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The Arab-Israeli Military Balance in 2002

Part Four

Trends in Chemical, Biological, Radiological, and Nuclear Weapons

(Note: For Iran and Iraq, see the Gulf Military Balance)

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List of Tables and Charts

Reasons for Proliferating and War Fighting Options

- **Reasons for proliferating outweigh disincentives, and motivation is growing.**
- **Arms control regimes harass proliferators without stopping stem and fail to offer non-proliferators security.**
- **War fighting concepts are likely to lack clear structure and be highly volatile in terms of enemy, targets, and crisis behavior.**
- **Only a few leadership and military elites -- such as Egypt and Israel -- have shown a concern with highly structured strategic planning in the past.**
- **Iran-Iraq and Gulf Wars have demonstrated missiles and weapons of mass destruction will be used.**
- **Israeli actions in 1967 and attack on Osirak, Egyptian and Syrian attack on Israel in 1973, demonstrate regional focus on surprise and preemption.**
- **Iraq has already demonstrated regional concern with launch on warning, launch under attack options. Syria probably has some option of this kind.**
- **Concentration of population and leadership in single or a few urban areas makes existential attacks possible.**

Reasons for Proliferating Outweigh Perceived Risks

- **Prestige**
- **Deterrence**
- **War fighting**
- **Lessons of Iran-Iraq War and Gulf War: Missiles and weapons of mass destruction have been used against military and civilian targets.**
- **Arms race with neighbors: Algeria-Libya-Morocco, Egypt-Israel-Syria, Iran-Iraq-Southern Gulf.**
- **Inability to know the future enemy, characterize risk.**
- **The "greater Middle East" -- growing overlap of arms races listed above, plus impact of North Korea and India-Pakistan arms race.**
- **Deterrence and safeguards: No way to know the scale of the efforts of key threats and other major regional actors.**
- **Intimidation**
- **Alternative to expensive conventional investments**
- **Compensate for conventional weakness and cost of conventional weapons.**
- **"Glitter Factor"**
- **Limit or attack US and other outside power projection options**
- **Create existential threat**
- **Force arms control; react to absence of meaningful arms control regimes.**
- **Momentum of arms race/respond to proliferation elsewhere**
- **State, proxy, or private terrorism.**
- **Exploit lack of effective civil and critical facility defense and anti-tactical ballistic missile defense capabilities.**

War Fighting Options

- **Covert-indirect, unconventional warfare, "terrorism"**

- **Surprise attack to support conventional war fighting**
- **Avoid conventional defeat**
- **Pose political threat - intimidation**
- **Regional Deterrence - threatened or illustrative use**
- **Attack power projection facilities**
- **Counterproliferation**
- **Extended deterrence**
- **Controlled escalation ladder**
- **Asymmetric escalation/escalation dominance**
- **"Firebreaks"**
- **Launch on warning/launch under attack**
- **Seek to force conflict termination**
- **Destroy enemy as state**
- **Martyrdom**
- **Alter strategic nature of conflict**

Unstable Possible Combinations of Adversaries

- **Iran versus Iraq**
- **Iraq versus Southern Gulf, US, and/or Israel**
- **Israel versus Syria**
- **Iran versus Southern Gulf, US, and/or Israel**
- **Libyan and Algerian wild cards**
- **Vestigial Yemeni use of gas**
- **Saudi Arabia joins the club in reaction to Iranian and Iraqi proliferation, changing the nature of war fighting involving the Southern Gulf.**
- **The US extends deterrence, compellance, and/or retaliation in reaction to an attack on an Arab ally or Israel.**
- **Egypt joins the club after arms control efforts fail, and finds itself involved against Iraq or dragged into confrontation with Israel.**

One-Half Cheer for Arms Control

- Egyptian-Israeli dispute has paralyzed ACRS and all near term progress.
- NNPT aids in early to mid-phases of proliferation. Transfer of technology for fuel cycle
- IAEA inspection and “visits” to declared facilities help, but can also be manipulated to disguise proliferation
- The strengthened safeguards regime the IAEA has recently agreed upon with strengthen the NPT and IAEA by strengthening inspection at declared facilities and allowing the use of more advanced methods such as environmental sampling. It offers some help in dealing with undeclared facilities.
- The 23+2 regime could further strengthen the NNPT and IAEA.
- Dual use technology now allows states to carry out virtually all aspects of weapons design and manufacture -- including simulated tests.
- In spite of Iraq’s grandiose effort, the ability to carry out all aspects of nuclear proliferation except acquiring fissile materials is becoming steadily cheaper, smaller in scale, and easier to conceal.
- The CWC only affects signer countries and large efforts or those disclosed through SIGINT; it cannot prevent development and assembly of up to several hundred weapons and warheads.
- The steady expansion of petrochemical, industrial process plants, and insecticide plants will make it progressively easier to produce chemical weapons without extensive imports of tell tale feedstocks.
- The need to purify and stabilize mustard and nerve agents is now well known, as is the need for more lethal warhead technology. All major proliferators have nerve gas technology.
- The BWC has no enforcement provisions and no near to mid-term prospects of acquiring them.
- Advances in biotechnology, food processing systems, and pharmaceuticals mean all regional states will soon be able to covertly mass produce dry storage biological weapons in optimal aerosol form.
- The MTCR slows things down and is very valuable, but it has not prevented any determined regional actor from getting missiles.
- All credible regional proliferators already have long-range strike aircraft and a wide range of unconventional delivery options.

- Only a broadly based UNSCOM/IAEA effort of the kind going on in Iraq -- supported by even more intrusive inspection and higher levels of technology -- can really enforce arms control, and it might not work for biological weapons.

Strategy, Tactics, and Operations

- Likely to be radical differences in every aspect of strategy, tactics, operations, and capability between Middle Eastern states.

- Israel likely to be only state to develop detailed war plans and tactical employment concepts, and its grand strategy precludes communicating any detailed doctrine of employment and deterrence before a war. Weapons of mass destruction are likely to be used only to prevent the military conquest of Israel after a conventional defeat or in response to major attacks on Israeli population centers.
- Many countries may not articulate detailed war plans and employment doctrine beyond the prestige of acquiring such weapons, broad threats, and efforts to intimidate their neighbors and the West.
- Even where nations appear to articulate a strategy of deterrence or employment, this may often consist more of words than detailed war fighting capabilities
- Most (all?) nations will engage in concealment, denial, and compartmentation -- focusing more on the acquisition and development effort than employment. Targeting plans, test and evaluation, and understanding of lethality will be limited. Joint warfare concepts will rarely be articulated, and doctrine will not be practiced.
- WMD forces will often be covert or compartmented from other forces, and under the direct control of ruling elites with little real military experience. Separate lines of C^4I/BM reporting directly to the leadership will be common. Actual weapons may be held separately from delivery systems and by special units chosen more for loyalty than capability.
- Any actual employment will be crisis driven, and utilization and escalation will be more a product of the attitudes and decisions of a narrow ruling political elite than any part of the military command chain. Risk taking will often be leader-specific and based on perceptions of a crisis shaped more by internal political attitudes than an objective understanding of the military situation.
- Employment is unlikely to be irrational or reckless, but restraint in attacking civilian targets or mass employment against armed forces may be limited. Regimes may also take existential risks in escalating if they feel they are likely to lose power.
- The use of proxies and unconventional delivery means may well be improvised without warning.
- Proliferating nations will pay highly detailed attention to US counterproliferation and ATBM efforts at the technical level, and the lessons of previous wars. They will seek to steadily improve concealment, denial, and countermeasures.
- Arms control will be seen as an extension of conflict and rivalry by other means; not as a valid security option.

Major Uncertainties

- **Uncertain weapons accuracy, reliability, and effectiveness: The CEP problem, the weapons effect problem**
- **Probable lack of full operational testing of all weapons used: The "Heisenberg factor."**
- **Acquisition does not mean war planning**
- **C^4I/BM breakdowns/lack of accurate battle damage assessment by both attacker and attacks.**
- **Uncertainties coming from use of different types of WMDs and delivery systems**
- **Unattributable attacks/proxy attacks**
- **Unconventional warfare, mass terrorism, covert delivery, delayed effects**
- **Impact of "Cocktails" = mixes of different agents or types of weapon of mass destruction**
- **Reliance on authoritarian leaders or elites who will never take the time to fully understand the technology and effects of weapons of mass destruction for sudden crisis decisions**
- **Coupling effects -- US linkages to allies**
- **Different perceptions of values/escalation ladder**
- **Risk of escalation "total war": willingness to risk use of infectious agents,**
- **Instability of preemption, launch on warning, launch under attack options.**
- **The risk of martyrdom and nothing to lose: Unplanned "doomsday machines"**
- **Unexpected collateral damage**
- **Uncertain impact on conventional conflict**
- **Uncertain capabilities for NBC defense/counterproliferation**
- **Impact on peripheral states**
- **Long term damage effects**

- **Next generation arms race**

Libya's Search for Weapons of Mass Destruction

Delivery Systems

- Has developed a liquid-fueled missile with a range of 200 kilometers. No evidence of deployment.
- Al-Fatih solid-fueled missile with 300-450 mile range reported to have been under development with aid of German technical experts, but no signs of successful development.
- FROG-7 rocket launchers with 40 kilometer range.
- Deployed 80 Scud B launchers with 190 mile range in 1976, but could not successfully operate system. Many of the launchers and missiles sold to Iran.
- Fired Scud missiles against the Italian island of Lampadusa in 1987.
- Purchased SS-N-2C and SSC-3 cruise missiles. Little operational capability.
- Pursued other missile development programs with little success. There are unconfirmed reports of some Libyan interest in the Iranian Shahab 3 program.
- Tu-22 bombers with minimal operational capability.
- Su-24 long range strike fighters. These are operational and have with limited refueling capability using C-130s.
- operational Mirage 5D/DE and 10 Mirage 5DD fighter ground attack aircraft.
- Mirage F-1AD fighter ground attack aircraft.
- MiG-23BM Flogger F and 14 MiG-23U fighter ground attack.
- Su-20 and Su-22 Fitter E, J. F fighter ground attack aircraft.
- Tube artillery and multiple rocket launchers.

The CIA estimated in January 1999 that, Libya continued to obtain ballistic missile-related equipment, materials, and technology during the first half of 1998. Outside assistance is critical to keeping its fledgling ballistic missile development programs from becoming moribund. Nevertheless, the UN embargo has restricted the flow of ballistic missile goods and technology reaching Libya.

Libya was caught smuggling Scud components from Hontex in Southern China which are being shipped from Taiwan via BA to Malta in November 1999. The parts include elements for the rocket propulsion system. The shipment is in 32 crates discussed as automobile parts. [1]

The DCI Nonproliferation Center (NPC) reported in February 2000 that Libya continued to obtain ballistic missile-related equipment, materials, technology, and expertise from foreign sources. Outside assistance is critical to keeping its ballistic missile development programs from becoming moribund.

- The CIA reported in August 2000 that Libya has continued its efforts to obtain ballistic missile-related equipment, materials, technology, and expertise from foreign sources. One example is the attempt last year to ship Scud-related parts as "auto parts" from a firm in Taiwan to Libya which were intercepted in the UK. Outside assistance is critical to its ballistic missile development programs, but Libya's current capability remains limited to its aging Scud B missiles. We expect that the suspension of UN sanctions last year will allow Libya to expand its procurement effort.
- In the past, Libya has sought to obtain major weapon systems, spare parts, and other support for its military forces from traditional sources in the former Soviet Union (FSU) and Eastern Europe, as well as from Iran. During the reporting period, Libya actively assessed both acquisition and repair/upgrade options not previously available, and ACW supplier countries openly offered to negotiate arms deals.
- The CIA reported in September 2001, that Libya continues to approach entities in Western Europe to provide needed acquisitions for WMD and missile programs. Increasingly rigorous and effective export controls and cooperation among supplier countries have led the other foreign WMD and missile programs to look elsewhere for many controlled dual-use goods. Machine tools, spare parts for dual-use equipment, and widely available materials**,** scientific equipment**,** and

specialty metals were the most common items sought. In addition, several Western countries announced their willingness to negotiate ACW sales to Libya.

- A Department of Defense report in January 2001 stated that,
  - Despite the presence of UN sanctions from 1992 to 1999, Libya continued to seek ballistic missile-related equipment, materials, technology, and expertise. However, the sanctions restricted the flow of ballistic missile goods and technology ultimately reaching Tripoli, although Libya has successfully obtained them, most notably from Serbia and from Indian companies. Such foreign assistance is critical to maintaining Libya's missile development program and, with the 1999 suspension of UN sanctions, Libya may have greater latitude to seek foreign assistance. Libya continues to maintain an aging SCUD missile force, although the missiles likely suffer from poor maintenance and their operational status is questionable.
  - Libya has tried, with limited success, to develop its own indigenous missile, and to extend the range of its aging SCUD force for many years under the Al Fatah and other missile programs. These indigenous pro-grams are heavily dependent on foreign support and remain in the testing phase. Similarly, Libya's SCUD modification efforts also have shown little progress despite some foreign assistance. Tripoli also is interested in a longer-range missile, such as the North Korean No Dong MRBM, or a similarly capable sys-tem, which it may pursue in light of the suspended UN sanctions. Should Libya succeed with its effort to purchase or perhaps develop such a missile, the missile could threaten Egypt, Israel, NATO countries in southern Europe and U.S. forces in the Mediterranean Region.
  - Libya has land- and sea-launched short-range anti-ship cruise missiles that it purchased from Soviet and European sources, which are potential means of delivery for NBC weapons. Many of the systems are old and likely are suffering from maintenance problems. In the future, while Libya likely will continue to focus on its anti-ship missile capabilities, it may try to purchase land attack cruise missiles. Libya also has a variety of fighter aircraft, some bombers, helicopters, artillery, and rockets available. Libya used transport aircraft in its attempt to deliver chemical agents against Chadian troops in 1987.
- The CIA reported in September 2001, that Libya is continuing its efforts to obtain ballistic missile–related equipment, materials, technology, and expertise from foreign sources. Outside assistance—particularly Serbian, Indian, North Korean and Chinese—is critical to it ballistic missile development programs, and the suspension of UN sanctions in 1999 has allowed Tripoli to expand its procurement effort. Libya's current capability probably remains limited to its Scud B missiles, but with continued foreign assistance it may achieve an MRBM capability—a long-desired goal—or extended-range Scud capability.
  - Following the suspension of UN sanctions, Libya has negotiated—and perhaps completed—contracts with Russian firms for conventional weapons, munitions, and upgrades and refurbishment for its existing inventory of Soviet-era weapons.
- The CIA estimated in January 2002 that,
  - The imposition of UN sanctions has impeded Libyan efforts to obtain foreign assistance for its longer range missile programs. Nevertheless, even if Libya were to obtain a No Dong-class MRBM, Tripoli would be likely to continue to try for longer range systems to increase the number of US and NATO targets it can hold at risk. If a missile were offered with range sufficient to strike 2,500 kilometers into Europe, Libya would try to obtain it.
  - Libya lacks the infrastructure required to develop by 2015 a ballistic missile system with sufficient range to target US territory. Libya's paths to obtaining an ICBM during the time frame of this Estimate probably would be to purchase a complete missile system or to set up a foreign assistance arrangement where foreign scientists and technicians design, develop, and produce a missile and the necessary infrastructure in Libya.
  - Libya's missile program depends on foreign support, without which the program eventually would grind to a halt.

Chemical Weapons

- Claims will not sign CWC as long as other states have nuclear weapons.
- May have used mustard gas delivered in bombs by AN-26 aircraft in final phases of war against Chad in September, 1987.
- Pilot plant near Tripoli has been producing small amounts of chemical weapons since early 1980s.
- Are probably two other small research/batch production facilities.

- Main nerve and mustard gas production facilities in an industrial park at chemical weapons plant at Rabta. This plant can produce both the poison gas and the bombs, shells, and warheads to contain it. Are probably two other research facilities.
- Rabta Plant seems to have started test runs in mid-1988. It is a 30 building facility defended by SAM batteries and special troops. Has sheltered underground areas.
- Libya has acquired large stocks of feedstocks for mustard gas like thiodiglycol, and precursors for nerve gas, and extensive amounts have been sent to Rabta.
- At least 100 metric tons of blister and nerve agents have been produced at Rabta since the late 1980s, but production rate has been very low and plant is either not successful or is not being utilized because of fear of attack.
- The plant would have a capacity of 100 metric tons per year if operated at full capacity.
- Fabricated fire at Rabta in 1990 to try to disguise the function of plant and fact was operating.
- German courts have convicted a German national in October 1996, for selling Libya a computer designed for use in chemical weapons programs and helping Libya to import equipment to clean the waste emissions from poison gas production from India using an Irish dummy corporation.
- Additional major chemical weapons plant in construction in extensive underground site near Tarhunah, a mountainous area 65 kilometers southeast of Tripoli, but few recent signs of activity.
- Tarhunah has been designed to minimize its vulnerability to air attack and has twin tunnels 200-450 feet long, protected by 100 feet of sandstone above the tunnels and a lining of reinforce concrete. This is far beyond the penetration capabilities of the US GBU-27B and GBU-28 penetration bombs. The GBU-28 can penetrate a maximum of 25-30 meters of earth or 6 meters of concrete.
- Libya rejected the proposal of President Mubarak that it open the Tarhuna facility to third country inspection to prove it was not a chemical weapons facility in April 1996.
- Reports of construction of another sheltered major facility near Sabha, 460 miles south of Tripoli.
- Reports of Chinese, North Korean, German, Swiss, and other European technical support and advisors.
- Reports of shipments of chemical weapons to Syria and Iran do not seem valid.
- Very low quality weapons designs with poor fusing and lethality.

The CIA estimated in January 1999 that Libya remains heavily dependent on foreign suppliers for precursor chemicals and other key CW-related equipment. UN sanctions continued to severely limit that support during the first half of 1998. Still, Tripoli has not given up its goal of establishing its own offensive CW capability and continues to pursue an independent production capability for the weapons.

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- The CIA reported in August 2000 that,
  - Libya remains heavily dependent on foreign suppliers for precursor chemicals and other key CW-related equipment. Following the suspension of UN sanctions in April 1999, it wasted no time in re-establishing contacts with sources of expertise, parts, and precursor chemicals abroad, primarily in Western Europe. Clearly, Tripoli has not given up its goal of establishing its own offensive CW capability and continues to pursue an indigenous production capability for the weapons.
  - It also reported that Western countries were important as sources for WMD-related goods and materials as in past years — where entities in Western European countries in particular remain significant suppliers for their WMD programs. Increasingly rigorous and effective export controls and cooperation among supplier countries have led the other foreign WMD programs to look elsewhere for many controlled dual-use goods. Machine tools, spare parts for dual-use equipment, and widely available materials**,** scientific equipment**,** and specialty metals were the most common items sought.

- A Department of Defense report in January 2001 stated that,
  - Libya has made the most progress with its chemical warfare effort. However, it remains heavily dependent on foreign suppliers for precursor chemicals, mechanical and technical expertise, and chemical warfare-related equipment. From 1992 to 1999, UN sanctions continued to limit the type and amount of support Tripoli receives from abroad. However, following the suspension of UN sanctions in April 1999, Libya wasted no time in reestablishing contacts with foreign sources of expertise, parts, and precursor chemicals for its program. Clearly, Tripoli has not given up its goal of reestablishing its offensive chemical warfare ability and continues to pursue an indigenous chemical warfare production capability.
  - Prior to 1990, Libya produced about 100 tons of chemical agents —mustard and some nerve agent —at a chemical facility at Rabta. However, it ceased production there in 1990 due to intense international media attention and the possibility of military intervention, and fabricated a fire to make the Rabta facility appear to have been seriously damaged. Libya maintains that the facility is a pharmaceutical production plant and announced in September 1995 that it was reopening the Rabta pharmaceutical facility. Although production of chemical agents has been halted, the Rabta facility remains part of the Libyan chemical weapons program, and future agent production cannot be ruled out.
  - After 1990, the Libyans shifted their efforts to trying to build a large underground chemical production facility at Tarhunah. However, the pace of activity there has slowed, probably due to increased international attention. The Libyans claim that the Tarhunah tunnel site is a part of the Great Man-made River Project, a nationwide irrigation effort. Libya has not become a state party to the CWC.
- The CIA reported in September 2001, that Libya remains heavily dependent on foreign suppliers for precursor chemicals and other key CW-related equipment. Following the suspension of UN sanctions in April 1999, Tripoli reestablished contacts with sources of expertise, parts, and precursor chemicals abroad, primarily in Western Europe. Libya still appears to have a goal of establishing an offensive CW capability and an indigenous production capability for weapons. Evidence suggests Libya also is seeking to acquire the capability to develop and produce BW agents.
- The CIA estimated in January 2002 that Libya has biological and chemical weapons programs.

Biological Weapons

- Libya acceded to the BWC in 1982.
- George Tenet, the Director of the CIA, testified before the Senate Foreign Relations Committee on March 20, 2000 and identified Libya as a key country seeking biological weapons.
- A Department of Defense report in January 2001 stated that Libya has ratified the BWC, but has continued a biological warfare program. This program has not advanced beyond the research and development stage, although it may be capable of producing small quantities of biological agent. Libya's program has been hindered by the country's poor scientific and technological base, equipment shortages, and a lack of skilled personnel, as well as by UN sanctions in place from 1992 to 1999. Without foreign assistance and technical expertise to help Libya use available dual-use materials, the Libyan biological warfare program is not likely to make significant progress beyond its current stage. On the other hand, with the suspension of UN sanctions, Libya's ability to acquire biological-related equipment and expertise will increase.
- The CIA estimated in January 2002 that Libya has biological and chemical weapons programs.

Nuclear Weapons

- The Idris regime signed the the United Nations (UN) Nuclear NonProliferation Treaty in 1969. Libya ratified it in 1975. In 1980 an agreement was reached with the International Atomic Energy Agency placing all of Libya's nuclear installations under international inspection.
- Has sought to create a development and production capability, but no evidence of any real progress or success.
- In the mid- and late 1970s, Qadhafi repeatedly proclaimed his determination to acquire nuclear weapons, primarily because of Israel.
- Rumors unsuccessfully attempted to buy nuclear weapons from China in the 1970s.
- Cooperation with Pakistan began in 1977 Libya appeared to be providing financial assistance and, later, deliveries of uranium "yellow cake" originating in Niger. In an interview with an Indian newspaper in March 1986, however, Qadhafi

declared that Libya would never help Pakistan acquire an atomic bomb. He said: "We consider nuclear weapons production a great mistake against humanity."

- Qadhafi again called for Libyan production of nuclear weapons on April 29, 1990.
- Facilities are limited:
- Has explored for uranium, but no active mines or uranium mills.
- 10 megawatt, Soviet-supplied nuclear research reactor at Tajura near Tripoli, was acquired from the USSR in 1979. The FAS reports it is staffed by 750 Libyan specialists and technicians. Many students were sent abroad; a group of 200 was studying in the US until early 1983 when the US prohibited training Libyans in nuclear science. Now Operates under IAEA safeguards.
- Had plan to build at 440 megawatt, Soviet-supplied reactor near the Gulf of Sidra in the 1970s, but canceled project.
- Libya negotiated with the Belgian firm of Belgonucleaire to take over the engineering contract and supply much of the needed equipment. After the United States objected, fearing use of the equipment in weapons development, Belgium decided in 1984 to refuse the US$1 billion contract. Shortly thereafter, Moscow's commitment to construct an 880-megawatt power station to be located in the Surt region was reaffirmed. It was to cost over US$4 billion, with repayment to stretch over 15 to 18 years.
- Continues to train nuclear scientists and technicians abroad.
- The CIA reported in August 2000 that Libya continues to develop its nascent and still rudimentary nuclear research and development program but still requires significant foreign assistance to advance to a nuclear weapons option. In the latter half of 1999, Tripoli and Moscow resumed discussions on cooperation at the Tajura Nuclear Research Center and on a potential power reactor deal. Should this civil-sector work come to fruition, Libya could gain opportunities to conduct weapons related R&D.
- A Department of Defense report in January 2001 stated that Libya has ratified the NPT, but has not signed the CTBT and has long intended to develop or acquire nuclear weapons. Libya has made little progress, however, as its nuclear program lacks well-developed plans, expertise, consistent financial support, and adequate foreign suppliers. In the face of these difficulties, nonetheless, Libya likely will continue to try to develop a supporting infrastructure. Libya has a Soviet-supplied research reactor at Tajura that is under IAEA safeguards. The Russians may become actively involved in the modernization of the Tajura nuclear research center and, in 1999, Tripoli and Moscow resumed discussions on cooperation involving the Tajura reactor as well as a potential power reactor deal. Should this civil sector work come to fruition, Libya could gain opportunities to conduct nuclear weapons-related research and development. Libya reportedly also is trying to recruit foreign scientists and technicians to aid its program.
- The CIA reported in September 2001, Libya—an NPT party with full scope IAEA safeguards—continues to develop its nuclear research and development program but would still require significant foreign assistance to advance a nuclear weapons option. The suspension of UN sanctions has accelerated the pace of procurement efforts in Libya’s drive to rejuvenate its ostensibly civilian nuclear program. In January and November 2000, for example, Tripoli and Moscow renewed talks on cooperation at the Tajura Nuclear Research Center and discussed a potential power reactor deal. Should such civil-sector work come to fruition, Libya could gain opportunities to pursue technologies that could be diverted for military purposes.
- The CIA estimated in January 2002 that Libya would need significant foreign assistance to acquire a nuclear weapon, but Tripoli’s nuclear infrastructure enhancements remain of concern.

Egypt's Search for Weapons of Mass Destruction

Delivery Systems

- Began three major design programs based on the V-2 missile in the 1950s, with help from German scientists. Test two missiles by 1965: A 350 kilometer range al-Zafir and a 600 kilometer range Al Kahir. A 1,500 kilometer range Ar-Ra'id was designed nut never tested. These missiles were liquid fueled aging designs and development ceased around 1967.
- Cooperated with Iraq in paying for development and production of "Badar 2000" missile with a 750-1,000 kilometer range. This missile is reported to be a version of the Argentine Condor II or Vector missile. Ranges were reported from 820-980 kilometers, with the possible use of an FAE warhead.
    - Began collaborating with Argentina in 1984 on the Badr-2000 (which paralleled the Argentine Condor II). The Badr/Condor was to be a two-stage, solid-fuel, inertially guided ballistic missile. It was expected to deliver a 700 kg payload over 1,000 km, accurate to within 100 meters.
    - Egyptian officers were arrested for trying to smuggle carbon materials for a missile out of the US. in June 1988. The Egyptian defense minister, Abdel Halim Abu Ghazala, was implicated in the scandal, and left office in April 1989.
    - US efforts then seem to have blocked the development effort. Assistant Secretary of State John Kelly testified to the House Foreign Affairs Middle East Subcommittee In late September 1989, that Egypt had terminated its cooperation with Iraq on the Condor I.
- Has Scud B TELs and missiles with approximately 100 missiles with 300 kilometers range.
- Reports has developed plant to produce an improved version of the Scud B, and possibly Scud C, with North Korean cooperation.
- Range is believed to be 500 kilometers.
- North Korean transfers include equipment for building Scud body, special gyroscope measuring equipment and pulse-code modulation equipment for missile assembly and testing.
- Reports in June 1996 that has made major missile purchase from North Korea, and will soon be able to assemble such missiles in Egypt. Seven shipments from North Korea reported in March and April.
- Another liquid-fueled missile under development known as 'Project T' has an estimated range of 450 kilometers. It is believe to be an extended-range Scuds designed with North Korean assistance.
- Media reports that US satellites detected shipments of Scud C missile parts to Egypt in February-May, 1996 -- including rocket motors and guidance devices -- do not seem correct. The Scud C has a range of roughly 480 kilometers.
- The CIA reported in June 1997, that Egypt had acquired Scud B parts from Russia and North Korea during 1996.

According to press reports in June 1990, China signed a protocol with Egypt to help modernize the Sakr missile factory, "enabling it to produce a newer version of Soviet antiaircraft missiles, the surface-to-surface Scud-B and Silkworm and the Egyptian Sakr rockets."

The CIA reported in January 1999 that Egypt continues its effort to develop and produce the Scud B and Scud C and to develop the two-stage Vector short-range ballistic missiles (SRBMs). Cairo also is interested in developing a medium-range ballistic missile (MRBM). During the first half of 1998, Egypt continued to obtain ballistic missile components and associated equipment from North Korea. This activity is part of a long-running program of ballistic missile cooperation between these two countries.

Three Egyptian companies are sanctioned by the State Department in March 1999 for transferring US-based technology to North Korea that is on the MTCR forbidden transfer list: Arab-British Dynamics, Helwan Machinery and Equipment Company, and Kader Factory for Development Industries.

> Some US and Israel experts believe that North Korea has used technology obtained from Egypt in the Tapeo Dong missile.

The DCI Nonproliferation Center (NPC) reported in February 2000 and August 2000 that Egypt continues its effort to develop and produce ballistic missiles with the assistance of North Korea. This activity is part of a long-running program of ballistic missile cooperation between these two countries.

- The CIA reported in September 2001, that during the last half of 2000, Egypt maintained a relationship with North Korea on ballistic missiles and maintained a Scud inventory. Egypt's ACW acquisition trends aim toward modernizing its Soviet-era equipment and acquiring newer, mostly US weapons.

There are other potential delivery systems.

- US suspects Egypt is developing a liquid-fueled missile called the Vector with an estimated range of 600-1200 kilometers.
- FROG 7 rocket launch units with 40 kilometers range.
- Cooperation with Iraq and North Korea in developing the Saqr 80 missile This rocket is 6.5 meters long and 210 mm in diameter, and weighs 660 kilograms. It has a maximum range of 50 miles (80 kilometers) and a 440 pound (200 kilogram) warhead. Longer range versions may be available.
- AS-15, SS-N-2, and CSS-N-1 cruise missiles.
- F-4E fighter ground attack aircraft.
- Mirage 5E2 fighter ground attack.
- Mirage 2000EM fighters.
- F-16A and 80 F-16C fighters
- Multiple rocket launcher weapons.
- Tube artillery

Chemical Weapons

- History of involvement with chemical weapons:
- Produced and used mustard gas in Yemeni civil war in 1960s, but agents may have been stocks British abandoned in Egypt after World War II. Effort was tightly controlled by Nasser and was unknown to many Egyptian military serving in Yemen.
- Completed research and designs for production of nerve and cyanide gas before 1963.
    - During the Yemen War of 1963 through 1967, Egypt e used mustard bombs in support of South Yemen against royalist troops in North Yemen, and that phosgene and mustard aerial bombs killed at least 1,400 people, and During the Yemeni civil war. Reports that used an organophosphate nerve agent against Yemeni Royalist forces do not seem to be correct
    - Israel and Egypt began to actively prepare for at least defensive chemical warfare before 1967. According to reports by the Federation of American Scientists (FAS), the fear that the Egyptian army was equipped with chemical weapons reportedly led to the preparation in Israel of thousands of graves that were designated for victims of gas attacks.
    - Egypt deployed extensive chemical defense equipment in preparation for the October 1973 War. Some reports indicate it had chemical weapons in the rear, and that Egypt supplied Syria with chemical weapons.
- Post-Camp David status is uncertain:
    - The Defense Intelligence Agency study "Offensive Chemical Warfare Programs in the Middle East" in 1990 that Egypt was continuing to conduct research related to chemical agents..
    - The London Times reported in Spetember 1993 that Egypt had purchased chemical weapons precursors from India, including about 90 tons of trimethyl phosphate, which is used in the production of mustard gas.
- Former Egyptian Minister of War, General Abdel Ranny Gamassay stated in 1975, that, "if Israel should decide to use a nuclear weapon in the battlefield, we shall use the weapons of mass destruction that are at our disposal."
- Seems to have several production facilities for mustard and nerve gas. May have limited stocks of bombs, rockets, and shells.
- Unconfirmed reports of recent efforts to acquire feed stocks for nerve gas. Some efforts to obtain feed stocks from Canada. May now be building feed stock plants in Egypt.

- Industrial infrastructure present for rapid production of cyanide gas.
- The most positive claim that Egypt retains significant chemical weapons capability comes from the Federation of American Scientists (FAS). “It is almost certain that the Egyptian chemical weapon stockpile continues to include mustard gas and phosgene, as were used in the 1960s in Yemen, and it is reported that the Egyptians also produce VX nerve gas. These agents are probably available for delivery in munitions such as mines, artillery shells, salvo bombs, rockets, air-to-surface bombs and missile warheads. It has been suggested, with some plausibility, that chemical agent warheads have been developed for the Condor missile project, which was abandoned, and for the Scud-C missile, which is operational.

Biological Weapons

- Research and technical base.
- US exports feel there is no evidence of major organized activity leading to production, stockpiling, or deployment.
- Israeli reports are different. One claims that Anwar al-Sadat said in 1970 that Egypt has biological weapons stored in refrigerators and could use them against Israel’s crowded population. It speculates that this declaration was apparently intended to warn Israel against a nuclear strike, and Israel did contemplate during the height of the October 1973 war. It reports that Egypt's biological warfare efforts mighty include work on plague, botulism toxin, encephalitis virus, anthrax, Rift Valley fever, and mycotoxicosis.[2]
- The US State Department report on arms control compliance states that Egypt has signed but has not ratified the BWC. The United States believes that Egypt had developed BW agents by 1972. There is no evidence to indicate that Egypt has eliminated this capability and it remains likely that the Egyptian capability to conduct BW continues to exist.

Nuclear Weapons

- History of nuclear efforts under President Nasser beginning in mid 1950s:
  - 1954. Egypt acquired its first nuclear reactor from the Soviet Union in 1961. The two megawatt reactor was opened by Nasser at Inchass, in the Nile Delta.
  - Weapons program seems to have ended following defeat in 1967. Egypt lost many of its nuclear experts who had to travel abroad to seek work opportunities. Some emigrated to Canada and others joined the Iraqi nuclear program.
- Has since subscribed to the Treaty on Nonproliferation of Nuclear Weapons. Since 1974, Egypt has proposed a Middle East nuclear-weapons free zone, calling all countries in the region without exception to join the Nuclear Non-Proliferation Treaty (NPT).
- In April 1990, Egypt took the initiative to render the Middle East free of weapons of mass destruction. The 1991 Madrid Peace Conference established a multinational mechanism to work on making the Middle East a nuclear weapon-free zone Egypt hosted in April 1996 the conference for signing the declaration on rendering Africa a nuclear-weapons free zone.
- Current status makes any nuclear weapons effort seem unlikely:
  - Research and technical base: Work on nuclear power engineering, agriculture, medicine, biotechnology, and genetics continues. Bilateral agreements in the area of the peaceful use of atomic energy with Germany, the United States, Russia, India, China, and Argentina. Agreements with Great Britain and India to provide assistance in training national cadres for scientific research and work on the country's atomic enterprises.
- Has negotiated a number of programs for nuclear power, and has some important capabilities:
  - In the mid-1970s, the US promised to provide Egypt with eight nuclear power plants and the necessary cooperation agreements were signed. In the late 1970s, the US unilaterally revised the bilateral agreements and introduced new conditions that were unacceptable to the Egyptian government.
  - Before his assassination in 1981, President Anwar Sadat announced plans to build two nuclear power stations along the Mediterranean coast.
  - In early 1992, a deal was made for Argentina to deliver one more reactor with a capacity of 22 megawatts to Egypt.
  - The contract signed in 1991 for the delivery to Egypt of a Russian MGD-20 cyclotron accelerator remains in force.

  - Since 1990 Egypt has been a member of the Arab Power Engineering Organization uniting 11 countries. A number of Egyptian scientific projects are being carried out under the aegis of the IAEA.
  - Has four explored uranium deposits and planning has gone on for industrial production, including extraction and enrichment of uranium for use as fuel for power plants.

- President Mubarak did say in October 1998, that Egypt could acquire nuclear weapons to match Israel's capability if this proves necessary,[3] "If the time comes when we need nuclear weapons, we will not hesitate. I say 'if' we have to because this is the last thing we think about. We do not think of joining the nuclear club." This speech was more an effort to push Israel towards disarmament talks, however, than any kind of threat.
- Mubarak also said that Israel, "enhances its military expenditure and develops its missile systems that are used for military purposes. It knows very well that this will not benefit it or spare it from harm. Its efforts to use the help of foreign countries will plunge the region ban into a new arms race which serves nobody's interests." Egypt has supported the indefinite extension of the NNPT, has long been officially committed to creating a nuclear weapons-free zone in the Middle East, and had advocated an agreement that would ban all weapons of mass destruction from the region
- In June 2000, a radioactive cylinder stolen from Cairo's Nuclear Research Center killed an Egyptian farmer and two of his children in Mit Halfa, some 40 kilometers away from the Center. A special Egyptian Army unit found the cylinder. The three died of radiation posioning.[4]

Israel's Search for Weapons of Mass Destruction

Delivery Systems

- Israel has done technical work on a TERCOM 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 400 miles 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.)
    - There are convincing indications that Israel has deployed nuclear armed missiles on mobile launchers. Most outside sources call the first of these missiles the "Jericho I", but Israel has never publicly named its long-range missile systems.
    - 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.
    - A number of sources indicate that Israel deployed up to 50 "Jericho I" (YA-1) missiles on mobile launchers in shelters in the hills southwest of Jerusalem, with up to 400 miles range with a 2,200 pound payload, and with possible nuclear warhead storage nearby.
    - The current deployment of the "Jericho I" force is unclear. Some sources say it has been phased out for the Jericho II missile.[5]
- 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.[6] Israeli carried out a launch in mid-1986 over the Mediterranean that reached a range of 288 miles (460 kilometers). It a 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.[7] Another test occurred on September 14, 1989.
    - Israel launched a missile across the Mediterranean that landed about 250 miles north of Benghazi, Libya. The missile flew over 800 miles, and US 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 USSR[8]
    - The most recent version of the missile seems to be a two-stage, solid-fueled missile with have 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 2 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.
    - 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, use of air-launched weapons, and possible sea-basing.
    - There are also 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.[9]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 that both the booster and any Israeli-South African cooperation may have focused on satellite launches.[10] Since 1994, however, there have been are numerous reports among experts that Israel is 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 estimates 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 declassifed DIA estimate of the launch capability of the Shavit booster that Israel tested on September 19, 1988.[11]
  - 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 cases 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 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.[12]
    - *Jane's Intelligence Review* published satellite photos of what it said as a Jericho II missile base at Zachariah (God remembers with a vengeance) several miles southeast of Tel Aviv in September 1997.[13] 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 communications vehicle and a firing control vehicle. This configuration is somewhat similar to that used in the US 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. [14]
  - 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. [15]
- F-15, F-16, F-4E, and Phantom 2000 fighter-bombers capable of long-range refueling and of carrying nuclear and chemical bombs.
- 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.
- Israel bought some Lance missile launchers and 160 Lance missiles, with 130 kilometers range, from the US in the 1970s. The US removed them from active duty during 1991-1994. The status of the Israeli missiles is unknown.
  - 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.
- Variant of the Popeye air-to-surface missile believed to have nuclear warhead.
- The MAR-290 rocket with 30 kilometers range is believed to be deployed
- MAR-350 surface-to-surface missile with range of 56 miles and 735 lb. payload believed to have completed development or to be in early deployment.
- Israel seeking super computers for Technion Institute (designing ballistic missile RVs), Hebrew University (may be engaged in hydrogen bomb research), and Israeli Military Industries (maker of "Jericho II" and Shavit booster).
- Israel 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.

- Some reports indicate that Israeli submarines may be capable of carrying nuclear-armed Popeye Turbo cruise missiles, to provide a second-strike capability that would ensure Israeli could deter a striking to take out its nuclear weapons with a surprise attack. The most detailed have appeared in Jane's Defense Weekly, the London Sunday Times, and reporting by the The Federation of American Scientists (FAS):
  - The FAS reports that Israel may have secretly carried out its first test launches from two German-built *Dolphin*-class submarines of cruise missiles capable of carrying nuclear warheads in May 2000. The missiles are reported to have been launched from vessels off Sri Lanka in the Indian Ocean and to have hit a target at a range of about 1,500 kilometers [about 930 statute miles]. Israel is reported to possess a 200kg nuclear warhead, containing 6kg of plutonium, that could be mounted on cruise missiles.
  - Israel has reportedly developed an air-launched cruise missile that could be operational by 2002, called the Popeye Turbo.
  - The Popeye Turbo is normally reported to have a range at between 200 km and 350 km, and to be a turbo-jet powered cruise missile that may incorporate avionics and other components developed for the Popeye family of missiles.. The Popeye Turbo missile is probably similar to if not identical with the Israeli submarine-launced cruise missile carried on the *Dolphin*-class submarines. The baseline Popeye missile with a range of 45 miles has a diameter of 21 inches, and is nearly 16 feet long.
  - The reported range of 1,500 km for the SLCM tested in May 2000 is several times greater than the previously reported range for the Popeye Turbo. However, open literature provides little information. There is no particular reason to doubt that Israel could develop a variant of the Popeye Turbo with a range of 1,500 km, simply by lengthening the fuel tank associated with a 300-350 km variant reported by US intelligence. The longer range reported in June 2000 would suit with Israeli targetting requirements.
  - The submarines have six 533-millimeter torpedo tubes suitable for the 21-inch torpedoes that are normally used on most submarines, including those of the United States. Some reports suggest that the submarines have a total of ten torpedo tubes -- six 533-millimeter and four 650-millimeter. The four larger 25.5 inch diameter torpedo tubes could be used to launch a long-range nuclear-capable submarine-launched cruise missile (SLCM). For comparison, the American MK-48 heavy torpedo is 21 inches in diameter, and 19 feet long, while the BGM-109 Tomahawk SLCM is 20.4 inches in diameter and 20.5 feet long [including the booster motor], and the Russian SS-N-21 SLCM is similar in configuration and dimensions to the American Tomahawk.
  - The FAS reports that Israeli is considering a system of rotation where two of the vessels would remain at sea: one in the Red Sea and Persian Gulf, the other in the Mediterranean. A third would remain on standby

Chemical Weapons

- Israeli has signed the CWC, but not ratified it.
- Reports of 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.
- 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.
- 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 on dimethyl methylphosphonate, a chemical used to make Sarin nerve gas. The chemical had been purchased from Solkatronic Chemicals in the US 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 only being imported to test gas masks.[16]
- 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 non-persistent 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 air crew protection system.
- Extensive field exercises in chemical defense.
- Gas masks stockpiled, and distributed to population with other civil defense instructions during Gulf War.
- Warhead delivery capability for bombs, rockets, and missiles, but none now believed to be equipped with chemical agents.

Biological Weapons

- Israel has not signed the BWC.
- Extensive research into weapons and defense.
- Ready to quickly produce biological weapons, but no reports of active production effort.
- Israel has at least one major research facility with sufficient security and capacity to produce both chemical and biological weapons.[17] There are extensive reports that Israel has 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 like the attempt on a Hamas leader in Jordan in 1997.[18]
- 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 Kingberg, served 16 years in prison for spying for the FSU.
- US experts privately state that Israel is one of the nations included in US 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 considerable 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.[19]

Nuclear Weapons

- Israel has signed the CTBT, but not the NPT. It has, however, supported a WMD free zone. Gideon Frank stated at the 43rd General Conference of the IAEA that he was reaffirming Israel's commitment "in due course and in the proper context, to establishing the Middle East as a zone free of WMD and missiles."
- Israel has significant nuclear facilities:
- Two significant reactor projects: the 5 megawatt HEU light-water IRR I reactor at Nahal Soreq; and the 40-150 megawatt heavy water, IRR-2 natural uranium reactor used for the production of fissile material at Dimona. Only the IRR-1 is under IAEA safeguards.
- Dimona has conducted experiments in pilot scale laser and centrifuge enrichment, purifies UO_2, converts UF_6 and fabricates fuel for weapons purpose.
- Uranium phosphate mining in Negev, near Beersheba, and yellow cake is produced at two plants in the Haifa area and one in southern Israel.
- Pilot-scale heavy water plant operating at Rehovot.
- 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 Palmikim, 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.
- Views differ over the history of the Israeli nuclear weapons effort. On outline of its history based on work by the Federation of American Scientists indiates that:

- The project began in the late 1940s when HEMED GIMMEL a special unit of the IDF's Science Corps, began a two-year geological survey of the Negev desert in 1949 that include the search uranium reserves. No significant sources of uranium were found, but recoverable amounts were located in phosphate deposits.
- The Israel Atomic Energy Commission (IAEC) was created in 1952. Its chairman, Ernst David Bergmann, had long advocated an Israeli bomb as the best way to ensure "that we shall never again be led as lambs to the slaughter." Bergmann was also head of the Ministry of Defense's Research and Infrastructure Division (known by its Hebrew acronym, EMET), which had taken over the HEMED research centers (HEMED GIMMEL among them, now renamed Machon 4) as part of a reorganization.
- Under Bergmann, the line between the IAEC and EMET blurred to the point that Machon 4 functioned essentially as the chief laboratory for the IAEC. By 1953, Machon 4 had not only perfected a process for extracting the uranium found in the Negev, but had also developed a new method of producing heavy water, providing Israel with an indigenous capability to produce some of the most important nuclear materials.
- In the fall of 1956, France agreed to provide Israel with an 18 MWt research reactor. The Suez Crisis then led the Soviet Union made a thinly veiled threat of a nuclear attack against Israel while the United States stood idly by. This convinced Israeli leaders that an independent nuclear capability was needed to prevent reliance on potentially unreliable allies, and the collapse of the Anglo-French attack led to a French willininges to provide weapons technology. French premier Guy Mollet is even quoted as saying privately that France "owed" the bomb to Israel.
- France and Israel signed a revised agreement on 3 October 1957 for France to build what was said to bea 24 MWt reactor. In fact, the cooling systems and waste facilities were designed to handle three times that power) and a secret protocol to provide a chemical reprocessing plant. This complex was secretly constructed at Dimona, in the Negev desert under the leadership of Col. Manes Pratt of the IDF Ordinance Corps. The effort was not reported to the IAEA.
- The United States became aware of Dimona's existence after U-2 overflights in 1958, but it was not identified as a nuclear site until two years later. Israel stated that Dimona was a textile plant, an agricultural station, and a metallurgical research facility, until December 1960.
- The CIA issued a report on December 8 1960 outlining Dimona's implications for nuclear proliferation, United States inspectors visited Dimona several times during the 1960s, but they were unable to obtain an accurate picture of Israeli activities because of Israeli control over the timing and agenda of the visit, and deceptions like a false control room panels and the bricking over of elevators and hallways to secret areas of the facility..
- A new Israeli intelligence agency, the Office of Special Tasks, was created to provide security for the nuclear weapons project which, at its height, employed 1,500 Israeli scientists, many with doctorates, and included a community of French workers and their families consisting of over 2,500 people. In addition, France bought heavy water from Norway on the condition that it not be transferred to a third country, and the French Air Force secretly flew as much as four tons to Israel.
- President de Gaulle altered Franco-Israeli cooperation even before the 1967 war. In May 1960, France began to pressure Israel to make the project public and to submit to international inspections of the site, and threatened to withhold the reactor fuel. The FAS reports that de Gaulle met with Ben-Gurion and offered to sell Israel fighter aircraft in exchange for stopping work on the reprocessing plant. Israel the worked out a compromise. France would supply the uranium and components already placed on order and would not insist on international inspections. In return, Israel would assure France that they had no intention of making atomic weapons, would not reprocess any plutonium, and would reveal the existence of the reactor, which would be completed without French assistance. In reality, nothing changed - French contractors finished work on the reactor and reprocessing plant, uranium fuel was delivered and the reactor went critical in 1963-64.
- In addition to the enriched uranium from the Pennsylvania facility, 200 tons of uranium ore that disappeared from a ship in the Mediterranean in 1968 probably were also diverted to Israel.

- There is a long history of uncertain estimates the numbers and kinds of weapons Israel posseses:
  - The CIA station in Tel Aviv estimated in the mid-1960s that the Israeli nuclear weapons program was an established fact, but US analyses of Israel's nuclear program then suffered from reliance on the assumptions - that Israel would need US assistance to successfully build a bomb, and that Israel would let its nuclear capability be publicly known.

  - Some type of non-nuclear test, perhaps a zero yield or implosion test, occurred on 2 November 1966 [possibly at Al-Naqab in the Negev].
  - The CIA reported in early 1968 that Israel had successfully produced four nuclear weapons. The FAS says, however, that this estimate was based on an informal conversation between Carl Duckett, head of the CIA's Office of Science and Technology, and Edward Teller, father of the hydrogen bomb. Teller said that, based on conversations with friends in the Israeli scientific and defense establishment, he had concluded that Israel was capable of building the bomb, and that the CIA should not wait for an Israeli test to make a final assessment because that test would never be carried out. The figure of four devices was based on the assumption that 100 kg of enriched uranium - enough for four crude weapons - missing from a facility at Apollo, Pennsylvania, but much of the missing material was eventually recovered from the floors and ventilation ducts of the plant when it was decommissioned in the 1980s).
  - In 1974, the CIA estimated that Israel had between ten and twenty nuclear weapons. The FAS reports that this estimate was based on the assumption that Israel could have separated enough plutonium for at least six bombs since 1970, in addition to those made with the allegedly stolen uranium. The upper bound was derived from CIA speculation regarding the number of possible Israeli targets, and not from any specific intelligence. Because this target list was presumed to be relatively static, this remained the official American estimate until the early 1980s.
- Some feel a suspected nuclear explosion in the southern Indian Ocean in 1979 was a joint South African-Israeli test.
  - Director of CIA indicated in May 1989, that Israel might be seeking to construct a thermonuclear weapon.
  - *Jane's Intelligence Review* published an article in September 1997 which refers to nuclear weapons bunkers at the Jericho 2 missile base at Zachariah (God remembers with a vengeance) several miles southeast of Tel Aviv and at 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. [20]
- Estimates of Israel's numbers and types of weapons differ sharply.
- Stockpile of at least 60-80 plutonium weapons.
- May have well over 100 nuclear weapons assemblies, with some weapons with yields over 100 Kilotons.
- US experts belief 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 200-300 weapons is possible.
- The FAS estimate is as follows: "The actual size and composition of Israel's nuclear stockpile is uncertain, and is the subject of various estimates and reports. It is widely reported that Israel had two bombs in 1967, and that Prime Minister Eshkol ordered them armed in Israel's first nuclear alert during the Six-Day War. It is also reported that, fearing defeat in the October 1973 Yom Kippur War, the Israelis assembled 13 twenty-kiloton atomic bombs. Israel could potentially have produced around 20 nuclear warheads in the period 1970-1980, and from 100 to 200 warheads by the mid-1990s. In 1986 descriptions and photographs were published in the London Sunday Times of a purported underground bomb factory. The photographs were taken by Mordechai Vanunu, a dismissed Israeli nuclear technician. His information led experts to conclude that Israel had a stockpile of 100 to 200 nuclear devices. As of the late 1990s Israel's nuclear arsenal was thought to consist of from 75-130 weapons, based on plutonium production estimates. The stockpile would certainly include warheads for mobile Jericho-1 and Jericho-2 missiles, as well as bombs for Israeli aircraft, and may include other tactical nuclear weapons of various types.

  - The FAS estimates that the upper and lower limits on Israel's stockpile may be limited by considering several variables. The current thermal power of the Dimona reactor is variously reported at between 100 MWt and 200 MWt. The reactor may have operated an average of between 250 and 300 days annually, and produced approximately 0.9 to 1.0 grams of plutonium for each thermal megawatt day. This would suggest an annual production rate of plutonium of between 20 and 60 kilograms, compared to the 40 kilograms annually reported by Vanunu. Israel may use between 4 and 5 kilograms of plutonium per weapon [5 kilograms is a conservative estimate, and Vanunu reported that Israeli

weapons used 4 kg]. Given this range of uncertainty, as of 2000 the Israeli stockpile almost certainly consists of at least 125 weapons and probably no more than about 425 weapons.

- Israel's position on nuclear weapons may be changing:
  - Several reports indicate that Israel's strategic review during 1997-1998 involved a review of Israeli nuclear strategy that included Prime Minster Netanyahu's Office, the Ministry of Defense, and Foreign Ministry. This effort seems to have decided that Israel should keep the nature of its weapons of mass destruction and missiles secret, strengthen its missile defenses, and reduce the vulnerability of its nuclear strike forces.[21]
  - The Israeli paper Yedioth Ahronoth, was allowed to print excerpts from the classified positions of the trial of Mordecai Vanunu, a former technician at Dimona, in November 1999.
  - Israel held its first parliamentary debate on nuclear weapons on February 2 2000, at the request of Issam Mahoul, a member of the Knesset from the largely Arab Hadash party.[22] Mahoul provided the first statistics and description of Israel's nuclear program ever mentioned in the Knesset, although the government rejected the numbers and the debate rapidly turned into an Arab-Israeli shouting match.[23]
  - Israel seems to be considering ways to reduce the vulnerability of its nuclear strike force, and to reduce the incentive for any strike on its delivery system. These seem to include new forms of dispersal, hardening some facilities, and the possible use of Israel's new Dolphin submarines to deliver cruise missiles.
- Israel still refuses to openly discuss its deterrent or the nuclear issue in various regional arms control talks, although it has increasingly supported arms control measures that do not force it to declare its nuclear capability.
  - It has agreed to abide by the terms of the Missile Technology Control Regime (MTCR), it signed the Chemical Weapons Convention (CWC) in January 1993, and the Comprehensive Test Ban Treaty in September 1996.[24]
  - In May 1997, Israel also carefully leaked an interview given by Gideon Frank, the former head of the Atomic Energy Commission in the Prime Minister's office. frank that said Israel could only give up its nuclear weapons when it reached a peace with Egypt, Syria, and other states similar to the one reached between Argentina and Brazil. Frank said that it would require a proven framework for mutual cooperation, particularly in the economic area, a "process of democratization" in the Arab world, and "a long, phased confidence-building process."[25]
- Israeli Foreign Minister David Levy stated on May 11, 2000 that Israel could not sign the Nuclear Non-Proliferation Treaty because Iran and Iraq posed too great a threat to be ignored. "WE have not reached the stage where the friends of Israel can guarantee the future."

Missile Defenses

- Israel has developed a comprehensive missile defense plan, including a 10-year funding plan. The Arrow missile defense program forms the core of this plan, but it involves layered defense, a possible boost-phase interceptor, new battle management systems and sensors, and close cooperation with the US. It also involves consideration of extending the defense umbrella to cover Jordan, reducing the vulnerability of Israeli missile and nuclear forces, and possible cooperation with Turkey.[26]
- The resulting Homa (barrier) project now calls for both tactical and theater defenses to be overlayed in ways that combine Israeli systems with US reinforcements. Israel recognizes, however, that any program must be technology and threat driven and respond to new developments and events. It also recognizes that effective defense against long-range missiles involves terminal velocities that severely limit the effectiveness of the anti-tactical ballistic missiles it can afford to develop. As a result, Israel is faced with the challenge of either finding either some form of boost phase defense or an "upper tier" wide-area threat defense with a high intercept capability even against missiles closing from ranges in excess of 1,000 kilometers. (Missile launch ranges from Iraq, Libya and Syria are under 1,000 kilometers and have closing velocities suited to lower tier theater missile defenses and which still give tactical ballistic missile defenses some effectiveness in point defense over a reasonably wide range of deployment locations. Iran must generally launch from ranges in excess of 1,000 kilometers, and the closing speeds of more modern and longer-range missiles like the Shahab are faster and present much more serious intercept problems.)
- The Tactical High Energy Laser (THEL) or Nautilus
  - The Tactical High Energy Laser or THEL program was originally a $100 million program, with the US paying $70 million and Israel paying $30 million. At present it is primarily a defense against unguided rockets, rather than guided

missiles. It is far from clear that it will work, since current versions need to hold a rocket in flight for nearly 15 seconds, and the average flight time of an 80-240 mm rocket is generally less than 30 seconds. They are also dependent on a clear line of sight, so haze and smoke present major problems.[27]

- Nevertheless, tests at White Sands in February 1996 proved that a laser could track a missile for the required time, and that a deuterium fluoride laser beam could destroy a missile in flight. The concept is still being pushed forward, largely in an effort to provide defenses against Hizbollah rocket attacks on northern Israel. Rockets can also be used to launch large numbers of biological and chemical weapons, however, and THEL provides a tactical layer of defense.[28]
- The THEL program ran into trouble in 1999 when a series of technical difficulties encountered during initial tests and chemical leaks caused by faulty valves delayed the project by up to a year.[29] The delays resulted in cost overruns totaling $30-50 million over the $130.8 million ceiling. The cost overruns jeopardized the future of the project as the contractor and the US government argued over who was responsible for the extra cost.[30] THEL was saved when the Israeli Ministry of Defense and the US Army agreed to each pay a quarter of the overruns while the contractor is still responsible for the other half.[31]
- The THEL deuterium fllouride laser has since been successful in tests against incoming Kathusha rockets, and the demonstrator may be dismantled and shipped to Israel for operational testing. The creation and deployment of an operational test bed is unlikely to be complete before early 2001, however, and the cost-effectiveness of the program remains uncertain.[32]

- The Patriot and PAC-3
  - Israel currently deploys three Patriot batteries using systems and missiles whose anti-tactical ballistic missile (ATBM) defenses have been upgraded since the Gulf War. They now have software that allows them to distinguish between the missile booster and warhead far more accurately, and they have a much greater kill probability against an oncoming warhead. Each battery has three missile launch vehicles. It is receiving new equipment with a value estimated at $73 million, which was approved by the US Department of Defense in June 1998. This equipment includes three AN/MPQ-53 radar sets, three AN/MSQ-104 engagement control stations, three M-983 tractors, nine M931A2 trucks and other equipment. It is also developing its own ATBM defenses.
  - The Patriot is an air defense system with moderate capabilities in a largely point defense mode as a tactical ballistic missile defense system. It also provides considerable defense against cruise missiles, adding a key layer to Israeli defenses, and is being steadily improved to widen its coverage against Scud-type threats. Its speed and range are limited, however, and cannot be particularly effective against IRBM-type threats like the Shahab-3 which have closing velocities that limited the Patriot's defense area coverage to a much narrower radius near the missile launcher.
  - The Patriot's capability will be further enhanced by the PAC-3 upgrade. The PAC 3 upgrade expands the area from which Patriot can intercept a missile, reduces the risk of "leakage" against ballistic missiles, introduces a superior direct hit to kill system, and improves defense against cruise missiles. The system has had major development problems and cost overruns, but did have a successful hit-to-kill intercept in March 1999. [33] The US Department of Defense licensed the new Patriot technology for export in November 1999.[34]

- The Arrow
  - The Arrow missile is an anti-tactical ballistic missile defense with limited area coverage that is tailored to Israel's needs and limited geographic area. The Arrow-2 is supposed to intercept incoming missile warheads at ranges, which have been variously reported as being from 10-40 kilometers or 33,000-131,000 feet. The missile is a two-stage, hypersonic, solid-fuel missile with a fragmentation warhead. Each Arrow-2 battery has four missile launchers with six missile tubes each, and will normally be equipped with at least 50 missiles. The system uses a Green Pine search and track radar, a Citron Tree fire control center, a Hazelnut Tree launch control center, and the Arrow 2 launcher. Its manning requires about 100 personnel.
  - Plans call for three batteries, although only two are fully funded. Israeli calculates that two batteries can defend "most populated areas in Israel." The official program cost is often said to be around $1.6 billion, although some Israelis feel the true total system-related cost will be in excess of $3 billion.[35]
  - The program is constantly evolving to respond to changes in technology, the development and test program, and changes in the threat. As of March 1999, it was a three-phase program with the following features:
    - Phase I: Validate Defense Concept and Demonstrate Pre-prototype Missile

- Fixed price contract: $158 million
- The US pays 80%; Israel pays 20%.
- Completed in December 1982.
- Phase II: Demonstrate Lethality, develop and demonstrate tactical interceptor and launcher.
- Fixed price contract: $330 million.
- The US pays 72%; Israel pays 28%.
- 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 US pays 48%; Israel pays 52%.
- Began in March 1996.
- System integration in progress.

  - Israel originally planned to deploy the Arrow in two sites near Tel Aviv and Haifa which could cover up to 85% of Israel's population. It expanded this plan to include a third site in June 1998, with an additional $57 million allocated to this battery. Partly because of the increasing pace of the threat from Iran and Syria, Israel accelerated work on the Arrow. It then planned to deploy the system in mid-1998. However, a fire at a plant near Tel Aviv caused an estimated $30 million in damage and delayed the program. As a result, the first Arrow 2 missile battery was activated on November 29, 1998, and began training in December 1998. [36] In 1999 Israel urged the US to consider expanding the Arrow system into a regional defense by including additional batteries in Jordan and Turkey. With additional batteries, the Arrow would protect all of Turkey, Jordan, and Israel against attacks from a country such as Iran. However, it is unlikely that the US will agree to this and it is unclear that Jordan even wants the Arrow.[37]
  - It is difficult to put the Arrow 2 into technical perspective. Like all systems this complex, it has had a troubled life in terms of its original technical design, management and system integration problems. It has had some successful tests, notably in an integrated weapon system test and fly out against a simulated target on September 14, 1998. It also destroyed an Israeli seal-launch TM-91 missile, which was simulating an Iraq Al Hussein missile, during its first comprehensive system test in November 1999. However, the Arrow has also had test failures and severe management and development problems. It had had only seven firing tests as of the end of 1999, and its current test program calls for less than one-fifth of the tests necessary to fully validate its reliability and effectiveness.[38]
  - The development schedule that Israel has adopted is a high-risk program with limited testing that raises serious questions about the extent to which even successful follow-up tests will provide high reliable data on its operational probability of intercept, particularly under real-world conditions against different types of missiles and different types of "volleys." It seems possible that it may prove highly effective against Scud type missiles. However, it clearly has only limited capability against newer systems like the Iranian Shihab series, which is already forcing Israel to develop a follow-on version of the Arrow 2. Occasional Israeli claims that Arrow can provide a reliable defense capability against the regional missile threat seem to be be designed to deter possible enemies from launching, rather than claims that even the Isrfael advocates of the Arrow feel are technically credible.[39]
  - The Arrow 2's growth capability to deal with missiles like the No Dong, Shahab 3, Taepo Dong-1, CSS-4, and Shahab-4 is also questionable. Under these conditions, the launch footprint – or defensive area -- the Arrow can cover with a high probability of intercept might well be so restricted in area that Israel would have to rely primarily on other layers of its missile defense system.[40]

- The Integrated Boost-Phase Intercept System and Moab

  - Israel is examining a number of options for an integrated boost-phase intercept system and gave such programs a high priority in its security talks with the US in 1999. Israel is closely studying the US airborne laser program, but its leading candidate for an Israeli system is the Moab. The Moab is a missile that can be carried on an F-15 or UAV, and

that is designed to engage theater ballistic missiles at ranges of around 100 kilometers soon after launch. The Moabs would be a modified form of the Python 4 with a new booster to accelerate the missile to speeds of 1.5-2 kilometers per second. Maximum firing range is stated to be 80 kilometers from a firing altitude of 30,000 feet and up to 100 kilometers from 50,000 feet.[41]

- The Moab would initially be deployed on the IAF's F-15Is, but would eventually use a high altitude UAV that would loiter at 60-66,000 feet. Israel is looking at possible use of its Hermes UAV or some form of the Teledyne Ryan Global Hawk UAV, which can loiter for 42 hours at 40,000 feet or beyond. Conceptual pictures of the UAV show some stealth characteristics. The UAVs would be flown in launch zone constellations, nominally of four UAVs. They would be controlled by a mobile command center which would use a data link with a low data rate of less than 1 kilobit per second and which would control flight and operations. The system would be integrated into the overall IAF BM/C^4I theater air defense network. [42]
- Cost and technical feasibility present major problems. The system is being designed by Rafael, and two cost-driven design characteristics include the use of engagement speeds below the aeroheating threshold of the missile to avoid cooling the infrared seeker, dome cooling, and a protective cap. The missile also locks on at launch to avoid an expensive data link. This design places considerable stress on the ability to design a missile with the required performance and the associated search/track systems and command and control capabilities. Much also depends on the threat being suitably close to Israel or an Israeli area of operations, the ability of Israeli intelligence to predict a narrow launch area for enemy missiles and the probable time of launch, since Israel may not be able to react to previous missile launches without risking the successful penetration of a first round or volley of enemy missiles.

- Warning and Command and Control
  - Israel receives spaced-based warning, tracking, and point of impact data from the US as part of an agreement signed in April 1996. It also receives warning data, and substantial information on Iranian, Iraqi, Libyan, and Syrian programs. Much of these same data are also, in fact, provided to Egypt, Jordan, and the Southern Gulf states.
  - Israel is, however, studying the possibility of creating its own space-based system and a space-based queuing system for intercept purposes. Such a system hardly seems cost-effective, given Israel's financial constraints, but the Technion Space Research Institute in Haifa has carried out studies of such options.[43] Israel began to acquire the capability to launch satellites with electro-optical sensors and digital down-links. The Shavit I 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.
  - This seems to be equally true of the Ofeq 2 launched in April 1990, one day after Saddam Hussein threatened to destroy Israel with chemical weapons if it should attack Baghdad. Israel used its three-stage Shavit launch vehicle to launch the Ofeq-3 from a secret launch site at the Palmachim test range near the coast south of Tel Aviv on April 5, 1995. Israeli radio almost certainly exaggerated in claiming that that the satellite could transmit imagery "that allows identification of license numbers in downtown Baghdad." In fact some reports indicate that only about 36 kilograms of its 225 kilogram weight was payload and the rest was structure. Nevertheless, the Ofeq 3 had a much larger payload than the Ofeq 2, and the IDF spokesman confirmed that the 495 pound satellite was in a low orbit that circled the earth every 90 minutes and covered Syria, Iran, and Iraq. It is scarcely coincidental that the Ofeq 3's orbit takes it almost directly over the Golan and Damascus, about 90 miles north of Teheran and 240 miles north of Baghdad.[44]
  - Since that time, other launches of Israel's Ofeq and Amos series of satellites have demonstrated Israel's technical capability to launch sophisticated satellites. The Ofeq 3 launch in April 1995 seems to have been of a more capable photo reconnaissance satellite, although it evidently did not include advanced all-weather coverage and real time data processing and transmission capability.[45] but there have been important technical failures like the failure to launch the Ofeq 4 intelligence satellite on February 4, 1998.[46] The Ofeq 4 was intended to be an all-weather photo reconnaissance satellite with real-time capability. It is unclear whether it was intended to replace the Ofeq 3 or work together with it. Changes in the orbit of the Ofeq 3 after the Ofeq 4 failed to reach orbit might suggest the latter.[47]
  - The IDF has concluded that its own warning system would require three or four satellites flying in a low earth orbit to provide continuous coverage of the most likely 1000 by 1000 kilometer launch area.[48] Israel's current space budget is only about $50 million a year and an effective program would cost hundreds of millions of dollars and provide less coverage and information than the US system. As a result, Israel may choose to rely on US capabilities. However, Israel may soon have another option. West Indian Space Ltd., a joint venture between US and Israeli companies, is

trying to become the first commercial provider of high-resolution satellite images. It plans to operate eight small satellites based on the Ofeq design. Israel is believed to be the company's first customer.[49]

Advanced Intelligence Systems

- The Shavit I 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.
- Ofeq 2 launched in April, 1990 -- one day after Saddam Hussein threatens to destroy Israel with chemical weapons if it should attack Baghdad.
- Launched 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 launch rocket, and is believed to carry an imagery system. Its orbit passes over or near Damascus, Tehran, and Baghdad.
- Agreement signed with the US in April 1996 to provide Israel with missile early warning, launch point, vector, and point of impact data.

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.
- Has 18 SS-21 launchers and at least 36 SS-21 missiles with 80-100 kilometers range. May be developing chemical warheads.
- Some experts believe 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 kilometers range. Believed to have chemical warheads. Scud B warhead weighs 985 kilograms. The inventory of Scud B missiles is believed to be approximately 200.
- New long-range North Korean Scud Cs deployed
- 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 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 north as possible reloads. There is a maintenance building and barracks.
- 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 kilometer south of Hama, with an underground facility where TELs and missiles are stored.
- 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 hear Damascus 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. 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.
- Reports of Chinese deliveries of missiles but little hard evidence:
- Reports of PRC deliveries of missile components by China Precision Machinery Company, maker of the M-11, in July1996. The M-11 has a 186-mile (280 kilometer) range with a warhead of 1,100 pounds.
- 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.
- 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."
- Washington Times reported on July 23, 1996 that the CIA had discovered that Syria's Scientific Studies and Research Center received a shipment of missile components from China Precision Machinery Import-Export Corporation, China's premier firm selling missiles (particularly M-11s) abroad.
- Sheltered or underground missile production/assembly facilities at Aleppo and Hamas 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.
- 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.

Syria continues to seek more advanced long-range systems:

The 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.

The DCI Nonproliferation Center (NPC) reported in February 2000 that Damascus continued work on establishing a solid-propellant rocket motor development and production capability with help from outside countries such as Iran..

- The London Times and Haaretz report on May 29 and 30 that Syria has taken delivery of a new ballistic missile from North Korea which would enable it to hit any target in Israel from launchers deep inside Syrian territory. *Haaretz* newspaper reported that Damascus had recently equipped its forces with the Scud D, and that Libya and Egypt were also buying the new weapon. These article seem to refer, however, to the North Korea deliveries which had actually taken place some years earlier.
- The CIA reported in August 2000 that Syria continued work on establishing a solid-propellant rocket motor development and production capability with help from outside countries. Foreign equipment and assistance to its liquid-propellant missile program, primarily from North Korean entities, but also from firms in Russia, also have been and will continue to be essential for Syria's effort. Damascus also continued its efforts to assemble—probably with considerable North Korean assistance—liquid-fueled Scud C missiles.
- Syria tests the Scud D in late Spetember 2000. It is stated to have a range of 435 miles.
- Air assets include:
- 20 Su-24 long range strike fighters.
- 30-60 operational MiG-23BM Flogger F fighter ground attack aircraft.
- 20 Su-20 fighter ground attack aircraft.
- 60-70 Su-22 fighter ground attack aircraft.
- Land force assets include:
- 18 FROG-7 launchers and rockets.
- Negotiations for PRC-made M-9 missile (185-375 mile range).
- Multiple rocket launchers and tube artillery.

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 CIA reported in September 2001, that during the second half of 2000, Damascus continued work on establishing a solid-propellant rocket motor development and production capability with help from outside countries. Foreign equipment and assistance to its liquid-propellant missile program—primarily from North Korean entities, but also from firms in Russia—have been and will continue to be essential for Syria's effort. Damascus also continued its efforts to assemble—probably with considerable North Korean assistance—liquid-fueled Scud C missiles.
- The CIA reported in September 2001, that Syria continues to acquire ACW—mainly from Russia and other FSU suppliers—although at a reduced level from the early 1990s. During the past few years, Syria has received Kornet-E (AT-

14), Metis-M (AT-13), Konkurs (AT-5), and Bastion-M (AT-10B) antitank guided missiles, RPG-29 rocket launchers, and small arms. Damascus has expressed interest in acquiring Russian Su-27 and MiG-29 fighters and air defense systems, but its outstanding debt to Moscow and inability to fund large purchases have hampered negotiations.

The CIA estimated in January 2002 that,

- Syria maintains a ballistic missile and rocket force of hundreds of FROG rockets, Scuds, and SS-21 SRBMs. With considerable foreign assistance, Syria progressed to Scud production using primarily locally manufactured parts.
- Syrian regional concerns may lead Damascus to seek a longer range ballistic missile capability such as North Korea's No Dong MRBM. The IC judges that Syria does not now have and is unlikely to gain an interest in an ICBM capability during the time frame of this Estimate.
- Syria has developed CW warheads for its Scuds and has an offensive BW program. The IC remains concerned about Syria's intentions regarding nuclear weapons.
- Foreign assistance is critical to Syrian efforts to improve its production capabilities and to gain access to export-controlled components and technology.

Chemical Weapons

- First acquired small amounts of chemical weapons from Egypt in 1973. The FAS reports that Syria acquired CW artillery shells as a "gift" from Egypt prior to the 1973 war. Syria then purchased defensive chemical warfare gear from the USSR and from Czechoslovakia.
- Began production of non-persistent nerve gas in 1984. may have had chemical warheads for missiles as early as 1985.
- The FAS reports that Syria used the expansion of its pharmaceuticals industry as a cover for purchases relating to its CW program.
    - Major German pharmaceuticals, chemicals, and machine-building companies helped Syria to establish its modest and well-dispersed production facilities, some with the support of official "Hermes" export credits from the German government. In addition to Schott Glasswerke, which continues to export licensed goods to Syrian chemicals plants, special mixing vats, high temperature furnaces, hot isostatic presses (HIP) and sophisticated machine-tools have been shipped with German export licenses to Syria's Scientific Research Council (CERS) by Ferrostaal, Carl Schenck, Leifeld, Weber GmbH, and other major German companies. It is not believed that these shipments were illegal under German law.
    - Firms in the French pharmaceuticals industry were active in Damascus in the 1980s. Many opened branch offices and built production facilities in Syria, to make French pharmaceuticals under license. French firms increased their share from 13.11% of Syria's pharmaceuticals imports in 1982 to 23% by 1986. France only began applying controls on production equipment that could go into a chemical weapons plant in early 1992. The FAS reports that a senior French foreign ministry official said in May 1992, "Only in the past six months has there been a universal will to impose this type of controls,". "Before then, CW production equipment was freely available."
    - The use of pharmaceuticals plants for poison gas production appears to have led to a series of accidents. In 1991, the Syrian Ministry of Health was compelled to close down five pharmaceuticals plants (three in Aleppo, one in Damascus, and one in Homs), following what were termed "complaints from citizens and doctors" that products "did not meet the required standards."
- CIA Director William Webster testified to Congress in 1989 that foreign assistance was of "critical importance in allowing Syria to develop its chemical warfare capability, and that West European firms were instrumental in supplying the required precursor chemicals and equipment. Without the provision of these key elements, Damascus would not have been able to produce chemical weapons".
- In 1991, Syria signed a cooperation agreement with Libya in that called for Syrian experts to train the Libyans in pharmaceuticals production.
- Believed to have begun deploying VX in late 1996, early 1997.
- CIA reported in June 1997 that Syria had acquired new chemical weapons technology from Russia and Eastern Europe in 1996.

- Unconfirmed reports 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.
- Seems to have cluster warheads and bombs.
- May have VX and Sarin in modified Soviet ZAB-incendiary bombs and PTAB-500 cluster bombs.
- Acquired design for Soviet Scud warhead using VX in 1970s.
- General Anatoly Kuntsevich, Russian President Yeltsin's personal adviser on chemical disarmament and Russia's highest official authority on the subject, dismissed for suspicion of smuggling nerve gas precursors to Syria in early 1995. The FAS reports that General Kuntsevich admitted in an interview in 1998 with the New York Jewish weekly The Forward that shipments to Syria of small amounts of nerve gas components had indeed taken place. According to him, however, these shipments were only intended for "research purposes" and had been authorized by the Russian government under previously undisclosed terms of a treaty with Syria. The materials shipped to Syria were intended for the production of the Soviet/Russian version of the VX nerve agent - code-named Substance 33 or V-gas. Such a deal might have been made in the early '90s or late '80s during a visit to Syria by the then-commander of the Russian Chemical Corps, General Pikalov.
- Major nerve gas, and possible other chemical agent production facilities north of Damascus. Two to three plants.
  - Syria is now believed capable of producing several hundred tons of CW agents per year.
  - Syria's principle suppliers of CBW production technology included large chemical brokerage houses in Holland, Switzerland, France, Austria and Germany, including many of the same companies that were supplying Iraq. At least one German company, Schott Glasswerke, has been subjected to an official inquiry, for its delivery of glass-lined reactor vessels, sarin precursors and production equipment to a suspected Syrian poison gas plant. And one French source suggests that the United States may have supplied Syria with precursors and CW production equipment prior to 1986, at a time when Syria was subjected to international sanctions for its attempt to plant a bomb on an El Al plane in London.
  - The FAS reports that four production sites have been positively identified, one located just north of Damascus, and the second near the industrial city of Homs. The third, in Hama, is believed to be producing VX agents in addition to sarin and tabun. Officials in Washington identified a fourth facility dedicated to the production of biological agents in Cerin, while Israeli intelligence is monitoring several additional "suspicious" sites.
  - Israeli Chief of Staff Ehud Baraq told an audience of leading industrialists in Tel Aviv on December 6, 1991 that Syria's chemical weapons capability was "larger than Iraq's."
  - Syria also runs a large urea and ammonia plant in Homs, and plans to build a $ 500 million super-phosphate complex in the desert near Palmyra.
  - Syria's CW plants tend to be relatively small, and as a result have been harder to detect..
- 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 is building new major plant near Aleppo.
- Reports that a facility co-located with the Center d'Etdues et de Recherche Scientifique (CERS) is developing a warhead with chemical bomblets for the Scud C.
- An industrial complex known as the Scientific Studies and Research Center is reported to have obtained expertise, technology and materials from Russian sources.
- 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.
- Experts believe has stockpiled 500 to 1,000 metric tons of chemical agents.
- FAS states thatr, "Syria's current CW stockpiles have been estimated at "several thousand aerial bombs, filled mostly with sarin," and between 50 to 100 ballistic missile warheads."

- Wide range of delivery systems:
- Extensive testing of chemical warheads for Scud Bs. May have tested chemical warheads for Scud Cs.
- 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 US or Israeli experts.
- Israeli sources believe Syria has binary weapons and cluster bomb technology suitable for delivering chemical weapons.

The CIA estimated 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.

The DCI Nonproliferation Center (NPC) reported in February 2000 that Syria sought CW-related precursors and expertise from foreign sources during the reporting period.

It also reported that Russian entities were expanding missile-related assistance to Syria and India.

- The CIA reported in August 2000 that Syria sought CW-related precursors and expertise from foreign sources during the reporting period. Damascus already has a stockpile of the nerve agent sarin and apparently is 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 reported in September 2001, that Syria sought CW-related precursors and expertise from foreign sources during the reporting period. Damascus already has a stockpile of the nerve agent sarin, and it would appear that Syria is 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. It is highly probable that Syria also is developing an offensive BW capability.

A Department of Defense report in January 2001 stated that,

- Syria is not a state party to the CWC and has had a chemical warfare program for many years, although it has never used chemical agents in a conflict. Damascus already has a stockpile of the nerve agent sarin that can be delivered by aircraft or ballistic missiles.
- Additionally, Syria is trying to develop the more toxic and persistent nerve agent VX. In the future, Syria can be expected to continue to improve its chemical agent production and storage infrastructure. Damascus remains dependent on foreign sources for key elements of its chemical warfare program, including pre-cursor chemicals and key production equipment. For example, during 1999, Syria sought chemical warfare-related precursors and expertise from foreign sources.

- The CIA estimated in January 2002 that Syria has developed CW warheads for its Scuds.

Biological Weapons

- Signed, but not ratified the 1972 Biological and Toxin Weapons Convention. Extensive research effort.
- ACDA report in August 1996 indicated that, “it is highly probably that Syria is developing an offensive biological capability.”
- Extensive research effort.
- Reports of one underground facility and one near the coast. Several dual-use sites are of concern, including a pharmaceuticals plant in Aleppo that was left mysteriously "unfinished" in 1989 after the Syrian government had invested nearly $ 40 million in its construction.
- Syria can tap the potential of more than a dozen government-run pharmaceuticals plants spread across the country, which could be converted rapidly to produce a wide variety of CBW agents.

- Syria's principle suppliers of CBW production technology were large chemical brokerage houses in Holland, Switzerland, France, Austria and Germany, including many of the same companies that were supplying Iraq.
- Probable production capability for anthrax and botulism, and possibly other agents.
- Israeli sources claim Syria weaponized Botulin and Ricin toxin in 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.[50]
- 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 advanced of wind and weather conditions. US and Soviet texts proved that this kind of "line source" delivery could achieve lethalities 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 CIA estimated 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 FAS estimates that Syria is rapidly expanding kits biomedical injdustrial base:

- Syria simplified the procedures for foreign investments in a May 1991 law, and companies are being set up to negotiate licensing and technology transfer agreements with foreign suppliers.
- The largest project of this kind has been announced by Saeb Nahas, whose GAS group is partially owned by the Syrian state. GAS owns a 51% share in the newly-formed Ibn Zahr Pharmaceuticals Company, which claims to be negotiating to build "one of the largest pharmaceuticals plants in the Middle East" at a cost of $ 15 million. Discussions are currently under way with companies in Germany, Britain, and Holland to obtain production licenses and manufacturing technology, and with the European Community to obtain export financing.
- The American medical supplier group, Baxter International, has contracted to build a factory to produce intravenous fluids for the Syrian military. Of concern in this case are the manufacturing processes, which could be applied to a broad-range of CBW activities, and the end-user, which is the Syrian army. Vigorous intervention by the Simon Wiesenthal Center with Baxter director, G. Marshall Abbey, caused the company to back off from this contract temporarily in 1991. However, it was subsequently reported that Baxter was attempting to complete the sale through the intermediary of an unknown supply house called Medport, located in Amhurts, Ohio.
- Despite the attempts to attract private sector interest, the two largest pharmaceuticals conglomerates in Syria, Thameco and DIMAS, remain under rigid state control. Together they control a third company, Saydalaya, which serves as the foreign procurement board for all Syrian imports of chemicals and processed medicines
- Thameco is controlled the Syrian Ministry of Industry and employs approximately 900 people at its principle production site in Damascus. A second plant, built in Aleppo at a cost of nearly $ 40 million by a consortium of French pharmaceuticals companies in the late 1980s, was reportedly "abandoned" in 1989 because of financial difficulties. However, suspicion remains that Syria may have simply switched suppliers, in order to better disguise conversion of the plant to the production of CW agents.

DIMAS (the General Establishment for Blood and of Medical Industries) is directly controlled by the Syrian Ministry of Defense, and is the only manufacturer of serum in Syria. DIMAS is run by General Hikmat Tahrani, and controls a large production plant in Damascus.

George Tenet, the Director of the CIA, testified before the Senate Foreign Relations Committee on March 20, 2000 and identified Syria as a key country seeking biological weapons.

A Department of Defense report in January 2001 stated that Syria has signed but not ratified the BWC but nonetheless is pursuing the development of biological weapons. Syria's biotechnical infrastructure is capable of supporting limited agent development. However, the Syrians are not believed to have begun any major effort to put biological agents into weapons. Without significant foreign assistance, it is unlikely that Syria could manufacture significant amounts of biological weapons for several years.

- The CIA estimated in January 2002 that Syria has an offensive BW program.

Nuclear Weapons

- Syria is a party to the Treaty on the Non- Proliferation of Nuclear Weapons (NPT), and Syria has called for an area free of all weapons of mass destruction in the Middle East.
- Ongoing research effort.
- No evidence of major progress in development effort.
- Has miniature 30 kilowatt neutron-source reactor, but unsuitable for weapons production.
- Does, however, continue to seek larger reactors:
- Announced nuclear reactor purchase plans including 10 megawatt research reactor and six power reactors in 1980s, but never implemented.
- Research by the FAS cites several efforts:
    - In 1991, China reported to the IAEA the potential sale of a 30 KW research reactor to Syria. The IAEA blocked the sale and Syria subsequently reduced its nuclear activities.
    - In 1995 the United States pressured Argentina into abandoning a proposed sale of a reactor to Syria.
    - In 1997 Russian government reported to be interested in selling a nuclear reactor to Syria.
    - On 23 February 1998 Syria and Russia signed an agreement on the peaceful use of nuclear energy. In July 1998 the two sides agreed on the time table for the realization of a 25-MW light-water nuclear research center project in Syria with the participation of Russia's Atomstroyeksport and Nikiet.
    - The Syrian fertilizers plant under construction at Homs [34° 40' N 36° 40' E] is owned and operated by the Atomic Energy Commission of Syria. The facility will engage in Uranium recovery from phosphates using the D2EHPA-TOPO process.
- The CIA reported in August 2000 that, "As to Syria's embryonic nuclear research and development program, we will continue to monitor the potential for this program to expand. Moscow and Damascus agreed in 1999 to cooperate on peaceful uses of nuclear energy in a wide area of disciplines."
- A Department of Defense report in January 2001 stated that Syria is not pursuing the development of nuclear weapons. However, it retains an interest in nuclear technology and has a small Chinese-supplied research reactor, which is under IAEA safeguards. In addition, in May 1999, Syria signed a broad nuclear cooperation agreement with Russia, which includes the construc-tion of a small light-water research reactor, which will be subject to IAEA safeguards. Syria currently lacks the infrastructure and trained personnel to establish a nuclear weapons program. Syria has ratified the NPT, but has not signed the CTBT.
- The CIA reported in September 2001, that Moscow approved a draft cooperative program with Syria in January 2000 that included civil use of nuclear power. Broader access to Russian scientists and Russia's large nuclear infrastructure could provide opportunities to solicit fissile material production expertise and other nuclear-related assistance if Syria decided to pursue nuclear weapons. In addition, Russia supplied India with material for its civilian nuclear program during this reporting period
- The CIA estimated in January 2002 that the IC remains concerned about Syria's intentions regarding nuclear weapons.

Missile Defenses

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

Strengths and Weaknesses of Weapons of Mass Destruction -Part One

Chemical Weapons:

Destructive Effects: Poisoning skin, lungs, nervous system, or blood. Contaminating areas, equipment, and protective gear for periods of hours to days. Forcing military units to don highly restrictive protection gear or use incapacitating antidotes. False alarms and panic. Misidentification of the agent, or confusion of chemical with biological agents (which may be mixed) leading to failure of defense measures. Military and popular panic and terror effects. Major medical burdens which may lead to mistreatment. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas.

Typical Military Targets: Infantry concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants.

Typical Military Missions: Killing military and civilian populations. Intimidation. Attack of civilian population or targets. Disruption of military operations by requiring protective measures or decontamination. Area or facility denial. Psychological warfare, production of panic, and terror.

Military Limitations: Large amounts of agents are required to achieve high lethality, and military and economic effects are not sufficiently greater than careful target conventional strikes to offer major war fighting advantages. Most agents degrade quickly, and their effect is highly dependent on temperature and weather conditions, height of dissemination, terrain, and the character of built-up areas. Warning devices far more accurate and sensitive than for biological agents. Protective gear and equipment can greatly reduce effects, and sufficiently high numbers of rounds, sorties, and missiles are needed to ease the task of defense. Leave buildings and equipment reusable by the enemy, although persistent agents may require decontamination. Persistent agents may contaminate the ground the attacker wants to cross or occupy and force use of protective measures or decontamination.

Strengths and Weaknesses of Weapons of Mass Destruction -Part Two

Biological Weapons

Destructive Effects: Infectious disease or biochemical poisoning. Contaminating areas, equipment, and protective gear for periods of hours to weeks. Delayed effects and tailoring to produce incapacitation or killing, treatable or non-treatable agents, and be infectious on contact only or transmittable. Forcing military units to don highly restrictive protection gear or use incapacitating vaccines antidotes. False alarms and panic. High risk of at least initial misidentification of the agent, or confusion of biological with chemical agents (which may be mixed) leading to failure of defense measures. Military and popular panic and terror effects. Major medical burdens, which may lead to mistreatment. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas.

Typical Military Targets: Infantry concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants. Potentially fare more effective against military and civil area targets than chemical weapons.

Typical Military Missions: Killing and incapacitation of military and civilian populations. Intimidation. Attack of civilian population or targets. Disruption of military operations by requiring protective measures or decontamination. Area or facility denial. Psychological warfare, production of panic, and terror.

Military Limitations: Most wet agents degrade quickly, although spores, dry encapsulated agents, and some toxins are persistent. Effects usually take some time to develop (although not in the case of some toxins). Effects are unpredictable, and are even more dependent than chemical weapons on temperature and weather conditions, height of dissemination, terrain, and the character of built-up areas. Major risk of contaminating the wrong area. Warning devices uncertain and may misidentify the agent. Protective gear and equipment can reduce effects. Leave buildings and equipment reusable by the enemy, although persistent agents may require decontamination. Persistent agents may contaminate the ground the attacker wants to cross or occupy and force use of protective measures or decontamination. More likely than chemical agents to cross the threshold where nuclear retaliation seems justified.

Strengths and Weaknesses of Weapons of Mass Destruction - Part Three

Nuclear Weapons

Destructive Effects: Blast, fire, and radiation. Destruction of large areas and production of fall out and contamination -- depending on character of weapon and height of burst. Contaminating areas, equipment, and protective gear for periods of hours to days. Forcing military units to don highly restrictive protection gear and use massive amounts of decontamination gear. Military and popular panic and terror effects. Massive medical burdens. Pressure to deploy high cost air and missile defenses. Paralysis or disruption of civil life and economic activity in threatened or attacked areas. High long-term death rates from radiation. Forced dispersal of military forces and evacuation of civilians. Destruction of military and economic centers, and national political leadership and command authority, potentially altering character of attacked nation and creating major recovery problems.

Typical Military Targets: Hardened targets, enemy facilities and weapons of mass destruction, enemy economy, political leadership, and national command authority. Infantry and armored concentrations, air bases, ships, ports, staging areas, command centers, munitions depots, cities, key oil and electrical facilities, desalinization plants.

Typical Military Missions: Forced dispersal of military forces and evacuation of civilians. Destruction of military and economic centers, and national political leadership and command authority, potentially altering character of attacked nation and creating major recovery problems.

Military Limitations: High cost. Difficulty of acquiring more than a few weapons. Risk of accidents or failures that hit friendly territory. Crosses threshold to level where nuclear retaliation is likely. Destruction or contamination of territory and facilities attacker wants to cross or occupy. High risk of massive collateral damage to civilians if this is important to attacker.

Source: Adapted by the Anthony H. Cordesman from Office of Technology Assessment, Proliferation of Weapons of Mass Destruction: Assessing the Risks, U.S. Congress OTA-ISC-559, Washington, August, 1993, pp. 56-57.

Major Chemical Agents - Part One[51]

NERVE AGENTS: Agents that quickly disrupt the nervous system by binding to enzymes critical to nerve functions, causing convulsions and/or paralysis. May be ingested, inhaled, and absorbed through the skin. Very low doses cause a running nose, contraction of the pupil of the eye, and difficulty in visual coordination. Moderate doses constrict the bronchi and cause a feeling of pressure in the chest, and weaken the skeletal muscles and cause filibration. Large doses cause death by respiratory or heart failure. Reaction normally occurs in 1-2 minutes. Death from lethal doses occurs within minutes, but artificial respiration can help and atropine and the oximes act as antidotes. The most toxic nerve agents kill with a dosage of only 10 milligrams be minute per cubic meter, versus 400 for less lethal gases. Recovery is normally quick, if it occurs at all, but permanent brain damage can occur:

Tabun (GA)
Sarin (GB) - nearly as volatile as water and delivered by air. A dose of 5 mg/min/m^3 produces casualties, a respiratory dose of 100 mg/min/m3 is lethal. Lethality lasts 1-2 days.
Soman (GD)
GF
VR-55 (Improved Soman) A thick oily substance which persists for some time.
VK/VX - a persistent agent roughly as heavy as fuel oil. A dose of 0.5 mg/min/m^3 produces casualties, a respiratory dose of 10 mg/min/m3 is lethal. Lethality lasts 1-16 weeks.

BLISTER AGENTS: Cell poisons that destroy skin and tissue, cause blindness upon contact with the eyes, and which can result in fatal respiratory damage. Can be colorless or black oily droplets. Can be absorbed through inhalation or skin contact. Serious internal damage if inhaled. Penetrates ordinary clothing. Some have delayed and some have immediate action. Actual blistering normally takes hours to days, but effects on the eyes are much more rapid. Mustard gas is a typical blister agent and exposure of concentrations of a few milligrams per meter over several hours generally at least causes blisters and swollen eyes. When the liquid falls onto the skin or eyes it has the effect of second or third degree burns. It can blind and cause damage to the lungs leading to pneumonia. Severe exposure causes general intoxication similar to radiation sickness. HD and HN persist up to 12 hours. L, HL, and CX persist for 1-2 hours. Short of prevention of exposure, the only treatment is to wash the eyes, decontaminate the skin, and treat the resulting damage like burns:

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Sulfur Mustard (H or HD) A dose of 100 mg/min/m^3 produces casualties, a dose of 1,500 mg/min/m3 is lethal. Residual lethality lasts up to 2-8 weeks.
Distilled Mustard (DM)
Nitrogen Mustard (HN)
Lewisite (L)
Phosgene Oxime (CX)
Mustard Lewisite (HL)

CHOKING AGENTS: Agents that cause the blood vessels in the lungs to hemorrhage, and fluid to build-up, until the victim chokes or drowns in his or her own fluids (pulmonary edema). Provide quick warning though smell or lung irritation. Can be absorbed through inhalation. Immediate to delayed action The only treatment is inhalation of oxygen and rest. Symptoms emerge in periods after exposure of seconds up to three hours:

Phosgene (CG)
Diphosgene (DP)
PS Chloropicrin
Chlorine Gas

Major Chemical Agents - Part Two

BLOOD AGENTS: Kill through inhalation. Provide little warning except for headache. nausea, and vertigo. Interferes with use of oxygen at the cellular level. CK also irritates the lungs and eyes. Rapid action and exposure either kills by inhibiting cell respiration or it does not -- casualties will either die within seconds to minutes of exposure or recover in fresh air. Most gas masks have severe problems in providing effective protection against blood agents:

- Hydrogen Cyanide (AC) A dose of 2,000 mg/min/m^3 produces casualties, a respiratory dose of 5,000 mg/min/m3 is lethal. Lethality lasts 1-4 hours.
- Cyanogen Chloride (CK) A dose of 7,000 mg/min/m^3 produces casualties, a respiratory dose of 11,000 mg/min/m3 is lethal. Lethality lasts 15 minutes to one hour.

TOXINS: Biological poisons causing neuromuscular paralysis after exposure of hours or days. Formed in food or cultures by the bacterium clostridium Botulinum. Produces highly fatal poisoning characterized by general weakness, headache, dizziness, double vision and dilation of the pupils, paralysis of muscles, and problems in speech. Death is usually by respiratory failure. Antitoxin therapy has limited value, but treatment is mainly supportive:

Botulin toxin (A) Six distinct types, of which four are known to be fatal to man. An oral dose of 0.001 mg is lethal. A respiratory dose of 0.02 mg/min/m^3 is also lethal.

DEVELOPMENTAL WEAPONS: A new generation of chemical weapons is under development. The only publicized agent is perfluoroisobutene (PFIB), which is an extremely toxic odorless and invisible substance produced when PFIB (Teflon) is subjected to extreme heat under special conditions. It causes pulmonary edema or dry-land drowning when the lungs fill with fluid. Short exposure disables and small concentrations cause delayed death. Activated charcoal and most existing protection equipment offers no defense. Some sources refer to "third" and "fourth" generation nerve gasses, but no technical literature seems to be available.

CONTROL AGENTS: Agents which produce temporary irritating or disabling effects which in contact with the eyes or inhaled. They cause flow of tears and irritation of upper respiratory tract and skin. They can cause nausea and vomiting: can cause serious illness or death when used in confined spaces. CN is the least toxic gas, followed by CS and DM. Symptoms can be treated by washing of the eyes and/or removal from the area. Exposure to CS, CN, and DM produces immediate symptoms. Staphylococcus produces symptoms in 30 minutes to four hours, and recovery takes 24-48 hours. Treatment of Staphylococcus is largely supportive:

Tear
Chlororacetophenone (CN)
O-Chlorobenzyl-malononitrile (CS)
Vomiting: Cause irritation, coughing, severe headache, tightness in chest, nausea, vomiting:
Adamsite (DM)
Staphylococcus

INCAPACITATING AGENTS: Agents, which normally cause short-term illness, psychoactive effects, (delirium and hallucinations). Can be absorbed through inhalation or skin contact. The psychoactive gases and drugs produce unpredictable effects, particularly in the sick, small children, elderly, and individuals who already are mentally ill. In rare cases they kill or produce a permanent psychotic condition. Many produce dry skin, irregular heart beat, urinary retention, constipation, drowsiness, and a rise in body temperature, plus occasional maniacal behavior. A single dose of 0.1 to 0.2 milligrams of LSD-25 will produce profound mental disturbance within a half-hour that lasts 10 hours. The lethal dose is 100 to 200 milligrams:

BZ
LSD
LSD Based BZ
Mescaline
Psilocybin
Benzilates

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Typical Warfighting Uses of Chemical Weapons

Mission	Quantity
Attack an infantry position: Cover 1.3 square kilometers of territory with a "surprise dosage" attack of Sarin to kill 50% of exposed troops.	216 240mm rockets (e.g. delivered by 18, 12 tube Soviet BM-24 rocket launchers, each carrying 8 kilograms of agent and totaling 1,728 kilograms of agent.
Prevent launch of enemy mobile missiles: Contaminate a 25 square kilometer missile unit operating area with 0.3 tons of a persistent nerve gas like VX per square kilometer.	8 MiG-23 or 4 Su-24 fighters, each delivering 0.9 ton of VX (totaling 7.2 tons.
Immobilize an air base: Contaminate a 2 square kilometer air base with 0.3 tons of VX twice a day for 3 days.	1 MiG-23 with six sorties or any similar attack aircraft.
Defend a broad front against large scale attack: Maintain a 300 meter deep strip of VX contamination in a front of a position defending a 60 kilometer wide area for 3 days.	65 metric tons of agent delivered by approximately 13,000 155-mm artillery rounds.
Canalize 1st and 2nd Echelon attacking forces: Force attacking Or retreating forces into fixed lines of movement. Guard flanks. Disrupt rear area operations.	8 MiG-23 or 4 Su-24 fighters, each delivering 0.9 ton of VX (totaling 7.2 tons.
Terrorize population: Kill approximately 125,000 unprotected civilians in a densely populated (10,000 square kilometer) city.	8 MiG-23 or 4 Su-24 fighters, each delivering 0.9 ton of VX (totaling 7.2 tons) under optimum conditions.

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

Key Biological Weapons that May Be in the Middle East - Part One

Disease	Infectivity	Transmissibility	Incubation Period	Mortality	Therapy
Viral					
Chikungunya fever	high?	none	2-6 days	very low (-1%)	none
Dengue feverhigh	none	5-2 days	very low (-1%)	none	
Eastern equine encephalitis	high	none	5-10 days	high (+60%)	developmental
Tick borne encephalitis	high	none	1-2 weeks	up to 30%	developmental
Venezuelan equine encephalitis	high	none	2-5 days	Low (-1%)	developmental
Hepatitis A -	-	15-40 days	-	-	
Hepatitis B -	-	40-150 days	-	-	
Influenza	high	none	1-3 days	usually low	available
Yellow fever	high	none	3-6 days	up to 40%	available
Smallpox (Variola)	high	high	7-16 days	up to 30%	available
Rickettsial					
Coxiella Burneti (Q-fever)	high	negligible	10-21 day	Low (-1%)	antibiotic
Mooseri	-	-	6-14 days	-	-
Prowazeki	-	-	6-15 days	-	-
Psittacosis	high	moderate-high	4-15 days	Mod-high	antibiotic
Rickettsi (Rocky mountain spotted fever)	high	none	3-10 days	up to 80%	antibiotic
Tsutsugamushi	-	-	-	-	-
Epidemic typhus	high	none	6-15 days	up to 70%	antibiotic/vaccine
Bacterial					
Anthrax (pulmonary)	mod-high	negligible	1-5 days	usually fatal	antibiotic/vaccine
Brucellosis	high	none	1-3 days	-25%	antibiotic
Cholera	low	high	1-5 days	up to 80%	antibiotic/vaccine
Glanders	high	none	2-1 days	usually fatal	poor antibiotic
Meloidosis	high	none	1-5 days	usually fatal	moderate antibiotic
Plague (pneumonic)	high	high	2-5 days	usually fatal	antibiotic/vaccine
Tularemia	high	negligible	1-10 days	low to 60%	antibiotic/vaccine
Typhoid fever	mod-high	mod-high	7-21 days	up to 10%	antibiotic/vaccine
Dysentery	high	high	1-4 days	low to high	antibiotic/vaccine

Key Biological Weapons that May Be in the Middle East - Part Two

Disease	Infectivity	Transmissibility	Incubation Period	Mortality	Therapy
Fungal					
Coccidioidomycosis	high	none	1-3 days	low	none
Coccidiodes Immitis	high	none	10-21 days	low	none
Histoplasma					
Capsulatum	-	-	15-18 days	-	-
Norcardia Asteroides	-	-	-	-	-
Toxins[a]					
Botulinum toxin	high	none	12-72 hours	high neromuscular paralysis	vaccine
Mycotoxin	high	none	hours or days	low to high	?
Staphylococcus	moderate	none	24-48 hours	incapacitating	?

a. Many sources classify as chemical weapons because toxin are chemical poisons.

Source: Adapted by Anthony H. Cordesman from Report of the Secretary General, Department of Political and Security Affairs, Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, New York, United Nations, 1969, pp. 26, 29, 37-52, 116-117; Jane's NBC Protection Equipment, 1991-1992; James Smith, "Biological Warfare Developments," Jane's Intelligence Review, November, 1991, pp. 483-487.

The Thermal and Blast Effects of Nuclear Weapons
Radius of Effect in Kilometers

Yield in Kilotons	Metals Vaporize	Metals Melt	Wood Burns	3rd Degree Burns	5 psi/ 160 mph Winds	3 psi 116 mph Winds
10	0.337	0.675	1.3	1.9	1.3	1.6
20	0.477	0.954	1.9	2.7	2.0	2.5
50	0.754	1.6	3.0	4.3	2.7	3.3
100	1.0	2.0	4.3	5.7	3.5	4.3
200	1.5	2.8	5.7	8.0	4.5	5.4

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

The Comparative Effects of Biological, Chemical, and Nuclear Weapons Delivered Against a Typical Urban Target in the Middle East

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

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

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

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

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

Unconventional Attacks Using Weapons of Mass Destruction

- A radiological powder is introduced into the air conditioning systems of Cairo's high-rise tourist hotels. Symptoms are only detected over days or weeks and public warning is given several weeks later. The authorities detect the presence of such a powder, but cannot estimate its long-term lethality and have no precedents for decontamination. Tourism collapses, and the hotels eventually have to be torn down and rebuilt.

- Parts for a crude gun-type nuclear device are smuggled into Israel or bought in the market place. The device is built in a medium sized commercial truck. A physics student reading the US Department of Defense weapons effect manual maps Tel Aviv to maximize fall out effects in an area filled with buildings with heavy metals and waits for a wind maximizing the fall out impact. The bomb explodes with a yield of only 8 kilotons, but with an extremely high-level of radiation. Immediate casualties are limited but the long-term death rate mounts steadily with time. Peace becomes impossible and security measures become draconian. Immigration halts and emigration reaches crisis proportions. Israel as such ceases to exist.

- Several workers move drums labeled as cleaning agents into a large shopping mall, large public facility, subway, train station, or airport. They dress as cleaners and are wearing what appear to be commercial dust filters or have taken the antidote for the agent they will use. They mix the feedstocks for a persistent chemical agent at the site during a peak traffic period. Large-scale casualties result, and draconian security measures become necessary on a national level. A series of small attacks using similar "binary" agents virtually paralyze the economy, and detection is impossible except to identify all canisters of liquid.

- Immunized terrorists visit a US carrier or major Marine assault ship during the first hours of visitor's day during a port call in the Middle East. They are carrying anthrax powder in bags designed to make them appear slightly overweight. They slowly scatter the powder as they walk through the ship visit. The immediate result is 50% casualties among the ship's crew, its Marine complement, and the visitors that follow. The US finds it has no experience with decontaminating a large ship where anthrax has entered the air system and is scattered throughout closed areas. After long debates over methods and safety levels, the ship is abandoned.

- A terrorist seeking to "cleanse" a nation of its secular regime and corruption introduces a modified type culture of Ebola or a similar virus into an urban area -- trusting God to "sort out" the resulting casualties. He scatters infectious cultures for which there is no effective treatment in urban areas. By the time the attack is detected, it has reached epidemic proportions. Medical authorities rush into the infected area without proper protection, causing the collapse of medical facilities and emergency response capabilities. Other nations and regions have no alternative other than to isolate the nation or center under attack, letting the disease take its course.

- A terrorist group modifies the valves on a Japanese remote-controlled crop spraying helicopter which has been imported legally for agricultural purposes. It uses this system at night or near dawn to spray a chemical or biological agent at altitudes below radar coverage in a line-source configuration. Alternatively, it uses a large home-built UAV with simple GPS guidance. The device eventually crashes undetected into the sea or in the desert. Delivery of a chemical agent achieves far higher casualties than any conventional military warhead. A biological agent is equally effective and the first symptoms appear days after the actual attack -- by which time treatment is difficult or impossible.

- A truck filled with what appears to be light gravel is driven through the streets of Tel Aviv or Cairo during rush hour or another maximum traffic period. A visible powder does come out through the tarpaulin covering the truck, but the spread of the powder is so light that no attention is paid to it. The driver and his assistant are immunized against the modified form of Anthrax carried in the truck that is being released from behind the gravel or sand in the truck. The truck slowly quarters key areas of the city. Unsuspected passersby and commuters not only are infected, but carry dry spores home and into other areas. By the time the first major symptoms of the attack occur some 3-5 days later, anthrax pneumonia is epidemic and some septicemic anthrax has appeared. Some 40-65% of the exposed population dies and medical facilities collapse causing serious, lingering secondary effects.
- A terrorist group scatters high concentrations of a radiological, chemical, or biological agent in various areas in a city, and trace elements into the processing intakes to the local water supply. When the symptoms appear, the terrorist group makes its attack known, but claims that it has contaminated the local water supply. The authorities are forced to confirm that water is contaminated and mass panic ensues.
- Immunized terrorists carry small amounts of anthrax or a similar biological agent onto a passenger aircraft like a B-747, quietly scatter the powder, and deplane at the regular scheduled stop. No airport detection system or search detects the agent. Some 70-80% of those on the aircraft die as a result of symptoms that only appear days later.
- Several identical nuclear devices are smuggled out of the FSU through Afghanistan or Central Asia. They do not pass directly through governments. One of the devices is disassembled to determine the precise technology and coding system used in the weapon's PAL. This allows users to activate the remaining weapons. The weapon is then disassembled to minimize detection with the fissile core shipped covered in lead. The weapon is successfully smuggled into the periphery of an urban area outside any formal security perimeter. A 100 kiloton ground burst destroys a critical area and blankets the region in fall out.
- The same device is shipped to Israel or a Gulf area in a modified standard shipping container equipped with detection and triggering devices that set it off as a result of local security checks or with a GPS system that sets it off automatically when it reaches the proper coordinates in the port of destination. The direct explosive effect is significant, but "rain out" contaminates a massive local area.
- Iraq equips a freighter or dhow to spread Anthrax along a coastal area in the Gulf. It uses a proxy terrorist group, and launches an attack on Kuwait City and Saudi oil facilities and ports. It is several days before the attack is detected, and the attacking group is never fully identified. The form of Anthrax involved is dry and time encapsulated to lead to both massive prompt casualties and force time consuming decontamination. Iraq not only is revenged, but benefits from the resulting massive surge in oil prices.
- A terrorist group scatters small amounts of a biological or radiological agent in a Jewish area during critical stages of the final settlement talks. Near panic ensures, and a massive anti-Palestinian reaction follows. Israeli security then learns that the terrorist group has scattered small amounts of the same agent in cells in every sensitive Palestinian town and area, and the terrorist group announces that it has also stored some in politically sensitive mosques and shrines. Israeli security is forced to shut down all Palestinian movement and carry out intrusive searches in every politically sensitive area. Palestinian riots and then exchanges of gun fire follow. The peace talks break down permanently.
- The Iranian Revolutionary Guards equips dhows to spread Anthrax. The dhows enter the ports of Dubai and Abu Dhabi as commercial vessels -- possibly with local or other Southern Gulf registrations and flags. It is several days before the attack is detected, and the resulting casualties include much of the population of Abu Dhabi and government of the UAE. The UAE breaks up as a result, no effective retaliation is possible, and Iran achieves near hegemony over Gulf oil policy.

War Fighting Options

- Covert-indirect, unconventional warfare, “terrorism”
- Surprise attack to support conventional war fighting
- Avoid conventional defeat
- Pose political threat - intimidation
- Regional Deterrence - threatened or illustrative use
- Attack power projection facilities
- Counterproliferation
- Extended deterrence
- Controlled escalation ladder
- Asymmetric escalation/escalation dominance
- “Firebreaks”
- Launch on warning/launch under attack
- Seek to force conflict termination
- Destroy enemy as state
- Martyrdom
- Alter strategic nature of on-going conflict

Possible Counterproliferation Policy

- Dissuasion to convince non-weapons of mass destruction states that their security interests are best served through not acquiring weapons of mass destruction.
- Denial to curtail access to technology and materials for weapons of mass destruction through export controls and other tools.
- Arms control efforts to reinforce the Nuclear Non-Proliferation Treaty, Biological and Chemical Weapons Conventions, nuclear free zones, conventional arms treaties that stabilize arms races, confidence and security building measures, and Anti-Ballistic Missile Treaty clarification efforts to allow US deployment of advanced theater ballistic missile defenses.
- Region-wide arms control agreements backed by intelligence sharing and ruthless, intrusive challenge inspection without regard for the niceties of sovereignty.
- International pressure to punish violators with trade sanctions to publicize and expose companies and countries that assist proliferators, and to share intelligence to heighten awareness of the proliferation problem.
- Defusing potentially dangerous situations by undertaking actions to reduce the threat from weapons of mass destruction already in the hands of selected countries -- such as agreements to destroy, inspect, convert, monitor, or even reverse their capabilities.
- Military capabilities to be prepared to seize, disable, or destroy weapons of mass destruction in time of conflict.
- Improve tracking and detection of sales, technology transfer, research efforts, extremist groups.
- Defensive capabilities, both active (theater missile defenses) and passive (protective gear and vaccines) that will mitigate or neutralize the effects of weapons of mass destruction and enable US forces to fight effectively even on a contaminated battlefield.
- Declared and convincing counterstrike options ranging from conventional strikes devastating a user nation’s economy, political structure and military forces to the use of nuclear weapons against the population centers of user nations and groups.

Key Force Improvements Affecting Counterproliferation Policy

- *Detection and characterization of biological and chemical agents.* This initiative is intended to accelerate the fielding of stand-off and point detection and characterization systems by up to six years. It also addresses the integration of sensors into existing and planned carrier platforms, emphasizing man-portability and compatibility with UAVs.
- *Detection, characterization, and defeat of hard, underground targets.* The US is seeking new sensors, enhanced lethality, and penetrating weapons to increase the probability of defeating the target while minimizing the risk of collateral damage.
- *Detection, localization and neutralization of weapons of mass destruction inside and outside the US.* The US is seeking to identify and evaluate systems, force structures, and operational plans to protect key military facilities and logistic nodes, and conduct joint exercises to improve the capability to respond to potential biological and chemical threats.
- *Development and deployment of additional passive defense capabilities for US forces, including development and production of biological agent vaccines.* This program will develop and field improved protective suits, shelters, filter systems, and equipment two to five years faster than previously planned. It also restores funding to the development of improved decontamination methods.
- *Support for weapons of mass destruction related armed control measures include strengthening the NNPT, CTB, and BWC.* They include establishing a COCOM successor regime, and improving controls on exports and technology by strengthening the MTCR, Nuclear Suppliers Group and Australia Group.
- *Missile defense capabilities, with primary emphasis on theater ballistic missile defenses.* This activity involves improvements in active and passive defenses, attack operations, and improvements in BM/C4I as well as the deployment of theater missile defenses. The primary focus, however, is on anti-ballistic missile defenses, and in the near-term, this involves the development of the Patriot Advanced Capability Level-3 (PAC-3/ERINT), Navy area theater missile defense (Aegis), and theater high altitude area defense (THAAD).
- *Publicized counterstrike options.* Options ranging from a convincing declared capability to conduct precision mass air and missile strikes with conventional weapons that can devastate user states to use of nuclear weapons escalating to the destruction of population centers.
- *New force tailored to dealing with terrorist and unconventional threats.* New intelligence and tracking systems dedicated to the prevention of mass terrorism, and tailored special forces to detect and attack terrorist groups and deal with unconventional uses of weapons of mass destruction.

[1] Kyodo News Service; Associated Press, January 9, 2000, 2322, 2214; Reuters, January 10, 1999, 0115, 1221, January 11, 2000, 0452, 1103.
[2] See Dany Shoham, "Evolution of Chemical and Biological Weapons in Egypt," Ariel Center for Policy Research and "Egypt War Preparations Against IDF Viewed," FBIS-NES-98-320 ; 11/17/98 [Tel Aviv Hatzofe in Hebrew 25 Sep 98]
[3] Jane's Defense Weekly, October 14, 1998.
[4] Reuters, June 27, 2000.
[5] Some reports give the range as 500 kilometers; Jane's Defense Weekly, March 10, 1999, p. 50-64.
[6] Baltimore Sun, November 23, 1988; Washington Post, September 16, 1989.
[7] 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.
[8] 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 100 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.
[9] 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.
[10] Washington Post, October 26, 1989, p. A-36; Boston Globe, October 30, 1989, p. 2; Newsweek, November 6, 1989, p. 52.
[11] 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.
[12] 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, p. 857; Economist, May 4, 1968, pp. 67-68; New York Times, July 22, 1987, p. A-6; Washington Times, July 22, 1987, p. D-4; Defense and Foreign Affairs, June, 1985, p. 1; Aerospace Daily, May 1, 1985, p. 5 and May 17, 1985, p. 100; Aerospace Daily, May 1, 1985, May 7, 1985; Shuey, et al, Missile Proliferation: Survey of Emerging Missile Forces, p. 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, p. 18; Michael A. Ottenberg, "Israel and the Atom," American Sentinel, August 16, 1992, p. 1.
[13] Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.
[14] Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.

[15] Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.
[16] Associated Press, October 5, 1998, 0316, October 8, 1998, 1350; Philadelphia Inquirer, November 1, 1998, p. A-7.
[17] 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.
[18] Philadelphia Inquirer, November 1, 1998, p. A-7; Associated Press, October 8, 1998, 1350.
[19] Washington Times, October 7, 1998, p. A-14.
[20] Harold Hough, "Could Israel's Nuclear Assets Survive a First Strike?," Jane's Intelligence Review, September, 1997, pp. 407-410.
[21] Defense News, June 29, 1998, p. 3; New York Times, June 21, 1998, p. A-6.
[22] January 21, 2000, 0645;
[23] Associated Press, February 2, 2000, 0834.
[24] Strategic Assessment, Vol. 1, No. 1, p. 3, April, 1998.
[25] Ha'aretz, May 22, 1997' Reuters, May 23, 1997, 0821, Washington Times, May 24, 1997, p. A-8
[26] Much of this analysis is based on interviews with US and Israeli officials. It includes data drawn from Jane's Defense Weekly, April 29, 1998 p. 3, June 3, 1998, p. 3, October 21, 1998, p. 4 December 9, 1998, p. 18; Defense News, June 8, 1998, p. 8; July 6, 1998, p. 3; Wall Street Journal, September 28, 1998, p. A-23.
[27] Jane's Defense Weekly, July 10, 1996, p. 3
[28] David Martin, "Ballistic Missile Defense Overview," Washington, Ballistic Missile Defense Office, Department of Defense, March 3, 1999; Defense News, July 8, 1996, p. 4, July 6, 1998, p. 6.
[29] Lennox, Duncan and David Eshel, "Israeli high-energy laser project may face more delays," Jane's Defense Weekly, April 7, 1999, p. 21.
[30] Bender, Bryan, "Future of US-Israeli laser project in doubt," Jane's Defense Weekly, June 2, 1999, p. 6.
[31] Bender, Bryan, "US and Israeli governments to bail out THEL," Jane's Defense Weekly, June 16, 1999, p. 6.
[32] Jane's International Defense Review, 2/2000, p. 4.
[33] "US approves extra patriot sales to bolster Israeli defenses," Jane's Defence Weekly, June 24, 1998, p. 17, March 24, 1999, p. 3; Associated Press, December 10, 1998, 1704.
[34] Jane's Defense Weekly, November 17, 1999, p. 3.
[35] Jane's Defence Weekly, May 6, 1995, p. 15, March 19, 1997, p. 19, August 27, 1997, p. 4, November 12, 1997, p. 29, January 14, 1998, p. 4, July 8, 1998, p. 17, September 23, 1998, p. 3, December 2, 1998, p 22, December 9, 1998, p. 18; Defense News, May 20, 1996, p. 33, July 22, 1996, p. 6; Washington Times, March 9, 1996, p., A-1 Aviation Week, June 21, 1993, p. 39; Reuters, March 27, 1998, 1733, September 15, 1998, 0528, November 29, 1998, 1044; Associated Press, August 3, 1998, 1125; Washington Post, September 16, 1998, p. A-37.
[36] Jane's Defence Weekly, May 6, 1995, p. 15, March 11, 1998, June 24, 1998, p. 17, p. 18 December 2, 1998, p 22, December 9, 1998, p. 18; Aviation Week, June 21, 1993, p. 39; Reuters, November 29, 1998, 1044; Jane's International Defense Review, 8/1999, p. 10.
[37] Opall-Rome, Barbara, "Israel Promotes Regional Arrow," Defense News, May 10, 1999, p. 3.
[38] Jane's Defense Weekly, January 14, 1998, February 4, 1998, p. 18, March 11, 1998, p. 18, November 10, 1999, p. 5; Reuters, February 26, 1998, 1409, November 1, 1999, 0914.
[39] The program manager has referred to a 100% leak-proof system. Then Israeli Defense Minister Yitzhak Mordecai referred to it as, "an almost complete shield against the present and future threat," on November 29, 1998. Reuters, November 29, 1998, 1044; Jane's Defense Weekly, January 5, 2000, p. 15.

[40] Jane's Defense Weekly, March 10, 1999, pp. 71-73, January 5, 2000, p. 15; Angelo M Codevilla, "Missiles, Defense, and Israel," Washington, IASP Papers in Strategy, No. 5, November 1997.

[41] David Martin, "Ballistic Missile Defense Overview," Washington, Ballistic Missile Defense Office, Department of Defense, March 3, 1999; Jane's International Defense Review, 7/1996, p. 5, 9/1997, p. 9; Jane's Defense Weekly, March 10, 1999, pp. 71-73; Defense News, March 29, 1999, pp. 1 & 28..

[42] David Martin, "Ballistic Missile Defense Overview," Washington, Ballistic Missile Defense Office, Department of Defense, March 3, 1999; Jane's International Defense Review, 7/1996, p. 5, 9/1997, p. 9; Jane's Defense Weekly, March 10, 1999, pp. 71-73.

[43] Defense News, June 8, 1998, p. 8; May 6, 1996, p. 24; Jane's Defense Weekly, March 10, 1999, pp. 71-73.

[44] Israel launched the Ofeq 1 prototype on September 19, 1988. It has a satellite mass of 156 kilograms. It sent up the Ofeq 2 on April 3, 1990, one day after Saddam Hussein threatened to destroy half of Israel with chemical weapons if Israel attacked Baghdad. The Ofeq satellite has a mass of 160 kilograms. Washington Post, April 6, 1995, p. 1; Jane's Intelligence Review, Volume 7, Number 6, June, 1995, pp. 265-268; Washington Post, April 6, 1995, p. 1.

[45] Jane's Pointer, August 1998, p. 7.

[46] Jane's Defense Weekly, February 4 ,1996, p. 18; Jane's Pointer, August 1998, p. 7.

[47] Clarke, Philip, "Another Israeli satellite fails," Jane's Intelligence Review, August 1998, p. 7; Jane's Pointer, August 1998, p. 7.

[48] Jane's Defense Weekly, March 6 ,1996, p. 23.

[49] "US-Israeli venture aims to capture high-res satellite image market," Jane's Defense Weekly, March 31, 1999, p. 17.

[50] Jane's Defense Weekly, September 3, 1997. P. 3

[51] Adapted from Matthew Meselson and Julian Perry Robinson, "Chemical Warfare and Chemical Disarmament," Scientific American, Vol. 242, No. 4, April, 1980, pp. 38-47; "Chemical Warfare: Extending the Range of Destruction," Jane's Defense Weekly, August 25, 1990, p. 267; Dick Palowski, Changes in Threat Air Combat Doctrine and Force Structure, 24th Edition, Fort Worth, General Dynamics DWIC-01, February, 1992, pp. II-335 to II-339; U.S. Marine Corps, Individual Guide For NBC Defense, Field Manual OH-11-1A, August, 1990; and unpublished testimony to the Special Investigations Subcommittee of the Government Operations Committee, US. Senate, by Mr. David Goldberg, Foreign Science and Technology Center, US. Army Intelligence Center on February 9, 1989.