 80-100 km, use a modified IR seeker, with a laser range-finder sharing the optical path for fuze initiation. MOAB would be 4.0 m, a body of 0.16 m and a launch weight of 150 kg. It has a projected in service date of 2002-2005.<sup>49</sup>

**Micro Unmanned Aerial vehicles (MUAVs):** MUAVs is a system designed “to destroy a missile immediately after it is launched” which was conceived at RAFAEL, the Israel Armament Development Authority.<sup>50</sup>

**Tomahawk Cruise Missile:** One of Israel's desires is to acquire cruise missiles, specifically Tomahawk cruise missiles with a 2,000 km range (this reportedly was brought up as part of the peace package discussed between President Clinton and Prime Minister Barak during negotiations at Shepardstown, West Virginia in early 2000).<sup>51</sup>

**Airborne Laser:** Another system that Israel would like is the Airborne Laser (ABL)



**Figure 12 Airborne Laser and Program Patch (right)**

or something like it. For example, they would like to place an airborne laser on a UAV. This would add another layer of defense to the *Homa* system. See Appendix A for further information on the ABL from the Federation of American Scientists web site.

### **Chapter Discussion and Conclusions**

As in any open democracy there are many critics of any given system or plan. One of the AWS detractors, Dr. Re'uven Pedatzur, Director of the Galili Center for Strategy and National Security and a fighter pilot in the Israeli Air Force, takes a dim view of the capabilities of the Arrow system:

According to Israeli military intelligence estimates, by mid-decade [2005], the Iranians, and perhaps the Iraqis as well, will have nuclear-tipped ballistic missiles in their arsenal. And

when that happens, the Arrow defense system will be totally useless, because its developers are not prepared to guarantee that the Arrow can intercept every missile fired at us. Which is very bad news, indeed, because it is obvious to everyone that Israel cannot afford to pay the price of even one nuclear missile hitting a target anywhere in this country

...

[T]his defense system [Arrow] will be incapable of effectively dealing with anticipated threats, such as self-maneuvering missiles, decoys, radar-jamming devices and submunitions. Thus, in any confrontation between attacker and defender, the attacker will always have the edge. With a relatively small investment of funds, the attacking country can develop means that will give its missiles the capability of defeating an entire defense system. In order to deal with such threats, the defender must invest huge sums of money. Even then, it is doubtful whether the defending country would be able to come up with effective solutions.<sup>52</sup>

Although many of his points are accurate, I would argue that the Arrow is only part of the missile defense system for the Israelis. Second, it is part of a layered system of missile defense. Third, no one can build a system that can do everything at first. The expression, one must learn to crawl, then to walk, before one can contemplate running is appropriate in this example. The fact that Israel has the beginnings of the first NMD also has an impact even if it has flaws. It does have a psychological impact on her enemies and potential foes. However, Dr. Pedatzur is correct relates in describing the cost-benefit ratios between the attacker and the attacked. For example, an Iraqi modified Scud-B (Al Hussein missile) costs about \$250,000.<sup>53</sup> Every Arrow missile costs approximately \$1.5 - \$2 million (a PAC-2 missile costs 1.1 million at 1991 prices)<sup>54</sup> or an 8 to 1 defender versus attacker ratio. Furthermore, many experts believe that the kill ratio will not be one-to-one, some speculate between one and two missiles for each missile attack—experts believe that 1.2 PAC-2 missiles will “be needed to destroy a single Scud.”<sup>55</sup> Even though the cost factor is huge (as high as 10 times the cost of the enemy’s missile), it has limited relevance when considering Israel’s ability to respond in kind. As long as Israel can minimize the effect of the first volley and counter-attack the launch sites as well as other strategic targets, Pedatzur’s cost argument becomes lessened. The attacker has to make sure that it not only

succeeds in getting some of its missiles through Israel's *Homa*, but that it also must destroy Israel's ability to counter-attack. In this manner, Israel increases its ability to counter-strike with the *Homa* missile defense system. Without the *Homa* system, Israel is much more vulnerable; its enemies only have to make sure that all targets include Israel's counter-strike capabilities. With the *Homa* system, now there is doubt. In this regard, Israel has re-assured its ability to increase deterrence while keeping its options open as to how it would respond, especially since the initial attack might or might not include WMD warheads. This logic works as long as the number of attacking missiles is a small small.<sup>56</sup> However, once Israel's enemies go all out for an arms race with large numbers of launchers and missiles, then Israel would eventually lose the race because it could not keep up with its richer neighbors. This fear is best described by 'Ofer Shelah quoting Professor Dror Sade, the former head of the Israel Space Agency: "How many Arrow missiles are needed to use up the defense budget?"<sup>57</sup>

If other countries purchase the AWS, then the long-term costs to Israel might decrease. For example, several countries have expressed an interest in the system to include Britain, Turkey, Japan, and India.<sup>58</sup> However, since it is a joint project with the US, Israel will not have a free hand to sell it to anyone. For example, the US has told Israel that it does not want India to purchase the Arrow. In fact, the US wants Israel to "consult with the US before concluding any defense deals with either China, India, Russia, or Pakistan."<sup>59</sup>

Dr. Pedatzur brings up another strategic argument in several of his articles.<sup>60</sup> He claims by having an Arrow system, this invites Israel's enemies to attack because Israel has the ability to defend itself. In other words, why would Israel counter-attack when it can defend itself? Even though his argument is logical, there are some other aspects that seem to be apparently lacking. For example, suppose a scenario where another Gulf War erupts and Israel was denied

involvement. This time, Israel would have the ability to defend itself from missiles beyond the point defense capability of PAC-2. It appears that Dr. Pedatzur is correct in saying that the Arrow might convey “a message that gives them [Israel’s enemies] the legitimization to attempt a missile attack against us, because, after all, we would have the defense system in place to counter the attack, would we not?” This statement makes two assumptions: (1) Arabs think that their missiles would not get through, begging the question, why would the Arabs attack in the first place? and (2) Israel would not counterstrike. Both issues seem to question Dr. Pedatzur’s essential argument, nevertheless he does bring out an intellectual debate that must be analyzed since it relates to one of the strategic threats to Israel, an extremely important issue to a small nation with limited assets.

## Notes

<sup>1</sup> “Iraq’s 50 Al Husseins,” *CDISS*, 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>2</sup> Pedro Moya (reporter), “Security in the Greater Middle East,” *NATO Parliamentary Assembly—Mediterranean Special Group*, November 1998. Available from <http://www.naa.be/publications/comrep/1998/ar309gsm-e.html#42>. Mr. Moya is referring to details from For details, see Shmuel Limone, “The Arab Threat: The Israeli Perspective”, National Threat Perceptions in the Middle East, United Nations Institute for Disarmament Research, Research Paper No. 37, 1995, pp. 9-15; Shai Feldman “Israel's National Security: Perceptions and Policy” in Shai Feldman & Abdullah Toukan, Bridging the Gap, A Future Security Architecture for the Middle East, Carnegie Commission on Preventing Deadly Conflict, 1997, pp. 7-31.

<sup>3</sup> Arie O’Sullivan. “Mordekhay Favors ‘Preemptive Strike’ in Certain Situations.” *The Jerusalem Post*, 28 Oct 97: 2. FBIS TA2810132197.

<sup>4</sup> “Israel: Syria Prepares Missiles,” *Associated Press* (Jerusalem), 24 June 1997, Available from [http://freeman.io.com/m\\_online/jul97/ap.htm](http://freeman.io.com/m_online/jul97/ap.htm). Accessed 4 November 2000

<sup>5</sup> An analysis of Israel’s counter-terrorism policy and practice is presented in an unpublished thesis by Guermantes E. Lailari, “On the Razor’s Edge: Israeli Domestic Counter-terrorism Policy Against Islamic Extremists,” Joint Military Intelligence College, September 1999. An example of unconventional method of delivering WMD is via a terrorist group. However, this paper will not discuss terrorism and unconventionally delivered non-conventional weapons such as a suit-case filled with anthrax smuggled into Israel and opened in a high rise building. More examples of various terrorism and unconventional delivery attack scenarios is discussed in Anthony H. Cordesman’s “Weapons of Mass Destruction in Iraq,” *Center for Strategic and International Studies* 20 September 1999, Available from <http://www.csis.org/mideast/reports/>.

<sup>6</sup> These include unilateral, bilateral, or multi-lateral such as peace treaties, 1970 Nonproliferation Treaty of Nuclear Weapons (NPT), 1975 Biological and Toxin Weapon Convention (BTWC), 1987 Missile Technology and Control Regime, or the 1997 Chemical Weapons Convention (CWC).

<sup>7</sup> Arie O’Sullivan.

<sup>8</sup> Barry B. Hughes, *Continuity and Change in World Politics*, Third Edition. Upper Saddle River, New Jersey: Prentice Hall, 1997, p. 41: “Realism portrays the world political system as an anarchic struggle for power and security among competing states.”

<sup>9</sup> Hughes, 41-42.

<sup>10</sup> *Strategic Assessment 1999: Priorities for a Turbulent World*. Institute for National Strategic Studies, National Defense University, June 1999: 298.

<sup>11</sup> Interviews with Israelis who wish to remain anonymous.

<sup>12</sup> Arie O’Sullivan.

<sup>13</sup> Rick Francona. *Ally to Adversary: An Eyewitness Account of Iraq’s Fall From Grace*. Annapolis, Maryland: Naval Institute Press, 1999: 37.

<sup>14</sup> “Israeli Casualties in Battle,” Available from [http://www.us-israel.org/jsource/History/casualty\\_table.html](http://www.us-israel.org/jsource/History/casualty_table.html). Casualties figures for Israel’s wars:

War Of Independence (1947-49):	6,373
1956 War:	231

## Notes

1967 War:	776
War of Attrition (1968-70):	1,424
1973 War:	2,688
Lebanon War (1982-85):	1,216
Miscellaneous engagements (through March 1999):	7,824
Total	20,532*

\*This number includes disabled IDF veterans who later died from their wounds and non- IDF personnel who fell in the line of duty.

Total number of Israelis killed in terrorist attacks (1967-1997) is 744.

The 1994 World Almanac's table for casualties in "principle wars" of the U.S. The source is the Department of Defense and the United States Statistical Abstract. Revolutionary War 1775-1783 4,435 War of 1812 1812-1915 2,260 Mexican War 1846-1848 1,733 Civil War 1861-1865 140,414 (Union Forces) 74,524 (Confederate Forces)<sup>iv</sup> Spanish-American War 1898 385 World War I 1917-1918 53,513 World War II 1941-1946 292,131 Korean War 1950-1953 33,651 Vietnam War 1961-1977 47,369 Lebanon 1982-1984 264 Grenada 1983 18 Panama 1989-1990 23 Persian Gulf War 1991 148, Total 650,858. Found at Available from <http://www.handguncontrol.com/press/1999/hci/123099.html>. Accessed 13 February 2001. As a percentage of Israel's population compared to the US population, the effect of one Al-Husayn missile would have the same impact, proportionally, as the US losing over 372,000 civilians—more deaths than any one of our wars (half of the total number of casualties since 1778).

<sup>15</sup> David Eshel, "Examining Israel's BMD Options," *Jane's Intelligence Review* 1 September 2000. *Jane's Online*.

<sup>16</sup> David Ivri, "Deterrence is not enough. Israel needs a multi-layered response to the ballistic missile threat." *Begin-Sadat (BESA) Center for Peace Studies*, Available from <http://www.biu.ac.il/SOC/besa/bulletin/no8art1.htm>, 28 December 1998. Accessed 13 November 2000.

<sup>17</sup> "Air Force, Israel," *Jane's Sentinel Security Assessment - Eastern Mediterranean* – 15 February 2001.

<sup>18</sup> "Air Force, Israel," *Jane's Sentinel Security Assessment - Eastern Mediterranean* – 15 February 2001.

<sup>19</sup> "Air Defense Corps – Israel," *Jane's World Air Forces* 23 November 1999, *Jane's Online*.

<sup>20</sup> "Air Force, Israel," *Jane's Sentinel Security Assessment - Eastern Mediterranean* – 15 February 2001.

<sup>21</sup> Arieh Stav. *Ballistic Missiles – The Threat and the Response*, Brassey's: London, England, 1999: 350 (glossary).

<sup>22</sup> Mark Hewish, "Raising the Ballistic Shield," *International Defense Review* 1 September 2000.

<sup>23</sup> "Arrow," *Jane's Strategic Weapons Systems* Issue 30 May 1999, p. 258.

<sup>24</sup> "Arrow TMD," *Federation of American Scientists* updated 28 June 2000. Available from <http://www.fas.org/spp/starwars/program/arrow.htm>. Accessed 15 December 2000.

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<sup>25</sup> Jack Katzenell, "Arrow system successfully intercepts missile in test off Israel," *Fox News*, 14 September 2000. Available from [http://www.foxnews.com/world/0914/i\\_ap\\_0914\\_108.sml](http://www.foxnews.com/world/0914/i_ap_0914_108.sml). Accessed 13 February 2001.

<sup>26</sup> "Arrow," *Jane's Strategic Weapons Systems* Issue 30 May 1999, p. 259.

<sup>27</sup> Mark Hewish, "Raising the Ballistic Shield," *International Defense Review* 1 September 2000.

<sup>28</sup> "Arrow," *Jane's Strategic Weapons Systems* Issue 30 May 1999, p. 259.

<sup>29</sup> "Israel makes history with new anti-missile system," *World Tribune*, 15 March 2000. Available from <http://www.worldtribune.com/Archive-2000/me-israel-03-15.html>. Accessed 6 January 2001.

<sup>30</sup> "Arrow," *Jane's Strategic Weapons Systems* Issue 30 May 1999, p. 259.

<sup>31</sup> "Arrow," *Jane's Strategic Weapons Systems* Issue 30 May 1999, p. 259.

<sup>32</sup> Steve Rodan, "Israel Seeks US Partner for Arrow," *Jane's Defense Weekly* 1 March 2000 Volume 033/009 and Amnon Barzilai, "Israel's response to the Ballistic Missile Threat," *Military Technology* Bonn, Germany, March 2000, Vol 24:3.

<sup>33</sup> Picture from Available from <http://www.defence.co.kr/~ruffino/imgsrc10/battery.htm> and from Available from URL: <http://www.canit.se/~griffon/aviation/text/missiles/sam.html>. Accessed 1 February 2001.

<sup>34</sup> "Israel Aircraft Industries Arrow Weapon System (AWS)," *Jane's Land-Based Air Defense* 2000-2001, 26 January 2000

<sup>35</sup> "Israel Aircraft Industries Arrow Weapon System (AWS)," *Jane's Land-Based Air Defense* 2000-2001, 26 January 2000.

<sup>36</sup> "Israel Aircraft Industries Arrow Weapon System (AWS)," *Jane's Land-Based Air Defense* 2000-2001, 26 January 2000.

<sup>37</sup> "Defensive Weapons Tables – Land-Based Theatre Defence Weapons," *Jane's Strategic Weapons Systems* Issue 30, May 1999, p. 504.

<sup>38</sup> James Plotts (compiler) "The Missile Index," Available from <http://infomanage.com/nonproliferation/primer/missilelist.html>. Accessed 11 March 2001. His source is Christopher F. Foss, "Israel Looks To Lightning," *Jane's Defence Weekly*, 3/19/94, p. 21.

<sup>39</sup> Wing Commander Mark Lax and Wing Commander Barry Sutherland, "An Extended Role for Unmanned Aerial Vehicles in the Royal Australian Air Force," *Air Power Studies Centre APSC PAPER NUMBER 46*, 1996, URL: <http://www.dod.gov.au/apsc-98/publishi/paper46.htm>. Accessed 16 March 2001.

<sup>40</sup> Interviews with numerous US and Israeli sources that prefer to remain anonymous.

<sup>41</sup> "Technology, Israel's Military," London *al-Hawadith* in Arabic, FBIS Document JN1511162099, 15 October 1999, p. 18-23.

<sup>42</sup> David Eshel, "Examining Israel's BMD Options," *Jane's Intelligence Review* 1 September 2000. *Jane's Online*.

<sup>43</sup> "Inventory, Israel," *Jane's World Air Forces*, 30 January 2001. *Jane's Online*.

<sup>44</sup> "Israel Weapons Investment," *Defense News* 15 November 1999, p. 6, 26.

<sup>45</sup> "Laser Gun to Stay at White Sands," *Albuquerque Journal* 7 December 2000 quoted in the *BMDO External Affairs Digest*, 7 December 2000.

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<sup>46</sup> “Laser Gun to Stay at White Sands,” *Albuquerque Journal* 7 December 2000 quoted in the *BMDO External Affairs Digest*, 7 December 2000.

<sup>47</sup> David Eshel, “Examining Israel’s BMD Options,” *Jane’s Intelligence Review* 1 September 2000. *Jane’s Online*.

<sup>48</sup> “Israel: Israeli Boost Intercept System (IBIS),” *Jane’s Strategic Weapons Systems Issue* 32 February 2000, p. 217.

<sup>49</sup> “Israel: Israeli Boost Intercept System (IBIS),” *Jane’s Strategic Weapons Systems Issue* 32 February 2000, p. 217.

<sup>50</sup> ‘Ofer Shelah, “Circle Painted Around Arrow,” Tel Aviv *Ma’ariv* (Shabat Supplement) in Hebrew, FBIS Document TA1511162799, 12 November 1999, p.9.

<sup>51</sup> “Israel Reduces Price for Withdrawal, Wants Missiles,” London *Al-Sharq al-Awat* in Arabic, FBIS Document MS060112900, 6 January 2000, p. 1.

<sup>52</sup> Re’uven Pedatzur, *The Arrow’s Toadies*,” Tel Aviv *Ha’aretz* in English, FBIS Document GMP20000314000071, 14 March 2000, Internet Version.

<sup>53</sup> Arie Stav, “The Israeli Strategy of BMD – Strategy by Default,” page 219 in Arie Stav’s book *Ballistic Missiles: The Threat and The Response*.

<sup>54</sup> Arie Stav, “The Israeli Strategy of BMD – Strategy by Default” page 219 and “The Arrow System Concept and Data” page 63 and in Arie Stav’s book *Ballistic Missiles: The Threat and The Response*.

<sup>55</sup> Arie Stav, “The Israeli Strategy of BMD – Strategy by Default,” page 219 in Arie Stav’s book *Ballistic Missiles: The Threat and The Response*.

<sup>56</sup> If Israel desires a 99 % successful interception rate, Israel must expend an average of 1.25 missiles per attacking missile according to ‘Ofer Shelah, “Circle Painted Around Arrow,” Tel Aviv *Ma’ariv* (Shabat Supplement) in Hebrew, FBIS Document TA1511162799, 12 November 1999, p.9. With a total of 200 Arrow missiles planned, this would mean, at best, Israel could successfully stop a maximum of 160 incoming missiles with the Arrow system. After that, the PAC-3 would either be used for other missiles or for missiles that the Arrow did not stop. With other planned systems and additional Arrow systems, the number of missiles Israel could stop would obviously increase.

<sup>57</sup> ‘Ofer Shelah, “Circle Painted Around Arrow,” Tel Aviv *Ma’ariv* (Shabat Supplement) in Hebrew, FBIS Document TA1511162799, 12 November 1999, p.9.

<sup>58</sup> “Israel makes history with new anti-missile system,” *World Tribune*, 15 March 2000. Available from <http://www.worldtribune.com/Archive-2000/me-israel-03-15.html>. Accessed 6 January 2001.

<sup>59</sup> “US to Make Israel ‘Strategic Partner’ in Exchange for Tech Export Controls,” *World Tribune Middle East Newslines*, 1 September 2000. Available from <http://www.worldtribune.com/Archive-2000/ss-israel-09-01.html>. Accessed 6 January 2001.

<sup>60</sup> See Re’uven Pedatzur, *The Arrow’s Toadies*,” Tel Aviv *Ha’aretz* in English, FBIS Document GMP20000314000071, 14 March 2000, Internet Version and Re’uven Pedatzur, “The Arrow and a Bunch of Irresponsible Promises,” Tel Aviv *Ha’aretz* in English, FBIS TA0311114099, 3 November 1999.

## Chapter 3

### Chapter 3: Confrontation/Potential Confrontation States

*Yours is a society which cannot accept 10,000 dead in one battle.*

—Saddam Hussein, 1991

*Had we possessed missiles when Americans attacked Tripoli and Benghazi in 1986, we would have launched them against London, Washington, and New York.*

— Mu'amar Qad'afi, 2 April 1991<sup>1</sup>

How much time does Israel have to react to a Scud launched at it from a country that is against Israel? It takes about seven minutes for an extended-range Al-Hussein missile to fly from western Iraq to Israel and approximately three minutes for a shorter range Scud-C from Syria to central Israel.<sup>2</sup> This research assumes that most of the countries in the Middle East are inimical to the interests of Israel. The confrontation states are defined as Iraq, Iran, Syria, Libya and potentially Pakistan, Egypt, and Sudan. Others that could join in on the fight or provide support are Saudi Arabia, and United Arab Emirates. Only two states in the region, Jordan and Egypt, even have a peace treaty with Israel. Turkey, being part of the NATO alliance, is the only other Muslim country that current has warm relations with Israel. Syria is still officially at war with Israel. Many of these countries sent their military to fight against Israel during the 1948, 1956, 1967, 1969-70, 1973, and/or the 1982 wars. Israel cannot afford to assume that the peace treaties will last indefinitely. Therefore, this paper assumes that all the countries that have participated in wars against Israel since its inception are susceptible enemies under *real politic*.

Iraq and Iran currently appear to be fighting for hegemony in the region because of their size, population, and oil wealth. Iraq and Iran have demonstrated their hostility to Israel since 1948. Both of these countries have used missiles and rockets in warfare, even against each other in the War of the Cities (1980-1988). With respect to their relationship to Israel, Dore Gold, former Israeli Ambassador to the UN explains Iraq's and Iran's role with respect to Israel:

The very capability to strike Israel could provide new roles for Iraq and Iran in future conflict scenarios in the Arab-Israeli sector of the Middle East. Iraq has been directly involved in past Arab-Israeli wars, dispatching significant expeditionary forces in 1948, 1967, and 1973; in 1991, as just noted, it launched ballistic missile strikes against Israel as part of the Gulf War. Today, both states have developed strong relationships with populations surrounding Israel. Iran's ties with the Lebanese Shi'ites not only included military supply to Hizballah, but the actual deployment of Iranian forces in Lebanon, including forces controlling Iranian al-Fajr missiles (with a 70-kilometer range) capable of striking Haifa. Had it not been for the intense peace efforts on the Syrian-Israeli track in the first half of 2000, this deployment of Iranian missiles on Lebanese soil could have become a Middle Eastern version of the Cuban missile crisis. In the meantime, a dangerous precedent has been established of foreign deployment of ballistic missiles that could be imitated elsewhere.<sup>3</sup>

Why have these confrontation states focused on developing missiles? First, once a country has missiles, especially pointed at Israel, it creates a great amount of prestige. Iraq was held in awe because it was able to strike Israel during the Gulf War without Israel able to respond. Second, missiles are not that difficult to maintain and manage compared to aircraft, which require a long-term investment in pilots, maintenance, and equipment. Former Israeli Ambassador to the UN Dore Gold explains this further:

Missile proliferation is not an entirely new development on the Middle Eastern strategic landscape. In fact, missiles have been the chosen instrument of Israel's military adversaries since 1973, to counter the deep penetration capability of the Israeli Air Force. Egypt received its first Scuds in 1973, and fired them in Sinai during the Yom Kippur War. Syria fired short-range Frog-7 rockets in 1973. It was easier to build up missile forces than to train pilots and acquire sophisticated fighter aircraft to beat the Israeli Air Force. Missiles, unlike aircraft, could achieve assured penetrability of Israel's airspace.<sup>4</sup>

Third, missile defense is an acknowledged weakness and is one area that these countries can excel at without much cost. Finally, this capability is a means to “overcome a perceived deadlock in the balance of power” between Israel and these confrontation states.<sup>5</sup>

Below is a short discussion of each of the confrontation states’ ballistic missile capabilities. In addition to the countries listed, this paper will also briefly discuss the possible Palestinian missile and artillery threat to Israel because it is an area that could be used to attack Israel’s population, infrastructure, and even its missile defense capabilities due to its close proximity. A brief chart of the ballistic missile threats facing Israel are presented below as an overview:<sup>6</sup>

<b>SHORT-RANGE TACTICAL MISSILES</b>			
SS-21 'Scarab' (OTR-21)	Payload 480kg	Range -70km very accurate	Syria, Libya
MGM-52 Lance	Payload 450kg	Range -130km	Iran
Iran 130 (Mushak-120)	Payload 190kg	Range -130Km	Iran
Zeizal 1	Payload 200Kg?	Range -100-150Km?	Iran
Nazeat N5	Payload 150kg	Range -105km	Iran
CSS-8 (M-7/8610)	Payload 190kg	Range -150Km	Iran, Iraq
Al-Samoud	Payload 200kg?	Range -150km+	Iraq test fired
<b>MEDIUM-RANGE MISSILES</b>			
CSS-7 (DF-11/M-11)	Payload 800kg	Range -280km	Iran
SS-1 Scud B (R-17)	Payload 985kg	Range -300km	Egypt, Iran, Syria
Scud B El Hussayin	Payload 500kg	Range -615km	Iraq
Scud C	Payload 500kg	Range -550km	Syria, Iran, Libya
CSS-6 (DF-15/M-9)	Payload 500kg	Range -600km	Syria, Iran
Scud D (SSle)	Payload 500kg?	Range -700km?	Syria (DPRK)
<b>LONGER-RANGE MISSILES</b>			
No-Dong 1 (Labor-1)	Payload 750kg	Range -1,300km?	Libya, Iran?
CSS-2 (DF-3)	Payload 2,150kg	Range -2,800km	Saudi Arabia
Shahab-3 (Zeizal 3?)	Payload 750kg?	Range -1,300km	Iran
Shahab-4 (Russian R-12?)	Payload 800kg?	Range -2,000km?	Iran
Shahab-5?	Payload 1,000kg?	Range -3,000km?	Iran

## Table 2 Confrontation States Missiles and Capabilities

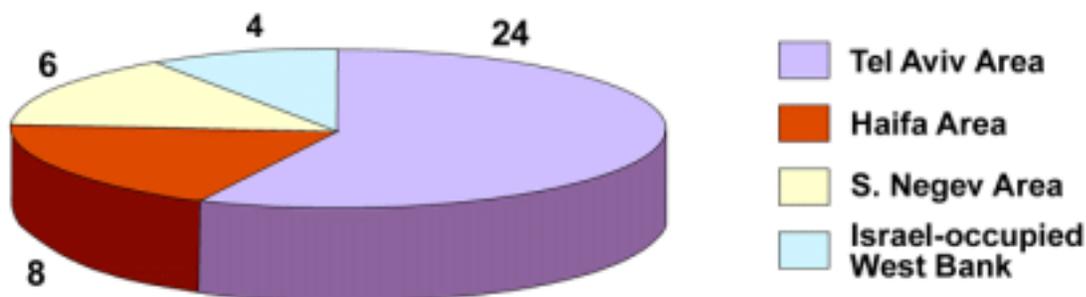
**Iraq:** On 2 April 1990, Saddam said in a speech that he would use his chemical weapons to burn at least half of Israel.<sup>7</sup> During the Gulf War, 39 out of the 42 Al Husseins (Iraqi-modified Scud B SRBM) fired by Iraq landed in Israel.<sup>8</sup> Altogether, Iraq fired a total of 92 Al Husseins at Israel and Saudi Arabia.<sup>9</sup> Uzi Rubin, a member of the Israeli National Security Council, stated that he thinks that Iraq still has approximately 50 hidden in Iraq.<sup>10</sup> However, this does not take into consideration the missiles that Iraq could have re-assembled or purchased since the departure of the UNSCOM in the summer of 1999 nor does it include missiles that could be hidden in other countries such as Sudan or Libya.<sup>11</sup>

According to a study by the Israeli Ministry of Defense, more destruction was caused by the Patriots attempting to shoot down Scuds than was caused by Scuds that were not hit by Patriots:

Post-Gulf War studies in Israel and the United States have shown that there was more damage in those areas protected by Patriot batteries than in those neighborhoods that were exposed to Scud attacks without any defense. A study by the Ministry of Defense revealed that thirteen Scuds launched at Tel Aviv before the deployment of the Patriots in Israel resulted in 115 human injuries and caused damage to twenty seven hundred apartments. The Patriots were fired at eleven Scuds that were aimed at greater Tel Aviv, which led to 168 injures and nearly eight thousand damaged apartments.

There was a very logical explanation for this: the Patriot missiles were not capable of completely annihilating the Iraqi Scuds. Thus, not only did the collision cause the Scuds and the Patriots both to disintegrate in mid-air spreading a rain of debris but some missiles exploded in mid-air without impact on a Scud, also showering fragments over the land.<sup>12</sup>

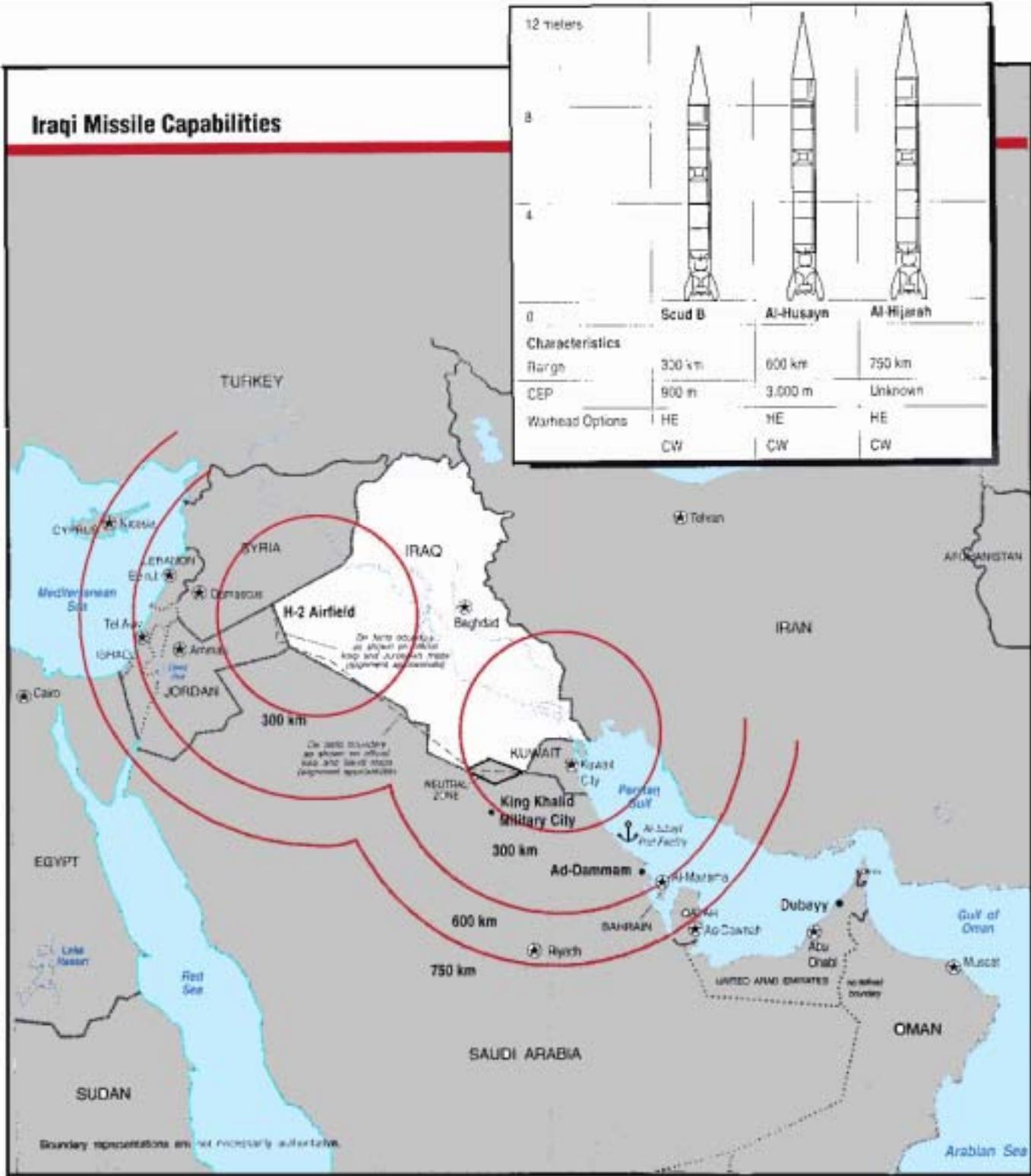
Figure 13 Iraqi Scud Attack Locations in Israel



**MISSILES IN DESIGN OR RESEARCH AND DEVELOPMENT BEFORE OPERATION DESERT STORM**



**Figure 14 Iraqi Missile Range Capabilities Prior to Desert Storm**



**Figure 15 Current Iraqi Missile Range Capabilities**

Iraq is Israel's biggest threat because the Iraqi Scud attacks against Israel did not elicit a response from Israel and in the Middle East; this inaction is perceived as a sign of weakness in the Middle East. Other information reflects the continuing threat of Iraq to Israel. Ambassador Gold provides two examples of why Iraq continues to be a threat to Israel:

During the last aggression [Winter 1998], they (the Americans) bombed seven sites which had considerable success in trying to produce al-Su-moud (Resistance) missiles of 150-kilometer range....They hit them because they know *that if anyone can produce a missile of 150-kilometer range, they can produce one with a 1,000-kilometer range* (emphasis added).

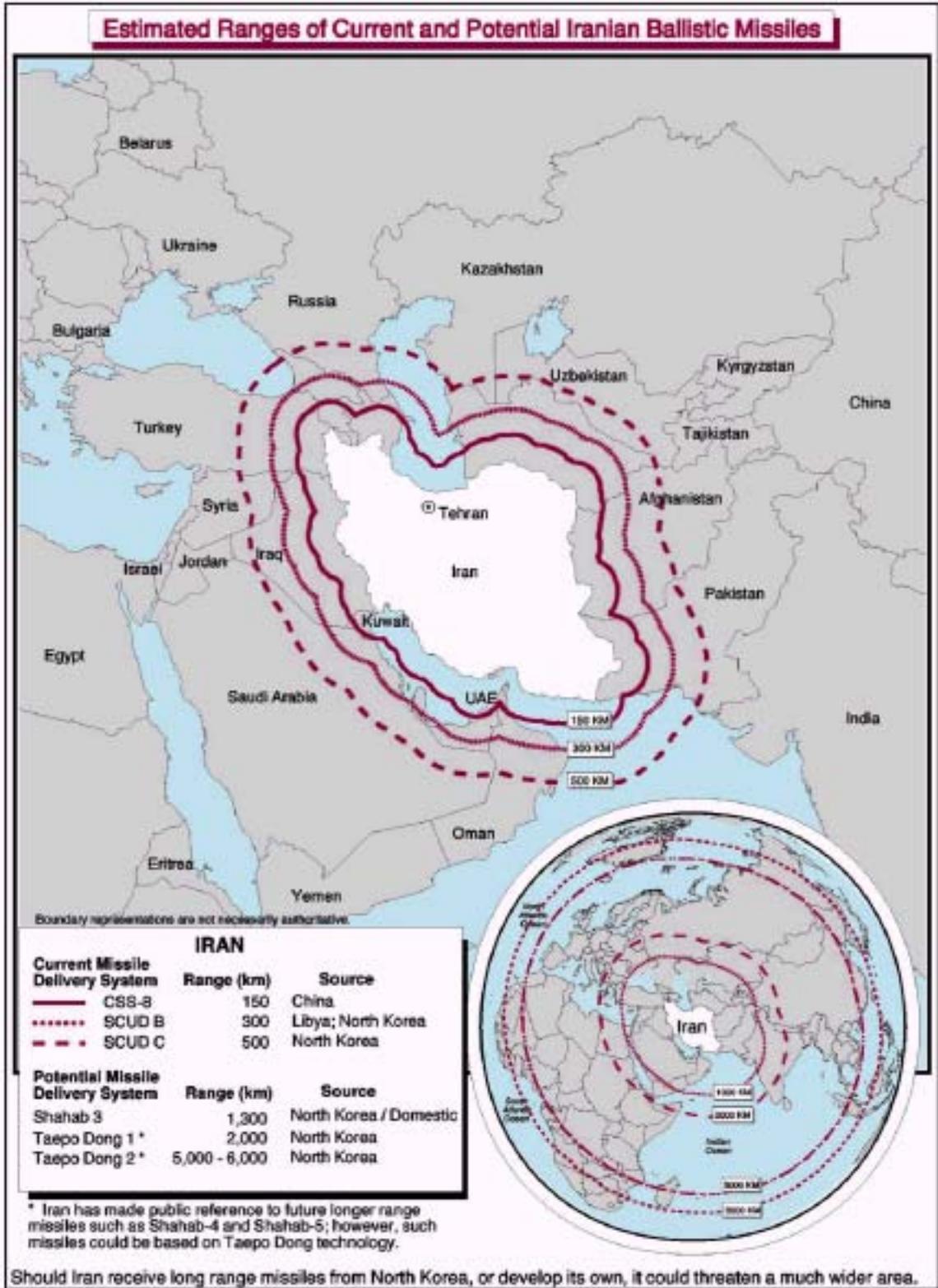
...

For example, Iraq admitted to UNSCOM that it had produced 75 special warheads for its ballistic missile forces, 25 of which contained biological weapons (like anthrax and aflatoxin) and 50 of which contained nerve gas agents (like sarin and binary chemicals); later it was revealed that Iraq had weaponized V-X agent as well. Tariq Aziz admitted to Richard Butler that Iraq maintained its biological weapons specifically for use against Israel. How would the US or Israel respond to a non-nuclear attack with weapons of mass destruction?<sup>13</sup>

**Iran:** Iran has been the biggest surprise, with its quick deployment of the new Shahab-3 as well as the developmental Shahab-4 (2000 km range).<sup>14</sup> Another source indicates that the ranges for the Iranian Shahab missiles have longer ranges: Shahab-3 1300 km, Shahab-4 2000 km, Shahab-5 5500 km, and Shahab-6 10000 km.<sup>15</sup>

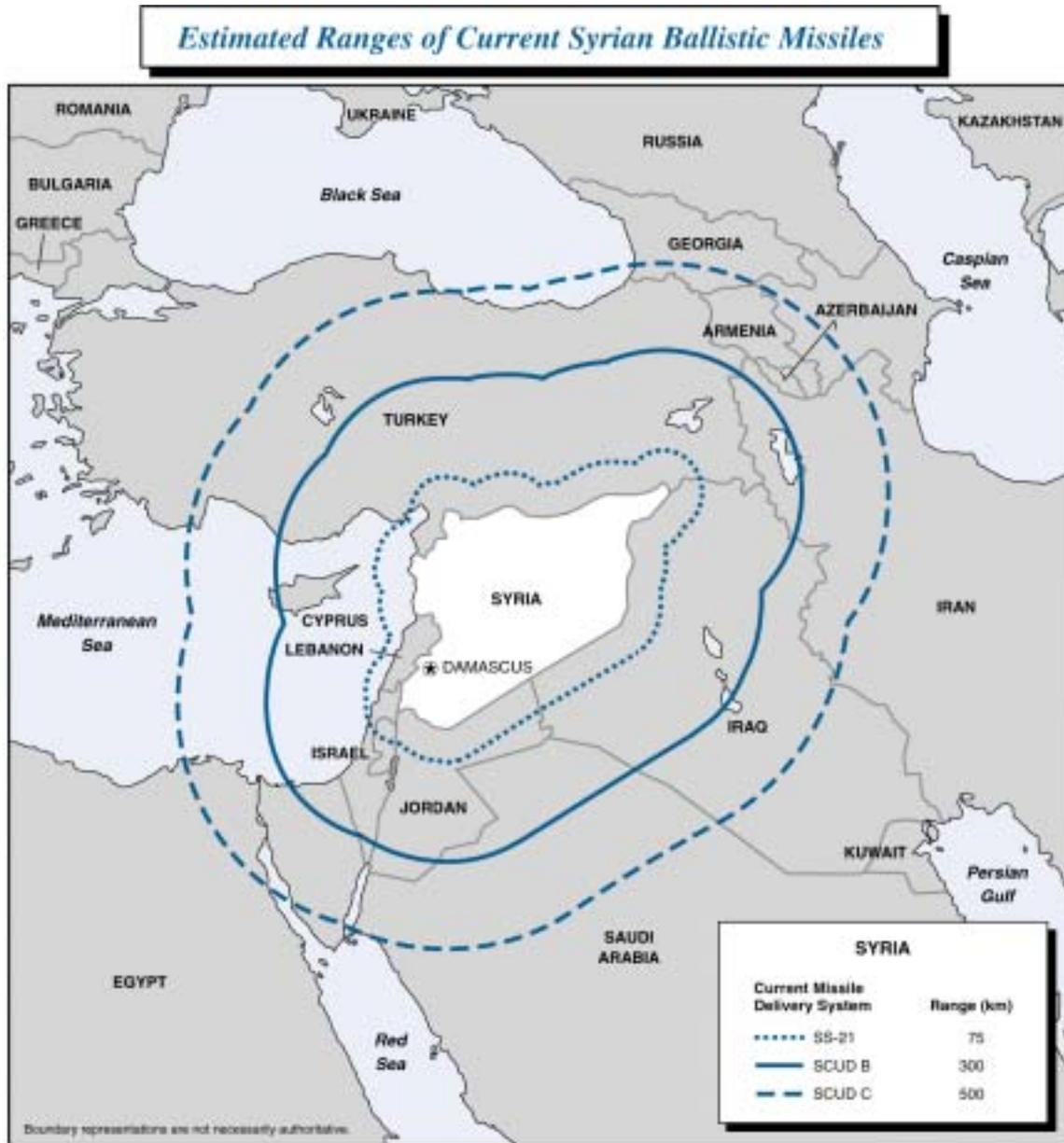
**Figure 16 Iranian Shihab-3 Missile (800 mile range) can reach Israel<sup>16</sup>**





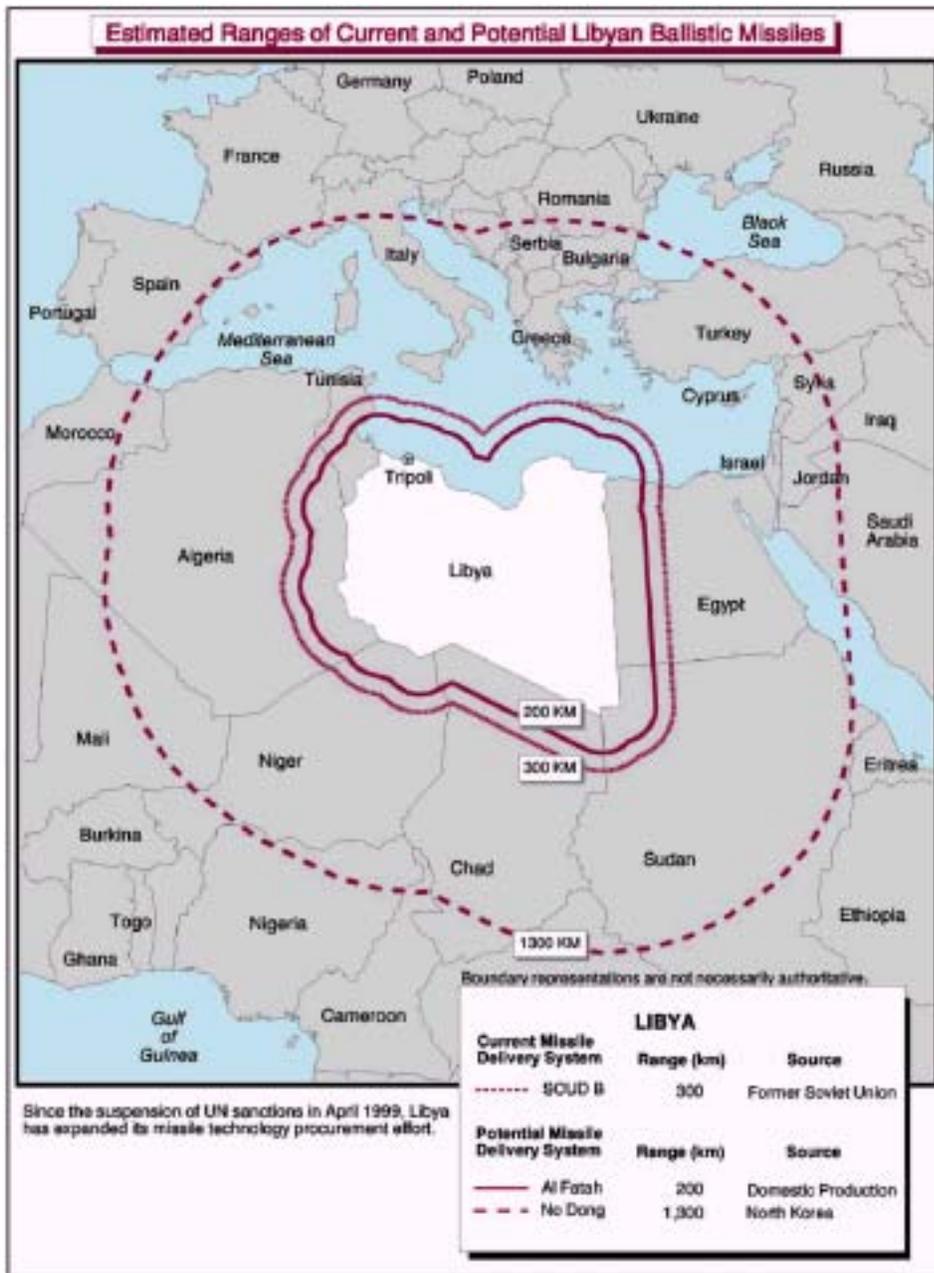
**Figure 17 Current Iranian Missile Range Capabilities**

Syria: Also according the Rubin, Syria has approximately “500 deployable SRBMs that can attack Israel.”<sup>17</sup> The map below is from *Proliferation: Threat and Response*.<sup>18</sup>



Syria's missiles allow it to threaten all of Israel.

**Figure 18 Current Syrian Missile Range Capabilities**



**Figure 19 Current Libyan Missile Range Capabilities**

**Libya:** As recently as November 2000, a variety of news sources and journals reported that Libya had operational North Korean No-Dong-1 surface to surface missiles (SSM) deployed along the Libyan Coast (estimated range of 1,000-1,300 km).<sup>19</sup> With these missiles, Libya is able to target southern European countries as well as Israel. According to the reports, Egypt,

Libya, and Iraq were secretly working on the joint missile project, but due to US pressure, Egypt withdrew. Iraq has been trying to develop its Surface-to-Surface Missiles (SSMs) outside of Iraq to avoid UN restrictions from developing SSMs with ranges longer than 150 km.<sup>20</sup>

**Nuclear, Biological, and Chemical Weapons and Missile Programs:** Iraq, Iran, Syria, and Libya NBC weapons and missile programs are summarized below:

<b>Iraq: NBC and Missile Programs</b>	
<b>Nuclear</b>	<p>Had comprehensive nuclear weapons development program prior to Operation Desert Storm. Infrastructure suffered considerable damage from Coalition bombing and IAEA dismantlement.</p> <p>Retains scientists, engineers, and nuclear weapons design information; without fissile material, would need five or more years and significant foreign assistance to rebuild program and produce nuclear devices; less time would be needed if sufficient fissile material were acquired illicitly.</p> <p>Ratified the NPT; has not signed the CTBT.</p>
<b>Biological</b>	<p>Produced and weaponized significant quantities of biological warfare agents prior to Desert Storm.</p> <p>Admitted biological warfare effort in 1995, after four years of denial; claimed to have destroyed all agents, but offered no credible proof.</p> <p>May have begun program reconstitution in absence of UN inspections and monitoring.</p> <p>Acceded to the BWC.</p>
<b>Chemical</b>	<p>Rebuilt some of its chemical production infrastructure allegedly for commercial use.</p> <p>UNSCOM discovered evidence of VX persistent nerve agent in missile warheads in 1998, despite Iraqi denials for seven years that it had not weaponized VX.</p> <p>May have begun program reconstitution in absence of UN inspections and monitoring.</p> <p>Has not signed the CWC.</p>
<b>Ballistic Missiles</b>	<p>Probably retains limited number of SCUD-variant missiles, launchers, and warheads capable of delivering biological and chemical agents. Retains significant missile production capability.</p> <p>Continues work on liquid- and solid-propellant SRBMs (150 kilometers) allowed by UNSCR 687; likely will use technical experience gained for future longer range missile development effort.</p> <p>Not a member of the MTCR.</p>
<b>Other Means of Delivery Available</b>	<p>Land-launched anti-ship cruise missiles; air-launched tactical missiles; none have NBC warheads; stockpile likely is very limited.</p> <p>Air systems: fighters, helicopters, UAVs.</p> <p>Ground systems: artillery, rockets.</p>

**Figure 20 Iraqi NBC Weapons and Missile Programs**

<b>Iran: NBC Weapons and Missile Programs</b>	
<b>Nuclear</b>	<p>Seeking fissile material and related nuclear technology for weapons development, especially from sources in Russia.</p> <p>Russia is completing construction of power reactor at Bushehr and recently agreed to additional nuclear cooperation; China has pledged not to sell a key facility and other nuclear technologies.</p> <p>Acceded to the NPT and signed the CTBT.</p>
<b>Biological</b>	<p>Possesses overall infrastructure and expertise to support biological warfare program.</p> <p>Pursues contacts with Russian entities and other sources to acquire dual-use equipment and technology.</p> <p>Believed to be actively pursuing offensive biological warfare capabilities; may have small quantities of usable agent now.</p> <p>Ratified the BWC.</p>
<b>Chemical</b>	<p>Began chemical warfare program during Iran-Iraq war; employed limited amounts of agent against Iraqi troops.</p> <p>Possesses weaponized stockpile of agents; capable of agent delivery; trains military forces to operate in contaminated environment.</p> <p>Seeking to improve chemical precursor production capability.</p> <p>Ratified the CWC and made declarations.</p>
<b>Ballistic Missiles</b>	<p>Has force of SCUD B, SCUD C and Chinese-made CSS-8 SRBMs; producing SCUDs.</p> <p>Main effort is to produce Shahab-3 MRBM, based on North Korean No Dong; effort involves considerable Russian and Chinese assistance.</p> <p>Flight tested Shahab-3 in July 1998, and in July and September 2000</p> <p>Seeking to develop additional longer-range missiles, such MRBMs, IRBMs and possibly an ICBM.</p> <p>Not a member of the MTCR.</p>
<b>Other Means of Delivery Available</b>	<p>Land-, sea-, and air-launched anti-ship cruise missiles; air-launched tactical missiles; none have NBC warheads.</p> <p>Aircraft: fighters.</p> <p>Ground systems: artillery, rocket launchers.</p>

**Figure 21 Iranian NBC Weapons and Missile Programs**

<b>Syria: NBC Weapons and Missile Programs</b>	
<b>Nuclear</b>	Is not pursuing the development of nuclear weapons. Ratified the NPT; has not signed the CT&T.
<b>Biological</b>	Possesses adequate biotechnical infrastructure to support limited biological warfare program. Believed to be pursuing biological agent development, but no major agent production effort likely is underway. Signed but not ratified the BWC.
<b>Chemical</b>	Possesses and is capable of delivering nerve agents; may be developing more advanced VX nerve agent. Making improvements to chemical infrastructure. Has not signed the CWC.
<b>Ballistic Missiles</b>	Maintains and is capable of using force of SCUD B, SCUD C, and SS-21 missiles. Producing SCUD Cs with North Korean assistance. Making improvements to missile production infrastructure. Not a member of the MTCR.
<b>Other Means of Delivery Available</b>	Land- and sea-launched anti-ship cruise missiles; none have NBC warheads. Aircraft: fighters, helicopters. Ground systems: artillery, rockets.

**Figure 22 Syrian NBC Weapons and Missile Programs**

<b>Libya: NBC Weapons And Missile Programs</b>	
<b>Nuclear</b>	Has made little progress with long-standing goal of acquiring or developing a nuclear weapon; may be trying to recruit foreign experts to assist with effort. Ratified the NPT; has not signed the CTBT. Signed the African Nuclear Weapon Free Zone Treaty.
<b>Biological</b>	Remains in research and development stage, but may be capable of producing small quantities of agent. Ratified the BWC.
<b>Chemical</b>	Produced blister and nerve agents in 1980s at Rabta; employed chemical agents against Chadian troops in 1987; attempted to construct underground chemical agent production facility at Tarhunah. Rabta and Tarhunah believed to be inactive, although chemical program not completely abandoned. Has not signed the CWC.
<b>Ballistic Missiles</b>	Maintains aging SCUD missile force of limited operational utility. Has made only limited success with over 20-year indigenous missile production effort; may renew focus on purchasing complete ballistic missile. Not a member of the MTCR.
<b>Other Means of Delivery Available</b>	Land- and sea-launched anti-ship cruise missiles; none have NBC warheads. Aircraft: fighters, bombers, helicopters, transport planes. Ground systems: artillery, rocket launcher.

**Figure 23 Libyan NBC Weapons and Missile Programs**

**Possible Confrontation States Courses of Action:** Pakistan, Egypt, Sudan, Saudi Arabia, United Arab Emirates, and Sudan could individually attack or assist any state involved in a conflict with Israel. Each of their capabilities is listed below as well as assistance they have provided the confrontation states, previously mentioned. Other states in the region, which are inimical to Israel and might not have a SSM capability, can still provide assistance (monetary, human resources, etc) to countries with SSMs. For example, Pakistan could share or sell its WMD and missile capabilities. Below is a list of Pakistani capabilities according to *Proliferation: Threat and Response*.

<b>Pakistan: NBC Weapons and Missile Programs</b>	
<b>Nuclear</b>	Conducted nuclear weapon tests on 28 and 30 May 1998 in response to India's tests; claimed a total of six tests. Capable of manufacturing complete sets of components for highly enriched uranium-based nuclear weapons; developing capability to produce plutonium. Has small stockpile of nuclear weapons components and can probably assemble some weapons fairly quickly. It can deliver them with fighter aircraft and possibly missiles. Has signed neither the NPT nor the CTBT.
<b>Biological</b>	Believed to have capabilities to support a limited biological warfare research effort. Ratified the BWC.
<b>Chemical</b>	Improving commercial chemical industry, which would be able to support precursor chemical production. Ratified the CWC but did not declare any chemical agent production. Opened facilities for inspection.
<b>Ballistic Missiles</b>	Has development and production facilities for solid- and liquid-propellant fuel missiles. Solid-propellant program: Hafiz I rocket — 80 kilometer range (produced) Hafiz III — 300 kilometer range; based on M-11 (being developed) Shaheen I — 750 kilometer range claimed (tested) Shaheen II/Ghaznavi — 2,000 kilometer range claimed (in design) Liquid-propellant program: Ghauri — 1,300 kilometer range; based on No Dong (tested) Is not a member of the MTCR.
<b>Other Means of Delivery</b>	Has ship-borne, submarine-launched, and airborne anti-ship cruise missiles; none has NBC warheads. Aircraft: fighter-bombers. Ground systems: artillery and rockets.

**Figure 24 Pakistani NBC and Missile Programs**



**Figure 25 Current Pakistan Missile Range Capabilities**

**Pakistan:** The only declared nuclear Muslim state in the region is over 2500 km from Israel, yet many of the confrontation states look to it as a source of accomplishment and a possible place for technology transfer, both in missile and WMD development. It is the only declared nuclear Muslim state (May 1998 detonations).

Pakistan has the HATF 1/1A, 2, 3, 5 (Ghauri), and 6 missiles with the following respective ranges: 80-100 km, 300 km, 550 km, 1300 km, and 2000 km (in development).<sup>21</sup> All of the warheads have the capability to have a HE and HATF 1/1A, 2, and 3 are chemical capable. HATF 3, 5, and 6 are also nuclear capable (*Jane's*). Another source also described two other missiles: Tipu (possibly the North Korean Taepo Dong 2) with a 4000 km range and Ghaznavi with an unknown range.<sup>22</sup> The Tipu's range would allow it to strike Israel. Below is a table from the Carnegie Endowment summarizing Pakistan's missiles:<sup>23</sup>

COUNTRY	SYSTEM NAME	STATUS	RANGE (KM)	PAYLOAD (KG)	ORIGIN	NOTES
Pakistan	M-11 (CSS-7)	S	280	800	PRC	
	Hatf-2	D	300	500	I/PRC?	M-11 derivative?
	Hatf-3	D?	600	500	I/PRC?	M-9 derivative?
	Shaheen-1	D/T	700	500	I/PRC?	M-9 derivative? Tested 14 April 1999.
	Ghauri	T	1,300	500-750	I/DPRK	From Nodong; tested 6 April 1998.
	<i>Ghauri-2</i>	D/T	2,000	1,000	I/DPRK	From Nodong; tested 14 April 1999.
	<i>Shaheen-2</i>	D?	2,500	?	I/DPRK?	From Nodong-2.
<i>Ghauri-3</i>	D/T	2,700-3,500	?	I/DPRK	Engines tested 23 July 1999 and 29 September 1999.	

**Table 3 Pakistani Missile Systems**

**Egypt:** Egypt and other Arab countries have conducted research on missiles over a long period of time. Egypt's current operational ballistic missile system is Project T. The Project T

missile has been operational since 1993 with a range of 450km and having a single High Explosive (HE) warhead.<sup>24</sup>

One project that Egypt was involved in was the Vector Project, which was probably a cover name for the Condor 2 project--a 900 km ballistic missile, that was being worked jointly with Iraq and Argentina.<sup>25</sup> *Jane's* and other military sources indicate that Egypt and Argentina stopped working on this project in the early 1990s. The Iraqi involvement continued also in the early 1990s and was called *Badr 2000*. The precise status of this program is unknown for all the countries involved.

Another dimension to the discussion of Egypt is its important role as a spokesperson for the moderate Arab regimes. It was the first country to make peace with Israel in 1978 with the Camp David Peace Treaty between President Anwar Sadat and Prime Minister Menachem Begin. Below is a table of Egypt's and Algeria's missile capabilities.

COUNTRY	SYSTEM NAME	STATUS	RANGE (KM)	PAYLOAD (KG)	ORIGIN	NOTES
<b>Algeria</b>	Scud-B	O	300	1,000	USSR	
<b>Egypt</b>	Scud-B	O/U	300	1,000	USSR/DPRK	
	Project T	O	450	1,000	I/DPRK	Improved Scud.
	Scud-C	O	500	700	DPRK	
	<i>Vector</i>	D	685	?	I/DPRK	

**Table 4 Algerian and Egyptian Missile Systems**

**Algeria:** One of the interesting benefits of the various Muslim nations is their ability to work together on various secret projects in parts of the Middle East to avoid discovery. Recent press reports discuss the possibility of Algerian work on nuclear weapons as well as reports in the recent past of Iraq moving its WMD and missile capabilities to countries like Sudan to avoid the

prying eyes of United Nations inspectors.<sup>26</sup> Other countries such as Libya continue to work other Muslim countries to improve their military capabilities.<sup>27</sup>

**Sudan:** Although the Sudan appears not to have any indigenous ballistic missile, several reports point to Sudan as being an alternative site for WMD research, especially by Iraq.<sup>28</sup>

**Saudi Arabia:** Saudi Arabia does not appear to intend to increase its missile capabilities, but could be involved in supporting other countries with finances or in technical assistance.

COUNTRY	SYSTEM NAME	STATUS	RANGE (KM)	PAYLOAD (KG)	ORIGIN	NOTES
Saudi Arabia	Dong Feng-3 (CSS-2)	O	2,600	2,150	PRC	Non-nuclear.
United Arab Emirates	Scud-B	O	300	1,000	Russia?	

**Table 5 Saudi Arabian and United Arab Emirates Missile Systems**

**United Arab Emirates:** Similar to Saudi Arabia, the UAE does not appear to want to increase its missile capabilities, but could be involved in supporting others.

**Palestinian Missile Threat:** In recent press reports, the Israeli Defense Forces announced that Palestinians might be receiving Katyusha rockets from Hizballah.<sup>29</sup> Appendix C contains more specific details about the Katyusha rocket and their range capabilities if fired from Palestinian ruled areas. Two parts of the potential Katyusha threat can have a dramatic impact on Israel:

- (1) The Katyushas could be deployed near Israel’s main population centers or targeted against other strategic sites.
- (2) The potential to arm the missiles with chemical or biological weapons.

Each truck can carry up to 48 rockets; each of the warheads can carry a 22 kg warhead (high explosive).<sup>30</sup> Since one salvo equals almost four Scud warheads (300 kgs each), the potential to

kill even more Israelis with chemical or biological weapons could become an extremely acute problem. In other words, if one salvo were fired, potentially 24,000 Israelis could be killed by chemical weapons and many more by biological weapons (an estimated 8,000 Israelis could die from each Scud chemical attack).<sup>31</sup> The fact that Israel is very interested in a mobile THEL correlates with the possible rocket threat from the Palestinian territories. The artillery threat is also similarly threatening (for more information on the artillery threat see Appendix B below).

In conclusion, Israel faces a formidable missile threat from individual states as well as multiple nations in the region. How Israel is able to counter the missile threat with a combination of active defense and offensive capabilities with a constrained budget compared to its many adversaries could determine Israel's fate in the next conflict in the Middle East.

### Notes

<sup>1</sup> Arieh Stav (Editor). *Ballistic Missiles: The Threat and The Response*. Washington, DC: ACPR Publishers, 1999: 201, from a TV interview, Granada, "World in Action," 2 April 1991.

<sup>2</sup> David A. Fulghum and Morrocco, John D. "First Arrow Battery Deployed Near Tel Aviv," *Aviation Week and Space Technology*, New York, 10 April 2000, p. 66.

<sup>3</sup> Dore Gold, "Middle East Missile Proliferation, Israeli Missile Defense, And The ABM Treaty Debate," *Jerusalem Letter*, 15 May 2000. Available from <http://www.jcpa.org/jl/jl430.htm>. Accessed 11 February 2001.

<sup>4</sup> Dore Gold, "Middle East Missile Proliferation, Israeli Missile Defense, And The ABM Treaty Debate," *Jerusalem Letter*, 15 May 2000. Available from <http://www.jcpa.org/jl/jl430.htm>. Accessed 11 February 2001.

<sup>5</sup> Barry Rubin, "Military in Middle East Politics," *Middle East Review of International Affairs* (MERIA) Volume 5, Number 1 (December 2000). Available at <http://meria.biu.ac.il>. Accessed 17 March 2001.

<sup>6</sup> David Eshel, "Examining Israel's BMD Options," *Jane's' Intelligence Review*, 1 September 2000. The chart used in the article is from A. Stav. *Ballistic Missiles - The Threat and Response*,. ACPR. Brassey's 1999.

<sup>7</sup> Rick Francona, *Ally to Adversary: An Eyewitness Account of Iraq's Fall From Grace*. Annapolis, Maryland: Naval Institute Press, 1999: 37. Also found in the Centre for Defence and International Security Studies (CDISS - Lancaster University, UK) "Future Dangers: Iraq, Iran, and Libya," Available from <http://www.cdiss.org/smt1f.htm>. "Saddam Hussein, who threatened to 'burn half of Israel' with chemical weapons prior to the Gulf war, is an expert at using such weapons for intimidation."

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<sup>8</sup> “Scud Incidents in Israel,” *Federation of American Scientists*, Available from [http://www.fas.org/nuke/guide/iraq/missile/scud\\_info/scud\\_info\\_s06.htm](http://www.fas.org/nuke/guide/iraq/missile/scud_info/scud_info_s06.htm). Accessed 17 March 2001. According to the article, “Iraq fired 42 Scuds that reached Israel or nearby areas of Jordan beginning on January 18, 1991. Iraq launched these missiles from Western Iraq against three general areas – Tel Aviv, Haifa, and the Negev Desert in Southern Israel, specifically, Dimona where Israel had a nuclear facility...the director of Israel’s Scud Recovery Unit indicated none of the missile warheads they recovered had chemical or biological warfare agent components. All had conventional warheads. The director of the Israeli Scud Recovery Unit also noted that when Patriots shot down a Scud, release of the residual rocket oxidizer (inhibited red fuming nitric acid) generated a cloud of yellow mist that caused burning sensations on exposed skin. Some who experienced Scud attacks incorrectly believed this yellow or orange cloud to be nerve agent.”

<sup>9</sup> “Iraq’s 50 Al Husseins,” *Centre for Defence and International Security Studies* (CDISS - Lancaster University, UK), 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>10</sup> “Iraq’s 50 Al Husseins,” *CDISS*, 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>11</sup> According to the Center for Non-Proliferation Studies at the Monterey Institute for International Studies: “Duncan Lennox, ed., “Country Inventory – In Service,” *Jane’s Strategic Weapons Systems Issue 24*, 5/97. There have been repeated but unconfirmed reports that Sudan may be in possession of Scud missiles exported from Iraq to avoid their destruction by UNSCOM. A 2/98 US congressional task force report produced by Yossef Bodansky alleged that in mid-1991, “about 400” Scud missiles were transferred from Iraq to Sudan, and that in late 1995, “some 50 ‘advanced Scud launchers’ and a similar number of Al Hussein missiles” were shipped from Iraq to Sudan. However, the claim that Iraq retained hundreds of ballistic missiles after the 1990-91 Gulf War is wildly at variance with public estimates by other sources, which estimate that Iraq may have retained two to a maximum of a few dozen Scud missiles. US National Security Council (NSC), “Iraq’s Program of Mass Destruction: Threatening the Security of the International Community,” 11/14/97, p. 4, (<http://www.usia.gov/regional/nea/gulfsec/nsc1119.htm>). US Government White Paper, “Iraq Weapons Of Mass Destruction Programs,” 2/13/98, (<http://www.usia.gov/regional/nea/iraq/whitepap.htm>). Anthony H. Cordesman, “Weapons of Mass Destruction in the Middle East: National Efforts, War Fighting Capabilities, Weapons Lethality, Terrorism, and Arms Control Implications” (Washington, DC: Center for Strategic and International Studies, 2/98), p. 31. Michael Eisenstadt, “Iraq’s Weapons of Mass Destruction (WMD): Unresolved Issues,” *Policywatch* #304, 2/27/98, (<http://www.washingtoninstitute.org>). For further background, see: “Iraqi Nuclear Equipment Said Sent to Algeria,” *Al-Ahrrar*, 7/22/91, p. 1; in *Proliferation Issues*, 8/8/91, p. 16. “Chronology 1991,” *Arms Control Reporter*, 3/91. “Sudan Strengthens Forces as Fighting Steps Up,” *Jane’s Defence Weekly*, 5/9/92, p. 806. Duncan Lennox, “Ballistic Missiles,” *Jane’s Defence Weekly*, 4/17/96, pp. 40, 43-44.”

<sup>12</sup> Melman, Yossi. *The New Israelis: An Intimate View of a Changing People*. NY, NY: Carol Publishing Group, 1992: 8.

<sup>13</sup> Dore Gold, “Middle East Missile Proliferation, Israeli Missile Defense, And The ABM Treaty Debate,” *Jerusalem Letter*, 15 May 2000. Available from

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<http://www.jcpa.org/jl/jl430.htm>. Accessed 11 February 2001. Iraqi targeting of Israel with biological warheads is also referred to in *Proliferation: Threat and Response*, January 2001 on p.40: "Iraq also admitted that, during the Persian Gulf War, it had developed biological agent-filled munitions to airfields and that these weapons were intended for use against Israel and coalition forces in Saudi Arabia."

<sup>14</sup> "Iraq's 50 Al Hussein's," *CDISS*, 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>15</sup> "Iran Missiles," *Federation of American Scientists*. Available from <http://www.fas.org/nuke/guide/iran/missile/index.html>. Accessed 16 March 2001.

<sup>16</sup> *Strategic Assessment 1999: Priorities for a Turbulent World*. Institute for National Strategic Studies, National Defense University, June 1999: 227.

<sup>17</sup> "Iraq's 50 Al Hussein's," *CDISS*, 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>18</sup> *Proliferation: Threat and Response*. Office of the Secretary of Defense, January 2001. Available from <http://www.defenselink.mil/pubs/ptr20010110.pdf>. Accessed 9 February 2001.

<sup>19</sup> "Libyan NODONG SSMS TARGETING NATO SITES, ISRAEL," *Defense and Foreign Affairs Strategic Policy*, Number 10, October 2000.

<sup>20</sup> "Iraq's 50 Al Hussein's," *CDISS*, 28 February 2000, Available from <http://www.cdiss.org/00feb28.htm>. Accessed 1 December 2000.

<sup>21</sup> "Offensive Weapons Table," *Jane's Strategic Weapons Systems* Issue 30, May 1999, p. 499.

<sup>22</sup> "Pakistan Missile Special Weapons Delivery Systems," *Federation of American Scientists*. Available from <http://www.fas.org/nuke/guide/pakistan/missile/>. Accessed 16 March 2001.

<sup>23</sup> Joseph Cirincione, "The Persistence of the Missile Defense Illusion," *Carnegie Endowment for International Peace*, 4 July 1998. Available from <http://www.ceip.org/programs/npp/bmd.htm>. Accessed 12 December 2000.

<sup>24</sup> "Offensive Weapons Table," *Jane's Strategic Weapons Systems* Issue 30, May 1999, p. 499.

<sup>25</sup> "Condor 2," *Jane's Strategic Weapons Systems* Issue 31 September 1999, p. 77.

<sup>26</sup> "Algeria," *Federation of American Scientists* 12 September 1996. Available from <http://www.fas.org/irp/threat/missile/algeria.htm>. Also, "Sudan's Special Weapons Guide," *Federation of American Scientists*. Available from <http://www.fas.org/nuke/guide/sudan/>. Accessed 20 March 2001.

<sup>27</sup> "Libya," *Federation of American Scientists* 13 April 2000. Available from <http://www.fas.org/irp/threat/missile/libya.htm>. Accessed 20 March 2001.

<sup>28</sup> "Sudan's Special Weapons Guide," *Federation of American Scientists*. Available from <http://www.fas.org/nuke/guide/sudan/>. Accessed 20 March 2001.

<sup>29</sup> Reuven Pedatzur. "A Superpower called Hizballah," *Ha'Aretz* English Internet Edition, 7 February 2001.

<sup>30</sup> "Katyusha," *The Probert Encyclopaedia (Weapons and Warfare)*. Available from <http://www.probert-encyclopaedia.com/F5.HTM>. Accessed 11 February 2001. "The Katyusha (Stalin's Organ) was a Russian free-flight rocket of the Second World War. It was fired from racks mounted in a heavy truck and had a range of about 5 km. Each truck had 48 launcher racks

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and a battalion could lay down an immense rapid-fire barrage. The rocket was 1.8 m long, 130 mm in diameter and weighed 42 kg complete with a 22 kg explosive warhead.”

<sup>31</sup> Rick Francona, *Ally to Adversary: An Eyewitness Account of Iraq's Fall From Grace*. Annapolis, Maryland: Naval Institute Press, 1999: 37.

## Chapter 4

### Chapter 4: Non-Confrontation States and Hegemonies

Referring to Secretary of Defense William S. Cohen's support for NMD...*Rumsfeld will be even more so. He'll be like Cohen on steroids.*<sup>1</sup>

—Joseph Cirincione  
*Director, Nonproliferation Project at the Carnegie Endowment for Peace*

The administration of President George W. Bush, Vice President Cheney, Secretary of State Powell, and Secretary of Defense Rumsfeld has a very strong military background, especially in missile defense (as the quote reflects on the perception of Secretary Rumsfeld's view of missile defense). This chapter will discuss the perspectives of countries that are not directly hostile to Israel as well as those friendly to Israel and the West. The list of countries discussed is not meant to be exhaustive, rather it highlights a few countries to show the global interest in missile defense. Specifically, Chapter 4 is divided into three sections: (1) regional non-confrontation states (Jordan and Turkey), (2) western-friendly countries (Japan, South Korea, and Holland), and (3) hegemonic or proto-hegemonic countries (US, China, Russia, United Kingdom, and India).

#### REGIONAL NON-CONFRONTATION STATES

**Jordan:** Jordanian officials have expressed concern that any conflagration between Israel and Iraq and/or Iran would mean that missile debris would be falling on its territory. Former Prime Minister Benjamin Netanyahu “reportedly offered Jordan a defensive umbrella of Arrow-2

missiles.”<sup>2</sup> Without forward deploying the AWS to Jordanian territory, debris is going to fall in Jordan. The problem becomes more difficult for Jordan when the warheads are not conventional. Without allowing Israel to forward deploy the AWS close to the Iraqi border or without allowing some other missile defense system in Jordan such as UAVs or aircraft with a TMD mission, Jordan will be caught between the warring states. The other option is for Israel to sell Jordan the AWS. This is most likely what former Prime Minister Netanyahu meant above. This possibility is also referred to in other news sources: “Last May [in 1999], Israel requested US approval for selling Arrow batteries to Turkey and Jordan, but no such approval has been given yet.”<sup>3</sup>

**Turkey:** Turkey is concerned about the proliferation of missiles in the Middle East just as Israel is. Turkey represents the closest NATO country to confrontation states such as Iraq and Iran (1300 km Shahab-3 covers most of Turkey). With these facts in mind, Turkey is also considering deploying a two tier missile system: “This would entail the attempted interception of an enemy missile high in the atmosphere by a long-range missile and a shorter range system will would seek to intercept the enemy missile as it descends towards its target.”<sup>4</sup> Turkey is also interested in Israel’s AWS, but has not decided what system it will purchase.

#### **WESTERN FRIENDLY COUNTRIES INTERESTED IN MISSILE DEFENSE**

The following countries are interested in missile defense, but are non-hegemonic countries in their respective regions of the world: Japan, South Korea and Holland.

**Japan and South Korea:** Both countries are interested in purchasing the Arrow system from Israel especially as a result of the launch of the Taepodong-1 by North Korea on 31 August 1998.<sup>5</sup> Oddly enough, the United Kingdom also expressed interest in the AWS in the same article. North Korea has been the biggest proliferator of ballistic missiles. Therefore, all countries aligned with the West in Asia feel the potential impact of North Korean missiles.

Those countries such as Japan and South Korea residing near North Korea feel this problem acutely. In a similar way, they are under the same threat as Israel is, except the animosity against Israel in the Middle East is more pervasive and has the history of several wars.

**Holland:** As recently as 5 November 1999, the Dutch have expressed interest “in the command and control system installed in the Israeli Arrow”<sup>6</sup> missile system. Holland is also a member of NATO.

### **HEGEMONIC AND PROTO-HEGEMONIC COUNTRIES**

The final section of chapter four discusses the perspective of hegemonic or potential hegemonic countries such as US, China, Russia, United Kingdom, and India. A recent report from the Director of Central Intelligence, George Tenet, states that the key suppliers of technology relating to WMD and advanced conventional weapons are Russia, North Korea, China, and some Western Nations; the same report also listed countries on the watch list that are trying to acquire technology relating to WMD and advanced conventional munitions—Iran, Iraq, North Korea, Libya, Syria, Sudan, India, Pakistan and Egypt. This paper will discuss more details about the activities of the two hegemonies listed in the key suppliers list: Russia and China.<sup>7</sup> This research paper has already mentioned seven of the nine countries in the later list (not included were North Korea and India). Note again that the same countries that are confrontation states to Israel are also the same ones pursuing WMD and ACM technologies and capabilities.

We begin this section with the US, a country friendly to Israel.

**United States:** Remarks given by Frank J. Gaffney, Jr., Director of the Center for Security Policy on 22 May 1991 to the Jewish Institute for National Security Affairs (JINSA) in Washington, D.C. ring true today as he made them just after the Gulf War:

Senior DoD officials have privately speculated that the “grand coalition” [during the Gulf War] would not have survived very long if *Europe* – as opposed to only Israel and Saudi Arabia – had been within range of Saddam’s missile force! Would that been any less true if the *United States itself had* been subjected to Iraqi blackmail? One can only imagine the dramatic arguments opponents of the war resolution in Congress would have used had they been able to argue that the consequences of conflict with Iraq would have been ballistic missile strikes on the United States! As a practical matter, in the absence of an American defense against such attacks, the first victim of blackmail backed by ballistic missiles may well have been the US defense commitment to Israel.<sup>8</sup>

These comments point out that as we march to the future of a world where rogue countries will be able to “reach out and touch” our allies or even our homeland, we need to consider the consequences of their new capabilities. Consequently, the US is becoming more interested in pursuing missile defense as well as western countries who get involved in conflicts around the world. Obviously, until this happens, the West has a one-time unique window of opportunity to figure out how to overcome this threat. This is one reason why I believe many countries are expressing interest in the Israeli Arrow program because it is the only working system on the market at this time. Consequently, Israel has a unique opportunity to exploit the current market before other countries and systems come on line.

Out of all of the major players on the world scene, the US appears to be the farthest along to creating a NMD. However, oddly enough, most Americans (73 %) already believe the US has a NMD.<sup>9</sup> The *Report of the Commission to Assess the Ballistic Missile Threat to the United States* (15 July 1998) chaired by the current Secretary of Defense, DONALD H. RUMSFELD, concluded that the US will be vulnerable in a few years to rogue states’ ballistic missiles. Therefore, the US needs to pursue a limited NMD program focused on protecting the US from these rogue states.<sup>10</sup> At the same time, most of US’ European allies as well as Russia and China do not want the US to pursue a NMD.<sup>11</sup> While Russia and Europe are expressing some doubts about the US NMD proposal, it is

odd that the first countries that will be in striking distance of these rogue states will be Russia and Europe.

**China:** China is strongly against the US' NMD program and claims the program will adversely affect relations in the future if the US pursues a NMD.<sup>12</sup> Taiwan's interest in its own NMD, in Israel's NMD project, and US pledges to Taiwan continue to strain relations between the US and China.<sup>13</sup> Another dimension to the missile defense debate is the fact that China and Russia are proliferators of missile and weapons technology, especially to many of the rogue states. China is not a member of the Missile Technology Control Regime (MCTR), however it has pledged not to sell MCTR Category I systems.<sup>14</sup> In effect, it is voluntarily following the MCTR as it interprets the various annexes.

With this in mind, the recently published *Proliferation: Threat and Response* provides an

Selected Chinese Proliferation Activity During the 1990s		
Recipient	Type Trade/Cooperation	Implication
Iran	Chemical precursor production technology and equipment.	Promotes Iran's effort to achieve a self-sufficient chemical warfare program.
Iran, North Korea, Libya, Pakistan	Missile-related items, raw materials, technical assistance.	Enhances recipient states' missile production efforts.
Iran	Small nuclear research reactor, zirconium production facility. Halted sale of uranium conversion facility.	Enhances Iran's knowledge of the nuclear fuel cycle. Slowed proliferation concerns.
Pakistan	Previous assistance with plutonium production reactor.	Assists Pakistan with effort to produce plutonium.
Pakistan	Supplied M-11 missiles.	Enhanced Pakistan's missile capabilities.

example of what China has provided to countries in the Middle East and South Asia:

**Figure 26 Chinese Proliferation of WMD and Missile Technology**

As can clearly be seen by the above figure and more recent reports, Chinese involvement in proliferating WMD and missile technology continues.

**Russia:** Russia, similar to China, is supplying many Middle Eastern countries, especially those confronting Israel, with missile systems and other military hardware. Russia has been

selling weapons to Middle East countries for a very long time. Most of the weapon systems that Israel faces are Russian made or variants thereof. In defense of the Russians, they sell their wares to states that have the hard currency.

The US appears to be concerned with Russian exports when they involve violations of the various treaties that Russia and the US have signed. Another area of US concern is when Russia sells weapon systems that affect the balance of power in the region. As Director of Central Intelligence (DCI) George Tenet “told the Senate Foreign Relations Committee...that Moscow continues to be a major arms proliferator to Iran and the Middle East.”<sup>15</sup> This concern was reinforced in the most recent DCI semi-annual report to the US Congress on the *Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions*:

Russian entities during the reporting period continued to supply a variety of ballistic missile-related goods and technical know-how to countries such as Iran, India, China, and Libya. Iran's earlier success in gaining technology and materials from Russian entities accelerated Iranian development of the Shahab-3 MRBM, which was first flight-tested in July 1998. Russian entities during the first six months of 2000 have provided substantial missile-related technology, training, and expertise to Iran that almost certainly will continue to accelerate Iranian efforts to develop new ballistic missile systems.

During the first half of 2000, Russian entities remained a significant source of dual-use biotechnology, chemicals, production technology, and equipment for Iran. Russia's biological and chemical expertise make it an attractive target for Iranians seeking technical information and training on BW-and CW-agent production processes.

Russia continues to be a major supplier of conventional arms. It is the primary source of Advanced Conventional Weapons (ACW) for China and India, it continues to supply ACW to Iran and Syria, and it has negotiated new contracts with Libya and North Korea, according to press reports.<sup>16</sup>

A concern with Russian arms sales is ballistic missile technology transfer. Technology transfer occurred when the USSR had sold Scud-Bs to Egypt and were used by Egypt against Israel in the 1973 October War.<sup>17</sup> In the early 1980s, Egypt and North Korea decided to work together to reverse engineer the Scud-B in North Korea; this is how the Scud-C was made and re-introduced into the Middle East from North Korea.<sup>18</sup> The Russians realized that if their Scud-

B was so popular, they could build an improved version within the guidelines of the MCTR and still make money. This is one of the reasons why the SS-21 was sold to ME countries and now the export version of the SS-26, Iskander-E, is being heavily marketed.

In March 2000, Russian officials announced that they would sell a multi-warhead missile that would be “capable of overcoming Israel’s new anti-missile system.”<sup>19</sup> This new missile system is called the Iskander-E (designed to be a competitor of the US Army’s Tactical Missile System): range 280 km, warhead weight 480 kg (“a cluster munition warhead [up to 54 bomblets], a fuel-air explosive enhanced-blast warhead, a tactical earth penetrator for bunker busting and an electro-magnetic pulse device for anti-radar missions,” high explosive, and probably biological and chemical warhead capable), world’s first two missiles on one TEL with at least one minute between each launch,<sup>20</sup> not dependent on satellites but is GPS/GLONASS/Inertial/Possibly IR Terminal Homing capable, optical seeker, all weather system, and attacks point and area targets.<sup>21</sup> The Iskander-E weapon designer, Nikolay Gushchin, reported that Russia plans to sell this missile weapon system to Algeria, Jordan, Kuwait, Syria, United Arab Emirates, Singapore, Vietnam, Malaysia, and South Korea.<sup>22</sup> This missile system is being touted as the “son of Scud” or the next generation of Scuds that Russia wants to sell—they could not sell the SS-23/Spider because of the INF treaty.<sup>23</sup>

**Figure 27 SS-26/Iskander-E Model and Photos<sup>24</sup>**





If Russia were able to sell this specific multi-warhead missile to its confrontation states, Israel's Arrow system would be ineffective against a missile that could deliver 54 separate bomblets. However, Israel's plan of attacking missiles prior to or during boost phase would defeat this missile system. Nevertheless, with the ability to possibly employ chemical or biological weapons on the warhead, this weapon system would be extremely deadly if it were ever used.

An on-going debate regarding the Iskander-E concerns its real capabilities, specifically its range. The Russian version has a 500 km range but the Russians claim that the export version is less than the 300 km maximum under MCTR. Although the Russians might sell the less than 300 km version, how much engineering would be required to make it 500 km or farther. With a warhead that is extremely accurate (*Janes* report a CEP within 30 meters<sup>25</sup>), Israeli strategic sites become more vulnerable. To reinforce the threat, the *CDISS* states that the advertised targets for the Iskander-E include the following:

- Hostile weapons fire (Surface-to-Air Missiles and missile batteries)
- Fixed and rotary-wing aircraft at parking areas
- Air and missile defense facilities
- Command posts and communications nodes
- Vital point and area targets
- Critical civilian facilities<sup>26</sup>

According to John Pike et al at the *Federation of American Scientists*, “even a small amount of such missiles drastically changes the balance of force in conflicts.”<sup>27</sup>

Although not mentioned in its list of countries to possibly buy the Iskander-E, Iraq would also be a possible purchaser of the missile. Iraq could acquire it directly or via one of the other nations on the list. One area of concern would be Iraq’s or another country’s (such as North Korea) ability to reverse engineer the warhead (chemical/biological bomblets) and place the warhead on one of Iraq’s existing systems. Another area of concern would be if the same were attempted with the Iskander-E targeting system so that other missiles systems would be more accurate.

Another interesting development since the beginning of the Bush Administration is the Russian attempt to try to sell its own concept of missile defense to Europe while claiming that the US NMD program would create a massive arms race.<sup>28</sup> This is another attempt by the Russians to try to compete in the highly competitive arms market.

**United Kingdom:** Even though relations between the UK and Israel have been tenuous over the years, the UK is one of the few countries that has faced a similar threat as Israel. During World War II, the UK was the victim of Germany's V-1, V-2 and almost V-3 projects.<sup>29</sup> England was able to shoot down some of the V-1 cruise missiles but was helpless against the V-2 ballistic missiles.<sup>30</sup>

As a member of NATO, the UK seems to be showing more interest in a TMD system, especially as Russia lessons its objections to the US' NMD concept. Oddly enough, the United Kingdom also expressed interest in purchasing the Israeli Arrow.<sup>31</sup>

**India:** In 1999, India desired to purchase the AWS,<sup>32</sup> however, as a result of the May 1998 India nuclear tests, India's ability to receive military technology from Israel was severely restricted due to US pressure. This pressure is not the same as the reasons why the US did not want Israel to sell the Phalcon AWACS to China (because it reportedly put US forces at a disadvantage in support of Taiwan), rather to discourage India's nuclear capabilities. It is interesting to note that India has also expressed interest in purchasing the Phalcon AWACS that China could not buy from Israel.<sup>33</sup>

Another relevant issue relating to Israel and India with respect to missile defense is the recent request by India to purchase the Barak-1 point defense missile (also called ADAM): "In January 2001 India placed a \$270 million order with Israel for the purchase of the Barak-1 point defense missile. (This is already in service with the Singaporean and South Korean navies.)"<sup>34</sup>

In chapter 1, the issue of strategically fighting non-state actors was briefly mentioned. As these non-state actors (terrorist and criminal elements) become more sophisticated and possibly acquire missiles, the ability of a state to deter, defend, or counter-attack is greatly diminished as has been seen in the use of Katyusha rockets by Hizballah in Lebanon against Israel. Israel will

need to develop new methods to deal with fighting non-state actors. This will also be a growing problem for the rest of the world as other similar groups begin to exploit cheap and effective asymmetric capabilities against states. Furthermore, in the near future, these weapons may be used with WMD warheads, giving any country a difficult decision on how to respond to non-state actors using such weapons. Hamas has already made statements that they will not rule out the use of chemical weapons in their struggle.<sup>35</sup> This will have to be an area of both technical innovation and strategic consideration especially considering the difficulty of determining who sent the weapon and who designed the WMD warhead.

### Notes

<sup>1</sup> “Rumsfeld a Mystery on Arms Shield,” *Boston Globe*, 11 January 2001 (quoted from *BMDO External Affairs Digest*, 11 January 2001, p. 1).

<sup>2</sup> “External Affairs – Jordan,” *Jane’s Sentinel Security Assessment - Eastern Mediterranean* – 9 January 2001. *Jane’s Online*.

<sup>3</sup> Dan Dagoni, “‘Defense News’: US May Withdraw Opposition to Turkey’s Incorporation in Arrow Project,” *Middle East News/Globes News Service* 27 April 2000 (published in *Israel’s Business Arena* on 23 April 2000).

<sup>4</sup> “External Affairs – Turkey,” *Jane’s Sentinel Security Assessment - Eastern Mediterranean* – 9 January 2001. *Jane’s Online*.

<sup>5</sup> Steve Rodan, “Israel Seeks US Partner for Arrow,” *Jane’s Defense Weekly*, 1 March 2000, Volume 033/009 and Joseph Cirincione, “The Persistence of the Missile Defense Illusion,” *Carnegie Endowment for International Peace*, 4 July 1998. Available from <http://www.ceip.org/programs/npp/bmd.htm>. Accessed 12 December 2000.

<sup>6</sup> “Dutch Interest in Israeli Arrow Missile,” *Israel Wire*, 5 November 1999.

<sup>7</sup> *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 2000*, Director of Central Intelligence Semi-Annual Report (delayed six months) February 2001. Available from [http://www.cia.gov/cia/publications/bian/bian\\_feb\\_2001.htm](http://www.cia.gov/cia/publications/bian/bian_feb_2001.htm). Accessed 21 March 2001.

<sup>8</sup> Frank J. Gaffney, Jr., “The Case for Ending US and Israeli Strategic Vulnerability,” *The Center for Security Policy* publication number 91-P 40 (Attachment), 22 May 1991. Available from <http://www.security-policy.org/papers/1991/91-P40at.html>. Accessed 4 November 2000.

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<sup>9</sup> “Missile Defense Apathy,” *St. Petersburg Times*, 10 January 2001 (quoted from *BMDO External Affairs Digest*, 11 January 2001, p. 1).

<sup>10</sup> Refer to the Rumsfeld Commission on Missile Defense Internet site/source?

<sup>11</sup> “Bush Courts Key Lawmakers for Support on Defense Goals,” *New York Times*, 9 January 2001 (quoted from *BMDO External Affairs Digest* 9 January 2001, p. 1).

<sup>12</sup> “China Fires Warning to New U.S. President,” *Reuters*, 9 January 2001 (quoted from *BMDO External Affairs Digest* 9 January 2001, p. 2).

<sup>13</sup> “China Fires Warning to New U.S. President,” *Reuters*, 9 January 2001.

<sup>14</sup> *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 2000*, Director of Central Intelligence Semi-Annual Report (delayed six months) February 2001. Available from [http://www.cia.gov/cia/publications/bian/bian\\_feb\\_2001.htm](http://www.cia.gov/cia/publications/bian/bian_feb_2001.htm). Accessed 21 March 2001.

<sup>15</sup> “Russia to Sell Multi-Warhead Missiles that Can Beat Israel’s New Anti-Missile System,” *World Tribune*, 23 March 2000. Available from <http://www.worldtribune.com/Archive-2000/eu-russia-03-23.html>. Accessed 6 January 2001.

<sup>16</sup> *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 2000*, Director of Central Intelligence Semi-Annual Report (delayed six months) February 2001. Available from [http://www.cia.gov/cia/publications/bian/bian\\_feb\\_2001.htm#13](http://www.cia.gov/cia/publications/bian/bian_feb_2001.htm#13). Accessed 21 March 2001. Other information related to Russia’s proliferation of nuclear materials in the Middle East include the following from the same report:

“Russia also remained a key supplier for civilian nuclear programs in Iran, primarily focused on the Bushehr Nuclear Power Plant project. With respect to Iran’s nuclear infrastructure, Russian assistance enhances Iran’s ability to support a nuclear weapons development effort. By its very nature, even the transfer of civilian technology may be of use in Iran’s nuclear weapons program. We remain concerned that Tehran is seeking more than a buildup of its civilian infrastructure, and the Intelligence Community will be closely monitoring the relationship with Moscow for any direct assistance in support of a military program.

“In January, Russia’s cabinet approved a draft cooperative program with Syria that included civil use of nuclear power. Broader access to Russian scientists could provide opportunities to solicit fissile material production expertise if Syria decided to pursue a nuclear weapons option. In addition, Russia supplied India with material for its civilian nuclear program during this reporting period. President Putin in May amended the presidential decree on nuclear exports to allow the export in exceptional cases of nuclear materials, technology, and equipment to countries that do not have full-scope IAEA safeguards, according to press reports. The move could clear the way for expanding nuclear exports to certain countries that do not have full-scope safeguards, such as India.”

<sup>17</sup> William C. Story, Jr. “Third World Traps And Pitfalls: Ballistic Missiles, Cruise Missiles, And Land-Based Air Power,” *School Of Advanced Airpower Studies*, Air University, Maxwell Air Force Base, Alabama, June 1994. Available from <http://www.fas.org/man/eprint/story.htm>. Accessed 21 March 2001. “One need only consider the uses of tactical ballistic missiles in the last 21 years to see how important they are becoming to Third World countries and regional

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powers. Egypt launched several hundred Scud-B and Frog 7 ballistic missiles at Israeli command posts in the Sinai during the opening hours of the 1973 Yom Kippur War. The attacks aimed to disrupt Israeli command and control. While few of the missiles struck their exact targets, their effect was almost as good as destroying a command post. One commander could not fly to his command post by helicopter because of the intermittent Scud and Frog attacks. He remained out of his headquarters during the key hours when the Egyptians crossed the Suez Canal and the Israelis organized their defenses and prepared to retreat.”

<sup>18</sup> A.K. Sachdev (Research Fellow, IDSA). “North Korea's Missile Programme: A Matter of Concern,” *Institute for Defense Studies and Analyses*, December 2000 Vol. XXIV No. 9. Available from <http://www.idsa-india.org/an-dec-00-7.html>. Accessed 21 March 2001. “The North Korea-Egypt connection probably took off in 1981 when the two entered into an agreement for technological co-operation and exchange including missile-related technologies; it was probably at this stage that Egypt provided North Korea with Scud B missiles. In 1983, the Iranian Prime Minister and Defence Minister visited North Korea to finalise arrangements for long term financing of North Korea 's Scud B development programme in exchange for purchase option on the missiles. A year later, the first successful test of a North Korean-built Scud B was conducted amidst speculation that it may have been the launch of an Egypt-supplied Scud B. During 1984, there were at least three Scud B tests from No Dong and by the next year, pilot production had begun and a special missile unit had been formed at To-Kol. Scud B production facilities were established near Pyongyang with an annual target of 50 missiles.

In 1987, Iran agreed to purchase 90-100 Scud B missiles (along with 12 TELs) from North Korea. Limited scale assembly of Scud B missiles is said to have begun in 1988 near Isfahan, Iran's ballistic missile plant, and all missiles on order delivered by February 1988. These were used during the "War of the Cities" from February 1988 to April 1988. North Korea 's own IV Corps received Scud B missiles in 1988.

The Scud C prototype was tested secretly during January 1987 in Hamgyong Namdo and production probably started in 1990. The first test-an unsuccessful one-was in early 1990, but a successful one followed in June 1990. Full scale production at the rate of 4-8 missiles a month was achieved by mid-1991. During this period, Egypt approached North Korea for help in upgrading Soviet Scud missiles held by Egypt, thus consummating the reverse-engineering cycle. Meanwhile, Iran extended its original arrangement and included the Scud C in its purchase order while seeking North Korea 's help in expanding the facility at Isfahan.”

<sup>19</sup> “Russia to Sell Multi-Warhead Missiles that Can Beat Israel’s New Anti-Missile System,” *World Tribune*, 23 March 2000. Available from <http://www.worldtribune.com/Archive-2000/eu-russia-03-23.html>. Accessed 6 January 2001.

<sup>20</sup> Sergei Sokut, “Iskander-E’s Guidance System Is A Combination Of Inertial With Radar Area Guidance.” Available from Found at [http://nvo.ng.ru/english/missile\\_system.html](http://nvo.ng.ru/english/missile_system.html). Accessed 21 March 2001.

<sup>21</sup> “Russia to Sell Multi-Warhead Missiles that Can Beat Israel’s New Anti-Missile System,” *World Tribune*, 23 March 2000. Available from <http://www.worldtribune.com/Archive-2000/eu-russia-03-23.html>. Other information on the SS-26 derived from “Iskander/SS-26,” *Federation of American Scientists*, 2 September 2000. Available from <http://www.fas.org/nuke/guide/russia/theater/ss-26.htm>. Accessed 6 January 2001.

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<sup>22</sup> “Russia to Sell Multi-Warhead Missiles that Can Beat Israel’s New Anti-Missile System,” *World Tribune*, 23 March 2000. Available from <http://www.worldtribune.com/Archive-2000/eu-russia-03-23.html>. Accessed 6 January 2001. He also added that older versions of this missile (Tochka tactical missile) were sold to Yemen and Syria.

<sup>23</sup> Grzegorz Holdanowicz, “Russia unveils Iskander-E, 'son-of-Scud' missiles,” *Jane’s Special Reports*, 2 November 2000. Available from [http://www.janes.com/defence/news/jidr/jidr001102\\_03\\_n.shtml](http://www.janes.com/defence/news/jidr/jidr001102_03_n.shtml). Accessed 20 March 2001.

<sup>24</sup> Photos from *Jane’s International Defense Review*, *Military Parade*, and *Federation of American Scientists*.

<sup>25</sup> Grzegorz Holdanowicz, “Russia unveils Iskander-E, 'son-of-Scud' missiles,” *Jane’s Special Reports*, 2 November 2000. Available from [http://www.janes.com/defence/news/jidr/jidr001102\\_03\\_n.shtml](http://www.janes.com/defence/news/jidr/jidr001102_03_n.shtml). Accessed 20 March 2001.

<sup>26</sup> “Russia Promotes Iskander-E Missile,” *Centre for Defence and International Security Studies* (CDISS - Lancaster University, UK), 19 August 1999. Available from <http://www.cdiss.org/99aug19.htm>. Accessed 21 March 2001.

<sup>27</sup> “Iskander/SS-26,” *Federation of American Scientists*, 2 September 2000. Available from <http://www.fas.org/nuke/guide/russia/theater/ss-26.htm>. Accessed 6 January 2001.

<sup>28</sup> Nikolai Sokov, “Russian Missile Defense for Europe: The February 20 Proposal is More Serious than It Seems,” *Center for Nonproliferation Studies*, Monterey Institute of International Studies, 14 March 2001. Available from <http://www.cns.miss.edu/pubs/reports/sokrmd.htm>. Accessed 21 March 2001.

<sup>29</sup> For more information on Germany’s V-3 and Super-Gun, see the *Secrets of War* series, episode “Super Guns” available at Available from <http://www.secretsofwar.com>. Covers the following: “From Germany’s Big Bertha in World War One to Iraq’s top secret Project Babylon, they are the ultimate projection of force... Secret cannons designed to strike their target from miles away, hand held rifles that pack the power of the atom and super guns capable of launching satellites into space...”

<sup>30</sup> James Adams, *Bull’s Eye: The Assassination and Life of Supergun Inventor Gerald Bull*, Times Books, London, UK, 1992. The V-3 project was Germany’s attempt to fire super-guns at London from the coast of France. Luckily for the UK, the site was bombed and Germany never attempted to fix or find another location for their super-gun. Gerald Bull who designed various super-guns for the United States, Canada, Chile, South Africa, and Iraq used this same super-gun concept.

<sup>31</sup> Steve Rodan, “Israel Seeks US Partner for Arrow,” *Jane’s Defense Weekly* 1 March 2000 Volume 033/009 and Joseph Cirincione, “The Persistence of the Missile Defense Illusion,” *Carnegie Endowment for International Peace*, 4 July 1998. Available from <http://www.ceip.org/programs/npp/bmd.htm>. Accessed 12 December 2000.

<sup>32</sup> Steve Rodan, “Arrow Missile Intercepts Incoming Target,” *Jane’s Defense Weekly* 20 September 2000.

<sup>33</sup> “Israel Aircraft Industries Arrow Weapon System (AWS),” *Jane’s Land-Based Air Defense* 2000-2001, 26 January 2000.

<sup>34</sup> “Procurement, India,” *Jane’s Sentinel Security Assessment - South Asia*, 26 Feb 2001.

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<sup>35</sup> Guermentes E. Lailari, "On the Razor's Edge: Israeli Domestic Counterterrorism Policy Against Islamic Extremists," Joint Military Intelligence College Master's Thesis, September 1999: 158.

## Chapter 5

### Chapter 5: Conclusions

*The simple truth of the matter is that the same lessons...in connection with Israeli interests in strategic defense are true in spades for the United States:*

*Being defended is better than not being defended.*

*Imperfect defense is better than no defense.*

*Offensive counter-fire is not necessarily a reliable means of either deterring an adversary from attacking with ballistic missiles or limiting the effectiveness of such an attack.*

— Frank J. Gaffney, Jr., “The Case for Ending US and Israeli Strategic Vulnerability,”  
*The Center for Security Policy*<sup>1</sup>

With the above quote from Frank Gaffney in mind, chapter 5 sums up the research presented and provides some concluding thoughts. Areas for further research were presented at the end of chapter 4 in the observation and recommendation section.

The desired general objective of the research was to discuss the strategic needs and military objectives in a particular region or country of how theater missile defense (TMD) supports or jeopardizes US National Missile Defense (NMD) strategy. From all the research conducted for this paper and after examining all the costs and benefits of an Israeli NMD, I would strongly recommend that the Israel, along with other friendly countries, and the US continue to work hard against the missile threat and overcome its tactical, operational, strategic effects. I have noted some possible abuses of this research, however, the gain of working together against a common enemy is far greater than the risks. Furthermore, these risks can be identified and monitored to

minimize their affects. The Israeli NMD gives the US a great opportunity to work closely with a friendly nation that faces threats US forces and other allies face in the region. By working with the US, Israel can accelerate its NMD program and potentially create another means to deter potential aggressors in the region.

### **GRAND STRATEGY**

Many analysts view the methodology of US policy of dealing with rogue states, especially with technology transfer, as using delaying and deterring methodologies.<sup>2</sup> W. Seth Carus explains these two methods as (1) delaying the development of WMD “though arms control, Cooperative Threat Reduction, and export controls” and (2) deterring the “use of such weapons, including theater missile defenses, biological and chemical defenses, and consequence management.”<sup>3</sup> However, the spectrum of options is actually broader. The author would like to propose that entire spectrums of options are available to include: (1) delay, (2) deter, (3) *destroy*, and (4) *defend*. The last two are added to remind us that *destroying* also acts to delay and deter. An example of this was Operation Babylon, when the Israeli Air Force attacked the Osirak nuclear reactor at Al Tuwaitha, near Baghdad on 7 June 1981.<sup>4</sup> The *destruction* certainly *delayed* Iraq’s ability to develop an indigenous nuclear capability. It also contributed to the success of the Gulf War since coalition forces did not have to worry about a nuclear capable Iraq which might have emboldened Iraq to use its chemical and biological weapons.

The last category added, *defend* are those actions taken to protect a nation during and after an attack such as passive defenses (gas masks, air tight bomb shelters, etc), active defenses (TMD) and consequence management actions of minimizing further casualties and making a contaminated area safe.

### **CONCLUSION OF PAPER**

The US support of Israel's NMD not only benefits Israel, it also is self-serving; Israel's faces the same threat as US forces and other allies face in the region. The US faces the similar ballistic missile threat in other regions of the world such as Asia (North Korea). Many allies of the US have or will have WMD in their arsenals. By providing these countries the option to defend themselves against an aggressor who chooses ballistic missiles to attack, missile defense is a way to give our allies another option—instead of immediately responding with a counter-force weapon.

The strategic advantage in the *Homa* project lies in creating doubt in an enemy's mind that a surprise strike may not work. It “increases the flexible response capability of the [Israeli] General Staff and the [Israeli] government by not forcing them into deciding on a preemptive attack.”<sup>5</sup> On the other hand, missile defense is essentially a defensive program. It should not be pursued at the expense of degrading conventional nor counter-strike capabilities. Israel cannot win a war with Patriot and Arrow missiles alone. However as more and more countries, especially its enemies acquire advanced missile technology and WMD, Israel will depend more and more on its missile defense as it decides how it will react to or pre-empts its enemies. Nevertheless, these systems do provide military, economic, and political benefits. Investments in UAV and missile technologies not only help missile defense, but also in other capabilities such as reconnaissance, targeting, and even combat (unmanned combat aerial vehicle). In the economic arena, Israel can sell these new systems to mutual allies and friends. Finally, missile defense weakens the political power of Israel's enemies by denying them the ability to strike at Israel and strengthens Israel's political power because it has a functioning NMD program which provides most of Israel's population a layered missile defense system—no other country has this capability at this time.

Given all of the positive benefits of an Israeli missile defense program, it will inevitably drive its enemies to find new ways to attack. These countries could try a variety of techniques to defeat Israel's missile defense: (1) mass—work on overwhelming the missile defense system by increasing the quantity of launchers and missiles, (2) deception—developing technical means to deceive missile defenses, (3) surprise—developing cruise missiles that deny Israel detection of the attack, and/or (4) asymmetric warfare—using trucks, terrorists, or even small boats to attack Israeli targets. While Israel focuses its energy in one area such as missile defense, others are designing another technique.

For every attempt to counter one technique, the other side is developing another counter. This is the cycle of warfare. Israel has many strategic threats to include terrorism, long-range missiles, non-conventional weapons, Islamic radicalism, and internal instability. The US faces or could face similar threats. The key for both countries is to stay ahead of their enemies in the right areas to avoid a Pearl Harbor or in Israeli terms, another Yom Kippur War.

## Notes

<sup>1</sup> Frank J. Gaffney, Jr., “The Case for Ending US and Israeli Strategic Vulnerability,” *The Center for Security Policy* publication number 91-P 40 (Attachment), 22 May 1991. Available from <http://www.security-policy.org/papers/1991/91-P40at.html>. Accessed 4 November 2000.

<sup>2</sup> W. Seth Carus. *Iran and Weapons of Mass Destruction*. New York, New York: The American Jewish Committee, June 2000: 14.

<sup>3</sup> W. Seth Carus. *Iran and Weapons of Mass Destruction*. New York, New York: The American Jewish Committee, June 2000: 14. According to *Proliferation: Threat and Response* January 2001, p. 104: **Consequence Management** is “actions taken to respond and assist in the mitigation of damage and collateral hazards from the deliberate employment or accidental release of chemical, biological, radiological, or nuclear materials or high-yield conventional explosive weapons in a domestic or foreign environment.”

<sup>4</sup> Dan McKinnon. *Bullseye One*. New York, New York: Berkley Books, 1987: 1 and Amos Perlmutter, Michael Handel, and Uri Bar-Joseph. *Two Minutes over Baghdad*. London, England: Corgi Books, 1982: 17.

<sup>5</sup> Amir Oren, “Arrow: Ready for any Crisis,” *Ha’Aretz News* Internet Edition, 16 September 2000.

## Appendix A

### Appendix A: Israeli Missile System Capabilities

Missile Data from the Federation of American Scientists ([www.fas.org](http://www.fas.org)):

#### **HAWK System:**<sup>1</sup>

The HAWK surface to air missile system provides medium-range, low to medium altitude air defense against a variety of targets, including jet and rotary wing aircraft, unmanned aerial vehicles, and cruise missiles. This mobile, all-weather day and night system is highly lethal, reliable, and effective against electronic countermeasures. The Hawk was originally named for the predatory bird but later the name was turned into an acronym for "Homing All the Way Killer."

The HAWK system has provided US forces with low to medium altitude air defense for the past forty years. The Hawk System has been the Marine Corp's primary air defense since the early 1960's. Basic HAWK was developed in the 1950s and initially fielded in 1960. The system has been upgraded through a series of product improvements beginning with the Improved HAWK in 1970. The Phase III product improvement and the latest missile modification were first fielded in the early 1990s to the US Army and US Marine Corps (USMC). The system has maintained it's effectiveness against succeeding generations of high technology aircraft through periodic preplanned product improvement programs. An evolving system, HAWK is now in its Phase III configuration with research and development underway to obtain a tactical missile defense capability.

This success lead many NATO countries to adopt HAWK as a primary air defense weapon. Today, HAWK systems are in the arsenals of over fifteen countries, including most of NATO countries. In the coming years, HAWK will continue its prominent position by undergoing system upgrades to allow it to deal with the changing nature of the battlefield threat.

Although HAWK missile batteries were deployed by the US Army during the conflicts in Vietnam and Persian Gulf, American troops have never fired this weapon in combat. The first combat use of HAWK occurred in 1967 when Israel successfully fired the missiles during the Six Day War with Egypt. Even though it was not used by the coalition during Operation Desert Storm, the HAWK missile did see action during the Persian Gulf War. Kuwaiti air defense units equipped with US HAWK anti-aircraft missiles downed about 22 Iraqi aircraft and one combat helicopter during the invasion of 2 August 1990.

Current developments will provide an engagement capability against Tactical Ballistic Missiles (TBM). The US Marine Corps and the Ballistic Missile Defense Organization (BMDO) have jointly funded improvements to the Marine Corp's HAWK system. The HAWK has been

modified and tested to intercept short-range ballistic missiles. Because HAWK is a well established system, the current program of upgrades and enhancements is seen as a low risk, near-term missile defense solution against short-range ballistic missiles and other airborne threats such as aircraft or unmanned aerial vehicles. In this role, HAWK can be considered a lower-tier missile defense system. All US HAWK systems are owned and operated by the Marine Corps and, as the Marine's only ballistic missile defense system, it will be relied on to protect Marine expeditionary forces. In September 1994, two LANCE target missiles were successfully intercepted by the modified HAWK system in an operational test by Fleet Marine Forces at White Sands Missile Range, New Mexico. By the end of 1997 over one third of the active Marine Corps HAWK equipment has been modified to provide a basic, short-range tactical ballistic missile defense (TBMD) for expeditionary Marine forces. The entire fleet inventory was modified by the end of 1998 year.

Units with HAWK missiles are teamed with acquisition radar, a command post, a tracking radar, an Identification Friend or Foe (IFF) system, and three to four launchers with three missiles each. The system can be divided into three sections: acquisition, fire control, and firing sections. Target detection is provided to the fire control section from pulse and continuous wave radars for engagement evaluation. Target data can also be received from remote sensors via data link. The fire control section locks onto the target with high-powered tracking radar. A missile or missiles can be launched manually or in an automatic mode from the firing section by the fire control section. Radars and missile have extensive electronic counter counter measures (ECCM) capabilities.

The HAWK Fire Unit is the basic element of the HAWK system.. The actual firing battery has two identical fire units, each consisting of a command post that houses the operator console, a continuous wave acquisition radar (CWAR) for target surveillance, a high power illuminator for target tracking, MK XII IFF interrogator set, and three launchers with three missiles each. Normally the HAWK is deployed in a battalion configuration, communicating with the controlling unit (usually a TSQ-73 Missile Minder) over an Army Tactical Data Link (ATDL-1) connection as well as on voice.

The TSQ-73 Missile Minder Fire Direction Center (FDC) is the system used for the Army HAWK Battalion and Air Defense Brigade. The TSQ-73 supplies command, control and communications for the Army fire units (both Patriot and HAWK) and provides a link to the Air Force C3I units (MCE and AWACS). The Brigade and HAWK battalion units rely on information passed over the data links to produce a comprehensive air picture, while the HAWK battalion can also deploy the Pulse Acquisition Radar (PAR) to generate its own air picture. With the command and control of Army fire units being moved to the Information Coordination Center (ICC) and Army ADTOC (Air Defense Tactical Operations Center), the TSQ-73 is gradually being phased out over the next several years. However, it still plays a vital role in the coordination of SAM assets into the integrated theater air defense environment.

The new HAWK systems will be composed of three major components: the TPS-59 radar, the HAWK launcher and HAWK missiles, and the Air Defense Communications Platform (ADCP). The TPS-59 radar provides target detection, discrimination, and tracking. The HAWK launcher transports, protects and launches the missiles. Each HAWK launcher can carry up to three missiles. HAWK missiles use radar guidance and destroy their targets in proximity explosions. Finally, the ADCP will connect the TPS-59 with the HAWK and the remainder of the theater missile defense architecture in order to create missile defense in depth. Under the

current program, the TPS-59 radar and the HAWK launcher and missiles are being upgraded, while the Air Defense Communications Platform [ADCP] will be a new addition.

The most prominent upgrade to the HAWK system includes modifying the Marine Corps primary air surveillance radar, the TPS-59. The AN/TPS-59 Radar Set is a Marine Air Command & Control System which serves as the primary sensor for the Marine Air Ground Task Force (MAGTF), providing air target information and raw video to the Tactical Air Operations Module (TAOM). It can also be forward-deployed as a stand-alone remote sensor and air traffic controller. The improved radar will detect theater ballistic missiles out to 400 nautical miles and up to 500,000 feet in altitude. These improvements will give the radar the sort of surveillance and tracking ability needed for theater ballistic missile defense (TBMD). The first units were equipped with upgraded TPS-59s in FY98.

The Air Defense Communications Platform, an entirely new addition to the HAWK system, will link the TPS-59 to the HAWK battery and will also transmit formatted data to other theater sensors. This will allow the HAWK to communicate with other TBMD systems through the Joint Tactical Information Distribution System. These links will allow the air defense commander to cue HAWK with other missile defense systems and integrate the HAWK into the theater missile defense architecture. The ADCP is fully developed, and began production in FY97.

The HAWK missile and warhead were modified to allow the HAWK to better engage enemy ballistic missiles. Specifically, the upgrade improved the HAWK's missile fuse and warhead which resulted in an "improved lethality missile." Additionally, improvements to the launcher made the HAWK more mobile and better able to interface with the missiles.

These new HAWK systems underwent extensive testing. In August of 1996, a single Marine Corps battery equipped with upgraded HAWK systems intercepted and destroyed a LANCE short range theater ballistic missile and two air breathing drones simultaneously in an operational test at White Sands Missile Range, NM. When fielded, the upgraded TPS-59 radars and ADCPs will belong to the Marine Air Control Squadrons, part of the Marine Air Wings.

## Specifications

<b>Service</b>	Marine Corps
<b>Contractor</b>	Raytheon
<b>Mission</b>	surface-to-air missile defense
<b>Targets</b>	
<b>Length</b>	12.5 feet (3.81 meters)
<b>Diameter</b>	13.5 inches (3.84 centimeters)
<b>Weight</b>	1400 pounds (635 kilograms)
<b>Range</b>	Officially: 14.9 miles (24 kilometers) 40 km, in excess of 20 NM
<b>Speed</b>	Officially: Supersonic 800 m/sec, in excess of mach 2.4
<b>Altitude</b>	Officially: 30,000 feet (9.14 kilometers) in excess of 60 KFT
<b>Propulsion</b>	Solid propellant rocket motor
<b>Guidance system</b>	Radar directed semi-active homing
<b>Warheads</b>	One 300 pound (136.2 kg) high explosive missile
<b>Type of fire</b>	Operator directed/automatic modes
<b>Magazine capacity</b>	48 missiles/battery

<b>Missile guidance</b>	Semi-active homing
<b>Target detection</b>	Continuous wave radar and pulse acquisition radars
<b>Target tracking</b>	
<b>Sensors</b>	High power continuous wave radar (HIPIR) Continuous wave acquisition radar (CWAR) Pulse Acquisition Radar (PAR) and passive optical scan
<b>Transport</b>	C-130/C-141/C-5 and heavy lift helo (extended load) One Light Antiaircraft Missile Battalion in each Marine Air Control Group of each Marine Air Wing (two active, one Reserve).
<b>Deployment</b>	Firing Platoon: 2 Fire sections of up to 3 Launchers per (1) PAR and (1) CWAR 3 missiles per launcher
<b>Units</b>	2 active duty and 1 reserve Light Anti-aircraft Missile Battalion
<b>Crew</b>	<i>Officer:</i> 2 <i>Enlisted:</i> 49
<b>Program status</b>	Operational
<b>First capability</b>	Air Defense - 1962 Missile Defense -
<b>Quantity</b>	total inventory is 37,000 missiles
<b>Development cost</b>	
<b>Production cost</b>	
<b>Total acquisition cost</b>	
<b>Acquisition unit cost</b>	
<b>Production unit cost</b>	
<b>Unit Replacement Cost</b>	\$250,000 per missile \$15 million per fire unit \$30 million per battery



Hawk Missile



Hawk Radar

## **Patriot TMD<sup>2</sup>**

Patriot can be transported worldwide via C5 cargo plane. Built in diagnostic software; the computer tells you what's wrong with the system, making maintenance and repair much easier. Patriot battalions can interface with Hawk battalions and with the Air Force AWACS.

### *Major Components*

1. Phased array radar. Its beam is electronically aimed at a different piece of the sky every few microseconds. No moving parts. Extremely difficult to jam.

2. Engagement Control Station (ECS). Where the computer and the operators fight the air battle. Man-machine interaction options here can range from letting the computer assist in target identification and prioritization to leaving the ECS and letting the computer fight the entire air battle itself.

3. 6 to 8 missile launchers. Missiles come factory packed in containers which are loaded directly onto the launcher. The Launcher can be located up to 1 kilometer away from the ECS/Radar, receiving commands automatically via microwave data link.

4. Patriot missile. Achieves supersonic speed within 20 ft of leaving the launcher. Range: 100+ km. It can outmaneuver any manned aircraft and most missiles. It is controlled in flight automatically by the computer.

Patriot-unique equipment at the Headquarters and Headquarters Battery (HHB) includes the information and coordination central (ICC), communications relay groups (CRGs), antenna mast groups (AMGs), trailer mounted electric power units (EPUs), and guided missile transporters (GMT). The Patriot firing battery equipment includes the AMG, radar set (RS), engagement control station (ECS), truck mounted electric power plant (EPP), and up to sixteen launching stations (LSs). Both the battalion and firing batteries are equipped with a semitrailer maintenance center.

(1) The ICC is manned during air battle operations and provides necessary command and control links to interface with higher echelon, lateral and subordinate battalions, and its own firing units.

(2) The ECS is the only manned station in the battery during the air battle and is the operations control center of the Patriot battery. The ECS contains the weapons control computer (WCC), man/machine interface and various data and communication terminals. Its prime mover is a 5-ton tactical cargo truck.

(3) The RS is a multifunction, phased-array radar mounted on an M860 semitrailer. The prime mover is an M983 10-ton heavy expanded mobility tactical truck (HEMTT) tractor.

(4) The LS is a remotely operated, fully self-contained unit, carrying integral on-board power. The launcher is mounted on an M860 semitrailer towed by a M983 HEMTT 10-ton tractor. Each LS may be loaded with four PAC-2 missile rounds (MRs), or 16 PAC-3 missile rounds if the LS is PAC-3 modified. The MR consists of a Patriot missile mounted within a sealed aluminum canister that functions both as a shipping and storage container and as a launch tube. Canisters are either single or 4-packs and are mounted two by two on the launcher.

(5) The CRG provides a multi-routed, secure, two-way data relay capability between the ICC and its assigned fire units and adjacent units. The CRG also provides the capability for both data and voice exit and entry point communications with elements external to the Patriot ADA battalion.

(6) The AMG consists of four ultra high frequency (UHF) antennas used for communications between the ICC, CRG, ECS and adjacent units and or higher echelons. The AMG can be remotely controlled in azimuth from within the ECS.

(7) The EPP consists of two 150-kw generator sets, a power distribution unit (PDU), cables, and accessories mounted on a modified HEMTT. The PDU is stored between the generators and contains a parallel powerbus and power contractors to supply prime power to the ECS and RS.

Testing of Patriot's response to a unique, advanced electronic countermeasure (ECM) technique exposed an air defense system weakness and recommended corrective measures. Over 155 Patriot surveillance investigations and 6 missile firings were completed in extensive ECM environments consisting of stand-off jamming, selfscreening jamming, and chaff.

In February 1995, the US Army took delivery of the first PATRIOT Advanced Capability-2 (PAC-2) Guidance Enhanced Missile (GEM). The GEM incorporates improvements to the front end of the PAC-2 missile receiver to enhance its effectiveness and lethality against SCUD-class ballistic missiles. The US Army will field about 350 PAC-2 GEM missiles.

### **Patriot Advanced Capability-3 (PAC-3)**

Patriot Advanced Capability-3 (PAC-3) is a high/medium advanced surface-to-air guided missile air defense system. PAC-3 is a major upgrade to the Patriot system. The PAC-3 Operational Requirements Document (ORD) represents the Army Air Defense need to buy back required battlespace lost against the current and evolving tactical missile and air breathing threat. PAC-3 is needed to counter/defeat/destroy the 2008 threat and to extend Patriot's capabilities to accomplish new/revised missions.

The PAC-3 Program consists of two interrelated acquisition programs - The PAC-3 Growth Program and the PAC-3 Missile Program. The Growth program consists of integrated, complementary improvements that will be implemented by a series of phased, incrementally fielded material changes. The PAC-3 Missile program is a key component of the overall improvements of the Patriot system, it will provide essential increases in battlespace, accuracy, and kill potential.

PAC-3 is a much more capable derivative of the PAC-2/GEM system in terms of both coverage and lethality. The PAC-3 has a new interceptor missile with a different kill mechanism - rather than having an exploding warhead, it is a hit-to-kill system. The PAC-3 missile is a smaller and highly efficient missile. The canister is approximately the same size as a PAC-2 canister but contains four missiles and tubes instead of a single round. Selected Patriot launching stations will be modified to accept PAC-3 canisters.

The Battalion Tactical Operations Center (BTOC) is an M900 series 5-ton expandable van that has been modified by the addition of data processing and display equipment, and utilized by the battalion staff to command and control the Patriot battalion. The BTOC allows the staff to perform automated tactical planning, communications link planning, and to display situational awareness information.

In the 1997 budget DOD added about \$230 million for the PAC-3 through the Future Years Defense Program (FYDP) and established a realistic schedule to lower the program execution risk by extending the engineering and manufacturing development (EMD) phase of the program by ten months. System performance will be improved by re-phasing the missile and radar procurements; upgrading three launchers per battery with Enhanced Launcher Electronics Systems; and extending the battery's remote launch capability. PAC-3 Low-Rate Initial Production (LRIP) will begin in the second quarter of fiscal year 1998, and the First Unit

Equipped (FUE) date is planned for the fourth quarter of fiscal year 1999. The FUE capability will consist of 16 missiles and five radars which will be placed in one battalion. As of 1996, in addition to funds being programmed for the Ballistic Missile Defense Organization, the Army planned to spend \$9.6 billion for all planned purchases of Patriot missiles, \$490 million for modifications and \$335 million for product improvements.

	<b>Specifications</b>		
	<b>PAC - 1</b>	<b>PAC - 2</b>	<b>PAC - 3</b>
<b>Type</b>	Land-mobile, surface-to-air guided weapon system	Single-stage, low-to-high-altitude	Single-stage, short-range, low-to high-altitude
<b>Length</b>	5.3 m	5.18 m	5.2 m
<b>Diameter</b>	41 cm	41 cm	25 cm
<b>Wingspan</b>		92 cm	50 cm
<b>Fins</b>	four delta shaped fins		
<b>Launch Weight</b>	914 kg	900 kg	312 kg
<b>Propulsion</b>	Single-stage solid propellant rocket motor	Single-stage solid propellant rocket motor	Single-stage solid propellant rocket motor with special attitude-control mechanism for in-flight maneuvering
<b>Guidance</b>	Command guidance and semi-active homing, track-via-missile (TVM)	Command guidance with TVM and semi-active homing	Inertial/Active millimeter-wave radar terminal homing
<b>Warhead</b>	HE single 90 kg	91 kg HE blast/fragmentation with proximity fuze	hit-to-kill + lethality enhancer 73 kg HE blast/fragmentation with proximity fuze]
<b>Max speed</b>	Supersonic (in excess of Mach 3)	Mach 5	Mach 5
<b>Max range</b>	70 km	70-160? km	15 km
<b>Min range</b>	NA	3 km	--
<b>Max attitude</b>	NA	24 km	15 km
<b>Time of flight</b>		minimum nine seconds maximum three and a half minutes	

<b>Launcher</b>	four-round Mobile trainable semi-trailer	eight-round Mobile trainable semi-trailer	
<b>Manufacturer</b>	Raytheon	Raytheon (Prime contractor), Lockheed, Siemens, Mitsubishi.	Lockheed Martin Vought Systems
<b>Status</b>	Not in production	In production	Under Development



Patriot PAC-2



Patriot PAC-3

### **Arrow Weapon System:**<sup>3</sup>

Israel began work on a potential theater missile defense (TMD) system in 1986, with the signing of a Memorandum of Understanding (MOU) with the United States. While the threat posed by ballistic missiles has been a concern for Israel since the mid-1980s, Iraqi ballistic missile attacks during the Gulf War underscored the danger posed by the buildup of missile technology in the region. Given the lack of available Israeli resources for TMD development, the United States agreed to co-fund and co-develop an indigenously-produced Israeli TMD system. In 1988, the US and Israel began what was to evolve into a three-phase program to develop the ARROW series of Anti-Tactical Ballistic Missiles (ATBMs).

Arrow II is intended to satisfy the Israeli requirement for an interceptor for defense of military assets and population centers and will support US technology base requirements for new advanced anti-tactical ballistic missile technologies that could be incorporated into the US theater missile defense systems. The Arrow missile, a joint international project with Israel, is a long-range interceptor that offers the United States technology infusion, including lethality data; development of optical window technology applicable to both THAAD and Navy Area Defense programs; data from stage separation at high velocities and dynamic pressures; and, interoperability development that will allow synergistic operations of Arrow with US TMD systems, if required in future contingencies.

The Citron Tree battle management center, built by Tadiran, guides the Arrow 2 interceptor, developed by Israel Aircraft Industries' MLM Division. The entire anti-tactical ballistic missile project is called Homa.

The Arrow 2 system can detect and track incoming missiles as far away as 500 km and can intercept missiles 50-90 km away [some sources suggest the engagement range is 16 to 48km]. The Arrow 2 uses a terminally-guided interceptor warhead to destroy an incoming missile from its launch at an altitude of 10 to 40km at nine times the speed of sound. Since the missile does not need to directly hit the target--detonation within 40-50 meters is sufficient to disable an incoming warhead. The command and control system is designed to respond to as many as 14 simultaneous intercepts.

Comprised of three phases, this initiative began with the **Arrow Experiments** project (Phase I) that developed the preprototype Arrow I interceptor. Arrow I provided the basis for an informed GOI engineering and manufacturing decision for an ATBM defense capability.

The Phase II **ARROW Continuation Experiments (ACES)** Program was a continuation of Phase I, and consisted of critical lethality tests using the Arrow I interceptor with the Arrow II warhead and the design, development and test of the Arrow II interceptor. The first phase of ACES, completed in the third quarter FY 94, featured critical lethality tests using the Arrow I interceptor with the Arrow II warhead. Since program initiation in 1988, Israel successfully improved the performance of its pre-prototype Arrow I interceptor to the point that it achieved a successful intercept and target destruction in June 1994. The ACES resulted in a successful missile target intercept by a single stage ARROW-1 interceptor. The second phase of ACES consisted of the design, development and test of the Arrow II interceptor, which achieved two successful intercepts of simulated SCUD missiles on August 20, 1996 and March 11, 1997. The ACES Program ended in FY 1997, upon the completion of ARROW intercept tests.

The third phase is the **Arrow Deployability Project (ADP)**, which began in FY96, aimed at integrating the entire ARROW Weapon System (AWS) with a planned User Operational Evaluation System (UOES) capability. Continuing through 2001, the ADP will be the

cornerstone for US/Israeli BMD cooperation. The Arrow Deployability Program involves a total commitment of \$500 million over five years, with \$300 million contributed by Israel and \$200 million from the United States. This will allow for the integration of the jointly developed Arrow interceptor with the Israeli developed fire control radar, launch control center and battle management center. This project will pursue the research and development of technologies associated with the deployment of the Arrow Weapon System (AWS) and will permit the GOI to make a decision regarding deployment of this system without financial participation by the US beyond the R&D stage. This effort will include system-level flight tests of the US-Israeli cooperatively developed Arrow II interceptor supported by the Israeli-developed fire control radar and fire control center.

After US planning activities in FY 94/95, the Arrow Deployability Project (ADP) pursued the research and development of technologies associated with the deployment of the Arrow Weapon System and to permit the Government of Israel to make a decision on its own initiative regarding deployment of this system without financial participation by the US beyond the R&D stage. This effort included three system-level flight tests of the Arrow II interceptor and launcher supported by the Israeli-developed fire control radar and battle management control center. Studies will be done to define interfaces required for Arrow Weapon System interoperability with US TMD systems, lethality, kill assessment and producibility.

Prior to obligation of funds to execute ADP R&D efforts, the President must certify to the Congress that a Memorandum of Agreement (MOA) exists with Israel for these projects, that each project provides benefits to the US, that the Arrow missile has completed a successful intercept, and that the Government of Israel continues to adhere to export controls pursuant to the Missile Technology Control Regime (MTCR). Subsequent US-Israeli cooperative R&D on other ballistic missile defense concepts would occur in the future.

Although there is a general policy of denial for Category I missile programs as defined in the the Missile Technology Control Regime (MTCR) guidelines, an exception has been made for the Arrow theater missile defense program. In the Arrow program, the challenge the United States faces is to transfer capabilities to defend against missile attacks without releasing technologies for manufacturing missiles.

In a test in September 1998 the Arrow 2 simulated an intercept against a point in space 97 seconds after being fired from the Palmachim military base south of Tel Aviv. The first integrated intercept flight test was successfully conducted in Israel on 01 November 1999. The Green Pine radar detected a Scud-class ballistic target and the Citron Tree battle management center commanded the launch of the Arrow II interceptor and communicated with it in-flight to successfully destroy the incoming missile.

An interface has been developed and delivered in Israel for AWS interoperability with US TMD systems based on a common JTIDS/Link-16 communications architecture and message protocol. The BMDO-developed Theater Missile Defense System Exerciser (TMDSE) will conduct interactive simulation exercises to test, assess, and validate the JTIDS-based interoperability between the AWS and US TMD systems. Once the TMDSE experiments are completed in FY01, the AWS will be certified as fully interoperable with any deployed US TMD systems.

Israel plans to defend itself against short- and medium-range ballistic missile attacks with two Arrow 2 batteries located at only two strategic sites. The first pair of Arrow Weapon System (AWS) batteries was deployed in Israel in early 2000. Israel deployed several batteries of Arrow-2 anti-missile missiles [according to some reports along the Israeli- Lebanese borders], with the

newly developed missile defense system entering operation on 12 March 2000. According to its original 1986 schedule, the Arrow system was supposed to enter operational service in 1995.

Israel had originally planned to deploy two Arrow 2 batteries but has since sought and won promises of funding for a third battery. The US Congress approved the funding of \$81.6 million toward the cost of a third batteries. Each battery reportedly costs about \$170m.

The joint US-Israeli project, which includes missiles, interceptor launcher batteries, the Green Pine radar and the Citron Tree fire-control system, cost \$1.3 billion to develop. The final bill is expected to be double the billion dollars spent so far. This cost could be reduced if the Arrow 2 is sold to other countries which have expressed interest - such as Great Britain, Turkey, Japan and reportedly India.

Arrow-2 Test Launch (20 February 1996)



## Tactical High Energy Laser (THEL) ACTD:<sup>4</sup>

The cooperative Tactical High Energy Laser (THEL) Demonstrator ACTD was initiated by a memorandum of agreement between the United States and the Government of Israel on 18 July 1996. The THEL is a high-energy laser weapon system that uses proven laser beam generation technologies, proven beam-pointing technologies, and existing sensors and communication networks to provide a new active defense capability in counterair missions. The THEL can provide an innovative solution not offered by other systems or technologies for the acquisition and close-in engagement problems associated with short- to medium-range threats, thereby significantly enhancing coverage of combat forces and theater-level assets. The THEL low-cost per kill (about \$3,000 per kill) will also provide a cost-effective defense against low-cost air threats. It features up to 60 shots without reloading and a P(k) near 1 at ranges of some 5 km.

A joint US-Israeli program has been initiated to develop a THEL demonstrator using deuterium fluoride chemical laser technologies. The US and Israeli THEL team members have completed a Concept Design Review in Israel for the demonstrator. Approximately 21 months will be required to design and build the system, followed by 12 to 18 months of field testing at the High Energy Laser Systems Test Facility in Israel. This program will deliver a THEL Demonstrator by March 1998 with a limited operational capability to defend against short-range rockets. The THEL weapon system concept definition studies using advanced technologies were awarded to four contractors on 30 September 1996. The prime contractor for THEL is TRW.

THEL conducted test firing in FY1998, and Initial Operational Capability (IOC) was planned in FY1999.



## **Airborne Laser (ABL):<sup>5</sup>**

The ABL weapon system will use a high-energy, chemical oxygen iodine laser (COIL) mounted on a modified 747-400F (freighter) aircraft to shoot down theater ballistic missiles in their boost phase. A crew of four, including pilot and copilot, will operate the airborne laser, which will patrol in pairs at high altitude, about 40,000 feet. The jets will fly in orbits over friendly territory, scanning the horizon for the plumes of rising missiles. Capable of autonomous operation, the ABL will acquire and track missiles in the boost phase of flight. A tracking laser beam will illuminate the missile, and computers will measure the distance and calculate its course and direction. After acquiring and locking onto the target, a second laser - with weapons-class strength - will fire a three- to five-second burst from a turret located in the 747's nose. The missiles will be destroyed over the launch area.

The airborne laser will fire a Chemical Oxygen Iodine Laser, or COIL, which was invented at Phillips Lab in 1977. The laser's fuel consists of the same chemicals found in hair bleach and Drano - hydrogen peroxide and potassium hydroxide - which are then combined with chlorine gas and water. The laser operates at an infrared wavelength of 1.315 microns, which is invisible to the eye. By recycling chemicals, building with plastics and using a unique cooling process, the COIL team was able to make the laser lighter and more efficient while - at the same time - increasing its power by 400 percent in five years. The flight-weighted ABL module will be similar in performance and power levels to the multi-hundred kilowatt class COIL Baseline Demonstration Laser (BDL-2) module demonstrated by TRW in August 1996. As its name implies, though, it will be lighter and more compact than the earlier version due to the integration of advanced aerospace materials into the design of critical hardware components. For the operational ABL system, several modules will be linked together in series to achieve ABL's required megawatt-class power level.

Atmospheric turbulence, which weakens and scatters the laser's beam, is produced by fluctuations in air temperature [the same phenomenon that causes stars to twinkle]. Adaptive optics relies on a deformable mirror, sometimes called a rubber mirror, to compensate for tilt and phase distortions in the atmosphere. The mirror has 341 actuators that change at a rate of about a 1,000 per second.

The Airborne Laser is a Major Defense Acquisition Program. After the Concept Design Phase is complete, the ABL will enter the Program Definition and Risk Reduction (PDRR) Phase. The objective of the PDRR phase is to develop a cost effective, flexible airborne high energy laser system which provides a credible deterrent and lethal defensive capabilities against boosting theater ballistic missiles.

The ABL PDRR Program is intended to show high confidence system performance scalable to Engineering and Manufacturing Development (EMD) levels. The PDRR Program includes the design, development, integration, and testing of an airborne high-energy laser weapon system.

In May 1994, two contracts were awarded to develop fully operational ABL weapon system concepts and then derive ABL PDRR Program concepts that are fully traceable and scaleable EMD. A single contract team was selected to proceed with the development of the chosen PDRR concept beginning in November 1996. Successful development and testing of the laser module is one of the critical 'exit criteria' that Team ABL must satisfy to pass the program's first 'authority-to-proceed' (ATP-1) milestone, scheduled for June 1998. Testing of the laser module is expected to be completed by April 1998. The PDRR detailed design, integration, and test will culminate in a lethality demonstration in the year 2002. A follow-on Engineering Manufacturing and

Development/Production (EMD) effort could then begin in the early 2003 time frame. A fleet of fully operational EMD systems is intended to satisfy Air Combat Command's boost-phase Theater Air Defense requirements. If all goes as planned, a fleet of seven ABLs should be flying operational missions by 2008.

Performance requirements for the Airborne Laser Weapons System are established by the operational scenarios and support requirements defined by the user, Air Combat Command, and by measured target vulnerability characteristics provided by the Air Force lethality and vulnerability community centered at the Phillips Laboratory. The ABL PDRR Program is supported by a robust technology insertion and risk reduction program to provide early confidence that scaling to EMD performance is feasible. The technology and concept design efforts provide key answers to the PDRR design effort in the areas of lethality, atmospheric characterization, beam control, aircraft systems integration, and environmental concerns. These efforts are the source of necessary data applied to exit criteria ensuring higher and higher levels of confidence are progressively reached at key milestones of the PDRR development.

The key issues in the program will be effective range of the laser and systems integration of a Boeing 747 aircraft.

### Notes

<sup>1</sup> "Hawk," Available from <http://www.fas.org/spp/starwars/program/hawk.htm>. Accessed 8 February 2001.

<sup>2</sup> "Patriot TMD," Available from <http://www.fas.org/spp/starwars/program/patriot.htm>. Accessed 8 February 2001.

<sup>3</sup> "Arrow TMD," Available from <http://www.fas.org/spp/starwars/program/arrow.htm>. Accessed 8 February 2001.

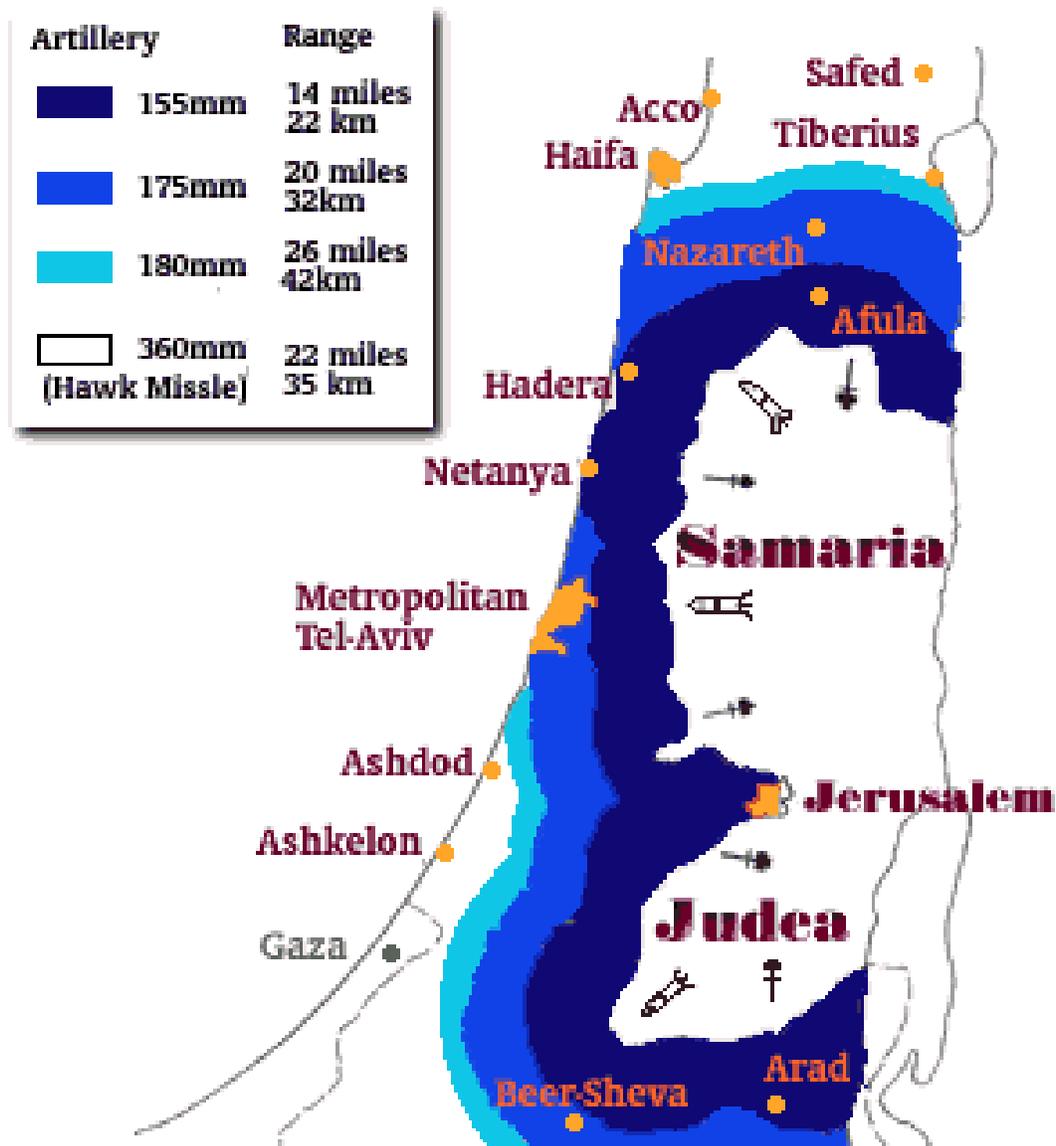
<sup>4</sup> "Tactical High Energy Laser ACTD," Available from <http://www.fas.org/spp/starwars/program/thel.htm>. Accessed 7 February 2001.

<sup>5</sup> "Airborne Laser," Available from <http://www.fas.org/spp/starwars/program/abl.htm>. Accessed 9 February 2001.

## Appendix B

### Appendix B: Artillery Threat From the Territories

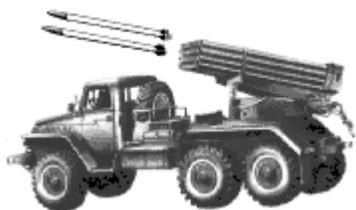
This map illustrates Israel's vulnerability to attack from Judea and Samaria. The range of artillery covers all of Israel's main population centers:<sup>1</sup>



## Notes

<sup>1</sup> “Missile and Artillery Ranges,” *The Jewish Agency for Israel-The Department for Jewish Zionist Education*, Available from <http://www.jajz-ed.org.il/100/maps/missile.html>. Accessed 10 December 2000.

## Appendix C: Palestinian Katyusha Rocket Threat to Israel



“Katyusha rockets are from time to time launched into towns in northern Israel by the Hizbullah Islamic fundamentalist group stationed in southern Lebanon. Residents are forced to sleep in bomb shelters, sometimes for days on end, in fear of the attacks. It is rarely realized, however, the potential danger such rockets could pose to Israel's main population centers should they fall into the wrong hands.

“The Katyusha Rocket ‘Multiple Rocket Launcher’ BM-21 pictured here could be easily taken apart and smuggled into a ‘demilitarized’ Palestinian state. Individual Katyushas can be launched from a pipe using just a car battery. The rockets on this truck have a range of **12.7 miles / 20.4 km**. Katyushas can easily carry chemical warheads.

## The Katyusha Rocket Threat



One full salvo of rockets from this truck would fire the explosive equivalent to four Iraqi-type Scud missiles, which were launched into Israel during the 1991 Gulf War. No apartment in Tel Aviv would be safe, as the map below demonstrates.

“The speckled region to the left is the Tel Aviv metropolitan area, which houses some 70% of Israel's Jewish population and 80% of the country's industrial base. The West Bank is a mountainous region overlooking the Mediterranean coastal plain and Gaza is a seaside district with its own port. If Israel relinquishes military control over these regions, it will be impossible to prevent the smuggling of weapons such as the Katyusha. The potential implications are clear. (*Information and map courtesy of Mark Langfan*).

### Notes

<sup>1</sup> “The Katyusha Rocket Threat,” *Information Regarding Israel's Security (IRIS)*. Available from <http://www.iris.org.il/katyusha.htm>.

## *Glossary*

<b>ABM</b>	antiballistic missile
<b>ALCM</b>	air launched cruise missile
<b>BMD</b>	ballistic missile defense
<b>BMDO</b>	Ballistic Missile Defense Organization
<b>BMEWS</b>	Ballistic Missile Early Warning System
<b>BPI</b>	boost phase intercept
<b>CR-UAV</b>	close-range unmanned aerial vehicle
<b>DOD</b>	Department of Defense
<b>E-UAV</b>	endurance unmanned aerial vehicle
<b>ICBM</b>	intercontinental ballistic missile
<b>HE</b>	high explosive
<b>KKV</b>	kinetic kill vehicle
<b>ME</b>	Middle East
<b>MCI</b>	mid-course intercept
<b>MR-UAV</b>	medium-range unmanned aerial vehicle
<b>NBC</b>	nuclear, biological, and chemical
<b>NMD</b>	National Missile Defense
<b>RPV</b>	remotely piloted vehicle
<b>SLBM</b>	sea-launched ballistic missile
<b>SRBM</b>	short-range ballistic missile
<b>SR-UAV</b>	short-range unmanned aerial vehicle
<b>TBM</b>	theater ballistic missile
<b>TBMD</b>	theater ballistic missile defense
<b>TI</b>	terminal intercept
<b>UAV</b>	unmanned aerial vehicle
<b>USAF</b>	United States Air Force
<b>VTOL-UAV</b>	vertical takeoff and landing unmanned aerial vehicle
<b>WMD</b>	weapons of mass destruction

## DEFINITIONS

(From **Department of Defense Dictionary of Military and Associated Terms**, Joint Pub 1-02, 7 December 1998)

- active defense.** Operations taken to protect against a TM attack by destroying TM airborne launch platforms and/or destroying TMs in flight.
- attack operations.** Operations taken to destroy, disrupt, or neutralize TM launch platforms and their supporting structures and systems.
- ballistic missile.** Any missile which does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated.
- boost phase.** That portion of the flight of a ballistic missile or space vehicle during which the booster and sustainer engines operate. See also **midcourse phase; reentry phase; terminal phase.**
- command, control, communications, computers, and intelligence (C4I).** Systems used to coordinate and integrate the joint force capabilities to conduct and link passive defense, active defense, and attack operations.
- consequence management.** Actions taken to respond and assist in the mitigation of damage and collateral hazards from the deliberate employment or accidental release of chemical, biological, radiological, or nuclear materials or high-yield conventional explosive weapons in a domestic or foreign environment.
- cruise missile.** Guided missile, the major portion of whose flight path to its target is conducted at approximately constant velocity; depends on the dynamic reaction of air for lift and upon propulsion forces to balance drag.
- intercontinental ballistic missile.** A ballistic missile with a range capability from about 3,000 to 8,000 nautical miles.
- intermediate-range ballistic missile.** A ballistic missile with a range capability from about 1,500 to 3,000 nautical miles.
- medium-range ballistic missile.** A ballistic missile with a range capability from about 600 to 1,500 nautical miles.
- midcourse guidance.** The guidance applied to a missile between termination of the boost phase and the start of the terminal phase of flight.
- midcourse phase.** That portion of the trajectory of a ballistic missile between the boost phase and the reentry phase. See also **boost phase; reentry phase; terminal phase.**
- reentry phase.** That portion of the trajectory of a ballistic missile or space vehicle where there is a significant interaction of the vehicle and the Earth's atmosphere. See also **boost phase; midcourse phase; terminal phase.**
- passive defense.** Measures taken to posture the force to reduce vulnerability and minimize the effects of a TM attack.
- remotely piloted vehicle.** An unmanned vehicle capable of being controlled from a distant location through a communication link. It is normally designed to be recoverable.
- short-range ballistic missile.** A ballistic missile with a range capability up to about 600 nautical miles. Also called **SRBM.**
- terminal phase.** That portion of the trajectory of a ballistic missile between reentry into the atmosphere or the end of the mid-course phase and impact or arrival in the vicinity of the target. See also **boost phase; midcourse phase; reentry phase.**

**theater missile.** A missile, which may be a ballistic missile, a cruise missile, or an air-to-surface missile (not including short-range, non-nuclear, direct fire missiles, bombs, or rockets such as Maverick or wire-guided missiles), whose target is within a given theater of operation.

**unmanned aerial vehicle.** A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semiballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles. Also called **UAV**.

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