

ISRAELI WEAPONS OF MASS DESTRUCTION

An Overview

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Israel's nuclear capabilities and other efforts to develop weapons of mass destruction are some of its most secret and most controversial force developments. Although there have been many unclassified reports on such developments, only a few have been credible and these have consisted largely of reports on its missile forces or nuclear activities that took place several decades ago. Many estimates of Israel's nuclear weapons trace back to rough estimates made a decade ago. No official Israeli data or credible outside reports data have emerged on the details of Israel's strategic doctrine, targeting plans, or systems for planning and executing nuclear strikes, or how these have changed in recent years. However, a great deal of speculation has emerged over how Israel might act in a war or crisis.

Figure One summarizes current reporting on Israeli weapons of mass destruction, drawing on U.S. government and IAEA reporting, and additional sources like the Nuclear Threat Institute, Global Security, Jane's, the Federation of American Scientists, Institute for Science and International Security, and the Center for Nonproliferation Studies at the Monterey Institute of International Studies. It should be stressed again that all of the estimates of this kind provided are highly uncertain and heavily dependent upon unclassified sources and the views of outside experts,

Probable Israeli Capabilities

Israel's biological weapons programs seem to be largely defensive, but advanced defensive programs provide the technology base for weapons production and Israel has advanced civil biotechnology and pharmaceutical programs with extensive dual capability to produce such weapons. There is no public evidence that the IDF has organized and trained for more than defensive chemical warfare. However, Israel has been detected importing significant amounts of precursors for chemical weapons.

It does seem highly likely that Israel can target virtually any Arab state and Iran with long-range missiles and deliver nuclear strikes using such missiles as well as by air using air-to-surface missiles. Israel almost certainly has "boosted" nuclear weapons with yields of 100 kilotons or more and may have thermonuclear weapons.

Israel probably has enough nuclear weapons, and a stock of weapons with low enough yields, so that it can use its nuclear strike capabilities against cities, populations, and military area targets and critical civilian facilities. There is no way to determine Israeli plans and targeting, but the fact that Israel's population is so small and concentrated may well mean that any Israeli retaliatory attack in response to the use of highly lethal weapons of mass destruction against Israel's population would take the form of massive retaliation against the enemy's continuity of government, economic recovery capability, and population.

It seems highly likely that Israel has long had tactical nuclear weapons. Israel is well aware of U.S., NATO, French, and former Soviet Union (FSU) doctrine and planning for the use and employment of such weapons, and probably has low yield weapons it can use in close proximity to its own territory and forces. In any case, airbursts of high-yield nuclear weapons largely eliminate fallout and allow the use of nuclear weapons under the same conditions.

Israel has acquired and developed intelligence satellites that could provide highly advanced targeting data for missile and air strikes, with some near-real time capability.

The current missile and air forces Israel would probably use to deliver nuclear strikes are somewhat vulnerable to air and missile attack. The survivability and effectiveness of such strikes is uncertain, and such threats would currently come from Iran or Arab states, which can use only chemical or conventional bombs and warheads. There are also indications that Israel relies on dispersal in a major crisis, and it certainly has capable enough sensors and battle management systems to maintain launch on warning and/or launch under attack capabilities. There are unconfirmed reports that Israel plans to sea base some of its nuclear weapons on ballistic or cruise missiles deployed on its *Dolphin*-class submarines as part of a possible second strike capability.

Shifts in Israeli Missile Defenses

Israel has acquired ballistic missile defense capabilities, although the real-world operational capability of such defenses is uncertain. Israel's testing programs have been minimal, and it has had to place an extraordinary reliance on engineering forecasts of effectiveness in moving to production and deployment.

Israel did declare that the improved Block 3 version of its Arrow ballistic missile defense system became active in April 2006, and further improvements in software are expected. It has improved its Green Pine and other radar warning and sensor systems and created a new battle management system, nicknamed the "Cube." It is working on Block 4 versions of both the Arrow and Green Pine to be deployed by 2009 capable of handling significantly greater numbers of missile tracks at the same time and intercepting incoming missiles with a higher closing velocity and at ranges of more than 700 kilometers. It is believed to be developing more advanced counter-countermeasures and the ability to detect decoy warheads.¹

Figure One

Israel's Search for Weapons of Mass Destruction

Delivery Systems

- Israel has done technical work on a terrain contour matching-type smart warhead. It has examined cruise missile guidance developments using GPS navigation systems. This system may be linked to a submarine launch option.
- As part of its first long-range missile force, Israel deployed up to 50 "Jericho I" (YA-1) missiles in shelters on mobile launchers with up to a 400-mile range with a 2,200-pound payload and with possible nuclear warhead storage nearby. These missiles were near copies of the two-stage, solid-fueled, French MD-620 missile. Some reports claim the first 14 were built in France. (Some reports give the range as 500 kilometers.)
 - NTI reports that, "It appears that some time in the early 1970s, Israel took over production and testing of the missile and by 1978 had domestically constructed around 50 Jericho-I missiles. Previously France had delivered 14 complete missiles to Israel. There are conflicting reports as to when the Jericho-I entered service. Some sources indicated that the Jericho-I was deployed with nuclear warheads during the 1973 war with Egypt and Syria. Other sources, however, indicate that at the time, the Jericho-I still suffered from problems with guidance and control and was not yet operational. Those problems, however, may have had more to do with insufficient accuracy to deliver a nuclear warhead and the missile may have been deployed during the 1973 war even with the knowledge that its accuracy was unreliable...There seems to be no dispute though that the Jericho-I was designed to deliver nuclear warheads, despite Israel's policy of opacity with regards to its status as a nuclear weapon state."ⁱⁱ
 - Israel is thought to have conventional, chemical and nuclear warheads for the Jericho I.
 - The current deployment of the "Jericho I" force is unclear. Some sources say it has been phased out for the Jericho II missile.ⁱⁱⁱ
- Israel has since gone far beyond the Jericho I in developing long-range missile systems. It has developed and deployed the "Jericho II" (YA-2).
 - The Jericho II began development in the mid-1970s and had its first tests in 1986.^{iv} Israel carried out a launch in mid-1986 over the Mediterranean that reached a range of 288 miles (460 kilometers). It seems to have been tested in May 1987. A flight across the Mediterranean reached a range of some 510 miles (820 kilometers), landing south of Crete.^v Another test occurred on September 14, 1989.
 - The Nuclear Threat Initiative reports that, "Some reports indicate that Israel began production of the two-stage Jericho-II ballistic missile as early as 1977. Other sources place the date several years later. In either case, Israel conducted several test-flights of the Jericho-II in the 1980s and 1990s. The Jericho-II was reported by a source to have entered service in 1989. However, during the first Persian Gulf War, Israel apparently balked at U.S. suggestions to limit any response to Iraqi Scud attacks to ballistic missile strikes in part because the Jericho was not yet fully operational. The Jericho-II is reported to have a range of between 1,500 and 3,500 km, depending on payload weight. It is said to be deployed in underground caves and silos primarily at the Zachariah facility....Much of the information about the Jericho-II has been gleaned from observation of launches of the Shavit space launch vehicle (SLV). The Shavit is a three-stage, solid-propellant launcher designed to carry payloads up to 250 kg into low earth orbit. It was speculated for some time that the first two stages of the Shavit were the Jericho-II. This was confirmed in 2001 when a spokesman for the Israeli Defense Forces admitted that the "Shavit is Jericho." Shavit launches are conducted from the Palmachim airbase near Tel Aviv. The first launch was in September 1988 and placed a satellite, the Ofeq-1, into orbit. The most recent launch was in June 2001 and placed the Ofeq-5 spy satellite in orbit."^{vi}
 - Israel launched a missile across the Mediterranean that landed about 250 miles north of Benghazi, Libya. The missile flew over 800 miles, and U.S. experts felt it had a maximum range of up to 900-940 miles (1,450 kilometers) — which would allow the Jericho II to cover virtually all of the Arab world and even the southern former Soviet Union.^{vii}
 - The most recent version of the missile seems to be a two-stage, solid-fueled missile with a range of up to 900 miles (1,500 kilometers) with a 2,200 pound payload.
 - Commercial satellite imaging indicates the Jericho II missile may be 14 meters long and 1.5 meters wide. Its deployment configuration hints that it may have radar area guidance similar to the terminal guidance in the Pershing II and probably has deployed these systems.

- Some Jericho IIs may have been brought to readiness for firing during the Gulf War.
- Israel began work on an updated version of the Jericho II no later than 1995 in an effort to stretch its range to 2,000 km. At least part of this work may have begun earlier in cooperation with South Africa. There have been unconfirmed reports of a Jericho III missile.
- Israel is also seeking technology to improve its accuracy, particularly with gyroscopes for the inertial guidance system and associated systems software.
- Israel is actively examining ways to lower the vulnerability of its ballistic missiles and nuclear weapons. These include improved hardening, dispersal, and the use of air-launched and sea-based delivery systems.
- There are reports that Israel is developing a Jericho III missile, based on a booster it developed with South Africa in the 1980s.
 - The tests of a longer-range missile seem to have begun in the mid-1980s.^{viii} A major test of such a booster seems to have taken place on September 14, 1989, and resulted in extensive reporting on such cooperation in the press during October 25 and 26, 1989.
 - It is possible that both the booster and any Israeli-South African cooperation may have focused on satellite launches.^{ix} Since 1994, however, there have been numerous reports that Israel was seeking a missile with a range of at least 4,800 kilometers, and which could fully cover Iran and any other probable threat.
 - Jane's estimated that the missile has a range of up to 5,000 kilometers and a 1,000-kilogram warhead. This estimate is based largely on a declassified Defense Intelligence Agency estimate of the launch capability of the Shavit booster that Israel tested on September 19, 1988.^x
- Reports of how Israel deploys its missiles differ. Initial reports indicated that 30-50 Jericho I missiles were deployed on mobile launchers in shelters in the caves southwest of Tel Aviv. A source claimed in 1985 that Israel had 50 missiles deployed on mobile erector launchers in the Golan, on launchers on flat cars that could be wheeled out of sheltered cases in the Negev. (This latter report may confuse mobile missile launchers with the rail transporter used to move missiles from a production facility near Be'er Yaakov to a base at Kefar Zeharya, about 15 kilometers south of Be'er Yaakov.
- More recent reports indicate that Jericho II missiles are located in 50 underground bunkers carved into the limestone hills near a base near Kefar Zeharya. The number that are on alert, command and control and targeting arrangements, and the method of giving them nuclear warheads has never been convincingly reported.^{xi}
- *Jane's Intelligence Review* published satellite photos of what it said was a Jericho II missile base at Zachariah (God remembers with a vengeance) several miles southeast of Tel Aviv in September 1997.^{xii} According to this report, the transport-erector-launcher (TEL) for the Jericho II measures about 16 meters long by 4 meters wide and 3 meters high. The actual missile is about 14 meter long and 1.5 meters wide. The TEL is supported by three support vehicles, including a guidance and power vehicle. The other two vehicles include a communications vehicle and a firing control vehicle. This configuration is somewhat similar to that used in the U.S. Pershing II IRBM system, although there are few physical similarities.
- The photos in the article show numerous bunkers near the TEL and launch pad, and the article estimates a force of 50 missiles on the site. It also concludes that the lightly armored TEL would be vulnerable to a first strike, but that the missiles are held in limestone caves behind heavy blast-resistant doors. It estimates that a nuclear-armed M-9 or Scud C could destroy the launch capability of the site.^{xiii}
- The same article refers to nuclear weapons bunkers at the Tel Nof airbase, a few kilometers to the northwest. The author concludes that the large number of bunkers indicates that Israel may have substantially more nuclear bombers than is normally estimated – perhaps up to 400 weapons with a total yield of 50 megatons.^{xiv}
 - 76 F-15s, 232 F-16s, 20 F-4Es, and 50 Phantom 2000 fighter-bombers capable of long-range refueling and of carrying nuclear and chemical bombs.
- Israel bought some Lance missile launchers and 160 Lance missiles from the United States in the 1970s. The United States removed them from active duty during 1991-1994. The status of the Israeli missiles is unknown.
 - IISS reports that Israel currently has some 20 Lance launchers in storage.
 - The Lance has a range of 130 km with a 450-kg payload.

- Reports indicate that Israel has developed conventional cluster munitions for use with the Lance rocket.
- Reports of a May 2000 test launch seem to indicate that Israel has a cruise missile with a range of 1,500 km capable of being launched from its new *Dolphin*-class, German-built submarines.^{xv}
 - It is believed that such a cruise missile, an extended-range, turbofan powered variant of the Popeye cruise missile, called the Popeye Turbo, can carry a nuclear warhead.
- There are reports of the development of a long-range, nuclear-armed version of Popeye with GPS guidance and of studies of possible cruise missile designs that could be both surface ship and submarine based.
 - A variant of the Popeye air-to-surface missile is believed to be capable of delivering a nuclear weapon payload.
 - The MAR-290 rocket with 30 kilometers range is believed to be deployed.
 - MAR-350 surface-to-surface missiles with a range of 56 miles and a 735-pound payload capacity are believed to have completed development or to be in early deployment.
 - Israel was seeking supercomputers for Technion (Israel Institute of Technology) (designing ballistic missile RVs), Hebrew University (may be engaged in hydrogen bomb research), and Israeli Military Industries (maker of Jericho II and the Shavit booster).
 - Israel's current review of its military doctrine seems to include a review of its missile basing options and the study of possible hardening and dispersal systems. There are also reports that Israel will solve its survivability problems by deploying some form of nuclear-armed missile on its new submarines.

Chemical Weapons

- Israel is reported to have begun chemical weapons research in 1948. Some reports that its chemical and biological weapons efforts were merged in 1952 as part of the creation of the Israel Institute for Biological Research at Nes Tona.
- Some reports began a "crash" chemical weapons production effort in 1955.
- Reports of a mustard and nerve gas production facility established in 1982 in the restricted area in the Sinai near Dimona seem incorrect. May have additional facilities. May have capacity to produce other gases. Probable stocks of bombs, rockets, and artillery.
- Extensive laboratory research into gas warfare and defense.
- An El Al 747-200 cargo plane crashed in southern Amsterdam on October 4, 1992, killing 43 people in the apartment complex it hit. This led to extensive examination of the crash, and the plane was found to be carrying 50 gallons of dimethyl methylphosphonate, a chemical used to make sarin nerve gas. The chemical had been purchased from Solkatronic Chemicals in the United States and was being shipped to the Israel Institute for Biological Research. It was part of an order of 480 pounds worth of the chemical. Two of the three other chemicals used in making sarin were shipped on the same flight. Israel at first denied this and then claimed it was being imported only to test gas masks.^{xvi}
- Israel did sign the Chemical Weapons Convention (CWC) on January 13, 1993, but has never ratified it.
- In 1998, Israel chose not to expand the facilities at the Israel Institute for Biological Research at Nes Tona because of concerns for the risk to the local population. It may later have constructed a new, remote site.
- Israel may have the contingency capability to produce at least two types of chemical weapons and has certainly studied biological weapons as well as chemical ones. According to one interview with an Israeli source of unknown reliability, Israel has mustard gas, persistent and nonpersistent nerve gas, and may have at least one additional agent.
- Development of defensive systems includes Shalon Chemical Industries protection gear, Elbit Computer gas detectors, and Bezal R&D aircrew protection system.
- Extensive field exercises conducted in chemical defense.
- Gas masks were stockpiled and then distributed to the population with other civil defense instructions during the first and second Gulf Wars.
- Warhead delivery capability for bombs, rockets, and missiles, but none now believed to be equipped with chemical agents.

- An unconfirmed October 4, 1998, report in the *Sunday Times of London* quotes military sources as stating that Israeli F-16s had been modified to carry out attacks using chemical and biological weapons produced at the Nes Ziona facility.^{xvii}
- No firm evidence Israel has stockpiled chemical weapons, or has gone beyond improving its defense and decontamination capabilities.

Biological Weapons

- Extensive research into weapons and defense. Ben Gurion initiates a search for experts as early as April 1948. A center called HEMED BEIT is reported to be established, but any biological weapons activity is never confirmed.
- Ready to quickly produce biological weapons, but no reports of active production effort.
- According to some reports, Israel revitalized its chemical warfare facilities south of Dimona in the mid-1980s, after Syria deployed chemical weapons and Iraq began to use these weapons in the Iran-Iraq War.
- Israel has at least one major research facility with sufficient security and capacity to produce both chemical and biological weapons.^{xviii} There are reports that HEMED BEIT was replaced in 1952 by a biological weapons research facility at the Israel Institute for Biological Research at Nes Tona, about 12 miles south of Tel Aviv, and that this same facility also has worked on the development and testing of nerve gas. This facility has created enough public concern in Israel so that the mayor of Nes Tona has asked that it be moved away from populated areas. The facility is reported to have stockpiled anthrax and to have provided toxins to Israeli intelligence for use in covert operations and assassinations such as the attempt on a Hamas leader in Jordan in 1997.^{xix}
 - The Israel Institute for Biological Research is located in a 14-acre compound. It has high walls and exceptional security and is believed to have a staff of around 300, including 120 scientists. A former deputy head, Marcus Klingberg, served 16 years in prison for spying for the FSU.
- U.S. experts privately state that Israel is one of the nations included in U.S. lists of nations with biological and chemical weapons. They believe that Israel has at least some stocks of weaponized nerve gas, although they may be stored in forms that require binary agents to be loaded into binary weapons.
- They believe that Israel has fully developed bombs and warheads capable of effectively disseminating dry, storable biological agents in micropowder form and has agents considerably more advanced than anthrax. Opinion differs over whether such weapons are actively loaded and deployed. Unconfirmed reports by the British *Sunday Times* claimed that IAF F-16s are equipped for strikes using both these weapons and chemical weapons.^{xx}
- No firm evidence Israel has stockpiled biological weapons, or has gone beyond improving its defense and decontamination capabilities.

Nuclear Weapons

- Uranium exploration began in Negev as early as 1949; Israeli Atomic Energy Commission began to discuss nuclear option in 1952. Cooperation with France in nuclear reactor design and technology began in 1950s. French-Israeli construction of a reactor in Dimona – whose actual capacity was much larger than its announced capacity, began in 1957. US detected the project in 1958, and visited the reactor during the 1960s, but Israel concealed its true output and performance characteristics.
- Britain sells 20-tons of heavy water to Israel in 1959-1960. It also sells beryllium and lithium-6. These sales are critical to bringing the kind of reactor Israel needs on line, and potentially useful in easing its problems in producing “boosted” fission and fusion weapons.
- Possible nuclear test (implosion proof of principle or “zero yield”) in Negev on November 2, 1966.
- By 1968, the CIA publicly estimated that Israel had nuclear weapons. It estimated that Israel had 10-20 nuclear weapons.
- By 1986, leaks by Mordecai Vanunu, and from other sources, led to estimates that Israel had some 100-200 fission weapons. The possibility existed that it had “boosted” fission weapons with yields in the 60-100 kiloton (KT) range.
- October 1973: reports that Prime Minister Golda Meir orders IDF to assemble nuclear weapons for delivery in response to Egyptian and Syrian attacks, and that Jericho missiles at Hirat Zachariah and nuclear strike F-4s at Tel Nof are armed.

- Reports of joint nuclear test with South Africa in 1979, but never confirmed. Israel does seem to have cooperated with South Africa in missile design and booster testing.
- The director of the Central Intelligence Agency (CIA) indicated in May 1989 that Israel may be seeking to construct a thermonuclear weapon.
- June 2000: reports begin to surface that Israel will arm submarines with nuclear-armed cruise or ballistic missiles. Such reports have continued ever since. Reports that Israel had modified the Harpoon cruise missile to have nuclear warheads have been regularly repeated since 2003. Germany sells Israel advanced Dolphin-class submarines in 2005.
- Israel has two significant reactor projects: the 5 megawatt highly enriched uranium light-water IRR I reactor at Nahal Soreq; and the 75-200 megawatt heavy-water IRR-2 natural uranium reactor used for the production of fissile Plutonium material at Dimona. Only the IRR-1 is under International Atomic Energy Agency safeguards.
- Dimona has conducted experiments in pilot scale laser and centrifuge enrichment, purifies uranium dioxide (UO₂), converts uranium hexafluoride (UF₆), and fabricates fuel for weapons purpose.
- Uranium phosphate mining in the Negev, near Beersheba, and yellowcake is produced at two plants in the Haifa area and one in southern Israel.
- Pilot-scale heavy water plant operating at Rehovot.
- Estimates of numbers and types of weapons differ sharply.
 - No agreement exists over the plutonium output from the reactor at Dimona. Which is reported at power outputs from 75-200 megawatts. Satellite photos indicate that output is more likely to be below 140 megawatts.
 - Stockpile of at least 60-80 plutonium weapons.
 - May have well over 100 nuclear weapons assemblies, with some weapons with yields over 100 kilotons.
 - U.S. experts believe Israel has highly advanced implosion weapons. Known to have produced Lithium-6, allowing production of both tritium and lithium deuteride at Dimona. Facility no longer believed to be operating.
 - Some weapons may be ER variants or have variable yields.
 - Stockpile of up to 300-400 weapons is possible. Lower limit could be 70-100.
 - There exists a possibility that Israel may have developed thermonuclear warheads.
- Major weapons facilities include production of weapons-grade plutonium at Dimona, nuclear weapons design facility at Nahal Soreq (south of Tel Aviv), missile test facility at Palmachim, nuclear armed missile storage facility at Kefar Zekharya, nuclear weapons assembly facility at Yodefat, and tactical nuclear weapons storage facility at Eilabun in eastern Galilee.

Missile Defenses

- Patriot missiles with future PAC-3 upgrade to reflect lessons of the Gulf War.
- Arrow 2 two-stage **anti-ballistic missile system**. with slant intercept ranges at altitudes of 8-10 and 50 kilometers, speeds of up to Mach 9, plus possible development of the Rafal AB-10 close-in defense missile with ranges of 10-20 kilometers and speeds of up to Mach 4.5. Taas rocket motor, Rafael warhead, and Tadiran BM/C4I system and "Music" phased array radar.
- Israel plans to deploy three batteries of the Arrow to cover Israel, each with four launchers, to protect up to 85 percent of its population. The first battery was deployed in early 2000, with an official announcement declaring the system operational on March 12, 2000.
- The Arrow program has three phases:
 - Phase I: Validate Defense Concept and Demonstrate Pre-prototype Missile.
 - Fixed price contract: \$158 million.
 - The United States pays 80 percent, Israel pays 20 percent.
 - Completed in December 1982.

- Phase II: Demonstrate lethality; develop and demonstrate tactical interceptor and launcher.
 - Fixed price contract: \$330 million.
 - The United States pays 72 percent, Israel pays 28 percent.
 - Began in July 1991.
 - Successfully completed.
- Phase III: Develop and integrate tactical system, conduct weapon system tests, and develop and implement interoperability.
 - Program cost estimated at \$616 million.
 - The United States pays 48 percent, Israel pays 52 percent.
 - Began in March 1996.
 - System integration in progress.
- The Arrow will be deployed in batteries as a wide area defense system with intercepts normally at reentry or exoatmospheric altitudes. Capable of multitarget tracking and multiple intercepts.
- Israel has designed the Nautilus laser system for rocket defense in a joint project with the United States. It has developed into the Theater High Energy Laser. The project has recently been expanded to include interception of not only short-range rockets and artillery, but also medium-range Scuds and longer-range missiles such as Iran’s Shahab series.
- Israel is examining the possibility of boost-phase defenses. The Rafael Moab UAV forms part of the Israeli Boost-Phase Intercept System. This is intended to engage **ballistic missiles** soon after launch, using weapons fired from a UAV. Moab would launch an improved Rafael Python 4 air-to-air missile. Range is stated as 80-100 km depending on the altitude of release.

Advanced Intelligence Systems

- Israeli space program to date:

Satellite	Launch Date	Status	Function
Ofeq 1	9/19/1988	Decayed 1/14/1989	Experimental
Ofeq 2	4/3/1990	Decayed 7/9/1990	Communications experiments.
Ofeq 3	4/5/1995	Decayed 10/24/2000	Reconnaissance/experimental?
Ofeq 4 (Eros A)	1/22/1998	Launch failed during second-stage burn	Reconnaissance/commercial imaging?
Eros A1	12/5/2000	In orbit	Reconnaissance/commercial imaging?
Ofeq 5	5/28/2002	In orbit	Reconnaissance
Ofeq-7	6/11/2007	In orbit	Reconnaissance
TecSAR	01/21/2008	In orbit/Awaiting final certification	Reconnaissance/radar imaging

Note: This chart does not include Israel’s commercial communications satellite ventures.

- The Shavit launched Israel's satellite payload on September 19, 1989. It used a three-stage booster system capable of launching a 4,000-pound payload over 1,200 miles or a 2,000-pound payload over 1,800 miles. It is doubtful that it had a payload capable of intelligence missions and seems to have been launched, in part, to offset the psychological impact of Iraq’s missile launches.
 - It is believed that the vehicle was launched for experimentation in generation of solar power and transmission reception from space, for verification of the system's ability to withstand vacuum and weightless conditions, and for data collection on space environment conditions and Earth's magnetic field.
- Ofeq 2 launched on April 3, 1990 — one day after Saddam Hussein threatened to destroy Israel with chemical weapons if it should attack Baghdad.
- This vehicle used the Ofeq 1 test-bed. Little open-source information exists on this vehicle although it is believed to be a test-bed for communications experiments.

- Israel launched its first intelligence satellite on April 5, 1995, covering Syria, Iran, and Iraq in orbit every 90 minutes. The Ofeq 3 satellite is a 495-pound system launched using the Shavit 1 launch rocket and is believed to carry an imagery system. Its orbit passes over or near Damascus, Tehran, and Baghdad.
 - The Shavit 1 differs from the Shavit only in the use of a somewhat different first stage. This change has not significantly affected vehicle performance. The Ofeq 3 and all subsequent launches have used the Shavit 1.
 - Reports conflict regarding whether this was an experimental platform or Israel's first surveillance satellite. Although it is thought to carry visible and ultraviolet wavelength imaging technology, the resolution is thought to be on the order of feet. The relatively low resolution, combined with its orbit, suggest to some observers that the satellite was capable of producing imagery of limited military usefulness.
- On January 22, 1998, the Ofeq 4/Eros A satellite was launched. Due to a failure in the second stage the satellite never made orbit. Reports conflict about whether this was a launch of a military reconnaissance satellite or was intended for producing commercial satellite imagery.
- The Eros A1 satellite was launched on December 5, 2000, on a Russian Start-1 rocket from the Svobodny launch site. This satellite produces commercially available satellite images. At a basic level, multispectral images with resolutions of 1.8 meters can be obtained. Currently, image processing techniques can yield resolutions of 1 meter. This is expected to improve to 0.6~0.7 meter resolutions in the next year or two. Some reports indicate that the Israeli government is a primary consumer of Eros imagery.
 - A successor craft, the Eros B, is reported to have a baseline ability to produce images with a panchromatic resolution of 0.87 meters and 3.5 meters for multispectral images. Launch on board a Russian vehicle was expected in early 2004, but this was not been confirmed.
- On May 28, 2002, the Ofeq 5 reconnaissance satellite was launched successfully.
- Agreement signed with the United States in April 1996 to provide Israel with missile early warning, launch point, vector, and point of impact data.
- Israeli Aircraft Industries, the manufacturer of the Shavit series SLV, is developing additional launchers to place satellites in polar orbits:
 - LK-A - For 350-kg-class satellites in 240x600-km elliptical polar orbits.
 - LK-1 - For 350-kg-class satellites in 700-km circular polar orbits.
 - LK-2 - For 800-kg-class satellites in 700-km circular polar orbits.
 - It is likely that these SLVs designed to place satellites in polar orbits could not be launched from Israel and would require an overseas launching site, such as the American site at Wallops Island.
 - On June 11, 2007, the Ofeq 7 reconnaissance satellite was launched successfully.^{xxi}
 - Ofeq 7, which began transmitting on June 14, 2007, would complement the 2002-launched Ofeq 5, which had surpassed its four-year service lifespan.
 - The Ofeq 7's camera is believed to be superior to the older Eros-B1 system, which, it was declared, has a resolution of 0.7 m.
 - The upcoming Ofeq 8 should present a major leap in image resolution and capability.
- On January 21, 2008, the TecSAR reconnaissance satellite was launched successfully. TecSAR was Israel's first radar imaging satellite and was designed by Israel Aerospace Industries. At the time of writing, TecSAR was undergoing testing under various operational modes before being declared fully operational. While no immediate data was available on image resolution, and Israeli space official estimated TecSAR's footprint to cover more than 500 square kilometers in "mosaic mode." TecSAR is expected to play an integral role, along with Ofeq-5, Ofeq-7 and Eros A and B in countering potential strategic threats posed by Iran and Syria.^{xxii}

ⁱ Barbara Opall-Rome, "Israel Explores Options in Face of Iran's Nuclear Work," Defense News, May 29, 2006, p. 6.

ⁱⁱ Nuclear Threat Initiative, country profile on Israel, "missile overview," http://www.nti.org/e_research/profiles/Israel/index.html

ⁱⁱⁱ Some reports give the range as 500 kilometers; Jane's Defense Weekly, March 10, 1999, p. 50-64.

^{iv} Baltimore Sun, November 23, 1988; Washington Post, September 16, 1989.

^v Tass International, 1216 GMT, September 15, 1989; Washington Post, September 16, 1989; Jane's Defense Weekly, November 19, 1988, September 23, 1989, p. 549; Washington Times, July 22, 1987, p. D-4; International Defense Review, 7/1987, p. 857, and New York Times, July 22, 1987, p. A-6, July 29, 1987; Mideast Markets, November 23, 1987, p. 11; in Harold Hough, "Israel's Nuclear Infrastructure," Jane's Intelligence Weekly, November, 1994, pp. 505-511.

^{vi} Nuclear Threat Initiative, country profile on Israel, "missile overview," http://www.nti.org/e_research/profiles/Israel/index.html

^{vii} BBC and ITV reporting efforts seem to give more credibility to the idea that Israel has some form of relatively short-range nuclear-armed missile. Ranges of anywhere from 750-930 NM have been reported, with accuracy's of anywhere from 0.1 Km to radar correlator guidance packages capable of CEPs of 10 meters. Bulletin of Atomic Scientists, Vol. 46, Jan/Feb. 19980, p. 48; Washington Post, September 16, 1989, p. A-17, November 15, 1989, p. A-14; Economist, August 1, 1987, p. 41; Washington Times, July 22, 1987, p. D-4; July 24, 1987, p. A-9 and April 4, 1988, p. 17; International Defense Review, 7/1987, p. 857, and New York Times, July 29, 1987, p. A-10.

^{viii} Tass International, 1216 GMT, September 15, 1989; Washington Post, September 16, 1989; Jane's Defense Weekly, November 19, 1988, September 23, 1989, p. 549; Washington Times, July 22, 1987, p. D-4; International Defense Review, 7/1987, p. 857, and New York Times, July 22, 1987, p. A-6, July 29, 1987; Mideast Markets, November 23, 1987, p. 11; in Harold Hough, "Israel's Nuclear Infrastructure," Jane's Intelligence Weekly, November, 1994, pp. 505-511.

^{ix} Washington Post, October 26, 1989, p. A-36; Boston Globe, October 30, 1989, p. 2; Newsweek, November 6, 1989, p. 52.

^x Jane's Intelligence Review, September, 1997, pp. 407-410; Jane's Defense Weekly, March 10, 1999, p. 50-64; International Defence Review, Extra, 2/1997, p. 2.

^{xi} It is also possible that Israel may have deployed nuclear warheads for its MGM-55C Lance missiles. Israel has 12 Lance transporter-erector-launchers, and at least 36 missiles. The Lance is a stored liquid fueled missile with inertial guidance and a range of 5-125 kilometers. It has a warhead weight of 251 kilograms, and a CEP of 375 meters. It was deployed in US forces with the W-70 nuclear warhead. International Defense Review, 7/1987, pp. 857; Economist, May 4, 1968, pp. 67-68; New York Times, July 22, 1987, pp. A-6; Washington Times, July 22, 1987, pp. D-4; Defense and Foreign Affairs, June, 1985, pp. 1; Aerospace Daily, May 1, 1985, pp. 5 and May 17, 1985, pp. 100; Aerospace Daily, May 1, 1985, May 7, 1985; Shuey, et al, Missile Proliferation: Survey of Emerging Missile Forces, pp. 56; CIA, "Prospects for Further Proliferation of Nuclear Weapons," DCI NIO 1945/74, September 4, 1974; NBC Nightly News, July 30, 1985; New York Times, April 1, 1986; US Arms Control and Disarmament Agency, World Military Expenditures and Arms Transfers, Washington, GPO, 1989, pp. 18; Michael A. Ottenberg, "Israel and the Atom," American Sentinel, August 16, 1992, pp. 1.

^{xii} Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.

^{xiii} Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.

^{xiv} Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.

^{xv} Uzi Mahnaimi and Matthew Campbell, "Israel Makes Nuclear Waves With Submarine Missile Test," *Sunday Times* (London), June 18, 2000; Walter Pincus, "Israel Has Sub-Based Atomic Arms Capability," *Washington Post*, June 15, 2002, pp. A1.

^{xvi} Associated Press, October 5, 1998, 0316, October 8, 1998, 1350; Philadelphia Inquirer, November 1, 1998, pp. A-7.

^{xvii} Uzi Mahnaimi, "Israeli Jets Equipped for Chemical Warfare," *Sunday Times* (London), October 4, 1998.

^{xviii} This information is unconfirmed, and based on only one source. Israel does, however, have excellent research facilities, laboratory production of poison gas is essential to test protection devices as is the production of biological weapons to test countermeasures and antidotes.

^{xix} Philadelphia Inquirer, November 1, 1998, pp. A-7; Associated Press, October 8, 1998, 1350.

^{xx} Washington Times, October 7, 1998, pp. A-14.

^{xxi} Alon Ben-David, "Israel Bolsters Reconnaissance Capabilities with Ofeq-7 Launch," *Jane's Defense Weekly*, June 20, 2007.

^{xxii} Barbara Opall-Rome, "Israel Tests 1st Radar-Imagery Satellite," *Defense News*, February 4, 2008, p. 8.

SYRIAN WEAPONS OF MASS DESTRUCTION

An Overview

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Syria has long sought missiles and weapons of mass destruction to match Israel's capabilities. In practice, however, it has never had the resources or technology base to compete with Israel.

Figure One summarizes current reporting on Syrian weapons of mass destruction, drawing on U.S. government and IAEA reporting, and additional sources like the Nuclear Threat Institute, Global Security, Jane's, the Federation of American Scientists, Institute for Science and International Security, and the Center for Nonproliferation Studies at the Monterey Institute of International Studies. The data are often speculative. It is clear, however, that Syria has pursued the updating of its surface-to-surface missiles in spite of all of its resource constraints and has given such forces high priority.

Syrian Chemical Weapons

Syria has chemical weapons, and most experts believe it has mustard agents and at least ordinary nerve gas. It may have persistent nerve gas as well. It is believed to have cluster warheads for delivering chemical weapons, and it probably has chemical bombs and rocket warheads as well. It may have chemical artillery shells.

There are other reports that Syria has benefited from sales and technology transfers from Iran. Some reports indicate that Syria is undertaking "an innovative chemical warfare (CW) program in cooperation with Iran."ⁱ Syria's CW program began in the mid-1970s, and its facilities are known to have successfully produced VX and sarin nerve agents as well as mustard blister agents, but not independently. The Scientific Studies and Research Center (CERS) runs the facilities in Dumayr, Khan Abou, Shamat, and Furklus.ⁱⁱ There are reports that Syria imported hundreds of tons of hydrochloric acid and ethylene glycol (MEG) from Iran. These chemical agents are precursors for the production of mustard blister agents and sarin nerve gas. The precursors would be used and mounted on Scud-B/C warheads and/or on aerial bombs. Construction of the chemical facilities was said to be due to start in late 2005, with what was then estimated an estimated one-year to complete construction. These reports have not been confirmed, but Syria has long sought to end its dependence on other countries for the precursors and other components of chemical agents.ⁱⁱⁱ

The same reports did not indicate that a contract had been signed, but that the draft agreements would lead Iranian scientists from the Iranian Defense Industries Organization to assist Syria in establishing the infrastructure and location of the new chemical facilities. It will also supply Syria with reactors, pipes, condensers, heat exchangers, and storage and feed tanks as well as chemical detection equipment for airborne agents. Then Iran will assist in producing and piloting the first four or five CW facilities throughout Syria, producing precursors for VX and sarin nerve agents and mustard blister agents.

Syrian Biological Weapons

Syria may be working on biological weapons. The nature of its progress, if any, is unclear. Syria does, however, have the technology base to develop such weapons. Its Scientific Studies and Research Center (CERS) may work on biological and nuclear, as well as chemical weapons. Its experience with UAVs and drones could be used to develop line-source delivery methods for disseminating biological agents, and its

experience with cluster munitions and chemical warheads could be adapted to deliver biological weapons.

Syrian Nuclear Weapons

Syria has long had an interest in acquiring nuclear weapons.^{iv} Its primary partner seems to have been North Korea, although it may have acquired some of the technology and weapons designs sold by the A.Q. Khan network, possibly through Iran, and may have acquired technology and design data from other sources.

However, new evidence surfaced in 2007 that Syria had a far more active nuclear weapons effort than had previously been reported. On September 8, 2007, the Syrian Arab News Agency reported Israeli air strikes and dropped “munitions” in Syria without any reports of damage or casualties.^v Unclassified satellite photographs later made it clear that an Israeli air raid had struck deep into northeast Syria on September 6, 2007, at a target that the imagery strongly indicated might have been a covert Syrian effort to build a nuclear reactor. The images were similar to those of facilities that could contain North Korean designs and that could be used to produce fissile material for nuclear weapons.^{vi}

A report by David Albright and Paul Brannan of the Institute for Science and International Security (ISIS) described the site as follows:^{vii}

ISIS recently obtained commercial satellite imagery from DigitalGlobe taken on August 10, 2007 of a large portion of Eastern Syria along the Euphrates River. After an extensive search and analysis of the imagery, ISIS found a site that could be the target of the Israeli raid inside Syria on September 6, 2007. The tall building in the image may house a reactor under construction and the pump station along the river may have been intended to supply cooling water to the reactor.

The tall building, located approximately 780 meters from the river, is square with approximately 47-meter length sides. There is what appears to be a pump station located on the banks of the river directly west of the tall building. A reactor requires a large volume of water for cooling and this pump station could serve that purpose. The purpose of the secondary building in the image...is unknown, but it does not appear to be a temporary structure. Trucks can be seen approximately 100 meters to the east of the tall building. This, along with evidence of heavy machinery tracks around this site, indicates recent construction activity.

...(The) site is approximately 145 kilometers from the Iraqi border and situated 11 kilometers north of At Tibnah in the Dayr az Zawr region of Syria...There is an airstrip located 3.5 kilometers north of the site...Such an airstrip would serve as quick transportation of personnel and officials.

ABC News reported on Friday, October 19th, 2007 that Israel had recruited a spy to take ground photographs of the reactor construction from inside the complex. Recruiting a spy to take ground photographs of an exposed reactor vessel is unnecessary—as high resolution non-commercial satellite imagery would negate this need. If, however, the reactor vessel and associated shielding were surrounded by a building and covered with a roof, a spy may have been necessary to take photographs from inside the reactor building.

The *Washington Post* reported on Friday, October 19th, 2007 that an official described a facility as similar in structure to a North Korean reactor. North Korean reactor construction is based on an old Russian model—in which the reactor vessel is built gradually and is not brought to the site already constructed or in large pieces, requiring a large crane to move heavy equipment inside. This North Korean/Russian approach would mean that a roof would be placed on a building earlier than in some other reactor designs, and it would hide what was inside the building earlier in the construction timeline.

In comparing the five megawatt-electric (or 20-25 megawatt-thermal) reactor building at North

Korea's Yongbyon nuclear facility to this suspected Syrian reactor building, the length of the outer walls of the structures are approximately the same...The taller roof of North Korea's reactor measures approximately 32 meters by 24 meters on its sides. There also appears to be a faint square on top of the Syrian building's roof. It is unclear whether something would be built there, but its dimensions, 24 meters by 22 meters, are consistent with the subsequent construction of an upper roof. From the image, the Syrian building is similar in shape to the North Korean reactor building, but the Syrian building is not far enough along in its construction to make a definitive comparison.

If the design of the reactor is similar to a North Korean reactor, it is likely a small gas-graphite reactor of the type North Korea built at the Yongbyon nuclear site north of Pyongyang. The Syrian building size suggests that the reactor would be in the range of about 20-25 megawatts-thermal, large enough to make about one nuclear weapon's worth of plutonium each year.

If Syria wanted to build nuclear weapons, it would need a specialized facility to chemically separate the plutonium from the irradiated fuel discharged from the reactor. It is unknown whether Syria has such a facility under construction or planned. On October 23, 2007, Google Earth posted imagery that covers a wide swath of eastern Syria and includes this site. The suspected reactor building can be seen, but the secondary structure and the pump station are both missing in this image. The exact date on which the image was taken is not provided by Google Earth, but it must be significantly earlier than August 10, the date of the DigitalGlobe imagery obtained by ISIS. The absence of the pump station would make interpretation of the purpose of the site very difficult.

The images raise as many questions as they answer. How far along was the reactor construction project when it was bombed? What was the extent of nuclear assistance from North Korea? Which reactor components did Syria obtain from North Korea or elsewhere, and where are they now? Is Syria able to produce any of the key reactor components itself? Could Syria have finished the reactor without on-going North Korean assistance? Did Syria plan to build a plutonium separation plant?

Images taken much later after the air strike revealed a rushed Syrian effort to cover up all visual indicators that the sight even existed.

On April 24, 2008, the White House released photographic images to support the position that the target of the Israeli air raid was a nuclear reactor constructed with the assistance of North Korea. The photographs were taken inside the reactor prior to the September 6, 2007 attack, and showed details like heat control rods. Some of the photographs may have gone as far back as 2002, suggesting a possible multi-year North Korean commitment.

Senior US intelligence officials provided photos, movies, and the following additional details at the briefing, all of which provided a unique set of insights into the intelligence effort to analyze Syria's programs:^{viii}

The reactor was built in a remote area of eastern Syria near the Euphrates River. The nearest town is called al Kibar. Our information supports the following key points: Syria was building a gas-cooled graphite-moderated reactor that was nearing operational capability in August 2007. The reactor would have been capable of producing plutonium for nuclear weapons. It was not configured to produce electricity and was ill-suited for research.

The reactor was destroyed in early September 2007 before it was loaded with nuclear fuel or operated. We are convinced, based on a variety of information, that North Korea assisted the Syrians covert nuclear activities both before and after the reactor was destroyed. Only North Korea has built this type of reactor in the past 35 years.

Features of the facility and its location indicate Syria attempted to maintain its secrecy. Syria moved quickly to cover up its covert nuclear activities by demolishing and burying the reactor

building and by removing incriminating equipment. These actions probably were intended to forestall identification of reactor debris by international inspectors and are inconsistent with peaceful nuclear intentions.

We have detailed information showing that the al Kibar facility was a nuclear reactor. Three dimensional computer model of the facility has been created using features and dimensions through photographs of the facility. This diagram shows key features of a gas-cooled graphite moderated reactor, the type built at al Kibar. We have photographs showing some of these important reactor components under construction including vertical tubes in the top of the reactor for control rods and for refueling, a reinforced-concrete steel-lined reactor vessel, and the water supply systems use heat exchangers to remove heat from the carbon-dioxide coolant.

The main feature of the reactor hall, shown here in the center of the building, was the top of the reactor vessel. The pattern of holes on the floor were the ends of vertical tubes used for control rods and refueling of the cores, a key feature of gas-cooled reactors. We judge other features of the building, such as heavily sealed reinforced-concrete rooms for heat exchangers and a spent fuel holding pool also are consistent with typical gas-cooled reactors. This photograph shows the top of the reactor vessel in the reactor hall before concrete was poured around the vertical control rod and refueling tubes.

Note the similar arrangement of vertical tube openings in the top of the Syrian reactor on the left and North Korea's Yongbyon plutonium production reactor on the right. We assess the Syrian reactor was similar in size and capacity to this North Korean reactor. Only North Korea has built such gas-cool graphite moderated reactors in the past 35 years.

This photograph shows the steel liner for the reinforced-concrete reactor vessel before it was installed. The network of small pipes on the outside of the liner is for cooling water to protect the concrete against the reactor's intense heat and radiation. The animated model shows how this component was positioned in the reactor vessel. This photograph and view of the computer model shows the concrete reactor vessel under construction. The photograph shows the steel liner in place within the vessel.

Satellite imagery, together with ground photographs of the facility under construction, showed features of the cooling water-supply system. A key feature was pipes running up a canyon to supply water from the Euphrates River to an underground storage tank at the reactor site. The site lacked key features of alternative facilities such as fuel storage and turbines for an oil-fired power plant or pipes from the site for irrigation or water treatment. The water would have been pumped from the tank through heat exchangers in the reactor building and the hot water would return to the river by a separate pipeline.

When the pipeline and pump house were externally completed in early August 2007, no further observable construction was necessary before the reactor could begin operations. We assess that the reactor could have been complete and that start of operations could have begun at any time although additional weeks to months of testing were likely.

We have information spanning more than a decade that indicates sustained nuclear cooperation between Syria and North Korea. We obtained this photograph, for example, showing the head of North Korea's nuclear reactor fuel manufacturing plant in Yongbyon. Seen also at the Six-Party talks in the photograph on the right, together is Syria with the head of the Syrian Atomic Energy Commission.

Other examples of cooperation include senior North Koreans from the Yongbyon nuclear complex made multiple visits to Syria before construction of the al Kibar reactor began in 2001. In 2002, North Korean officials were procuring equipment for an undisclosed site in Syria. North Korea, that same year, sought a gas-cooled reactor component we believe was intended for the Syrian site. A North Korean nuclear organization and Syrian officials involved in the covert nuclear program reportedly were involved in a cargo transfer from North Korea to probably al Kibar in 2006.

North Korean nuclear officials were located in the region of the reactor both early and late in 2007. Our information shows that North Korean advisors also probably assisted with damage assessment after the reactor was destroyed. A high-level North Korean delegation traveled to Syria shortly after the reactor was destroyed and met with officials associated with Syria's covert nuclear program. The reactor building was irreparably damaged early in the morning of September 6th, 2007, before it became operational, causing a collapse of the central reactor hall and surrounding light walls and roof structures.

Damascus, including Syrian President Assad has specifically and forcefully denied that a nuclear facility was destroyed or that it has any undeclared nuclear facilities. Syria has gone to extraordinary lengths to conceal the existence and nature of the al Kibar reactor both during its construction and after it was destroyed. These photographs show how a light roof and thin curtain walls were added after the main reactor hall was completed. They alter the building's outline, which otherwise resembles the profile of North Korea's plutonium-production reactor at Yongbyon seen in the photograph on the left.

This photograph shows how much the building's appearance changed after the curtain walls and roof were added. The reactor building was located in a remote area of the Syrian Desert and was built in a canyon which concealed it from view. Further measures including earthen wall or mound that has been in place to block the view of the reactor from the bottom of the canyon.

The concealment afforded by the reactor site's terrain and by the building modifications suggest Syrian attempts to maintain the secrecy of the facility. Immediately after the building was destroyed, the Syrians began taking additional measures to limit potential observation of the reactor and their activities including covering the exposed reactor vessel with tarpaulins; erecting structures to prevent satellite observation of their activities; and opening holes in the building, probably to remove heavy reactor-related equipment.

Syria destroyed the remainder of the reactor building with a massive controlled demolition on October 10th, 2007, as part of an ongoing effort to remove all evidence of the reactor's existence. Demolition of the building, however, revealed key nuclear-related interior structures that remain because they were made of heavily reinforced concrete. These corresponded in configuration and location to key gas-cooled reactor features of our photography-based computer model, including the concrete reactor vessel, the shielded heat-exchanger rooms, and the probably spent fuel storage pool area.

Syria continued to demolish the building and remove equipment and by late October covered the excavation for the reactor building and remaining debris with earth. Syria subsequently erected a light metal-framework building over the site of the destroyed reactor and began preparing a pipeline to connect the site's water-pumping system to a water-treatment plant a few kilometers away, most likely an attempt to further cover up the nuclear nature of the al Kibar site. We do not know the function of the new building, but we assess it is not nuclear related and primarily is intended to discourage excavation of any remaining reactor debris.

In conclusion, our information shows that Syria was building a gas-cooled, graphite-moderated reactor that was nearing operational capability in August 2007. The reactor would have been capable of producing plutonium for nuclear weapons. It was not configured to produce electricity and was ill-suited for research. The reactor was destroyed in early September 2007 before it was loaded with nuclear fuel or operated. We are convinced based on a variety of information that North Korea assisted Syria's covert nuclear activities both before and after the reactor was destroyed. Only North Korea has built this type of reactor in the past 35 years.

A number of questions still remained about the nature of the project and Syria's nuclear weapons efforts. There were no indications that Syria had the ability to provide fuel for the reactor, and no reports it had begun construction of a facility to use the irradiated rods from the reactors to separate out weapons grade Plutonium.^{ix} This was a critical issue because later reports indicated that the reactor at the Al Kibar facility was nearly complete when it was attacked, and had far more infrastructure support than was initially

made public. Syria was able to draw upon an extensive North Korean covert purchasing network run by Ho Jin Yin, and which used a commercial cover and office in Beijing – the Namchongan Trading Co. or NCG – to buy precisely machined equipment like specialized steel pipes, aluminum tubes, transformers, and vacuum pumps for what were claimed to be commercial purposes. This North Korean effort had attracted the attention of Western intelligence agencies no later than 2003, and had previously led to concerns that its imports were designed to help North Korea build a facility to develop fissile Uranium.^x

Work by the Institute for Science and International Security also indicated that the building had a false roof and wall to partly conceal its shape, and that the relatively low profile of the building concealed the fact that it had extensive underground facilities that could conceal a reserve water tank and space for spent fuel rods. It also had hidden power lines; hidden underground water cooling systems that discharged into the Euphrates river, rather than the normal cooling towers; and ventilation systems built into the walls rather than the usual smokestack-like vents.^{xi}

Neither the US nor Israel provided further background on how Syria might have planned to build, deploy, or use nuclear weapons. Major questions remain unanswered about the level of North Korean support Syria did or did not receive, how much technical data and nuclear weapons design information Syria had gotten from such sources as the A.Q. Khan network, and about the level of Syrian-Iranian cooperation, if any.

Syrian Delivery Systems

Syria had some 18-20 SS-21 launchers at the end of 2007, plus 18 Scud Bs and 30 North Korean-made “Scud C” launchers. Syria’s four SS-C-1B Sepal and six SS-C-3 Styx cruise missile fire units might also be adapted to fire missiles for use against area targets. Syria could use virtually any of its combat aircraft for one-way missions or adapt them to remote single sortie use. There are unconfirmed reports that other countries in the region, including Iraq, examined the use of remotely piloted fighters for the line source delivery of chemical weapons.

Syria is reported to have fired three Scud missiles in 2005. All seem to have been tested in an “airburst” mode where the warheads might be using cluster munitions that could carry chemical or biological weapons. One was an older Scud B, with a range of about 300 kilometers, but two were the improved No Dong missiles sometimes called the Scud D, with a range of up to 700 kilometers. There are some analysts who still feel Syria might have acquired Iraq’s weapons of mass destruction when Saddam Hussein had them smuggled out of Iraq before the U.S.-led invasion. Such reporting is anecdotal and so far has not produced any evidence to give it credibility.

As previously noted, some sources have reported that Syria has tried to upgrade its missile forces by buying the Russian SS-X-26 or Iskander E missile from Russia. The missile has a maximum range of 280-300 kilometers and could hit such Israeli cities as Haifa, Jerusalem, and Tel Aviv. Unlike Syria’s present missiles, the SS-X-26 is solid fueled and could improve Syria’s ability to rapidly disperse its missiles and fire without delays for fueling or preparation. So far, however, Russia seems to have rejected such sales, as well as the sale of new surface-to-air missiles that might be converted for such use.^{xii}

The SS-X-26 is believed to be a replacement for both the Scud and the SS-23, which had to be abandoned as a result of the intermediate-range ballistic missile treaty. It is a mobile system mounted on a tracked TEL that can carry two missiles. Work by the Federation of American Scientists (FAS) indicates that it is a high-technology system that could be armed with a cluster munition warhead, a fuel-air explosive enhanced-blast warhead, a tactical earth penetrator for bunker busting, and an electromagnetic pulse device for antiradar missions. The FAS indicates that its small (480-kilogram) conventional warhead would need advanced terminal precision guidance to ensure its efficacy. It speculates that this could be provided by using “active terminal sensors such as a millimeter wave radar, satellite terminal guidance using GLOSNASS, an improved inertial platform, or some combination of these approaches.”^{xiii}

Possible Syrian Strategy, Tactics, and Employment

Various experts have postulated that Syria could use its chemical and possibly biological weapons against Israel or any other neighbor in range as terror weapons and see them as at least a partial deterrent to Israeli strikes with weapons of mass destruction in anything other than an existential conflict.

Other experts have suggested that Syria might use chemical weapons against Israeli army forces as they mobilized, to support a surprise attack on the Golan Heights, on Israel's weapons of mass destruction, or in attacks on some other critical Israeli target or facility. There have also been suggestions that Syria might attempt covert attacks or use a terrorist or other proxy.

It is impossible to dismiss such possibilities, and there are no reliable unclassified sources on Syrian doctrine, plans, or intentions for using weapons of mass destruction. Syria does, however, face the fact that any such attack might be seen as the prelude to a Syrian attack on Israeli population centers and that a mass attack producing high lethality against Israel's mobilization centers would probably be viewed as unacceptable for Israel to ignore.

Israeli plans and doctrine are as obscure as their Syrian equivalents. However, given Israel's past actions, the response might well be Israeli massive retaliation with a mix of air and missile strikes designed to destroy much of Syria's continuity of government, military facilities and capabilities, and economy and infrastructure. A major Syrian attack on Israeli civilian targets might well lead to Israeli retaliation against Syrian cities with nuclear weapons. If Israel sought to send a decisive signal to Syria as to the cost of strikes on Israel, it might come in the form of nuclear ground bursts designed to both cripple Syria and prevent its recovery.

It also seems likely that if Israel ever came to believe Syria was acquiring highly lethal biological weapons, or nuclear weapons, it would massively preempt, possibly without warning.

Figure One

Syria's Search for Weapons of Mass Destruction

Delivery Systems

- Four SSM brigades: 1 with FROG, 1 with Scud Bs, 1 with Scud Cs, and 1 with SS-21s.
- 18 SS-21 launchers and at least 36 SS-21 missiles with 80-100-kilometer range. May be developing chemical warheads.
- According to the May 1998 estimate of the Center for Nonproliferation Studies at the Monterey Institute of International Studies, Syria possessed 200 SS-21 Scarab missiles.^{xiv}
- Some experts believe that some Syrian surface-to-surface missiles armed with chemical weapons began to be stored in concrete shelters in the mountains near Damascus and in the Palmyra region no later than 1986 and that plans have long existed to deploy them forward in an emergency since that date.
- Up to 12 Scud B launchers and 200 Scud B missiles with 310-kilometer range. Believed to have chemical warheads. Scud B warhead weighs 985 kilograms. The inventory of Scud B missiles is believed to be approximately 200.
- The Monterey Institute of International Studies' Center for Nonproliferation Studies reports that the Chinese provided technical assistance to upgrade Scud B missiles in 1993.^{xv}
- New long-range North Korean Scud Cs deployed:
 - *Jane's* cites an American Department of Defense document published in 1992 alleging that Syria had purchased 150 Scud C missiles.
 - Two brigades of 18 launchers each are said to be deployed in a horseshoe-shaped valley. This estimate of 36 launchers is based on the fact that there are 36 tunnels into the hillside. The launchers must be for the Scud C since the older Scud Bs would not be within range of most of Israel. Up to 50 missiles are stored in bunkers to the north as possible reloads. There is a maintenance building and barracks.
 - Underground bunkers are thought to have sufficient storage for some 1,000 Scud-C missiles according to a fall 2002 article in the *Middle East Quarterly*.^{xvi}
 - Estimates indicate that Syria has 24-36 Scud launchers for a total of 260-300 missiles of all types. The normal ratio of launchers to missiles is 10:1, but Syria is focusing on both survivability and the capability to launch a large preemptive strike.
 - The Scud Cs have ranges of up to 550-600 kilometers. They have a CEP of 1,000-2,600 meters. Nerve gas warheads using VX with cluster bomblets seem to have begun production in early 1997. Syria is believed to have 50-80 Scud C missiles.
 - A training site exists about 6 kilometers south of Hama, with an underground facility where TELs and missiles are stored.
- *Jane's* reported, "It was reported in early 1998 that Israeli intelligence experts had estimated that there were between 24 and 36 'Scud' launchers at most Syrian missile sites – far more launchers than previously estimated." Traditionally, armies deploying Scuds stock about ten missiles per launcher. The higher number of Syrian launchers suggests a ratio closer to two missiles per launcher – this would enable Syria to launch a large first-wave strike before launchers were destroyed.
- Syria can now build both the entire Scud B and Scud C. It has sheltered and/or underground missile production/assembly facilities at Aleppo, Hama, and near Damascus, which have been built with aid from Chinese, Iranian, and North Korean technicians. Possibly some Russian technical aid.
- Israeli defense officials have been reported as stating that Syria has been producing about 30 Scud C missiles per year at an underground facility.^{xvii}
- A missile test site exists 15 kilometers south of Homs where Syria has tested missile modifications and new chemical warheads. It has heavy perimeter defenses, a storage area and bunkers, heavily sheltered bunkers, and a missile storage area just west of the site. According to some reports, Syria has built two missile plants near Hama, about 110 miles north of Damascus; one is for solid fueled rockets and the other is for liquid

fueled systems. North Korea may have provided the equipment for the liquid fuel plant, and Syria may now be able to produce the missile.

- There are reports of Chinese deliveries of missiles, but little hard evidence:
 - There are reports of People's Republic of China (PRC) deliveries of missile components by China Precision Machinery Company, maker of the M-11, in July 1996. The M-11 has a 186-mile (280 kilometer) range with a warhead of 1,100 pounds. Missile components may have "contained sensitive guidance equipment."^{xxviii}
- All reports of Syrian purchases and production of Chinese M-9 missile are unconfirmed and of uncertain value:
 - Some sources believe M-9 missile components, or M-9-like components, delivered to Syria. Missile is reported to have a CEP as low as 300 meters.
 - Some intelligence reports indicate that 24 M-9 launchers were sighted in late 1991.^{xix} Other reports suggest that the 1991 missile deliveries were subsequently canceled due to U.S. pressure.
 - Since 1989 there have been persistent rumors that Syria was trying to import the M-9 from China. Up to the mid-1990s, Israeli sources believed that these attempts ended in failure - Beijing reportedly backed out of the deal due to U.S. pressure. The reports surfaced again in the late 1990s, with suggestions that the M-9 had been delivered from China - possibly in kit form, or partly assembled.
 - *Jane's* reported in March 1999 that Syria had created a production facility to build both the M-11 (CSS-7/DF-11) and M-9 missiles with ranges of 280 and 600-800 kilometers, respectively. It reports that production of the booster stage of the M-11 began in 1996 and that missile production is expected to start "soon."
 - An April 1993 report in *Jane's Intelligence Review* report indicated that North Korea and Iran (with Chinese assistance) helped in the construction of underground production facilities for the Scud C and M-9 missiles. At the time of the article (April 1993), production of the Scud C was believed to be 12-18 months off, while M-9 production was believed to be two to three years away.^{xx}
- Senior administration officials were quoted as stating that China had sold missile technology to Syria; 30-90 tons of chemicals for solid propellant were sold to Syria by mid-1992.^{xxi}
- Syria has also developed, with considerable North Korean assistance, a Syrian version of the Korean No Dong missile (sometimes referred to as the Scud D).
 - A number of sources reported the September 23, 2000, test flight of the Syrian No Dong.
 - Four tunnels for shelters for No Dong launchers have been excavated, as of late 2002.^{xxii}
 - Syria is expected to produce or have already started production at the rate of about 30 missiles per year.^{xxiii}
 - Israeli officials claimed that Syria was developing "multiple warhead clusters" in a bid to defeat Israel's Arrow missile defense system.^{xxiv}
- The Center for Nonproliferation Studies at the Monterey Institute of International Studies has compiled a chronology of North Korean assistance to Syria through 2000^{xxv}:

Date	Item(s)	Remarks
1991 March	24 Scud-Cs and 20 TELs	Syria pays approximately \$250 million, and Libya reportedly helps finance the transaction.
1991 April	60 Scud-Cs and 12 TELs	First delivery after agreement for Syria to acquire 150 Scud-Cs for an estimated \$500 million.
1991 May	36 Scud-Cs	Missiles transported by Yugoslavian freighter.
1991 summer	Unknown number of Scud-Cs	Missiles delivered by North Korean ship <i>Mupo</i> and transferred to Syria via Cyprus.
1992	24 Scud-C missiles; missile-production and assembly equipment	Delivered by North Korean freighter <i>Tae Hung Ho</i> in March. Part of the shipment was airlifted to Syria via the Iranian port of Bandar Abbas, and the remaining cargo was transported directly to the Tartus. The manufacturing equipment reportedly was destined for suspected missile factories in Hama and Aleppo.

1992	Approximately 50 Scud-Cs	A North Korean ship carrying 100 Scud Cs departs for the Iranian port Bandar Abbas in October. Half of the delivery is transported overland to Syria.
1993	Seven MAZ 543 chassis and an unknown number of Scud-Cs	In August, two Russian Condor aircraft transport the missiles and chassis from Sunan International Airport to Damascus. According to Israeli Foreign Minister Shimon Peres, North Korea offered to stop the delivery if Israel paid \$500 million.
1994	Unknown number of Scud C missiles and TELs	
1994	Unknown number of Scud C cluster warheads	
1996	Missile expertise	Syrian missile technicians spend two weeks training in North Korea.
1999	Ten tons of powdered aluminum	Originally from China, shipment delivered to the Centre des Etudes de Recherche Scientifique (CERS), the institute in charge of Syria's missile program.
2000	Scud D missile	Unconfirmed; Syria conducted Scud-D flight test on 23 September 2000.
2000	No Dong missiles and TELs	Unconfirmed; North Korean firm Ch'ongchon'gang reportedly delivers 50 No Dong missiles and seven TELs to Syria. Missiles possibly procured on behalf of Iraq, Egypt, and Libya for \$600 million.

- Sheltered or underground missile production/assembly facilities at Aleppo and Hama have been built with aid from Chinese, Iranian, and North Korean technicians. Possibly some Russian technical aid.
- A missile test site exists 15 kilometers south of Homs where Syria has tested missile modifications and new chemical warheads. It has heavy perimeter defenses, a storage area and bunkers, heavily sheltered bunkers, and a missile storage area just west of the site.
- The Nuclear Threat Initiative states that,
 - “Evidence that Syria continues to advance its missile technology and capabilities was revealed in May 2006 in a de-classified report to the United States Congress. The report indicates that for the period 1 January to 31 December 2004, “Syria continued to seek help from abroad to establish a solid-propellant rocket motor development and production capability.” The report also states that Syria’s liquid-propellant missile program continues to depend on essential foreign equipment and assistance, and that “Syria was developing longer range missile programs, such as the Scud D and possibly other variants with assistance from North Korea and Iran.”^{xxvi}
 - The Nuclear Threat Initiative reports that Syria may have test-fired a Scud D short-range ballistic missile capable of striking any target in Israel in January 2007. Israel’s Arrow Missile Defense System detected the launch and tracked the test. Such a test would confirm that Syria received Scud D missiles from North Korea.^{xxvii}
- Syria has shorter-range systems:
 - Short-range M-1B missiles (up to 60 miles range) seem to be in delivery from PRC.
 - SS-N-3 and SSC-1b cruise missiles.
- May be converting some long-range surface-to-air and naval cruise missiles to use chemical warheads.
- 20 Su-24 long-range strike fighters.
- 44 operational MiG-23BN Flogger F fighter ground attack aircraft.
- 20 Su-20 fighter ground attack aircraft.
- 90 Su-22 fighter ground attack aircraft.^{xxviii}
- 18 FROG-7 launchers and rockets.
- Negotiations for PRC-made M-9 missile (185-375 mile range).
- Multiple rocket launchers and tube artillery.

- Syria thought to be interested in purchasing Russia's Iskander-E (SS-X-26) ballistic missile once it has finished development.^{xxix}
- Syria has improved its targeting capability in recent years by making extensive direct and indirect use of commercial satellite imagery, much of which now offers 3 meter levels of resolution and comes with coordinate data with near GPS-like levels of accuracy. One-meter levels of resolution will become commercially available.
- The Central Intelligence Agency (CIA) estimated in January 1999 that Syria continued work on establishing a solid-propellant rocket motor development and production capability. Foreign equipment and assistance have been and will continue to be essential for this effort.

Chemical Weapons

- Unconfirmed reports that first acquired small amounts of chemical weapons (Mustard and Sarin) from Egypt in 1973.
- Acquired design for Soviet Scud warhead using VX in 1970s.
- May have acquired chemical bombs and warheads for Scud missiles in 1979-1982. Reports had VX agents as early as 1982 seem premature.
- Syria imports specialized glass ware, suitable for chemical weapons production, from Germany in 1983.
- The NTI reports that a U.S. Special National Intelligence Estimate (SNIE) issued on September 15, 1983, states that that Syria is "a major recipient of Soviet CW assistance, [and] probably has the most advanced chemical warfare capability in the Arab world, with the possible exception of Egypt. Both Czechoslovakia and the Soviet Union provided the chemical agents, delivery systems, and training that flowed to Syria. As long as this support is forthcoming, there is no need for Syria to develop an indigenous capability to produce CW agents or materiel, and none has been identified."^{xxx}
- Syria imports specialized glass ware, suitable for chemical weapons production, from Germany in 1983.
- Reports that began production of nonpersistent nerve gas surface in 1984. May have had chemical warheads for missiles as early as 1985. US intelligence sources confirm on a background basis that Syria has Sarin gas in 1986.
- The Nuclear Threat Initiative reports that,
 - "The Syrian CW program was established under the aegis of the Centre D'Etude et Recherché Scientifique (CERS), an ostensibly civilian research institute that appears to be responsible for all research, development, and production activities and facilities. Once the decision to proceed with a CW program had been made, it appears that the initial focus was the establishment of a facility for research and development, and possibly pilot production, in the Damascus area. This facility has continued to be used for CW-related research. Simultaneously, work commenced on the construction of larger dedicated CW production facilities. These plants in Al-Safira, Hama, and Homs all came online in the mid- to late 1980s. The first priority of the Syrian CW program was the production of sarin; initial, small-scale production appears to have started in 1984. Originally, this agent was to be carried by Syrian Air Force bombers, but this was an unreliable means of delivery given Israeli air superiority. Intense efforts were undertaken to provide a more dependable delivery system.
 - By 1987, Syria was able to fit sarin-filled warheads, probably unitary rather than cluster, on some of its Scud missiles creating a limited long-range CW strike capability. Since that time, the focus of Syrian efforts has been on increasing the range and effectiveness of their strike capability by obtaining longer-range missiles from foreign suppliers such as North Korea and by improving the sophistication of the warheads. The fitting of bomblet-filled cluster warheads to Scud-C missiles after 1997 was a significant development that greatly increased the potential effectiveness of Syrian chemical weapons. Additionally, Syria has sought to increase the lethality of its force by developing V-agents. Syria has been researching this type of agent since the late 1980s. Throughout the 1990s, reports pointed to continuing work on V-agents but also suggested a lack of success...Following the successful weaponization of sarin in the 1980s, Syria turned to developing additional agents, most notably vesicants. Syria appears to have built up a stockpile of mustard and sarin for tactical uses in the 1990s. By the mid-1990s, the Syrian CW program seems to have reached a plateau in terms of capability and production. There is no current information conclusively suggesting that Syria is engaged in ongoing large-scale production and stockpiling of CW agents.

...Syria is currently believed to deploy between 100 and 200 Scud missiles fitted with sarin warheads. Some of these missiles may be fitted with V-agent warheads although this information is less reliable. In

addition, Syria is believed to have stockpiled several hundred tons of sarin and mustard agents for tactical uses in the form of artillery shells and air-dropped munitions. Syria retains its production infrastructure of at least three and possibly four facilities; however, it is not known whether these are currently being used to produce new agent. Syria conducted one missile test in July 2001, which probably involved the use of a simulated chemical warhead.[5] Since that time, the CW program has maintained a very low profile.^{xxxvi}

- Reports in 1986 that Syria is helping Iran acquire chemical weapons technology as part of its support of Iran in the Iran-Iraq War.
- In December 1986, then Israeli Defense Minister Yitzhak Rabin tells the Israel Knesset that, "we are aware that Syria is armed with chemical weapons—artillery shells, bombs, and ground-to-ground missile warheads...including nerve gas." ^{xxxvii}
- US intelligence officials testify to Congress in 1989 that Syria is stockpiling a variety of chemical weapons.
- Reports in 1990 that a classified DIA report states Syria has chemical munitions depots at Khan Abu Shamat and Furqlus, and that the primary chemical weapons development facility is the Centre D'Etude et Recherche Scientifique, near Damascus.
- In May 1992, Syria's Sema Ltd. Corporation obtains a 45-ton shipment of trimethyl phosphite, a the nerve gas precursor. Large German shipments of the same precursor are intercepted in July. Shipments of other precursors from Russia are detected in 1993. In October 1995 Russia announces the investigation of Lt-Gen Anatoliy Kuntsevich for allowing illegal exports.
- Reports in June 1996 that a new major chemical weapons plant is under construction near Aleppo. Other facilities are reported in the general area of Damascus and Homs.
- Believed to have begun deploying VX in late 1996, early 1997.
 - The CIA reported in June 1997 that Syria had acquired new chemical weapons technology from Russia and Eastern Europe in 1996.
 - Unconfirmed reports in 1997 of sheltered Scud missiles with unitary sarin or tabun nerve gas warheads, now being replaced by cluster warheads with VX bomblets, deployed in caves and shelters near Damascus.
 - Tested Scuds in manner indicating possible chemical warheads in 1996 and 1998, and possible cluster warhead in 2004 .
 - Seems to have cluster warheads and bombs.
 - May have VX and sarin in modified Soviet ZAB-incendiary bombs and PTAB-500 cluster bombs. Reports stated that a U.S. intelligence source had obtained information indicating a late October 1999 test of a live chemical bomb dropped by a Syrian MiG-23. ^{xxxviii}
- CIA estimates in January 1999 that Syria continued to seek CW-related precursors from various sources during the reporting period. Damascus already has a stockpile of the nerve agent sarin and may be trying to develop more toxic and persistent nerve agents. Syria remains dependent on foreign sources for key elements of its CW program, including precursor chemicals and key production equipment.
- The CIA stated that Chinese entities sought to supply Iran and Syria with CW-related chemicals during this reporting period.
- Convincing reports of covert imports of precursors in 2000 and 2003.
- In 2002-2006, a series of unclassified CIA reports confirms Syrian chemical weapons efforts in unclassified reports in 2003. A U S officials says on background that Syria may now have the largest inventory of chemical weapons in the world, but provide no details or comparisons with US, Russian, and Chinese programs. ^{xxxix}
- On January 17, 2005, US officials deny there is valid intelligence that Iraqi chemical weapons were smuggled to Syria. The Iraq Survey Group report issued on April 27, 2005 is more ambiguous. It finds no evidence that such smuggling took place, but cannot exclude the possibility. ^{xl}
- Reports in 2005 that Iran will assist Syria in producing its own precursors for chemical weapons. Syria and Iran sign a new defense cooperation agreement on June 15, 2006.

- Syria conducts two long-range (600-700 kilometer) Scud missile tests in May 2005. Some reports indicate that they had cluster warheads.
- U.S. Department of the Treasury designate three Syrian organizations -- the Higher Institute of Applied Science and Technology (HIAST), the Electronics Institute, and the National Standards and Calibration Laboratory (NSCL) – as involved in proliferation on January 5, 2007.
- Major nerve gas and possible other chemical agent production facilities north of Damascus. Two to three plants.
 - One facility is located near Homs and is located next to a major petrochemical plant. It reportedly produces several hundred tons of nerve gas a year.
 - Reports on the building of a new major plant at Safira, near Aleppo.
 - Reports that a facility co-located with the CERS is developing a warhead with chemical bomblets for the Scud C.
- Many parts of the program are dispersed and compartmented. Missiles, rockets, bombs, and artillery shells are produced/modified and loaded in other facilities. Many may be modified to use VX bomblets.
- Wide range of delivery systems:
 - Extensive testing of chemical warheads for Scud Bs. May have tested chemical warheads for Scud Cs. Recent tests include a July 2001 test of a Scud B near Aleppo and a May 1998 test of a Scud C with a VX warhead near Damascus.
 - May have started production of extended range Scuds in 2002.
 - Shells, bombs, and nerve gas warheads for multiple rocket launchers.
 - FROG warheads may be under development.
 - Reports of SS-21 capability to deliver chemical weapons are not believed by U.S. or Israeli experts.
 - Israeli sources believe Syria has binary weapons and cluster bomb technology suitable for delivering chemical weapons.
- Experts believe Syria has stockpiled 500 to 1,000 metric tons of chemical agents. Holdings thought to include persistent (VX) and nonpersistent nerve agents (sarin) as well as blister agents.

Biological Weapons

- Syria signed, but did not ratify the 1972 Biological and Toxin Weapons Convention. Syria has an extensive research effort.
- US intelligence officials testify to Congress in 1991 and 1992 that Syria is believed to have an offensive biological weapons effort.^{xxxvi}
- In 1997 and 1998, The U.S. Arms Control and Disarmament Agency 1996 compliance reports state that "it is highly probable that Syria is developing an offensive biological warfare capability."^{xxxvii}
- In 2001-2004, the CIA unclassified biannual reports on WMD proliferation state that it is considered, "highly probable that Syria also is developing an offensive BW capability."^{xxxviii}
- On January 17, 2005, US officials deny there is valid intelligence that Iraqi chemical weapons were smuggled to Syria. The Iraq Survey Group report issued on April 27, 2005 is more ambiguous. It finds no evidence that such smuggling took place, but cannot exclude the possibility.^{xxxix}
- In february2006, the Director of DIA states, "'we also believe the Syrian government maintains an offensive biological weapons research and development program."^{xl}
- Current capabilities may be summarized as follows:
 - Extensive research effort. Reports of one underground facility and one near the coast.
 - Possible production capability for anthrax and botulism, and possibly other agents.
 - Israeli sources claim Syria weaponized botulinum and ricin toxins in the early 1990s, and probably anthrax.

- Limited indications may be developing or testing biological variations on ZAB-incendiary bombs and PTAB-500 cluster bombs and Scud warheads.
- Major questions exist regarding Syria's strike capabilities. Older types of biological weapons using wet agents, and placed in older bomb and warhead designs with limited dissemination capability, can achieve only a small fraction of the potential effectiveness of biological weapons. Dry micropowders using advanced agents – such as the most lethal forms of anthrax – can have the effectiveness of small theater nuclear weapons. It is difficult to design adequate missile warheads to disseminate such agents, but this is not beyond Syrian capabilities – particularly since much of the technology needed to make effective cluster munitions and bomblets for VX gas can be adapted to the delivery of biological weapons.^{xli}
- The design of biological bombs and missile warheads with the lethality of small nuclear weapons may now be within Syrian capabilities, as is the design of UAV, helicopter, cruise missile, or aircraft-borne systems to deliver the agent slowly over a long line of flight and taking maximum advantage of wind and weather conditions. U.S. and Soviet texts proved that this kind of “line source” delivery could achieve lethality as high as 50-100 kiloton weapons by the late 1950s, and the technology is well within Syria's grasp. So is the use of proxy or covert delivery.
- The Nuclear Threat Initiative has a more conservative estimate:^{xlii}
 - It is probable, though undemonstrated, that limited research into biological weapons is undertaken by Syrian military scientists. As in many countries, it may only be to identify defensive needs and possible offensive military applications. Claims that Syria has weaponized botulinum toxin and ricin are dubious given the profound difficulties associated with transforming these agents into useful weapons... Research on anthrax may be undertaken in support of efforts to improve the productivity and limit the vulnerability of Syrian agriculture to this disease, which is endemic to the region. Such research could be used to conceal a military program and may be the source of cautious claims that Syria is attempting to weaponize anthrax. If anthrax has in actuality been developed and deployed as a weapon, it is possible that Syria would seek to employ bomblet technology such as that allegedly developed for the dispersal of CW agents... However, on the basis of present knowledge, any conclusions about weaponization or deployment modes must be speculative.
 - Public statements by Western intelligence agencies concur in describing Syria as possessing a limited biotechnical capability that would require significant outside technical assistance before it could undertake large-scale production and weaponization of BW agents. At the same time these reports generally maintain that Syria is engaged in an ongoing BW R&D effort that has not yet resulted in weaponization. Occasional assertions that Syria has weaponized and deployed biological agents or toxins are unsupported by facts and probably reflect political goals more than technical analyses. In the absence of new revelations, it is impossible to support or refute allegations that Syria has an active BW program. It is equally difficult to make any claims regarding military or strategic aspects of this alleged program in the absence of more information

Nuclear Weapons

- Ongoing research effort whose overt aspects are directed by the Syrian Atomic Energy Commission (AECS).
- Syria became a member of the International Atomic Energy Agency (IAEA) in June 1963, and ratified the Nuclear Non-Proliferation Treaty in September 1969.
- Syria launched an ongoing research effort no later than the 1970s. Its overt aspects are directed by the Syrian Atomic Energy Commission (AECS), which was created in 1979.
- The AECS began studies of nuclear power options in 1979-1980 that could be used to conceal efforts to obtain weapons-grade fissile materials.
- Beginning in 1982, the IAEA began to assist Syria in creating a nuclear research laboratory for peaceful nuclear power purposes and research, and in obtaining training for Syrian scientists overseas. This effort was expanded in 1983 to include a nuclear laboratory for the AECS and the Arab Center for the Study of Arab Zones and Dry Lands in Damascus. In 1986, the NTI reports that the IAEA helped Syria create a micro-plant facility for the recovery of yellowcake uranium on an experimental basis from the phosphoric acid being sold by the Syrian General Fertilizer Company Plant at Homs. Syria mines phosphatic rock from deposits at Charkia and Knifes -- which have 60-100 parts per million of uranium.^{xliii}
- Strong evidence that Syria sought to develop the capability to acquire fissile Plutonium for a weapon.

- Russia and Syria sign a nuclear cooperation agreement in February 1983. They began joint study of a nuclear power option for Syria in the spring of 1983.
- At some point in the 1980s, Syria started a program to extract uranium from phosphoric acid. Syria has extensive phosphate mining and refining capability and is an exporter of phosphoric acid-based fertilizers. The NTI reports that the AECS conducted studies in 1992, in cooperation with the International Atomic Energy Agency (IAEA) to examine this option, and the United Nations Development Program (UNDP) funded a project in 1996 to assist the AECS with a pilot plant to extract from a facility in Homs, run by the General Company for Phosphate and Mines. No overt effort to make the plant operational has been reported but Syria has the capability to extract uranium from phosphoric acid on a pilot scale.^{xliv}
- In 1996, the IAEA helps the AECS to acquire a cyclotron similar to one operated in Iran in Karaj, and that can be used to experiment with uranium enrichment. NTI reports that Belgium's Ion Beam Applications has sold Syria a Cyclon-30 cyclotron and the plan is for facility design in 1996-1997; construction and hot cell equipment order and installation in 1997-1999; and cyclotron installation in 1998-1999.^{xlv} In 1997, the IAEA helps Syria obtain an ion beam accelerator for materials research.
- Syria tried to obtain six power reactors (for a total of 6,000 megawatts of generating capacity) in the 1980s from a number of countries, including the Soviet Union, Belgium, and Switzerland, but plans were never implemented.
- Syria becomes a founding member of the Arab Atomic Energy Agency in February 1989.
- Syria announced nuclear reactor purchase plans in the late 1980s. In 1990, it sought to buy a 10 megawatt research reactor from Argentina's National Institute of Applied Research (INVAP) and Argentine National Nuclear Energy Commission (CNEA) reactor was supposed to be used for research into isotope production and would have had uranium fuel enriched to 20% U-235. Negotiation continued through 1995, but the sale was eventually blocked by US negotiating efforts with Argentina.
- In December 1991 Syria purchased a 30-kilowatt neutron-source research reactor from China, with technical assistance from the IAEA. The reactor is not suitable for weapons production. The AECS received 980 grams of 90.2 percent enriched uranium 235 as part of the deal. The reactor went critical in 1996. It is located at the Der Al-Hadjar Nuclear Research Center (also known as Dayr al Hajar or Der Al-Hadjar), and is a Miniature Neutron Source Reactor (MNSR). The Center seems to be roughly 140km north of Damascus, and its overt mission is nuclear and chemical research with a focus on obtaining nuclear fuel, medical research, and nuclear safety. (Syria was also negotiating with India for a 5 megawatt reactor, but the sale seems to have been halted by US diplomatic efforts.)
- Syria seems to have signed a nuclear cooperation agreement with Iran in 1992.
- The Center for Nonproliferation Studies at the Monterey Institute of International Studies quotes a *Jane's Intelligence Review* article from 1993 claiming Syria attempted to purchase "large (thousand ton) quantities" of yellowcake from Namibia.^{xlvi}
- Russia and Syria approved a draft of a plan for cooperation on civil nuclear power in February 1998, which is signed later that summer.^{xlvii} There are reports that Russia will sell Syria a 25MW light water pool-type research reactor. There are other reports of possible reactor sales in 1998 and 2003. Reports surfaced in January 2003 indicating that Syria and Russia had reached an agreement on the construction of a \$2-billion facility that would include a nuclear reactor. Although within several days, Russian Foreign Ministry officials had indicated that no reactor would be sold.^{xlviii}
- Unconfirmed reports begin that Iraq has transferred its nuclear and other programs to develop weapons of mass destruction as early as 1992. Unconfirmed reports that Iraq's nuclear weapons scientists and teams have fled to Syria began to surface shortly after the US-led invasion in March 2003. Officials in the Bush Administration announce on January 25, 2005, that that US intelligence and analysis efforts found these reports to be untrue. The report of the Iraq Survey Group reaches the same general conclusion on April 25, 2005, but notes that it cannot exclude the possibility.
- Reports in April 1994 confirm that Syria has "hot cells" larger than normally required for peaceful research. Such cells provide robotic ability to handle radioactive material and can be used to handle spent fuel rods.
- Reports in mid-2004 indicate that Syria was involved in negotiations and possible technology sales with the A. Q. Khan Network that has sold nuclear weapons materials and technology to countries like Iran and Libya. Declassified US intelligence reports, issued in May 2006, strongly indicate that Syria did make use of the A Q Khan Network.

- Syria built a heavy water reactor suited to produce Plutonium between 2001 and 2007, with North Korean support. The Israeli Air Force destroyed the reactor in September 2007, just as construction was nearly completion.

Missile Defenses

- Seeking Russian S-300 or S-400 surface-to-air missile system with limited antitactical ballistic missile capability.

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- ⁱ Robin Hughes, "Iran Aides Syria's CW Program," Jane's Defense Weekly, October 26, 2005.
- ⁱⁱ Robin Hughes, "Iran Aides Syria's CW Program," Jane's Defense Weekly, October 26, 2005.
- ⁱⁱⁱ Robin Hughes, "Iran Aides Syria's CW Program," Jane's Defense Weekly, October 26, 2005.
- ^{iv} For a detailed chronology of Syria's efforts, see the "Syria Profile" and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html.
- ^v Alon Ben-David, "Alleged IAF incident over Syria heightens tensions," Jane's Defense Weekly, September 10, 2007
- ^{vi} See the work of David Albright in Institute for Science and International Security (ISIS) <http://www.isis-online.org/publications/SuspectSiteUpdate26October2007.pdf>
- ^{vii} David Albright and Paul Brannan, Suspect Reactor Construction Site in Eastern Syria; The Site of the September 6, 2007 Raid? Institute for Science and International Security, October 23, 2007,, <http://www.isis-online.org/>.
- ^{viii} Adapted by the author from a working transcript of "Background Briefing with Senior U.S. Officials on Syria's Covert Nuclear Reactor and North Korea's Involvement, April 24, 2008.
- ^{ix} David E. Snager, "Bush Administration Releases Images to Bolster Its Claims About Syrian Reactor," New York Times, April 25, 2008, p. 6.
- ^x Robin Wright and Joby Warwick, "Purchases Linked North Korea to Syria," Washington Post, May 10, 2008, p. A18
- ^{xi} Joby Warwick, "Experience With Syria Exemplifies Challenge that Detection Presents," Washington Post, May 12, 2008, p. A16.
- ^{xii} See Lee Kass, "Syria After Lebanon: The Growing Syrian Missile Threat," Middle East Quarterly, Fall 2005, <http://www.meforum.org/article/755>
- ^{xiii} <http://www.fas.org/nuke/guide/russia/theater/ss-26.htm>,
- ^{xiv} Center for Nonproliferation Studies, Monterey Institute of International Studies, "Syria Weapons of Mass Destruction Profile," May 1998, <http://www.cns.miis.edu/research/wmdme/syria.html>, accessed March 2003.
- ^{xv} Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April 1993, pp. 168-173.
- ^{xvi} Dani Shoham, "Poisoned Missiles: Syria's Doomsday Deterrent," Middle East Quarterly, Fall 2002.
- ^{xvii} Jane's Defense Weekly, June 19, 2002, p. 40.
- ^{xviii} Sid Balman Jr., UPI, 23 July 1996; Executive News Service, July 24, 1996.
- ^{xix} Far Eastern Economic Review, August 22, 1991, pp. 6.
- ^{xx} Michael Eisenstadt, "Syria's Strategic Weapons," Jane's Intelligence Review, April 1993, pp. 168-173
- ^{xxi} Elaine Sciolino with Eric Schmitt, "China Said to Sell Parts for Missiles," New York Times, January 31, 1992, pp A1, A2.
- ^{xxii} Dani Shoham, "Poisoned Missiles: Syria's Doomsday Deterrent," Middle East Quarterly, Fall 2002.
- ^{xxiii} Steven Rodan and Andrew Koch, "Syria Preparing to Build Extended-Range 'Scud'," Jane's Defense Weekly, June 19, 2002, pp. 40.
- ^{xxiv} Jane's Sentinel Security Assessment posted June 28, 2001.
- ^{xxv} Center for Nonproliferation Studies, Monterey Institute of International Studies, "North Korean Missile Exports and Technical Assistance to Syria," http://www.nti.org/db/profiles/dprk/msl/ie/NKM_EesyriGO.html, accessed March 2003.

^{xxvi} Excerpted from “Syria Profile” and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html.

^{xxvii} Excerpted from “Syria Profile” and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html.

^{xxviii} Numbers of aircraft are from various editions of IISS, “The Military Balance”.

^{xxix} Jane’s Sentinel Security Assessment, posted June 28, 2001

^{xxx} Implications of Soviet Use of Chemical and Toxin Weapons for US Security Interests, SNIE 11-17-83, Central Intelligence Agency, 15 September 1983, p. 11, <<http://www.foia.cia.gov/> .

^{xxxi} Excerpted from “Syria Profile” and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html

^{xxxii} Excerpted from “Syria Profile” and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html

^{xxxiii} Bill Gertz and Rowan Scarborough, “Syrian Gas Practice,” The Washington Times, November 26, 1999, pp A10.

^{xxxiv} Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 30 June 2002, (Washington, DC: Office of the Director of Central Intelligence, 2003), http://www.cia.gov/cia/reports/721_reports/pdfs/721report_jan-june2002.pdf; Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions (Washington, DC: Office of the Director of Central Intelligence, 2003), p. 6, http://www.cia.gov/cia/reports/721_reports/pdfs/jan_jun2003.pdf; Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions 1 July Through 31 December 2003 (Washington, DC: Office of the Director of Central Intelligence, 2004), p. 6, http://www.cia.gov/cia/reports/721_reports/pdfs/721report_july_dec2003.pdf; -- Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions for the period 1 January to 31 December 2004, (Washington, DC: Office of the Director of National Intelligence, 2006), p. 5, <http://www.dni.gov/reports/2004_unclass_report_to_NIC_DO_16Nov04.pdf>.

^{xxxv} "Addendums to the Comprehensive Report of the Special Advisors to the DCI on Iraq's WMD (Duelfer Report)," March 2005, http://www.cia.gov/cia/reports/iraq_wmd_2004/addenda.pdf.

^{xxxvi} See statement of Rear Admiral Thomas A. Brooks, USN, Director of Naval Intelligence, before the Seapower, Strategic, and Critical Materials Subcommittee of the House Armed Services Committee, on Intelligence Issues, 7 March 1991, pp. 56-59; and Robert Gates, Director of Central Intelligence, Prepared Testimony, Senate Committee on Governmental Affairs, 15 and 22 January 1992.

^{xxxvii} Threat Control Through Arms Control: Annual Report to Congress 1996, (Washington, DC: US Government Printers Office, 1997); Threat Control Through Arms Control: Annual Report to Congress 1997, (Washington, DC: US Government Printers Office, 1998).

^{xxxviii} Central Intelligence Agency, "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 July Through 31 December 2001; Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 30 June 2002 (Washington, DC: Office of the Director of Central Intelligence, 2003), http://www.cia.gov/cia/reports/721_reports/pdfs/721report_jan-june2002.pdf; Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions 1 July Through 31 December 2003 (Washington, DC: Office of the Director of

Central Intelligence, 2004), p. 6,
http://www.cia.gov/cia/reports/721_reports/pdfs/721report_july_dec2003.pdf.

^{xxxix} "Addendums to the Comprehensive Report of the Special Advisors to the DCI on Iraq's WMD (Duelfer Report)," March 2005, http://www.cia.gov/cia/reports/iraq_wmd_2004/addenda.pdf.

^{xl} Lieutenant General Michael Maples, Current and Projected National Security Threats to the United States, Statement for the Record before the US Senate Select Committee on Intelligence, 28 February 2006, p. 10, <http://www.dia.mil/publicaffairs/Testimonies/statement24.pdf>.

^{xli} *Jane's Defense Weekly*, September 3, 1997. pp. 3.

^{xlii} Excerpted from "Syria Profile" and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html

^{xliii} Based on data in the Excerpted from "Syria Profile" and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html.

^{xliv} Excerpted from "Syria Profile" and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html

^{xlv} Excerpted from "Syria Profile" and related chronologies on the web site of the Nuclear Threat Initiative, http://www.nti.org/e_research/profiles/Syria/index.html

^{xlvi} Michael Eisenstadt, "Syria's Strategic Weapons," *Jane's Intelligence Review*, April 1993, pp 168-173, in Center for Nonproliferation Studies, Monterey Institute of International Studies, "Country Overviews: Syria (Nuclear)," <http://www.nti.org>, accessed March 2003.

^{xlvii} Central Intelligence Agency, "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 July Through 31 December 2001."

^{xlviii} "Russian Nuclear Assistance to Syria: Scam or Scandal?," *Middle East Intelligence Bulletin*, Vol. 5 No. 1, January 2003.