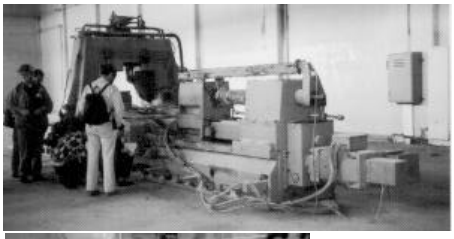
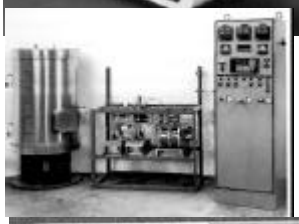
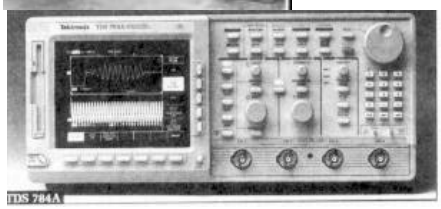






SECTION I
PART A

DUAL-USE AMERICAN EQUIPMENT LICENSED FOR EXPORT TO CHINA
1988 – 1998

The following tables, compiled from records at the Commerce Department's Bureau of Export Administration, show that China was licensed to receive more than $15 billion in sensitive "dual-use" equipment from 1988 to 1998. That is an average of $1.5 billion per year for the decade. Dual-use equipment has civilian applications but is uniquely capable of helping to make weapons of mass destruction or other military items.

The equipment, by definition, is of great strategic value. Only the highest performing machine tools, instruments, computers and other such items require a Commerce Department export license. This equipment has been placed on the U.S. export control list by U.S. experts who have judged that special care--and government review--is needed before releasing it to foreign countries.

More than half of the $15 billion was for computers. China was allowed to buy more than 11,000 controlled computers valued at $7.7 billion. China was, however, effectively denied access to high-performance computers until 1993. In that year, the Clinton Administration began to loosen computer export controls. By February 1994, it had drastically changed the definition of a "supercomputer," which is subject to the most stringent export controls. Before the change, a supercomputer was defined as a machine performing 195 million or more operations per second; machines above that level were strictly controlled. After the change, a supercomputer was defined as a machine performing 1.5 billion or more operations per second. The effect was a sevenfold relaxation in supercomputer export controls.

In early 1996, the administration cut computer controls even more deeply. American computers performing up to two billion operations per second were completely decontrolled to China, and if a Chinese buyer did not admit to being a nuclear, missile or military site, it could import computers performing up to seven billion operations per second.

The result of these successive decontrols was to give China access, for the first time, to high-performance computers. Such computers are used, among other things, to encode and decode secret messages, to design and test nuclear warheads and to simulate the performance of missiles from launch to impact.

According to data published by the U.S. General Accounting Office and the U.S. Department of Commerce, China imported a total of 286 high-performance American computers from January 1996 to November 1998. The machines were supposed to be imported for civilian purposes, but the United States has not been allowed to verify the whereabouts of more than three of them. Thus, it must be assumed that China's military scientists have access to the other 283. Since November 1998, more than 100 additional high-performance computers have been approved for export, bringing the total number sold to China to approximately 400. The great majority of these machines were sold without an export license.

China was also allowed to buy other American equipment especially useful for developing nuclear weapons, missiles and military equipment. The approvals include the following:

- **Equipment to manufacture and test semiconductors: 593 approvals worth $241.8 million**. Used to produce a wide variety of militarily critical components for avionics, missiles, torpedoes, smart munitions, fuses and secure communications equipment.

- **High-speed oscilloscopes: 1,653 approvals worth $131.3 million**. Used to record data from nuclear weapon tests, to design nuclear weapon firing circuits, and to develop missile guidance, control and tracking systems.

- **Equipment for controlling high-accuracy machine tools: 294 approvals worth $111.9 million**. Used to produce the precision parts needed for nuclear weapons and long-range missiles.

- **Vibration testing equipment: 14 approvals worth $5.4 million**. Used to test nuclear weapons, missiles, and a variety of military equipment to ensure combat reliability in situations of sudden shock, impact or rapid acceleration.

Viewed as a whole, American exports have provided the key equipment China needs to build a potent nuclear arsenal and a modern missile force to deliver it. China has bought American equipment used to design nuclear weapons, process and analyze nuclear material, machine high-accuracy nuclear weapon components, measure those components to make sure they work, and diagnose nuclear weapon tests. In addition, China's American imports can be used to simulate missile performance, improve missile design, manufacture missile components, improve missile guidance, transmit data from missile tests, and form missile bodies, nozzles and nose cones.

The following tables present only a sampling of the dual-use equipment approved for export to China. The value presented, however, is more than half the total approved. The tables, therefore, paint a fair picture of what China has received--and is still receiving. For each equipment category, the tables give a brief description of the export's strategic importance. The reader should note that licensing data for fiscal year 1995 was unavailable from the Department of Commerce.

Computers (ECCNs: 1565, 4A01-03, 4A001-003)

Computers are used in almost every weapon application, including the design and testing of nuclear warheads, estimation of nuclear yield, simulation of missile trajectories, and missile aerodynamics.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
2,721 approved	2,684 approved	2,055 approved	1,212 approved	845 approved	924 approved	617 approved	20 approved	16 approved
$1,503,286,287	$1,611,924,877	$1,603,944,830	$819,407,941	$655,640,106	$619,614,954	$925,612,981	$39,322,120	$8,283,859

Total approved: 11,094
Total value: $7,787,037,955

Dimensional inspection or measuring systems and equipment (ECCNs: 1093, 1099, 2B06, 2B46, 2B006)

Dimensional inspection machines are used for the inspection of gas centrifuge components such as rotor tubes, end caps, baffles, and scoops; the inspection of ion sources and product collectors for the electromagnetic isotope separation (EMIS) process; and the inspection of components for nuclear explosive devices. Highly accurate inspection machines can ensure the quality and reliability of parts used in nuclear explosive device assemblies.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
		6 approved	14 approved	16 approved	12 approved	17 approved	13 approved	3 approved
		$447,200	$427,631	$1,182,467	$1,606,143	$2,654,331	$3,197,784	$61,182

Total: 81 approved
Total value: $9,576,738

Fibrous and filamentary materials (ECCNs: 1763, 1C10, 1C50, 1C010, 1C210)

Carbon, glass, and aramid fibers (composite fibers) are extremely strong but lightweight, and are often used in missile bodies. Composite fibers can also form the high speed rotors of gas centrifuges used to enrich uranium and plutonium, and can be used in the bodies of nuclear warhead reentry vehicles.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
	2 approved	2 approved	2 approved	1 approved		3 approved	12 approved	4 approved
	$30,951	$17,461	$402,490	$2,240		$73,800	$8,627,490	$2,768,260

Total: approved: 26
Total value: $11,922,692

Gravity meters (gravimeters) and gravity gradiometers (ECCNs: 1595, 6A07)

Gravity meters measure variations in the earth's gravitational field. They are used in rocket and missile applications to determine changes in the force of gravity exerted on a missile or rocket while in flight. Gravity meter accuracy is essential for compensation of inertially guided long-range ballistic missiles, cruise missiles and aircraft.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
1 approved	4 approved	5 approved	2 approved	1 approved		1 approved	1 approved	
$276,240	$484,708	$1,534,303	$84,990	$47,633		$248,000	$285,000	

Total approved: 15
Total value: $2,960,874

Gyroscopes, compasses and accelerometers (ECCNs: 1485, 7A23)

This equipment is used in navigation systems for missiles, rockets, aircraft, and submarines. A navigation system is a self-contained unit that continuously measures position, velocity, acceleration, and attitude of a moving object. The more sophisticated the navigation equipment, the more accurate a weapon will be.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
64 approved	51 approved	43 approved	60 approved	31 approved	28 approved	7 approved	7 approved	7 approved
$6,596,262	$25,486,965	$9,678,375	$20,536,368	$10,207,731	$4,738,767	$1,507,235	$7,546,478	$2,118,632

Total approved: 298
Total value: $88,416,813

High-speed and high-definition cameras (ECCNs: 1585, 4585, 6A03, 6A43, 6A003, 6A203)

High-speed cameras are used extensively to develop high explosive components and initiation systems for nuclear explosive devices. Framing cameras provide useful qualitative information on the performance of nuclear explosive device components driven by high explosives.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
13 approved	7 approved	2 approved	2 approved	2 approved		12 approved	14 approved	7 approved
$67,018	$141,660	$28,392	$6,260	$138,000		$1,117,458	$982,460	$521,246

Total approved: 59
Total value: $3,002,494

Isostatic presses (ECCNs: 1312, 2B04, 2B24, 2B44, 2B004, 2B104, 2B204)

Isostatic presses are used to pressurize a closed cavity through various media (gas, liquid, and solid particles) to create equal pressure in all directions within the cavity. They are used to produce parts with controlled densities for nuclear explosive devices and for diffusion bonding of dissimilar materials used in such devices. The presses may be used for isostatic pressing of shaped plastic bonded explosives (PBX) for implosion devices. They can also be used to improve the density of structural composites used to make rocket nozzles and missile nose cones.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
			1 approved	2 approved	1 approved	4 approved	3 approved	
			$300,000	$683,850	$160,000	$1,158,423	$802,500	

Total approved: 11
Total value: $3,104,773

Mass spectrometers (ECCNs: 4530, 3A51, 3A233)

Mass spectrometers are used to determine the amount of uranium and plutonium present in a sample. Samples analyzed are usually nitrate compounds from plutonium reprocessing facilities, fluorine compounds in uranium enrichment facilities, and metallic forms in nuclear explosive device fabrication facilities.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
				45 approved	14 approved	1 approved	3 approved	3 approved
				$3,844,792	$2,423,265	$349,429	$785,000	$698,227

Total approved: 66
Total value: $8,100,713

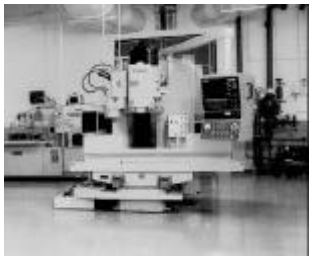
Neutron generators (ECCNs: 3261, 2A19, 3A231)

Neutron generators can be used to initiate the nuclear fission chain reaction in a nuclear explosive device.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
	4 approved	1 approved	1 approved		5 approved	1 approved	3 approved	1 approved
	$511,000	$45,000	$156,000		$3,199,000	$102,000	$233,750	$102,000

Total approved: 16
Total value: $4,348,750

Numerical control equipment (ECCNs: 1091, 2B01, 2B41, 2B001, 2B290)

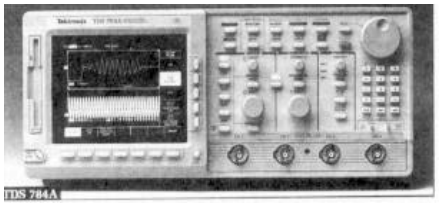


Numerical control equipment, including milling, grinding and turning machines, can be outfitted with electronic devices or computers for simultaneous "contouring control" in two or more axes (e.g., horizontal and vertical). The more accurate the machine, the more accurate the parts manufactured on the machine will be. These machines are useful for manufacturing nuclear explosive device components such as hemishells and for making uranium enrichment equipment components such as end caps for centrifuges and magnet components for electromagnetic isotope separation (EMIS) separators. They are also used to make molds and crucibles for casting uranium or plutonium, and components of plutonium production reactors such as fuel assemblies. These machines can also be used to precisely manufacture a variety of missile and rocket parts, all of which need to machined accurately.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
75 approved	82 approved	54 approved	33 approved	5 approved	2 approved	20 approved	19 approved	4 approved
$18,330,771	$21,506,260	$19,963,363	$9,919,754	$4,593,958	$311,992	$11,537,050	$19,438,064	$6,343,975

Total approved: 294
Total value: $111,945,187

Oscilloscopes (ECCNs: 1529, 1541, 1584, 3A52, 3A202)



Oscilloscopes are used for recording the results of hydrodynamic tests and full-scale nuclear tests (particularly with advanced designs). They also are used to develop very-high-speed diagnostic systems used in nuclear explosive device testing and are useful in developing fast hydrodiagnostic systems. In addition, they are used in designing and testing timing, firing, and safing circuits for nuclear explosive devices. Oscilloscopes are also used to develop missile guidance, control, and tracking systems. In August 1997, export controls on oscilloscopes were relaxed, making it possible for China to obtain more powerful oscilloscopes than before.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
495 approved	432 approved	351 approved	145 approved		1 approved	22 approved	93 approved	114 approved
$32,975,227	$57,457,951	$26,460,929	$3,128,131		$25,000	$1,137,550	$4,301,109	$5,772,198

Total approved: 1,653
Total value: $131,258,095

Pressure transducers (ECCNs: 4592, 1B51, 2B230)

Pressure transducers are used to measure the pressure of uranium hexafluoride (UF6) gas in facilities that separate uranium isotopes by the gas centrifuge process. Pressure measuring devices that are compatible with UF6 are also used in UF6 production plants and nuclear fuel fabrication plants.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
12 approved	19 approved	10 approved	13 approved	4 approved		7 approved	15 approved	14 approved
$79,166	$224,167	$49,743	$134,729	$22,904		$220,640	$710,164	$119,638

Total approved: 94
Total value: $1,561,151

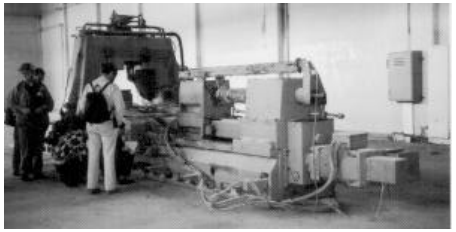
Semiconductor manufacturing and testing equipment (ECCNs: 1355, 3B01)

Semiconductor manufacturing is one of the most critical military technologies. Virtually all weapons in a modern military arsenal rely on electronics. More advanced electronic manufacturing capabilities mean higher performance and reliability at a smaller size. Semiconductor electronics are used in avionics, missiles, torpedoes, smart munitions, fuses, and secure communications equipment.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
228 approved	180 approved	95 approved	50 approved	7 approved	5 approved	5 approved	7 approved	16 approved
$44,012,989	$39,904,717	$29,841,209	$15,216,954	$1,510,027	$2,315,300	$10,300,000	$3,487,488	$95,165,785

Total approved: 593
Total value: $241,754,469

Spin-forming and flow-forming machines (ECCNs: 1075, 2B50, 2B115)



Spin-forming machines and flow-forming machines can be used to produce components for nuclear explosive devices. Rotor tubes and end caps for gas centrifuges may also be manufactured by flow-forming or spin-forming. These machines are also used to manufacture missile casings, rocket motor cases, rocket staging mechanisms, and liquid and slurry propellant control systems for missiles.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
1 approved				2 approved			1 approved	1 approved
$280,000				$1,777,000			$1,187,500	$601,240

Total approved: 5
Total value: $3,845,740

Telemetering and telecontrol equipment (ECCNs: 1518, 5A20)

This equipment is used to transmit measurements and instrument readings over long distances, usually by electromagnetic means. Missiles, rockets and unmanned aerial vehicles (UAVs) all use telemetry equipment to transmit flight and guidance information and measurements back to the launch site.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
2 approved	1 approved	3 approved		2 approved	3 approved	4 approved	3 approved	4 approved
$1,385,000	$239,763	$171,500		$23,225	$68,399	$16,787	$46,262	$14,256,873

Total approved: 22
Total value: $16,207,809

Vacuum induction furnaces (ECCNs: 1B50, 2B226)

Vacuum induction furnaces are used for casting uranium into key parts of nuclear explosive devices. They also are used for plutonium processing. These furnaces also may be used in the heat treatment of maraging steel for use in the rotor assemblies of gas centrifuges for uranium enrichment.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
			1 approved	5 approved	22 approved	8 approved	2 approved	3 approved
			$99,240	$1,778,579	$9,219,785	$3,673,188	$783,600	$13,142,000

Total approved: 41
Total value: $28,696,392

Vibration test systems, equipment and components (ECCNs: 1362, 9B06, 2B40, 9B26, 2B116)

Specialized equipment, such as digitally controlled centrifuges, are used to generate specific g profiles and vibrations for testing nuclear explosive device systems, including their arming and safing systems. Vibration testing equipment is also used to test a wide variety of military equipment and munitions to ensure combat reliability in situations of sudden shock, impact, or very rapid acceleration. It is used in the aerospace industry to test missiles.

FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1996	FY 1997
2 approved		2 approved	1 approved		1 approved	1 approved	5 approved	2 approved
$138,667		$1,423,443	$12,000		$14,500	$91,000	$3,222,828	$530,593

Total approved: 14
Total value: $5,433,031

Total number of licenses approved in Section I, Part A: 14,380
Total value of licenses approved in Section I, Part A: $8,459,173,676

SECTION I
PART B

U.S. EQUIPMENT APPROVED FOR CHINESE NUCLEAR, MISSILE OR MILITARY SITES

From 1989-1993, the U.S. Commerce Department approved hundreds of licenses worth over $75 million for the export of sensitive American technology to Chinese entities that are involved in the development of weapons of mass destruction and the buildup of the Chinese military. Some of these Chinese entities have also, in turn, supplied military equipment to Iran and Pakistan. Among the most notable approvals are the following:

- **China National Electronics Import-Export Corporation (CEIEC)** was licensed to receive American microwave research equipment, integrated circuit testing equipment, computer gear and other equipment useful for developing radar. The Corporation then exported a three-dimensional air surveillance radar to Iran that could someday threaten American pilots.

- **China Precision Machinery Import-Export Corporation (CPMIEC)** was licensed to receive American network analyzers and a computer workstation for simulating wind effects, both of which were apparently useful for building China's new C-801 and C-802 anti-ship cruise missiles. After receiving the American imports, CPMIEC exported the missiles to Iran where, according to the U.S. naval commander in the Persian Gulf, they threaten U.S. ships and personnel.

- **Chinese Academy of Sciences (CAS)** was licensed to receive American computer equipment to help develop nuclear data from an experimental fusion reactor. The Academy then exported the reactor to Iran, where it is being used to train scientists in the Iranian nuclear program, which U.S. intelligence believes is devoted to developing nuclear weapons.

- **China National Nuclear Corporation (CNNC)** was licensed to receive American computer and image analysis equipment for uranium prospecting. CNNC then helped Iran prospect for uranium that U.S. intelligence believes will be used for nuclear weapons.

- **China Aerospace Industry Corporation (CASC)** was licensed to receive $2.6 million worth of American equipment including computers for computer-aided design, and signal processors and computers for vibration analysis and structural testing, all useful for missile design and development. CASC develops most of the missiles that China offers for export, including the M-11 missile, and was sanctioned by the U.S.

government in 1993 for selling Pakistan the M-11. Pakistan has also received Chinese help in designing a plant to produce the M-11.

- **China Great Wall Industry Corporation** was licensed to receive equipment for developing vibration-related instruments such as frequency signal generators, charge amplifiers, accelerometers, magnetic recorders and data acquisition units, all useful for missile development. China Great Wall manufactures China's Long March rockets and was sanctioned by the U.S. government in 1993 for supplying missile components to Pakistan.

The Commerce Department also approved sensitive exports to key organizations in China's nuclear weapon, missile and military infrastructure, including the following:

- **China Academy of Space Technology (CAST)** was licensed to receive $3.3 million worth of equipment for electronic circuit design, including oscilloscopes, sweep generators, spectrum analyzers and computers, all apparently useful for developing missile-related electronics. CAST is China's main space research center, and was sanctioned by the U.S. government in 1993 for supplying missile technology to Pakistan.

- **Beijing University of Aeronautics and Astronautics (BUAA)** was licensed to receive over $650,000 worth of equipment for computer-aided design and for aviation and radar design and simulation. The university develops systems for simulating the flight conditions of missiles and conducts classes in inertial guidance, navigation, and flight dynamics. In the 1960s it helped design China's first aerial casings for nuclear bombs.

- **China National Aero-technology Import-Export Corporation (CATIC)** was licensed to receive over $17 million worth of equipment including computers, flight testing equipment, data recorders and turbofan engines. CATIC imports and exports China's advanced military aircraft including fighters and bombers, as well as helicopters, aero-engines and aircraft components. In 1995, CATIC illegally diverted American machine tools imported for civilian use in Beijing to a missile and military aircraft plant in Nanchang.

- **China National Electronics Import-Export Corporation (CEIEC)** was licensed to receive $8.4 million worth of high-performance computers and other equipment for microwave research, semiconductor wafer testing, and semiconductor manufacture. CEIEC markets military radar, cryptographic systems, laser rangefinders, and equipment for military communication, command, control and intelligence. As stated above, CEIEC exported a three-dimensional air surveillance radar to Iran after importing American equipment useful for building the radar.

- **Chengdu Aircraft Industrial Corporation** was licensed to receive $5.3 million worth of high-performance machine tools and computer equipment for producing aircraft parts. Chengdu manufactures China's F-7 series of fighter aircraft, is reported to be developing more advanced fighter aircraft in cooperation with Russia and Israel, and is reportedly China's second largest fighter aircraft production plant.

- **Shanghai Jiaotong University** was licensed to receive advanced computers, oscilloscopes, diagnostic equipment and computer software to conduct vibration and structural analysis. The University conducts research sponsored by the Chinese Ministry of Defense, and specializes in aerospace and nuclear activities, including the development of testing equipment for the Long March-4 rocket, high precision inertial navigation devices, and inertial and satellite hybrid navigation systems. In the nuclear field, the University conducted early research on thermohydraulic experiments for the design of research reactors, nuclear production reactors, and pressurized-water power reactors.

In addition to these approvals, other organizations that are part of China's nuclear, missile and military production base also received permission to import sensitive U.S. equipment. These include the **National University of Defense Technology**, which trains personnel from the People's Liberation Army in the design of advanced weapon systems, the **University of Electronic Science and Technology**, which develops advanced military radar and technology for stealth aircraft, and **China Electronics Systems Engineering Corporation**, which manufactures electronic equipment for the People's Liberation Army.

The approvals reveal an alarming pattern. Sensitive American equipment has been approved for sale by the Commerce Department to organizations that form China's strategic backbone. These organizations develop Chinese nuclear weapons, build China's largest long-range missiles and furnish some of the most advanced equipment available to the Chinese armed forces. Several of these organizations have also contributed, through their exports, to the nuclear and missile programs of proliferant countries. The data show that American exports to China have helped increase China's strategic might and outfitted Chinese companies that fuel proliferation around the world.

APPROVALS FOR CHINESE COMPANIES HELPING IRAN AND PAKISTAN

China Aerospace Industry Corporation (CASC)

The China Aerospace Industry Corporation (CASC - now known as the Astronautics Industry Corporation) was sanctioned by the United States in August 1993 for providing missile components to Pakistan. CASC was created as the successor to the Ministry of Aerospace Industry. It is involved in the research and development of China's long-range nuclear missiles, submarine-based strategic missiles, surface-to-surface tactical missiles, air defense missiles, and cruise missiles. It oversees more than 300 academies, factories, research institutes, companies and universities located throughout China dedicated to the design and production of launch vehicles, rocket control systems, propulsion systems, computers and inertial guidance systems, and ground facilities. According to a bill introduced in the U.S. Senate in 1997, CASC transferred approximately 24 medium-range M-11 missiles to Sargodha Air Force Base in Pakistan in December 1992, and transferred as many as 30 more M-11s from September 1994 to June 1996.

CASC was licensed to obtain over $2.6 million worth of equipment useful in missile design, including computers to conduct vibration analysis, structural testing, and mechanical computer-aided engineering (CAE), and spare parts for aircraft.

Approved licenses to the China Aerospace Industry Corporation, 1989-1993:

License #	Date	Value	Technology
D 047544	11/13/89	$7,985	Electronic equipment used in the development of a PABX system
D 053023	1/8/90	$80,446	Equipment, including a signal processor and multi-channel measurement system, to conduct vibration analysis and structural testing
D 054243	10/13/89	$115,506	Computer equipment to conduct vibration analysis and structural testing
D 097671	5/24/90	$1,000,000	Computer equipment for mechanical computer-aided engineering (CAE) design, drafting and analysis

License #	Date	Value	Technology
D 127026	2/13/91	$84,000	Computer workstation for machinery design in the aviation industry
D 143432	6/25/91	$170,000	Computer and related equipment
D 148114	8/26/91	$1,000,000	Aircraft engine spare parts
D 155243	12/23/91	$164,316	Computers and related equipment

Total: $2,622,253

China Great Wall Industries Corporation

China Great Wall Industries Corporation coordinates and provides international space launch services from China. Overseen by the China Aerospace Industry Corporation (CASC), Great Wall imports and exports space technology and equipment, precision machinery, electronics, instruments and meters. In 1993, it was sanctioned by the United States for supplying missile components to Pakistan. In 1997, it reportedly supplied, according to Israeli military intelligence, telemetry equipment for testing missiles to Iran.

Great Wall was licensed to receive a system for developing vibration-related instruments such as frequency signal generators, charge amplifiers, accelerometers, magnetic recorders and data acquisition units, all of which could be useful in missile development.

Approved licenses to China Great Wall Industries Corporation, 1989-1993:

License #	Date	Value	Technology
D 020464	10/24/89	$123,443	Equipment to manufacture signal generator, accelerometer and vibration-related instruments
D 027383	1/10/90	$124,155	Calibrator and assorted equipment
D 067582	6/20/90	$12,655	Microwave devices for satellite reception

License #	Date	Value	Technology
D 091145	4/23/90	$37,400	Communication equipment
D 092012	5/17/90	$35,675	Microwave testing equipment
D 117787	1/13/91	$1,364	Circuits for electronic equipment
D 131564	5/3/91	$56,810	Equipment to measure electromagnetic interference (EMI) levels
D 160937	5/15/92	$15,377	Integrated circuits for microcomputer numerical control system

Total: $406,879

China National Nuclear Corporation (CNNC)

It was revealed in 1996 that a subsidiary of the China National Nuclear Corporation (CNNC) exported specialized ring magnets, which are used in the suspension bearings of gas centrifuge rotors, to the A. Q. Khan Research Laboratory in Pakistan, which enriches uranium for nuclear weapons. CNNC may also be helping to construct Pakistan's secret nuclear reactor at Khusab. A CNNC subsidiary is currently constructing a 300 megawatt power reactor for Pakistan at Chashma.

CNNC has been discussing with Iran the sale of a 25 to 30 megawatt nuclear research reactor, a size capable of making enough plutonium for up to two nuclear weapons per year. Also on the horizon is a plant to produce uranium hexafluoride from uranium concentrate, a step necessary to enrich uranium to nuclear weapon grade.

The China National Nuclear Corporation was licensed to receive U.S. computer and image analysis equipment for uranium prospecting. CNNC then helped Iran prospect for uranium that U.S. intelligence believes will be used for nuclear weapons.

Approved licenses to the China National Nuclear Corporation (CNNC), 1989-1993:

License #	Date	Value	Technology
D 040656	12/11/89	$2,223	Computer equipment for a uranium feasibility study

License #	Date	Value	Technology
D 046971	12/11/89	$9,630	Computer equipment
D 105713	5/14/91	$43,405	Image viewing and analysis stations for uranium resource assessment

Total: $55,258

China Precision Machinery Import-Export Corporation (CPMIEC)

Sanctioned by the United States in August 1993 for missile proliferation, the China Precision Machinery Import-Export Corporation (CPMIEC) has supplied C-801 and C-802 anti-ship cruise missiles to Iran, and, according to United States intelligence, shipped M-11 missiles to Pakistan in 1992. CPMIEC markets and sells the M-family of medium-range surface-to-surface missiles, a variety of shipborne, anti-ship, and tactical missiles, as well as liquid and solid rocket motors, precision machinery, optical equipment, and radars.

It is estimated that Iran received 60 C-801 and C-802 missiles, some of which are mounted on "Houdong" highly maneuverable fast attack boats which China also supplied (above). The missiles are a threat to U.S. ships and sailors in the Gulf as well as to commercial shipping.

The U.S. Commerce Department approved six licenses for export of equipment to CPMIEC from 1989 to 1993. Most notably, exports of computer workstations for the simulation of wind effects, flight data recorders, and navigational instruments were all licensed. The ability to simulate wind effects is something the designer of an anti-ship missile could find useful. All of this equipment was deemed so sensitive that it required an individual validated export license to leave the United States.

Approved licenses to the China Precision Machinery Import-Export Corporation (CPMIEC), 1989-1993:

License #	Date	Value	Technology
D 062049	4/9/90	$45,834	Cables and adapters
D 078850	3/12/90	$7,707	Computer equipment

License #	Date	Value	Technology
D 082433	3/27/90	$4,876	Analyzers
D 110105	8/3/90	$32,628	Modems for data transmission
D 114649	8/28/90	$6,630	Modem for data transmission
D 131751	11/7/91	$43,700	Computer workstation for simulation of wind effects

Total: $141,375

Institute of Plasma Physics, Chinese Academy of Sciences

In 1993-94, the Institute of Plasma Physics of the Chinese Academy of Sciences (CAS) transferred a "Tokamak" nuclear fusion research reactor to the Azad University in Tehran. The reactor is being used to train scientists in the Iranian nuclear program, which U.S. intelligence believes is devoted to developing nuclear weapons.

Approved licenses to the Institute of Plasma Physics, 1989-1993:

License #	Date	Value	Technology
D 102345	7/24/90	$500	Equipment for a control and data acquisition system for a Tokamak reactor
D 108676	8/24/90	$88,800	Computer equipment to conduct experiments with Tokamak reactors
D 135538	10/30/91	$454,886	Computer with scaler/vector capabilities, used for numerical calculations in nuclear physics, fusion-related engineering, and data processing for Tokamak reactors

Total: $544,186

APPROVALS FOR CHINESE COMPANIES DEVELOPING NUCLEAR WEAPONS AND LONG-RANGE MISSILES

China Academy of Space Technology (CAST)

Also known as the Fifth Academy of the China Aerospace Industry Corporation (CASC), CAST was sanctioned by the United States in August 1993 for missile proliferation to Pakistan. CAST is China's primary research center for space and satellite technology, and oversees a myriad of research institutes and factories working on satellites, spacecraft systems, structures, attitude control and on-board electronics.

CAST was licensed to receive $3.3 million worth of equipment for electronic circuit design, including oscilloscopes, sweep generators, spectrum analyzers and computers, all useful for developing missile-related electronics.

Approved licenses to the China Academy of Space Technology (CAST), 1989-1993:

License #	Date	Value	Technology
D 042609	1/10/90	$12,075	Oscilloscope for space research
D 057869	1/8/90	$38,092	Sweep generator for use in characterization and calibration of microwave components
D 076153	8/24/90	$747,560	Electronic equipment for testing electromagnetic susceptibility (EMS) and electromagnetic interference (EMI)
D 090101	5/30/90	$1,670,000	Computer equipment for mechanical product and electronic circuit design
D 116909	11/21/90	$30,941	Spectrum analyzer for use in testing of satellite receivers
D 121378	11/16/90	$475,000	Computer equipment for mechanical and electronic circuit design

License #	Date	Value	Technology
D 136141	6/17/91	$127,007	Computer equipment, including coprocessor and software
D 136153	6/17/91	$10,920	Computer equipment
D 136643	6/11/91	$190,254	High-density digital recorder/reproducer to record satellite sensor data
D 140621	7/26/91	$6,177	Universal counter for telecommunications system

Total: $3,308,026

China Institute of Atomic Energy (CIAE)

The China Institute of Atomic Energy (CIAE) conducted early research on development of the Chinese hydrogen bomb and uranium hexafluoride production. Overseen by the China National Nuclear Corporation (CNNC) and the Chinese Academy of Sciences (CAS), the CIAE conducts research and development in nuclear physics, reactor engineering, nuclear technology, plutonium extraction and uranium isotope separation. Its laboratories are equipped with ten accelerators, two electromagnetic isotope separators, hot cells, and other facilities for reactor engineering, radiochemistry and isotope research and production.

CIAE was licensed to receive computer equipment used for nuclear research, as well as integrated circuits used in an accelerator.

Exports to the China Institute of Atomic Energy, 1989-1993:

License #	Date	Value	Technology
D 029456	12/11/89	$16,669	Computer equipment for isotope research and production, and nuclear research
D 029457	12/11/89	$5,866	Equipment for neutron analysis, charged particle activation and X-ray fluorescence analysis

License #	Date	Value	Technology
D 037799	12/11/89	$8,287	Computer for isotope and nuclear research
D 091161	5/9/90	$4,906	Computer equipment for nuclear research on an accelerator
D 100827	10/2/90	$3,885	Controller for use in a data acquisition system to measure neutron spectra
D 102592	7/3/90	$867	Integrated circuits and transistors for the HI-13 tandem accelerator
D 124870	12/23/90	$21	Integrated circuits for the HI-13 tandem accelerator
D 128850	1/28/91	$4	Integrated circuit for the HI-13 tandem accelerator

Total: $40,505

Chinese Academy of Sciences (CAS)

Also known as the Academica Sinica, the Chinese Academy of Sciences is China's highest academic institution in the fields of natural sciences, mathematics, physics, chemistry, geology, systems engineering, energy, remote sensing, computers, automation, semiconductors and microelectronics. It helped develop liquid hydrogen and oxygen rocket boosters, conducted early research on the development of a computer for the DF-5 ICBM, and developed a large-scale integrated circuit 16-digit microcomputer, used in or to develop strategic missiles and large rockets. In the nuclear field, CAS institutions conduct research on copper vapor lasers, uranium isotope spectroscopy and uranium vapor generation collection technology, and have developed separation membranes for gaseous diffusion uranium enrichment diffusers.

CAS was licensed to receive over $4.2 million worth of nuclear- and missile-related components, including instruments useful in molecular reaction dynamics, lasers, transducers, krytrons (above), semiconductor wafer manufacturing, array processors for satellite data, nuclear reactor control equipment, and laser rangefinding equipment.

Approved licenses to the Chinese Academy of Sciences (CAS), 1989-1993:

License #	Date	Value	Technology
B 293188	11/16/89	$10,235	Digital instrument for research on molecular reaction dynamics
D 051501	11/16/89	$3,000	Attendant console for telephones
D 058698	11/9/89	$25,000	Extended silicon intensified target vidicon detector for two-dimensional measurement of light scattering and angle shifts caused by pulse laser stimulation of complex polymers, and for research on surface molecular structures
D 065559	12/2/89	$19,669	Computer equipment for computer data processing
D 066764	2/6/90	$1,430	Transducers for use in a laser molecular beam interaction chamber
D 067087	12/8/89	$3,740	Computer equipment for research on X-ray lasers, and collection, memory and processing of data
D 068335	12/27/89	$3,524	Linear photodiode array, and printed circuit boards for use in radio frequency spectrum analyzer
D 070022	2/7/90	$1,840	Computer equipment
D 070829	6/30/90	$66,240	Computer equipment for studies in remote sensing for natural resources
D 072068	1/19/90	$37,000	Computer graphics controller
D 072070	1/19/90	$49,920	Computer graphics controller
D 073417	3/14/90	$7	Triethyl phosphite used for organic synthesis

License #	Date	Value	Technology
D 074830	5/15/90	$226,000	Digital ionospheric sounder used in gathering geophysical data of the higher atmosphere
D 075220	6/5/90	$15,000	Microwave pulse counter for measuring microwave frequencies
D 075243	1/24/90	$21,790	Graphics workstation
D 075542	3/29/90	$10,087	Electronic encoders to be used in polarizer experiments
D 091442	8/31/90	$749,000	Wafer stepper for semiconductor device fabrication
D 097473	6/18/90	$4,060	Vacuum gauge and tunable diode laser for a spectrometer
D 102345	7/24/90	$500	Control and data acquisition system for a Tokamak nuclear reactor
D 102834	8/30/90	$78,789	Equipment for LAN and software development
D 103402	7/20/90	$500,000	Floating point array processors to process satellite data
D 107258	7/3/90	$512	Krytrons for use in the single-pulse acquisition unit of a high power YAG laser
D 108676	8/24/90	$88,800	Computer equipment to conduct experiments with Tokamak nuclear reactors
D 109674	7/20/90	$637,500	Computer equipment to be used in the development of China's National Computing and Networking Facility (NCFC)

License #	Date	Value	Technology
D 109830	8/22/90	$74,200	Computer equipment for scientific data processing
D 111596	8/9/90	$3,688	Computer equipment for use in machinery computer-aided design (CAD)
D 112952	11/21/90	$60,000	Laser systems
D 113418	8/28/90	$2,680	Unix computer system
D 115537	9/12/90	$230,980	Laser reliability test system used for semiconductor laser research
D 118870	12/14/90	$8,112	Equipment for laser ranging system
D 119608	12/24/90	$50,000	Spare parts for equipment previously exported
D 120425	10/12/91	$119,991	Computer equipment for simulation of non-linear phenomena, such as gravity waves, vortex and separation, bifurcation, chaos and turbulence in fluids
D 120570	1/2/91	$295,650	Computer equipment
D 1257695	3/6/91	$60,000	Computer workstation
D 126084	4/17/91	$25,500	Ion beam system for pre-cleaning of substrates and ion assisted deposition
D 127266	1/22/91	$174,216	Computer server
D 130568	3/8/91	$42,600	Computer workstation
D 131138	3/18/91	$1,750	Absolute transducers for research on infrared laser chemistry of inorganic molecules

License #	Date	Value	Technology
D 132184	11/15/91	$49,341	Computer workstation to develop software
D 132178	3/26/91	$32,851	Computer workstation to develop software
D 133196	3/21/91	$1,240	Power operational amplifiers for optical research instruments
D 135538	10/30/91	$454,886	Computer with scaler/vector capabilities, used for numerical calculations in nuclear physics, fusion-related engineering, and data processing for Tokamak nuclear reactors
D 138957	8/9/91	$20,070	Cesium beam tube
D 140061	5/22/91	$49,731	Computer equipment
D 140285	6/4/91	$50	Finished mask for lithography
D 140681	1/28/91	$104,000	Advanced computational element (computer equipment)
D 143110	7/16/91	$27,841	Synthesized microwave signal generator to test telecommunication systems
D 144563	8/13/91	$180,000	Software for integrated circuit design
D 144870	7/8/92	$4,125,000	Computer equipment
D 148145	9/27/91	$4,040	Transducers for basic physics research
D 149661	10/8/91	$75	Bacteria

License #	Date	Value	Technology
D 151268	2/14/92	$236,590	Magnetic property measurement system for measuring induced and residual magnetic moments of small quantities
D 184762	3/5/93	$33	Diisopropylamine for organic synthesis

Total: $8,988,758

APPROVALS FOR CHINESE MILITARY SITES

Beijing Institute of Radio Measurement

The Beijing Institute of Radio Measurement has expertise in military radar system engineering and radio electronic technology. It conducts research and development in modern radar systems (right) for precision tracking and instrumentation, vessels and air traffic control radar systems, high precision antennae, feed systems and servo control systems.

The Institute was licensed to receive over $480,000 in electronics and radio measurement equipment.

Approved licenses to the Beijing Institute of Radio Measurement, 1989-1993:

License #	Date	Value	Technology
B 326445	12/27/89	$30,580	Portable microwave spectrum analyzer and a frequency converter
D 057520	6/25/91	$350,400	Phase noise measurement system to be used for the design, development and metrology of radio measurement equipment
D 057521	11/8/89	$18,900	Instrument controller to be used with an arbitrary waveform synthesizer used for the design, development and metrology of radio measurement equipment
D 114534	8/31/90	$770	Oscillator
D 114535	8/31/90	$520	Pin diode switches and attenuators
D 114536	8/30/90	$7,125	Decoder and encoder
D 127522	3/22/91	$73,530	Spectrum analyzer for emissions and susceptibility testing of electric and electronic products

Total: $481,825

Chengdu Aircraft Industrial Corporation (CAIC)

Reportedly China's second largest fighter plane production base, CAIC produces the F-7 (J-7) series of fighter aircraft (right). CAIC is reportedly cooperating with Pakistan's Aviation Integrated Company and Russia's Mikoyan Aero-Science Production Group in the development of the FC-1 lightweight multi-purpose fighter plane, and is reportedly developing with Israeli assistance the J-10 multi-role combat aircraft (modeled on the Lavi fighter developed by Israel Aircraft Industries [IAI]). CAIC was licensed to receive over $5.3 million worth of equipment for building military aircraft including machine tools, generators, frequency synthesizers and computer equipment.

Approved licenses to Chengdu Aircraft Industrial Corporation (CAIC), 1989-1993:

License #	Date	Value	Technology
D 059356	3/19/90	$1,269,000	Three-axis milling, drill/router gantry-type machine to manufacture structural parts for aircraft
D 059394	7/20/90	$2,320,000	Single spindle five-axis bridge-type tooling machine to manufacture structural parts for aircraft
D 082205	3/21/90	$19,626	Tracking generator to calibrate electronic equipment on aircraft
D 082776	5/9/90	$205,491	Computer equipment to aid in design of aircraft
D 093117	4/27/90	$29,285	Frequency synthesizer for development of aircraft antenna
D 125218	1/3/91	$6,100	Computer equipment used in aircraft
D 129176	2/22/91	$685,432	Computer equipment to automate aircraft manufacturing process
D 147627	6/19/91	$842,855	Horizontal machining center and accessories to produce aircraft parts

Total: $5,377,789

China Electronic Systems Engineering Corporation (CESEC)

Overseen by the General Staff Department (GSD) of the People's Liberation Army (PLA), the China Electronic Systems Engineering Corporation (CESEC) manufactures communications and electronics technology and equipment for the Chinese military.

CESEC was licensed to receive over $6.6 million worth of equipment for electronic circuit design, including integrated circuits, a spectrum analyzer, a reflectometer, and an oscilloscope, all useful in developing military electronics.

Approved licenses to the China Electronics Systems Engineering Corporation, 1989-1993:

License #	Date	Value	Technology
D 055329	4/10/90	$25,327	Equipment to be used with a sweep oscillator mainframe for testing bandwidth and frequency response
D 089051	4/6/90	$354,043	Digital telecommunications switch equipment for intra-city telecommunications network
D 090922	7/18/90	$6,900	CCD imager for solar and astronomical observation
D 100804	5/24/90	$1,762	Integrated circuits and IC boards for measuring frequency signals
D 115332	2/22/91	$4,040,000	Digital switching equipment for telecommunications network
D 115354	7/12/91	$558,586	Spectrum analyzer
D 171593	8/29/92	$89,892	Optical time domain reflectometer and an oscilloscope
D 173345	3/2/92	$1,535,699	Spare parts for a digital switching system
D 173564	11/4/92	$50,000	Training for a digital switching system

Total: $6,662,209

China National Aero-Technology Import-Export Corporation (CATIC)

CATIC imports and exports aviation systems including advanced fighters, attack aircraft, bombers, primary and advanced trainers, transport planes, helicopters, aero-engines, and aircraft components. It is cooperating with Russia and Pakistan in the manufacture of the FC-1 fighter, and with Pakistan alone in the development of the Karakorum-8 (K-8) trainer aircraft (right). In 1995, CATIC illegally diverted American machine tools imported for civilian use in Beijing to a missile and military aircraft manufacturing plant in Nanchang.

CATIC was licensed to receive over $17 million worth of equipment including computers, flight testing equipment, data recorders and turbofan engines.

Approved licenses to the China National Aero-Technology Import-Export Corporation (CATIC), 1989-1993:

License #	Date	Value	Technology
D 032648	5/30/80	$2,480,000	Four turbofan engines for training aircraft
D 037864	1/16/90	$146,782	Equipment for Y-8DII aircraft
D 044973	12/18/89	$104,524	Airborne weather radar equipment for Y-8DII aircraft
D 054438	10/24/89	$1,908	Voltage regulator and amplifier
D 057459	10/26/89	$24,400	Computer equipment
D 060733	11/14/89	$146,000	Computer equipment
D 074349	2/26/90	$25,420	Decommutator and synchronizer spare parts
D 077151	2/6/90	No declared value	Unigraphics computer and software equipment for demonstrations to potential end users
D 078438	4/10/90	No declared value	Sale of air data instruments

License #	Date	Value	Technology
D 086054	9/12/90	No declared value	Equipment to make the K-8 trainer aircraft, which are exported to Pakistan
D 086869	4/6/90	No declared value	Provision of technical data for Boeing 727 aircraft engine starters and control valves
D 096962	7/23/90	No declared value	Testing equipment for aircraft development
D 100549	5/29/90	No declared value	Airplane engine parts
D 101621	6/11/90	$288,000	Auxiliary power units for aircraft
D 102468	9/28/90	$500	Boron trifluoride monoethylamine complex for resale to Xian Aircraft Company
D 103193	7/6/90	$250,000	Aircraft spare parts
D 103868	6/27/90	$5,500,000	Computer equipment
D 108705	8/8/90	No declared value	Technical data and other information to support aircraft sales
D 112310	10/30/90	$68,089	Weather radar test set and portable spectrum analyzer
D 121804	12/7/90	$17,356	Flight data recorder and spare parts
D 127493	2/21/91	$36,070	Air data computer for flight testing
D 128830	1/25/91	$23,578	Flight data recorders and spare parts
D 130990	6/12/91	$7,500,000	15 turbofan engines for K-8 Pakistani trainer aircraft
D 134487	6/20/91	No declared value	Technical data for machining of nickel alloy non-air-cooled low pressure turbine castings

License #	Date	Value	Technology
D 136101	4/11/91	No declared value	Engineering data and concept drawings for MD-90 aircraft engine
D 142586	6/10/91	No declared value	Data blueprints and specifications of specific aircraft engines
D 143003	7/18/91	No declared value	Participate in discussions on telemetry, data acquisition and equipment
D 152762	12/4/91	$4,025	Low-level multiplexer card for aircraft flight testing
D 156716	12/18/91	$21,695	Vaxbi to VME adapter for aircraft design and development
D 160061	5/16/92	$165,200	"Pyralin" polymide coating for LCD manufacture
D 164240	6/10/92	$4,350	"Pyralin" polymide coating for LCD manufacture
D 170943	12/2/92	$528,000	"Pyralin" polymide coating for LCD manufacture
D 174630	9/30/92	$51,920	Laser modules for cable optics transmitters and cable optics receivers

Total: $17,387,817

China National Electronics Import-Export Corporation (CEIEC)

Overseen by China's Ministry of Electronics Industry (MEI--which is now known as the Ministry of Information Industry [MII]), the China National Electronics Import-Export Corporation (CEIEC) markets cryptographic systems, radars, mine detection equipment, fiber and laser optics, and communications technology. MEI, also known as Chinatron or the China Electronics Industry Corporation (CEIC), is responsible for overseeing the development and manufacture of electronics systems, equipment and products and oversees the research,

development and production of special purpose electronics equipment and auxiliary products for Chinese national defense.

Iran recently imported a powerful surveillance radar from CEIEC (right). The radar is now part of Iran's air defense system, and it can detect targets up to 300 kilometers away. This radar may have been built using U.S. equipment. Microwave research equipment, a very large scale integrated system for testing integrated circuits, equipment for making semiconductors, and computer equipment were all licensed for export to CEIEC. All of this equipment appears highly useful for developing military electronics and radar.

Approved licenses to the China National Electronics Import-Export Corporation (CEIEC), 1989-1993:

License #	**Date**	**Value**	**Technology**
D 023062	10/12/89	$13,648	Transistors and amplifiers
B 332160	3/19/90	$60,000	Equipment for electronic component testing
D 038099	2/5/80	$32,610	Electronic test equipment
D 038931	1/9/90	$10,916	Equipment for basic microwave research
D 064996	3/5/90	$82,610	Wafer parameter tester for semiconductor wafer testing
D 069736	1/8/90	$82,610	Wafer parameter tester for semiconductor wafer testing
D 083410	3/2/90	$4,375,000	Computer equipment and software
D 085246	4/18/90	$20,770	Ten Omnimux 162 computers
D 089299	3/27/90	$32,000	Equipment for sweep generators for resale to Ministry of Machinery and Electronics Industry
D 094261	9/6/90	$243,160	Circuit design software

License #	Date	Value	Technology
D 095600	5/11/90	$15,000	Telephone system
D 098338	5/14/90	$1,820	Computer chips
D 110588	8/13/90	$107,000	Plasma etchers to make semiconductors
D 112343	11/1/90	$1,924	Computer equipment
D 112622	8/20/90	$10,457	Computer equipment
D 115678	10/22/90	$9,580	Equipment to design circuit boards
D 122069	2/15/91	$33,600	Traveling wave tube amplifier
D 123120	12/12/90	$92,916	Computer equipment for oil reservoir numerical simulation
D 123122	11/29/90	$32,500	Computer equipment
D 129310	3/29/91	$6,124	Microwave frequency counter
D 129964	4/17/91	$21,754	Radio communication service monitor for testing radio signals
D 134017	3/22/91	$75,632	Statistical multiplexer systems and accessory boards
D 138056	9/6/91	$1,579,830	Personal computers and processor boards
D 138611	5/14/91	$4,100	Protocol tester for telecommunications
D 139577	5/29/91	$17,326	Integrated circuits
D 139587	5/13/91	$46,022	Computer equipment
D 155642	12/16/91	$29,094	Computer equipment

License #	Date	Value	Technology
D 161429	11/7/92	$1,315,000	VLSI system to test integrated circuits
D 161965	3/18/92	$65,120	Statistical multiplexers for use in data communications network
D 181497	1/23/93	$7,397	Phosphorus oxychloride (nerve gas precursor) for transistor manufacture

Total: $8,425,520

China North Industries Corporation (NORINCO)

NORINCO develops, manufactures and exports armored fighting vehicles, howitzers, mortars, rocket launchers, anti-aircraft weapons, anti-tank missile systems, small arms, ammunition, radars, sighting and aiming systems, high-performance engines, optical-electronic products, nuclear/biological/chemical warfare protection systems, sensor-fuzed cluster bombs, explosives and blast materials. Established in 1980, NORINCO oversees hundreds of research and manufacturing complexes and is responsible for the production of Chinese weaponry. NORINCO was indicted in 1996 by the United States for illegally conspiring to import 2,000 fully automatic AK-47 assault rifles into California intended for street gangs.

Approved licenses to China North Industries Corporation (NORINCO):

License #	Date	Value	Technology
D 070761	2/16/90	$39,980	Computer spare parts
D 073635	6/11/90	$1,400	Computer software updates
D 124949	3/15/91	$28,042	Switches and circuits for electronics measurement data conversion
D 150867	10/3/91	$71,000	Spare parts for a PABX system

Total: $140,422

North China Institute of Computing Technology

The North China Institute of Computing Technology designs, develops and produces advanced computer systems for China's national defense. The Institute has participated in tests of Chinese atomic and hydrogen bombs, and provided computer engineering for the measurement and control system for the launch of the first Chinese ICBM into the Pacific Ocean, as well as for a submarine-launched ballistic missile (SLBM). The institute also performs research on massive parallel processing technology and artificial intelligence.

Approved licenses to the North China Institute of Computing Technology, 1989-1993:

License #	Date	Value	Technology
D 075816	1/31/91	$104,763	Electronic computer equipment, including floating point accelerator
D 105265	6/27/90	$134,738	Computers and related equipment
D 105275	3/7/91	$5,000	Computers and related equipment
D 115105	11/21/90	$1,200	Computer training classes
D 116520	12/24/90	$261,865	Computer equipment
D 120245	12/26/90	$84,080	Computer equipment
D 132785	4/1/91	$2,700	Mechanical design and drafting software for engineering design and drafting of factory equipment
D 162550	6/26/92	$54,389	Computer workstation for computer aided design (CAD) of electronic circuits for minicomputers

Total: $648,735

Polytechnologies

Polytechnologies was formed in 1983 and is reportedly authorized to sell abroad every type of conventional weapon and military equipment, including AK-47 assault rifles, handguns, advanced military aircraft, tactical missiles and surface-to-surface short-to-medium range ballistic missiles. Indicted in 1996 in the United States for illegally importing 2,000 AK-47s into

the U.S., Polytechnologies also negotiated the $2 billion 1987 sale of nuclear-capable DF-3 (CSS-2) missiles to Saudi Arabia, which were reportedly installed by a People's Liberation Army (PLA) engineering corps. According to the U.S. Defense Intelligence Agency, Poly is controlled by the Equipment Department of the PLA General Staff Department.

Approved licenses to Polytechnologies, 1989-1993:

License #	Date	Value	Technology
D 032929	10/17/89	$2,430	Switching equipment
D 085213	3/19/90	$19,640	Spare parts for packet switching equipment
D 130207	2/25/91	$5,000,000	Non-military aircraft engines

Total: $5,022,070

Shanghai Institute of Metallurgy, Chinese Academy of Sciences

The Shanghai Institute of Metallurgy manufactures integrated circuits and application specific integrated circuits (ASICs) for the Chinese defense industry. It develops semiconductor materials and devices, magnetic and superconducting materials, and conducts research on physics and physical chemistry of materials, internal friction in solids, quantum chemistry, computational chemistry, and physical chemistry of compound semiconductors. It also performs research on the development of pressure transducers, infrared thermal sensors, special metallic materials for powder metallurgy, and ion beam technologies.
Approved licenses to the Shanghai Institute of Metallurgy, 1989-1993:

License #	Date	Value	Technology
D 054781	2/6/90	$310	Phosphine for production of semiconductor devices
D 065327	12/2/89	$1,190	Controller board for use with an analysis system
D 092743	6/4/90	$2,640	Arsine and phosphine for semiconductor device production

License #	Date	Value	Technology
D 116180	12/28/90	$710,000	Photo-optical step and repeat system for manufacture of integrated circuits
D 144308	7/29/91	$200,000	Computer software package for integrated circuit design verification
D 144558	7/26/91	$258,000	Software for integrated circuit design
D 146603	8/7/91	$500,000	Plasma etch system for production of integrated circuits
D 146604	8/7/91	$500,000	Plasma etch system for production of integrated circuits

Total: $2,172,140

Tianjin Institute of Power Sources (TIPS)

The Tianjin Institute of Power Sources is China's largest research institute for electrochemical and physical power sources, and has developed over 400 types of batteries and energy conversion devices, including sealed lead-acid batteries, solar cells, thermoelectric generators, and semiconductor cooling modules. TIPS develops and manufactures nickel-cadmium, nickel-hydrogen and nickel-metal hydride alkaline batteries for aerospace vehicles, aircraft, high voltage switches, communication equipment and "sophisticated weapons of national defense." It develops and manufactures silver-zinc batteries for use in guided missiles, torpedoes, space vehicles, and electronic instruments. It also manufactures thermal batteries for missiles, bombs, decoys and jammers, and lithium-thionyl chloride batteries for use in missiles, torpedoes, satellites, lasers, mines and portable communication devices.

Approved licenses for Tianjin Institute of Power Sources, 1989-1993:

License #	Date	Value	Technology
D 089216	7/6/90	$6,835	Multimeter used to test power sources

License #	Date	Value	Technology
D 103654	6/26/90	$228,800	Diffusion furnace and related accessories to manufacture batteries and solar batteries
D 122523	2/11/91	$122,500	Evaporator and dying saw for manufacture of batteries and solar batteries

Total: $358,135

APPROVALS FOR CHINESE UNIVERSITIES AND RESEARCH INSTITUTES

China's universities and research institutes provide the education and training needed to develop China's nuclear, missile and military arsenals. Many of these institutions possess "key laboratories" or research centers equipped with advanced instruments and technologies to boost research in strategic and military areas. These universities and institutes develop defense technologies which are then transferred to production entities for integration into the Chinese military.

Beijing University of Aeronautics and Astronautics (BUAA)

The Beijing University of Aeronautics and Astronautics (BUAA) is one of China's premier aerospace research universities. BUAA conducts classes in aerodynamics, air-breathing engines, inertial guidance and navigational equipment, space vehicle control, guidance and simulation, flight dynamics, solid mechanics, metallic materials, and heat treatment. It possesses "state key laboratories" for aerodynamics and aero-thermodynamics and laboratories for research on fluid dynamics, thermal dynamic engineering, and fluid mechanics. It developed a numerically-controlled system to simulate aerodynamic flight conditions of missiles, and has assisted in research on the aerodynamic configurations of aerial nuclear bomb casings. BUAA also develops unmanned aerial vehicles (UAVs) including the WZ-5 high altitude photographic reconnaissance UAV.

Approved licenses to the Beijing University of Aeronautics and Astronautics (BUAA), 1989-1993:

License #	Date	Value	Technology
D 035535	1/18/90	$26,956	Gallium arsenide (GaAs) equipment for research on non-invasive automatic detective instruments
D 063078	3/19/90	$26,016	Horizontal situation indicator and a heading course panel
D 063935	9/28/90	$75,468	Computer workstations for use in computer-aided design and manufacturing systems (CAD/CAM)
D 075891	6/18/90	$5,085	Absolute transducer for research on optical materials storage
D 078073	2/7/90	$17,000	Computer workstation

License #	Date	Value	Technology
D 085070	3/27/90	$78,500	Computer equipment to develop a program for mechanical computer-aided design (CAD) software
D 089330	3/28/90	$23,618	Computer equipment for teaching computer-aided design and manufacture (CAD/CAM) programs
D 105293	7/27/90	$10,888	Computer equipment to enhance computer-aided design and manufacture (CAD/CAM)
D 112639	8/29/90	$5,950	Computer equipment
D 116009	5/10/91	$330,700	Computer equipment to be used in the CAD/CAM laboratory for aviation and radar design and simulation
D 133981	3/21/91	$2,500	Computer equipment
D 140260	5/17/91	$4,500	Computer equipment
D 142227	6/7/91	$50,000	Computer workstation
D 148921	9/20/91	$61,816	Computer equipment
D 150791	9/23/91	$3,269	Computer equipment for mechanical CAD/CAM software research

Total: $722,266

Fudan University

Fudan University in Shanghai was named by the U.S. Department of Commerce in 1994 as a suspect buyer engaged in tomography, which allows non-destructive testing of solid propellants for missiles and testing of the reliability of the detonation package and nuclear material used in atomic bombs. Faculty at Fudan conduct research in accelerator-based atomic and nuclear physics, applied chemistry, laser chemistry, nuclear electronics, modification of materials by electron, ion and laser beams, low temperature conductivity, superconductivity, and

semiconductor physics. Staff from the university were involved in the early development of a separation membrane for use in uranium enrichment by the diffusion method. Its Parallel Processing Research Institute developed a parallelizing compiler system for computers, and transferred a version of the software to the National University of Defense Technology (NUDT) where the software will be used with China's Yinhe ("Galaxy") supercomputers.

Approved licenses to Fudan University, 1989-1993:

License #	**Date**	**Value**	**Technology**
D 039312	12/4/89	$5,400	Flight mass detector for research in atomic and molecular physics
D 039313	12/20/89	$67,343	YAG laser with accessories for research in atomic and molecular physics
D 060326	1/19/90	$8,035	Digital signal averager to record fluorescence decay in photochemistry and photophysics
D 089022	3/28/90	$5,000	Computer equipment
D 091717	4/11/90	$23,360	Electronic testing equipment to be used with a sweep oscillator mainframe
D 094516	4/9/91	$3,125	WAN software
D 096058	8/10/90	$2,470	Transducer
D 105911	6/28/90	$3,814	Multichannel buffer and emulation software for teaching time spectroscopy
D 108291	7/31/90	$109,915	Computer equipment
D 112800	8/21/90	$206,482	Computer equipment
D 126371	1/23/91	$46,500	Engineering workstations for training in integrated circuit design
D 127261	2/18/91	$18,923	Computer workstation

License #	Date	Value	Technology
D 128359	2/5/91	$78,605	Computer workstation
D 128642	3/27/91	$1,650	Variable leak valve
D 141902	7/30/91	$71,206	Computer equipment
D 141906	9/9/91	$6,552	Computer equipment
D 148412	9/18/91	$51,093	Computer equipment for computer-aided design (CAD) research
D 149710	9/17/91	$88,400	Computer equipment
D 156614	3/27/92	$70,000	Computer workstation
D 156970	12/13/91	$34,325	Computer workstation
D 160305	4/23/92	$21,486	Computer workstation
D 164480	5/21/92	$11	Trimethyl phosphite for studying chemical modification of phosphorus on metal

Total: $923,695

Harbin Institute of Technology (HIT)

Overseen by the China Aerospace Corporation (CASC), China's principal missile and rocket manufacturer, the Harbin Institute of Technology (HIT) has developed a remote-controlled responder automated testing system for surface-to-air missile guidance equipment. HIT has manufactured aluminum alloy plates for rocket casings, and conducts space robotics research. It has reportedly developed a new radar system to detect low-altitude and ultra-low-altitude aircraft targets, as well as a spaceflight simulator featuring a drive mechanism with permanent magnet brushless DC torque motor. Its School of Astronautics trains specialists and scientific researchers in astronautics, and conducts courses in flight vehicle control, guidance and simulation, intelligent control systems, tunable (gas) laser technology, electronics, communications, optics and optoelectronics, astrodynamics, vibration and control, and composites. HIT's School of Material Science and Engineering conducts doctoral programs in metals and heat treatment, casting, welding and the technology of plasticity and maintains laboratories for precision welding production technology and precision hot-processing of metals.

Approved licenses to the Harbin Institute of Technology (HIT), 1989-1993:

License #	Date	Value	Technology
B 314776	2/9/90	$40,615	Equipment for mass data storage, plug-in modules, and an X-Y plotter
D 056764	12/26/89	$18,233	Controller to measure signal spectrum, frequency stability and accuracy of amplitude frequency
D 056770	12/5/89	$62,025	Microwave frequency counter to measure signal spectrum, frequency stability and accuracy of amplitude frequency
D 071396	1/19/90	$66,261	Computer equipment
D 074791	7/17/90	$53,972	Laser processing system, laser discharge tube, laser beam expander, deionizer cartridge, and particle filter for lasers
D 078960	2/8/90	$27,281	Computer equipment
D 085589	4/10/90	$1,335	Metrology software to be used with a laser measurement system
D 088291	3/27/90	$20,000	Computer equipment
D 088732	3/29/90	$56,188	Semiconductor chips
D 088945	4/16/90	$92,556	Computer equipment for use in laser measurement experiments
D 099944	6/6/90	$1,144	Signal processing software for use with an oscilloscope
D 122109	3/28/91	$9,035	Logic analyzer
D 133350	3/11/91	$25,000	CAD/CAM software

Total: $473,645

Institute of Computing Technology, Chinese Academy of Sciences

The Institute of Computing Technology participated in the early development of the "109C" transistorized digital electronic computer, which was used in the theoretical computation of launch vehicle models, the flight orbit of the Long March-1 rocket, the computation of the trajectory of a long-range rocket which landed in the Pacific Ocean, and the trajectory of the Long March-3 rocket. It conducts research on large-scale computers and computer technology, and possesses a computer-aided design (CAD) laboratory.

Approved licenses to the Institute of Computing Technology, 1989-1993:

License #	Date	Value	Technology
D 078755	6/5/90	$18,342	Four channel oscilloscope (similar to above) for digital magnetic recording research
D 082943	3/7/90	$17,193	Microprocessor analysis system used for digital magnetic recording
D 091024	5/3/90	$1,178,284	Computer workstation for research on artificial intelligence applications
D 093730	8/7/90	$45,367	Very large scale integrated (VLSI), large scale integrated (LSI), and medium scale integrated (MSI) devices
D 125942	1/15/91	$26,000	Computer workstation CPU for research on artificial intelligence
D 126953	1/25/91	$41,716	Computer equipment
D 128895	3/20/91	$300,000	Computer equipment
D 139315	6/4/91	$165,000	Computer workstation for use in developing computer-aided design and engineering (CAD/CAE) systems

License #	Date	Value	Technology
D 139316	12/13/91	$175,000	Computer workstation for use in developing computer-aided design and engineering (CAD/CAE) systems
D 139431	5/13/91	$8,195	Computer software
D 139445	5/13/91	$1,625	Computer software
D 139446	5/14/91	$2,640	Computer software
D 139527	6/12/91	$8,500	Computer software
D 139431	5/13/91	$8,195	Computer software
D 139528	5/30/91	$9,800	Computer software to develop artificial intelligence systems
D 140044	5/30/91	$6,600	Computer workstation software for development of artificial intelligence language
D 140113	5/14/91	$11,000	Computer software
D 141373	6/3/91	$5,760	Computer workstation computer software
D 141377	612/91	$10,530	Oracle database computer software
D 141378	6/3/91	$15,500	Computer software
D 141568	5/30/91	$26,600	DEC Station 5000 computer for computer-aided design and engineering (CAD/CAE) research
D 141569	5/30/91	$44,000	DEC Station 5000 computer for computer-aided design and engineering (CAD/CAE) research

License #	Date	Value	Technology
D 141570	8/9/91	$15,000	Logic analyzer prism used to analyze and debug microprocessors in computer workstations
D 142127	8/7/91	$900,000	Spare parts for computer microcomputer systems
D 142599	10/15/91	$47,650	Computer equipment
D 142667	7/9/91	$70,000	Computer software for computer-aided design (CAD)
D 144882	7/9/91	$122,600	Computer equipment
D 152474	4/6/92	$52,890	Peripheral image processing workstation for imaging, computing, calculation, analysis and processing technology
D 161547	4/1/92	$33,000	Systems programmers package for computer RISC stations
D 164252	6/26/92	$257,400	Computer workstations
D 174331	12/9/92	$60,000	Computer workstation

Total: $3,684,387

Nanjing University of Aeronautics and Astronautics (NUAA)

Previously known as the Nanjing Aeronautical Institute (NAI), the NUAA develops the CK-1 (Changkong) medium-high altitude unmanned aerial vehicle (UAV) (right), superlight aircraft, Y-2 helicopters and the WZ-1 remote pilotless helicopter. It also developed the CK-1 nuclear test sampling UAV, the CK-1 maneuvrable UAV, and the CK-1 ultra-low altitude UAV. NUAA possesses research institutes for aerodynamics, automatic control, computer research, electrical engineering, electronic engineering, mechanical engineering, sensors and testing, and vibration engineering.

Approved licenses to the Nanjing University of Aeronautics and Astronautics (NUAA), 1989-1993:

License #	Date	Value	Technology
D 063419	1/16/90	$1,510	Adapters for research on noise analysis on receiving systems
D 071056	2/15/90	$5,885	Memory module and high density data cartridges for enhancement of a computer system
D 071374	1/19/90	$67,889	Computer equipment
D 071946	1/19/90	$68,985	Computer equipment for use in photo-geography, mapmaking and image matching
D 074823	1/22/90	$123,625	Computer for computer-aided design (CAD)
D 076315	8/24/90	$10,758	Computer equipment
D 078962	2/13/90	$7,740	Reciprocal counter and oven oscillator
D 086702	6/27/90	$9,498	Microwave silicon bipolar semiconductor transistors for an air traffic control system
D 087599	3/27/90	$4,633	Computer equipment to upgrade an existing workstation
D 097650	5/9/90	$18,634	Computer workstations
D 107528	6/30/90	$700	Computer equipment
D 117446	12/21/90	$9,371	Microwave amplifier for remote sensing
D 117992	9/28/90	$44,605	Computer memory board to enhance a controller

License #	Date	Value	Technology
D 118272	12/24/90	$27,276	Laser head for laser measurement system, angular optics and laser head cable
D 118414	1/29/91	$35,903	Vision system and accessories for existing robots
D 130511	2/13/91	$121,413	Computer equipment for computer-aided design (CAD)
D 131767	4/25/91	$4,352	Equipment to measure analog output signals, to be used with a signal processing system

Total: $562,777

National University of Defense Technology (NUDT)

The National University of Defense Technology (NUDT), also known as the University of Science and Technology for National Defense (USTND) or the Changsha Institute of Technology, is a science and engineering college overseen by the People's Liberation Army (PLA). Its main tasks are to train PLA technical personnel in scientific research, design, production, test and operation of highly sophisticated weapons and equipment, and to train technical personnel and commanders from strategic weapon test and operation units.

Approved licenses to the National University for Defense Technology (NUDT), 1989-1993:

License #	Date	Value	Technology
D 010084	1/8/90	$9,194	Graphics station for computer-aided design of circuits and printed circuit boards
D 093000	4/25/90	$157,512	Computer equipment
D 103778	6/15/90	$120,500	Computer equipment
D 140453	6/5/91	$282,578	Computer equipment

License #	Date	Value	Technology
D 149714	9/6/91	$50,000	Computer equipment

Total: $619,784

Shanghai Jiaotong University (SJU)

The Shanghai Jiaotong University conducts research sponsored by the Chinese Ministry of National Defense, and has academic departments performing aerospace and nuclear research, including the Department of Instrumentation Engineering, which developed a low overload acceleration tester for the Long March-4 rocket, for which it received the Chinese National Science and Technology Achievement Award. Other departments conduct research on composites, inertial and satellite hybrid navigation systems, optics, acoustics, image processing, computational fluid mechanics, hydrodynamics, underwater noise and cavitation.

Approved licenses to the Shanghai Jiaotong University, 1989-1993:

License #	Date	Value	Technology
D 046808	1/9/90	$9,143	Dual trace portable digital storage oscilloscope
D 076223	4/30/90	$4,000	Positive resistors for development and manufacture of magnetic recording heads for computer disk drives and peripherals
D 097509	5/23/90	$4,866	Computer equipment
D 101948	6/5/90	$369,095	Computer workstations and equipment
D 110079	7/31/90	$1,420	Microprocessor interface module to be used with a logic analyzer
D 111674	8/15/90	$203,200	Analog interface for use in measurement of mechanical properties of metallic materials
D 124868	11/30/90	$16,290	Computer equipment

License #	Date	Value	Technology
D 127391	1/9/91	$23,000	Computer workstation
D 128325	2/15/91	$21,904	Computer workstation
D 129636	3/28/91	$2,500	Aluminum oxide/titanium carbide ceramic composite
D 132474	5/3/91	$28,041	Control systems analyzer
D 138285	6/17/91	$27,625	Computer equipment
D 138286	4/25/91	$23,780	Computer equipment
D 138410	6/12/91	$773	Preprocessor for use with a logic channel analyzer
D 139597	7/26/91	$19,000	Logic analyzer for development of microprocessor-based node stations for fiber-optic network
D 139883	7/12/91	$18,700	Computer software to conduct vibration and structural analysis
D 141443	6/17/91	$16,637	Computer equipment
D 147478	9/20/91	$80,701	Computer equipment
D 156601	3/24/92	$20,000	Computer workstations
D 156704	3/24/92	$45,000	Computer workstation
D 159186	1/29/92	$79,079	Computer equipment for design of robot peripherals and interfaces
D 162876	3/30/92	$360,000	Computer equipment
D 164860	7/10/92	$81,747	Computer workstations
D 177490	1/8/93	$34,995	Computer equipment

Total: $1,491,496

University of Electronic Science and Technology (UESTC)

The University of Electronic Science and Technology (UESTC) conducts military research on the design and use of low radar cross section (RCS) radar antennae, and aircraft stealth techniques. It also conducts research on communications and electronics systems, physical electronic and optoelectronics, signal and information processing, circuits and systems, electromagnetic field and microwave technology, electronic materials and devices, computer applications, semiconductor devices, microelectronic sciences, and optical sciences. Its Department of Electronics Engineering conducts research on data processing algorithms for synthetic aperture radar (SAR), and its Research Institute of Applied Physics has developed a multimedia laser imaging radar system which can report target information, target shape, velocity, and range.

Approved licenses to the University of Electronics Science and Technology (UESTC), 1989-1993:

License #	Date	Value	Technology
D 066992	5/15/90	$10,350	Four-channel portable oscilloscope for testing an optical electronic converter
D 075865	2/13/90	$169,913	Computer equipment and software
D 076332	4/3/90	$101,722	Computer workstation
D 148888	9/17/91	$1,000,000	Computer equipment for use in computer-aided design (CAD) applications
D 148893	3/2/92	$900,000	Computer equipment for use in computer-aided design (CAD)
D 173023	8/20/92	$13,885	Computer equipment

Total: $2,195,870

Xian Jiaotong University

One of China's most prestigious universities in science and engineering, the Xian Jiaotong University has participated in the construction of thermohydraulic experimental facilities and experimental research on research reactors, nuclear fuel production reactors and pressurized-water power reactors. Its Ceramics Division produces boron carbide reactor control rods.

Approved licenses to the Xian Jiaotong University, 1989-1993:

License #	Date	Value	Technology
D 078746	2/7/90	$177,834	Computer equipment
D 093913	4/25/90	$19,641	Computer equipment
D 133297	3/22/91	$6,336	Data analysis software for use with a computer to conduct turbulence measurement in air flow using an anemometer and digitizer
D 133357	6/17/91	$86,988	Three component signal analysis systems including “dynamic signal analyzers” to be used in fluid mechanics experiments to process signals in particle velocity measurements
D 141503	12/13/91	$110,000	Computer workstations
D 154378	1/7/92	$24,799	Computer equipment
D 156321	5/6/92	$40,000	Computer workstation for computer aided design (CAD) training
D 156604	2/29/92	$20,000	Computer workstation
D 162274	3/27/92	$70,043	Computer equipment
D 170697	10/7/92	$35,681	Computer workstation for computer-aided design (CAD) education
D 170709	9/23/92	$1,027,632	Computer equipment

Total: $1,618,954

Xidian University

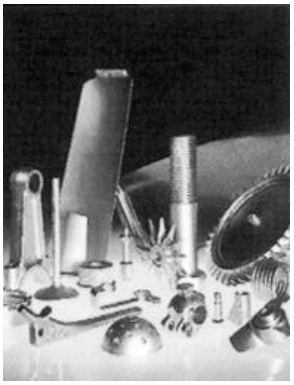
Xidian University is a leader in research in communications engineering, signal processing, computer peripheral equipment, microwave technology and antenna engineering, and cryptography. Its Information Science Institute (ISI) is China's primary military communications institute, and conducts research on key technologies required to develop an Integrated Battlefield Area Communications System (IBACS), on mobile and personal communications, packet radio networks, digital high frequency communications, VHF/UHF telemetering and control systems, meteor burst communications, speech and audio signal processing, image processing, application specific integrated circuits (ASIC) design and broadband integrated services digital networks (B-ISDN). Xidian maintains a Key Laboratory for Radar Signal Processing conducting research on radar signal processing, spatial temporal two-dimensional signal processing, array signal processing, target identification and imaging, artificial neural network and wavelet theory and their applications, and high speed parallel algorithm and electronic design automation (EDA). Its School of Mechanical and Electronic Engineering (SMEE) conducts research in mechatronics, computer-aided design and manufacturing (CAD/CAM), vibration and control, antenna structures, computer peripherals, electronic and electromagnetic technology compatibilities, and electromagnetic protection technology for electronic devices. It receives funding from China's Defense Technology Foundation and the Chinese Military Electronic Technology Project.

Approved licenses to Xidian University, 1989-1993:

License #	Date	Value	Technology
D 042286	12/4/89	$37,031	Programmable spectrum analyzer for teaching signal processing
D 093857	7/3/90	$27,660	Sweep generator and waveguide detector
D 141549	8/9/91	$158,800	Sample integrated circuits

Total: $223,491

Total value of licenses approved in Section I, Part B: $75,300,267



SECTION II

ESPIONAGE AND DIVERSIONS

Several incidents of Chinese nuclear espionage--all reported by the press--have come to light in recent years. The most recent has been the theft of information describing the small, sophisticated W-88 thermonuclear warhead. Investigations in the past have focused on the theft of laser information useful for simulating nuclear explosions and on the theft of the secrets of the W-70 nuclear warhead, known as the neutron bomb. According to the U.S. General Accounting Office, China has also managed to obtain sensitive information during officially-sanctioned visits by its scientists to U.S. nuclear weapon laboratories.

In addition to espionage, China has benefitted from diversions. Chinese companies have diverted machine tools, high-performance computers and controlled materials from civilian to leaded guilty to charges that it illegally exported DEC computer equipment to China without first having obtained the required exprt control laws. Presented here are cases that have come to light recently. They may be a small fraction of the total number of thefts and diversions that have occurred.

PART A - ESPIONAGE

Case #1: Theft of information about the W-88 nuclear warhead

The report of a select committee of the U.S. House of Representatives, chaired by Representative Christopher Cox, indicates that China stole secret nuclear weapon design information from the Los Alamos National Laboratory in the mid-1980s. According to a report in the Wall Street Journal, the information described the W-88 nuclear warhead, which tops the U.S. Trident II submarine-launched ballistic missile. The information is said to have included general, but secret information about the warhead's weight, size, explosive power, and internal configuration. Although China does not appear to have developed a weapon system using this information, U.S. analysts believe China tested a warhead with characteristics similar to the W-88 in the mid-1990s. The stolen information could help China develop smaller, more powerful warheads for nuclear missiles and reduce the research and design time necessary to do so.

Although the espionage occurred in the mid-1980s, it was not detected until 1995, when American officials who were analyzing Chinese nuclear test results found similarities to the W-88. According to the New York Times, U.S. Government investigators identified a suspect, a

Chinese-American scientist at Los Alamos, and concluded that Beijing was continuing to steal secrets from the other U.S. weapons laboratories, which have been increasingly open to foreigners. Also in

1995, the CIA obtained a Chinese document that specifically mentioned the W-88 and described some of its design features. In late 1995 and early 1996, an Energy Department intelligence official, Notra Trulock, and his team took their findings to the FBI. The FBI proceeded to investigate the scientist and the allegations of stolen secrets, a process not yet complete. It was not until March 1999 that the scientist, Wen Ho Lee, was fired from Los Alamos, after failing a polygraph test and refusing to cooperate with the FBI investigation. Lee had been under investigation since late 1997, but was allowed to remain at his classified job and to travel. President Clinton's national security adviser, Samuel R. Berger, acknowledged that "there's no question" that China benefitted from the information leaked from the Los Alamos National Laboratory.

The warhead in question, the two-stage thermonuclear W-88, is highly sophisticated. The reentry vehicle reportedly weighs less than 800 pounds, is said to be only 68.9 inches long and has a base diameter of 21.8 inches. The warhead has a yield of 475 kilotons. It is estimated that 400 are in service, atop Trident II missiles.

Case #2: Lasers to simulate nuclear explosions

In 1997, Peter Lee, a Los Alamos scientist born in Taiwan, confessed that in 1995 he had passed information to China on the U.S. laser fusion program, on which he worked in the mid-1980s. The information was passed during an exchange program in which Lee lectured in China. The laser fusion program at Los Alamos was used to simulate nuclear explosions during laboratory research. Such research is useful in developing smaller and lighter nuclear warheads.

Case #3: The W-70 warhead (neutron bomb)

In 1981, a Taiwan-born scientist working at Lawrence Livermore National Laboratory reportedly resigned after being under investigation by the FBI for two years. The investigation focused on secrets provided to China on the U.S. W-70 warhead, or the neutron bomb, and is still underway. The neutron bomb was touted by the Soviets as the capitalist's bomb, since it kills through radiation effects rather than via high explosive impact, thereby leaving buildings intact while killing their occupants. It has been reported that the Chinese actually tested a neutron bomb in September 1988.

Case #4: Visits to U.S. nuclear weapon laboratories

Chinese nationals have managed to obtain sensitive information during U.S. government-sanctioned visits to U.S. nuclear weapon laboratories. A General Accounting Office (GAO)

report in 1988 identified several lab visits which included unauthorized discussions of sensitive subjects. These included the visit of eleven Chinese nationals to Lawrence Livermore National Laboratory to discuss inertial confinement fusion, which is useful for research into thermonuclear weapons. A second instance involved the visit of four Chinese nationals to U.S. nuclear weapon labs to discuss rail guns, free electron lasers, and particle beams. These topics relate to directed energy weapons. And two Chinese nationals visited Livermore to discuss the feasibility of manufacturing components for special cameras used in nuclear weapons tests. Despite the sensitive nature of these topics, none of the visits were identified as sensitive by the labs, and as a result, DOE was not alerted that additional security might be necessary.

In a follow-up report in 1997, the GAO found that "most of the problems with controls over foreign visitors persist." The GAO found "that procedures for identifying sensitive subjects lack clear criteria and controls to ensure that visits potentially involving such subjects are reviewed by DOE." Furthermore, the GAO concluded that "as in 1988, visitors with connections to foreign intelligence organizations were gaining access to laboratories without DOE and/or laboratory officials' advance knowledge of the visitors' connections." In this light, the GAO's 1997 findings that "since the end of the Cold War, the number of foreign visits to the laboratories has increased significantly," and that "this increase is attributable primarily to visitors from China, India, and former Soviet states" are alarming. The average number of Chinese visitors to U.S. nuclear weapon labs jumped from 67 per year in 1988 to 488 per year by 1997.

PART B - DIVERSIONS

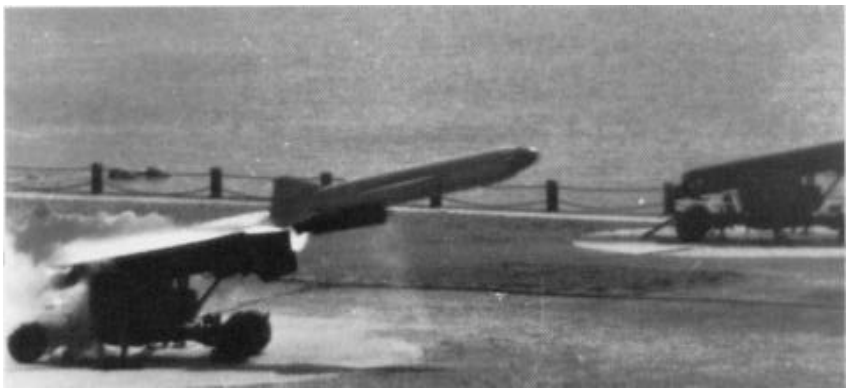
Case #1: High-accuracy machine tools (McDonnell Douglas and China National Aero-Technology Import-Export Corporation)

McDonnell Douglas and China National Aero-Technology Import-Export Corporation (CATIC) agreed in 1992 to co-produce MD-80 and MD-90 aircraft in China for that country's domestic "trunk" routes. The four Chinese factories involved in the Trunkliner program included the Shanghai Aviation Industrial Corporation, the Xian Aircraft Company, the Chengdu Aircraft Industrial Corporation and Shenyang Aircraft Company.

The Shenyang Aircraft Corporation (SAC) is known as the "cradle of China's jet fighter aircraft" because it has developed and produced more than two dozen types of military aircraft. The Chengdu Aircraft Industrial Corporation (CAIC) is reportedly China's second largest fighter plane production base. It produces the F-7 (J-7 in China) series of fighter aircraft, and is reportedly cooperating with Pakistan's Aviation Integrated Company and Russia's Mikoyan Aero-Science Production Group (MASPG) in the development of the FC-1 lightweight multipurpose fighter plane. CAIC is also developing China's J-10 multirole combat aircraft.

In May 1994, McDonnell Douglas submitted U.S. export license applications to ship sophisticated machine tools to China. The machine tools were to be wholly dedicated to the production of the 40 Trunkliner aircraft and were to be exported to the CATIC Machining Center in Beijing. However, at the time the license applications were being considered by the Department of Commerce, the Machining Center did not yet exist. McDonnell Douglas informed the U.S. government that construction of the facility would begin in October 1994. Aircraft parts production would start 14 months later.

The machine tools included five-axis milling machines, five-axis gantry profilers, five-axis numerical control machining centers, four-axis vertical profilers, three-axis milling machines, three-axis coordinate measuring machines, and a hydraulic stretch press. Five-axis machine tools can simultaneously cut and form metal in five different directions which allows them to produce parts with minimal weight and maximum strength. The machines had been used at a U.S. government-owned plant to produce parts for the B-1 bomber, C-17 military transport aircraft, and the Peacekeeper (MX) missile.



After the Commerce Department granted an export license, the machine tools were shipped to three locations contrary to the license conditions and CATIC's assurances regarding end-use. Six machine tools, including a hydraulic stretch press, a five-axis machine tool, three three-axis machine tools, and a coordinate measuring machine, were diverted to the China Nanchang Aircraft Manufacturing Corporation and the rest were stored in two locations in Tianjin, near Beijing. China Nanchang produces military aircraft and Silkworm anti-ship cruise missiles (above).

McDonnell Douglas officials reported the diversion to the U.S. government after the company had inventoried the equipment on March 24, 1995, in accordance with license conditions. McDonnell Douglas officials later reported that the stretch press had been installed in a new building designed specifically to house it. Satellite photos showed that the building was under construction even as the Chinese were promising Clinton administration officials that they would use the stretch press at the Beijing machining center.

After the diversion was discovered, McDonnell Douglas arranged for all of the equipment except the stretch press to be moved from Nanchang to Shanghai. In April 1996, about a year after the diversion was first reported, a U.S. Embassy official confirmed that all the machine tools, except the stretch press, were in Shanghai. The case is pending before a federal grand jury.

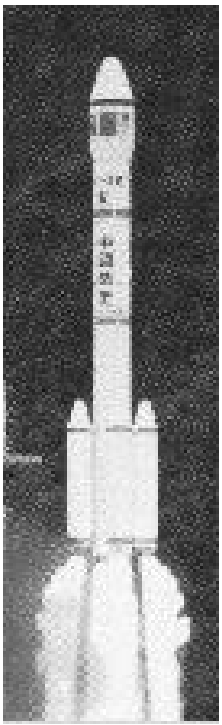
Case #2: High-performance computers (Silicon Graphics and the Chinese Academy of Sciences)

In 1996, Silicon Graphics sold a powerful supercomputer, capable of performing approximately six billion operations per second, to the Chinese Academy of Sciences, China's highest academic institution. The Academy performs research in the nuclear, missile and military fields and it develops computers, semiconductors, and microelectronics. It helped develop a computer for China's DF-5 intercontinental ballistic missile, and has helped in the development of liquid hydrogen and oxygen rocket boosters. The computer was sold without an export license and the sale is now being investigated.

According to information published by Silicon Graphics, the supercomputer, when shipped, was the "most powerful SMP supercomputer in China," and provided China with "computational power previously unknown." The computer, which was financed by a loan from the World Bank, has become the centerpiece of the Academy's Computer Network Information Center. According to the Academy, the computer is now available to "all the major scientific and technological institutes across China." This means that any Chinese organization that is designing nuclear weapons or long-range missiles has access to it. Chinese weapon designers can use the Silicon Graphics machine to design lighter nuclear warheads to fit on longer-range and more accurate missiles capable of reaching U.S. cities.

Case #3: High-performance computers (Sun Microsystems and the National University of Defense Technology)

In 1997, it was revealed that China had diverted a supercomputer, manufactured by Sun Microsystems, from a civilian site to the National University of Defense Technology, which is operated by the People's Liberation Army. The university trains technical personnel in scientific research, design, production, test and operation of sophisticated weapons and equipment, and trains technical personnel and commanders from strategic weapon test and operation units. It also performs research on missile design, detonation physics, automatic target recognition, rocket engine design, aerodynamics, solid mechanics, and experimental mechanics.



Case #4: Missile technology (Hughes Space and Communications Company)

An investigation by the Pentagon's Defense Threat Reduction Agency and National Air Intelligence Center determined that Hughes Space and Communications Company directly aided China's rocket program when it collaborated with Chinese engineers to assess the causes of the failed 1995

launch of a Long March 2E rocket (previous page) carrying the Apstar II satellite. This aid included the provision of specific details on modifying the fairing design and launch operations of Chinese rockets to improve their performance. It also included insight into U.S. diagnostic techniques that would allow Beijing's engineers to detect flaws in launch vehicles, whether they were used to launch satellites or missiles. This insight was sufficient to help the Chinese to perform more accurate coupled loads analysis and to improve China's finite elements model.

Case #5: Computers (Gateway 2000)

On June 19, 1998, the Commerce Department imposed a $402,000 civil penalty on Gateway 2000, Inc. of North Sioux City, South Dakota, to settle allegations that, on 30 separate occasions, Gateway 2000 exported U.S.-origin computer systems to 16 countries, including Iran, Syria and China, without the required validated export licenses that it knew or had reason to know were required by the Export Administration Regulations. The Department also alleged that, on 27 separate occasions, Gateway 2000 filed Shipper's Export Declarations containing false or misleading statements of material fact.

Case #6: Sintering furnace (Advanced Vacuum Systems, Inc.)

On May 1, 1997, the Commerce Department imposed a $5,000 civil penalty on Advanced Vacuum Systems, Inc. (AVS), of Ayer, Massachusetts, for allegedly exporting commodities to China without obtaining the required export license. Based on an investigation conducted by Export Enforcement's Boston Field Office, the Department alleged that AVS exported a low pressure sintering furnace and spare parts valued at over $600,000 to the PRC without the required export license. At the time of the export, the furnace was controlled worldwide for nuclear nonproliferation reasons.

Case #7: Titanium alloys (Allvac)

On January 22, 1997, the Department imposed a $122,500 civil penalty on Allvac, a Monroe, North Carolina, manufacturer, to settle allegations that the company violated the Export Administration Regulations. Based on an investigation conducted by Export Enforcement's Washington Field Office, the Department alleged that Allvac made 48 shipments of titanium alloy products (samples at left) from the United States to Australia, China, France, Ireland, Israel, Italy, Japan, Germany, Switzerland, Taiwan, and the United Kingdom, as well as one shipment of a maraging steel product from the United States to Germany, all without the required U.S. export licenses.

Case #8: Computers (Compaq Computer Corporation)

On April 18, 1997, the Commerce Department imposed a civil penalty of $55,000 on Compaq Computer Corporation, of Houston, Texas, for allegedly exporting computer equipment without obtaining the required validated licenses, in violation of the Export Administration Regulations. Based on an investigation conducted by Export Enforcement's Dallas Field Office, BXA alleged that, on three separate occasions from September 1992 through June 1993, Compaq exported computer equipment from the United States to Venezuela, Chile, and China without obtaining the required validated licenses.

Case #9: Computers (Digital Creations)

On June 13, 1997, United States District Court Judge William Walls of the District of New Jersey fined Digital Creations Corporation of Closter, New Jersey, $800,000 for violating the Export Administration Act and Regulations. In December 1994, Digital Creations Corporation pleaded guilty to charges that it illegally exported DEC computer equipment to China without first having obtained the required export license from the Commerce Department.

Case #10: Computers (Lansing Technologies Corporation)

On June 17, 1997, Lansing Technologies pleaded guilty in U.S. District Court to exporting a vector computer processor and a data acquisition control system to China without the required export licenses. Lansing was fined $10,000 and a $400 special assessment.

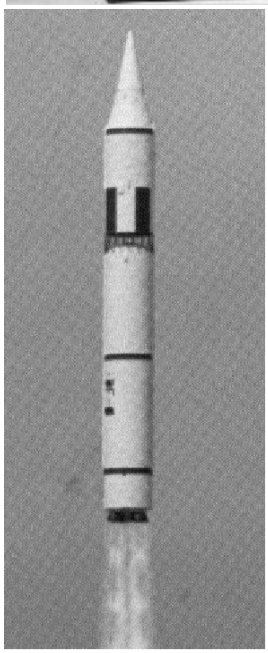
Case #11: Computers (New World Transtechnology)

On December 20, 1996, New World Transtechnology (NWT), Galveston, Texas, pleaded guilty to two counts of violating the International Emergency Economic Powers Act, and one count of making false statements. A criminal fine of $10,000 was imposed and a special assessment of $600 was levied against NWT. Courts alleged that NWT had exported three Sun Microsystems computers to a nuclear equipment factory located in the China in August 1992, without the required export license. It was also alleged that, in October 1992, NWT attempted to illegally export a computer to the same destination in China. Export Enforcement Special Agents seized another computer before it could be shipped to China via Hong Kong.

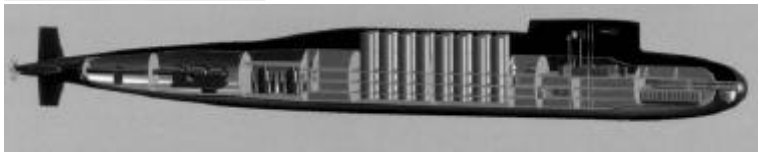
Case #12: Hafnium (Well Complex International)

Well Complex International pleaded guilty in March 1998 to a one-count federal indictment in U.S. District Court for failing to obtain the required Department of Commerce export license when it exported hafnium granules to China in 1996. The company's president, David Chan, also pleaded guilty to one charge of causing a false statement.

SECTION III



CHINA:
THE STRATEGIC OUTLOOK



Although China's nuclear, missile, and submarine forces are smaller and less sophisticated than those of the United States, they pose a growing threat to both the continental United States and U.S. allies and forces in the northeast Asian region. China has undertaken a steady modernization of all of its strategic forces, which promises to create more accurate, survivable, and capable nuclear weapon systems in the future.

PART A - CHINA'S NUCLEAR PROGRAM

According to a recent Pentagon report, China has decided to improve its nuclear arsenal to achieve two aims. First, a more powerful arsenal would enhance deterrence of major strategic rivals such as the United States or a resurgent Russia; second, it would improve China's "status as an international power." In addition to these aims, an improved arsenal would give China the ability to defeat American-supplied theater missile defenses, which might someday shelter Taiwan and Japan.

Historical Development

China's nuclear weapon program officially began in 1955, when China and the Soviet Union began a series of nuclear cooperation agreements. The Soviet Union rapidly built up China's nuclear infrastructure until relations cooled in the 1960s. China tested an A-bomb in 1964 and three years later tested its first thermonuclear weapon. Since then, China has produced an arsenal estimated at around 400 warheads, of which about 250 are on land-based ballistic missiles, bombers, and submarine-launched ballistic missiles, and some 150 are tactical nuclear weapons.

China is now modernizing its nuclear forces by developing lighter warheads for the longer-range, more accurate missiles it is building. Currently, China is not believed to be producing fissile material, but it has a stockpile sufficient to increase or improve its weapon inventory significantly. It is estimated that China has up to 4 tons of plutonium and 23 tons of high-enriched uranium, enough material for more than 2,000

nuclear weapons. While the Chinese rely on a far smaller number of warheads than that to achieve deterrence, the existence of this stockpile facilitates Chinese modernization efforts and keeps strategic options open for the future.

China's Modernization Efforts

Until the Comprehensive Test Ban Treaty (CTBT) was opened for signature in September 1996, the Chinese braved international condemnation to continue to test nuclear weapons. China conducted about two tests per year until July 1996, after which China declared a self-imposed moratorium. In September 1996, China signed the CTBT but it has yet to ratify it.

Chinese Nuclear Tests After 1990

Date of Test	Estimated Yield
May 21, 1992	660 kT - 1 MT
September 25, 1992	1-20 kT
October 5, 1993	40-80 kT
June 10, 1994	10-100 kT
October 7, 1994	40-150 kT
May 15, 1995	40-150 kT
August 17, 1995	20-80 kT
June 8, 1996	20-80 kT
July 29, 1996	1-5 kT

China detonated its largest nuclear device at its Lop Nur test site on May 21, 1992. The device was widely reported by the media to have a one megaton yield, but one respected group of analysts put the yield at closer to 660 kilotons, roughly 50 times the power of the bomb dropped on Hiroshima. This large underground test greatly exceeded the 150 kiloton limit agreed to by the United States and the Soviet Union in 1976. The device was reportedly a warhead for one of China's new intercontinental ballistic missiles, either the DF-31 or DF-41.

The purpose of China's last sequence of tests was modernization. China wanted to develop smaller, more potent warheads before it could no longer conduct underground tests under the CTBT. With smaller warheads, China would be able to increase the range of its ballistic missiles by reducing their payload. In addition, China appears to be interested in deploying multiple re-entry vehicles (MRVs)

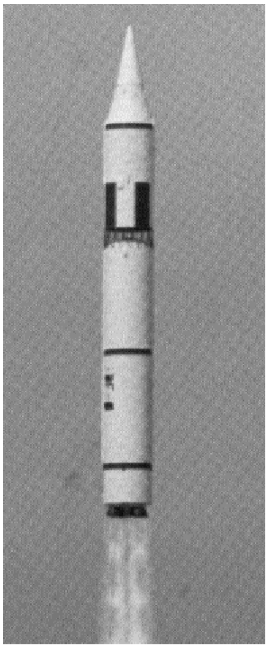
or multiple independently-targeted re-entry vehicles (MIRVs) on ballistic missiles. In order to do so, China must develop warheads small enough to be grouped on the top of a single rocket.

PART B - CHINA'S BALLISTIC MISSILES

Although in June 1998 Chinese President Jiang Zemin said that he and President Clinton agreed "we will not target each other with the strategic nuclear arms under our control," Robert Walpole, the CIA's National Intelligence Officer for Strategic and Nuclear Programs, said in September 1998 that China has about 20 CSS-4 (DF-5) intercontinental ballistic missiles (ICBMs), most of which "are targeted against the United States." According to Walpole, China's "modernization efforts will likely increase the number of Chinese warheads aimed at the United States." These efforts include the new 8,000 km range road-mobile Dong Feng-31 (DF-31), which will be able to reach western parts of the United States, and the 12,000 km range DF-41, which could reach any part of the United States. China will also be able to target the United States with its forthcoming submarine launched ballistic missile, the Julang-2.

Historical Development

China's missile program began in 1956, when Chairman Mao Zedong urged Chinese industry to start building nuclear weapons and the missiles to deliver them. Within a decade, China had tested both an atomic bomb and a nuclear-capable missile, the Dong Feng-2. The latter benefitted greatly from Russian tutelage and technology. China would proceed to build a series of DF missiles, each of greater range than the last.

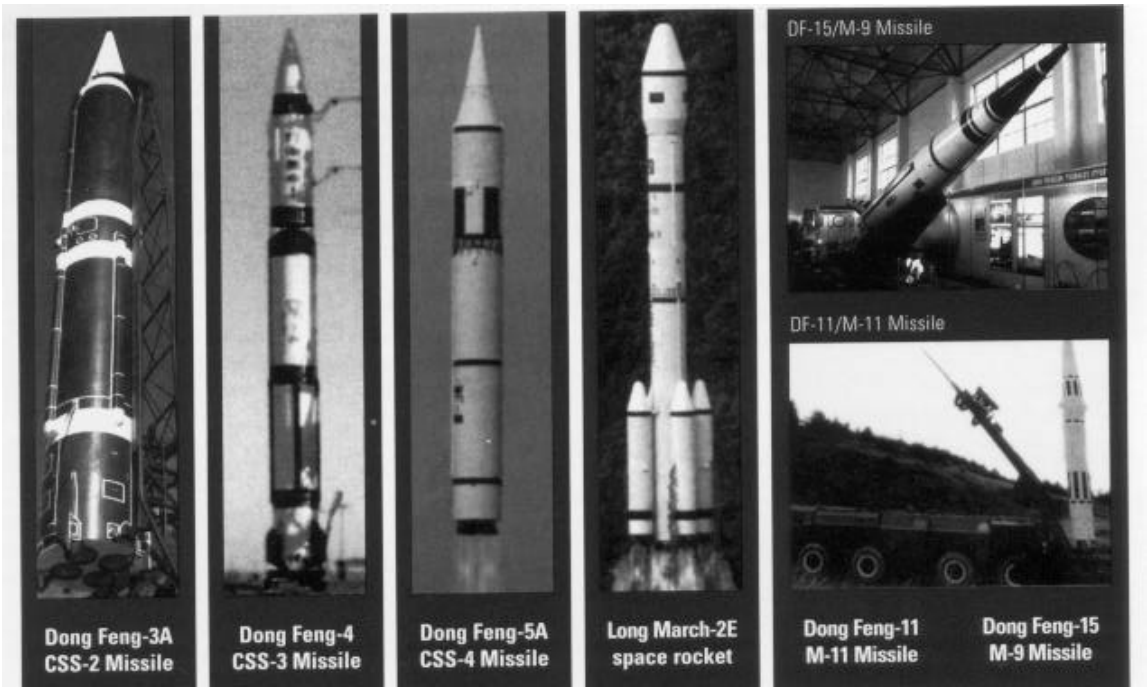


The liquid-fuel DF-2 was initially aimed at U.S. military bases in Japan. A copy of the Soviet R-5 missile, it was turned against the Soviet Union when Sino-Soviet relations soured in the late 1960s. The liquid-fuel DF-3, tested in 1966, more than doubled the DF-2's range to 3,000 kilometers. The DF-3 engines are used in the DF-4 missile and to power China's Long March-1 space launcher. It also earned China nearly $3 billion from sales to Saudi Arabia in 1988. The DF-4 was designed to target U.S. forces in Guam, but it could also strike Moscow and the Middle East.

Since 1981, the mainstay of China's long-range ballistic missile force has been the liquid-fuel, silo-based DF-5 (right), China's first ICBM. China has about twenty of these missiles, most of which are targeted at the United States. According to a Pentagon study, China had more than 100 nuclear warheads deployed on operational ballistic missiles by 1997.

China's Missiles and Rockets

These are some of China's nuclear-capable missiles and rockets. Dong Feng means "East Wind," but the missile is better known in the West as the CSS (Chinese surface-to-surface). China's Long March space launchers are derived from Dong Feng missiles.



	Dong Feng-3A (CSS-2)	Dong Feng-4 (CSS-3)	Dong Feng-5A (CSS-4)	Long March-2E space rocket	Dong Feng-11 (M-11 missile)	Dong Feng-15 (M-9 missile)
Range (in kilometers)	2,800	4,750	Intercontinental	Low-earth orbit	300	600
Payload (in kilograms)	2,150	2,200	3,200	8,800	800	950
Weight (in metric tons)	64	80	183	462	N/A	6.2
Propulsion	Single-stage, liquid fuel	Two-stage, liquid fuel	Two-stage, liquid fuel	Three-stage liquid fuel; four strap-on motors	Two-stage; solid fuel	Single-stage; solid fuel
Mission	Nuclear-armed	Nuclear-armed	Nuclear-armed	Launch satellites	Nuclear-armed	Nuclear-armed
Status	First flight, December 1966; current production uncertain	First flight, January 1970; deployed	First flight, September 1971; deployed and in production	First flight, July 1990	First flight, mid-1990; in production	First flight, June 1989; in production

Source: Official Chinese publication by the Commission on Science, Technology and Industry for National Defense (COSTIND); *China Today: Defense Science and Technology*, 1992; Natural Resources Defense Council, *Nuclear Weapons Databook*, 1994; John Lewis and Xue Litai, *China Builds the Bomb*, 1988.

China's Modernization Efforts

The Chinese are now modernizing their ballistic missile forces. This modernization consists in part of an increase in numbers, but also includes a move to more mobile, solid-fuel missiles with multiple warheads. Solid-fuel missiles can be launched faster than liquid-fuel missiles, which makes solid-fuel missiles less vulnerable. Mobility also adds a dimension of strategic surprise, since missiles may be launched from more than one area. According to one report, China is currently upgrading its medium-range missile forces with improved mobile systems designed to hit targets in Russia, India, Taiwan and Japan. In addition, all of China's newest and future ICBMs – the DF-21, DF-31, and DF-41 – are or will be mobile.

There are reports that China is trying to deploy MIRVs on the DF-31 and the DF-41. MIRV capability would enable China to increase the threat from its ballistic missiles significantly. Because China has far fewer missiles than either Russia or the United States, MIRV capability would maximize China's strategic deterrent. MIRVs would also help defeat any potential missile defenses that the United States or its allies may develop and deploy.

China's modernization effort is centered on the DF-21, DF-31, and DF-41 missiles.

DF-21:

The DF-21, a land-based version of the submarine-launched JL-1, is a two-stage solid-fuel, mobile intermediate-range ballistic missile. With a range of 1800 km and a payload of 600 kg, the DF-21 has a diameter of 1.4 m, weight of 14.7 tons, and length of 10.7m. It carries a single nuclear warhead with a yield of 200-300 kilotons. The missile underwent its first test flight in May 1985 and has subsequently been deployed. Estimates of the number of DF-21 missiles deployed vary.

DF-31:

In 1978, China began the development of another road-mobile, solid-fuel ballistic missile, the DF-23, which was renamed the DF-31 in January 1985. The DF-31 reportedly will be a three-stage solid-propellant ICBM, with an 8,000 km range carrying a 700 kg payload. Before firing, the transporter-erector-launcher would move the missile to a preselected launch site. Its nuclear warhead is estimated to have a yield between 250 and 500 kilotons. According to a report in the *Washington Times*, quoting a classified report by the National Air Intelligence Agency, the DF-31 will carry at least one nuclear warhead and penetration aids, such as decoys or chaff. It will be able to hit targets along the western coast of the United States. It is estimated that the DF-31 may enter service by the turn of the century, and that ten to twenty may be deployed. China is reported to have tested a solid-fuel rocket motor for the DF-31 on July 1, 1998, at the Wuzhai Space and Missile Test Center. The test occurred during President Clinton's visit to China. In late 1998, U.S. satellites reportedly detected Chinese plans to conduct an "ejection test" at the Wuzhai Space and Missile Test Center, in which a missile is ejected outside its launch canister shortly before the engines ignite.

DF-41:

China is also developing the DF-41, which will be a road-mobile, three-stage missile. This solid-fuel ICBM will have a 12,000 km range, with a reported payload of 500-700 kg. The DF-41 may also have multiple independently-targeted re-entry vehicles. It is scheduled to replace the DF-5 in the first decade of the 21st century. This missile will be capable of reaching most of the United States.

Submarine-based Missiles

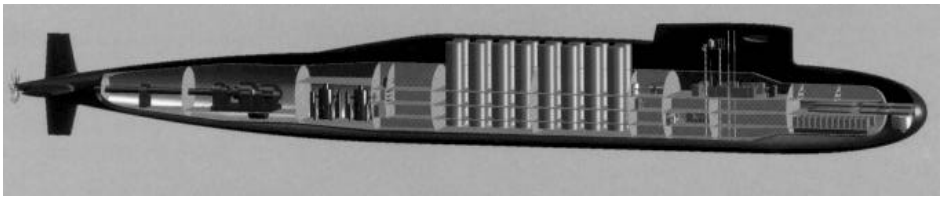
In addition to these three land-based missiles, China has been expending great effort to develop a longer-range follow-on to its current submarine-launched ballistic missile, the JL-1. This new missile will be called the JL-2.

China currently possesses an aging force of Romeo- and Ming-class diesel submarines, as well as five nuclear-powered Han-class (SSN) submarines. China deploys only one Xia-class nuclear-powered ballistic missile submarine (SSBN) (right), which carries twelve Julang-1 (JL-1) missiles. The Xia is assumed to be patrolling only in its own regional waters, though theoretically, it would be capable of coming to the U.S. coast to launch its missiles, which could then reach into the western United States.

To modernize its forces, China has turned to both foreign suppliers and its own development and production for new, more capable submarines. Improvements sought include increased stealth, more capacity to carry submarine-launched ballistic missiles, enhanced survivability for nuclear weapons, and the ability to project naval force globally.

China has ordered a total of four Kilo-class submarines from Russia. The Kilo is a medium-range diesel-powered attack submarine, used primarily for anti-submarine and anti-surface ship warfare. Russia delivered the first Kilo in February 1995, the second in October 1995. Both were the 877EKM model, an export version. Two additional Kilos of a more advanced design were ordered as well. The first arrived in January 1998 and second was sent in late 1998. These Kilo-636 submarines had not previously been exported. They are among the most quiet diesel submarines in the world. Their weapons package includes both wake-homing and wire-guided acoustic homing torpedoes. The Kilo can carry up to 18 torpedoes, which are fired from 6 tubes in its bow. While it does not carry ballistic missiles, the submarine could be upgraded to carry an anti-ship cruise missile system. These Kilos, in addition to filling out its force, will help China to improve sonar design and quieting technologies for its own submarines.

China has also been busy constructing several new classes of submarines on its own. The first Song-class diesel attack submarine is in sea trials, and two more are under construction. The Song has a quieter propeller and more hydrodynamic hull than the Ming-class submarine it succeeds. In order to enhance their sophistication, these indigenously-produced submarines will incorporate Russian technology. The Song-class submarine is expected to be the first Chinese submarine capable of firing a submerged-launch anti-ship cruise missile.



In addition, China is designing a Type 093 nuclear-powered guided missile submarine (SSGN), the launch of which is expected in the next century. It will supplement China's five existing Han-class nuclear submarines. The Type 093 will be a multi-purpose nuclear attack submarine with enhanced quieting, weapons, and sensor systems. It will carry torpedoes, possibly anti-submarine warfare missiles, and a submerged-launch anti-ship cruise missile, probably a follow-on to the C-801.

China's most ambitious project is a new nuclear-fueled submarine that will carry ballistic missiles. The first Project 094 SSBN (above) is expected to enter service early in the next century. This submarine, the largest ever constructed in China, will be a significant improvement over the Xia-class submarine, featuring better quieting, sensor systems, and propulsion. It is likely to carry sixteen Julang-2 (JL-2) ballistic missiles, which are the longer-range follow-on to China's current stock of Julang-1s. China's new SSBN would be able to target the entire United States; however, Chinese time lines from concept to deployment have historically been very long, so it is uncertain when this capability will actually come on line.

The importance of these submarine developments lies in the prospect of China projecting its naval force regionally and deploying nuclear missiles. The former capability will enable China to threaten sea lanes or Taiwan; the latter will enhance China's strategic standing and the survivability of its nuclear forces.

China currently relies upon the Julang-1 (JL-1/CSS-N-3) as its sole nuclear-capable submarine-launched ballistic missile. Twelve are deployed on its Xia-class submarine. The JL-1 is a single-warhead, two-stage missile, which has a range of 1700 km and carries a payload of 600 kg. With a diameter of 1.4 m, a weight of 14.7 tons, and a length of 10.7 m, the JL-1 is the first Chinese missile to use only solid fuel. The yield of its warhead is reported to be in the 200-300 kiloton range. China is estimated to have produced at least 50 JL-1s.

The Julang-2 (JL-2/CSS-N-4) missile, now under development, is reported to be a three-stage solid fuel missile with a range of over 4,000 nautical miles. It is derived from the DF-23 road-mobile, solid-fuel intermediate-range ballistic missile (which was later named the DF-31). China successfully test fired the rocket engine for the missile at the end of 1983 and flight tested the land variant (DF-31)

in May 1995 for the second time. According to one report, the test flight included multiple reentry vehicles, suggesting the missile will carry multiple warheads. It is estimated the warheads will yield 200-300 kilotons each. With these missiles, China will be able, for first time, to target Hawaii from submarines operating near the Chinese coast.

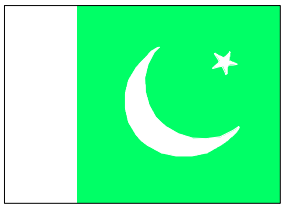
Outlook

China's ballistic missile program poses a growing threat to the United States and its security interests. China targets the United States with its long-range missiles and targets U.S. forces and allies in the Asia Pacific region with its medium- and short-range missiles. Although this threat currently is a limited one, it is growing.

A larger issue is how China is likely to use its increased capability. One clear rationale for the modernization of China's ballistic missile forces is to provide a better strategic deterrent against a global foe, in particular the United States. The Director of the Defense Intelligence Agency, General Patrick Hughes, stated in 1999 that "China will modernize and expand its relatively small and dated strategic deterrent force, and the number of Chinese warheads capable of hitting the United States will increase." Although Chinese President Jiang Zemin said in June 1998 that China would no longer target the United States with strategic missiles, CIA officials have cast doubt on whether this pledge has been fulfilled.

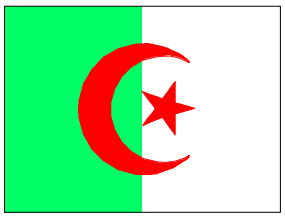
A second objective for China is to protect its interests with respect to Taiwan. During a 1995-1996 winter visit to China by former Pentagon official Charles Freeman, a Chinese official asserted that the United States would not challenge China militarily over Taiwan because American leaders "care more about Los Angeles than they do about Taiwan." In other words, China's strategic deterrent would give it the ability to act against Taiwan without fearing reprisals from the United States. It is important to note that the Chinese government's July 1998 paper on National Defense does not rule out the use of force to reunify mainland China and Taiwan. When testifying on Taiwan before Congress in February 1999, CIA Director George J. Tenet noted that China "refuses to renounce the use of force as an option and continues to place its best new military equipment opposite the island." And according to one report, China conducted military exercises in late November through early December 1998 that included simulated missile firings against Taiwan and, for the first time, also included mock attacks against U.S. troops in the region. Road-mobile CSS-5s (DF-21) and silo-housed CSS-2s (DF-3A) were included in the exercises, though the missiles were not actually fired.

In the past few years, China has been vastly increasing its deployments of DF-11 (M-11) and DF-15 (M-9) missiles in its southern regions facing Taiwan. The Chinese military has reportedly stationed from 150 to 200 M-9 and M-11 missiles in these regions and is planning to increase this number to 650 missiles over the next few years. By comparison, China had only 30 to 50 such missiles stationed there in 1995-1996 when it launched missile "tests" into the waters off Taiwan. The new deployments show China's intent to use such missiles in a regional conflict.



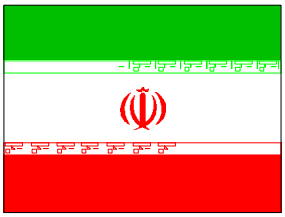
PAKISTAN

IRAQ

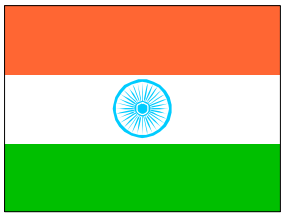


ALGERIA

SYRIA



IRAN



INDIA

SECTION IV

CHINA'S DANGEROUS EXPORTS

During the 1980s, China secretly supplied nuclear and missile technology to South Asia, South America, South Africa and the Middle East. In the 1990s, this pattern continued with Chinese technology and know-how going to South Asia, the Middle East and Algeria. In each region, China's exports contributed to the success of secret nuclear and missile programs, some of which have resulted in nuclear weapons and the deployment of nuclear-capable missiles. These exports have continued despite U.S. diplomatic efforts to stop them and repeated Chinese pledges to adhere to non-proliferation norms.

CHINA'S DANGEROUS EXPORTS

	ALGERIA	ARGENTINA	BRAZIL	INDIA	IRAQ	ISRAEL	SYRIA	SAUDI ARABIA	SOUTH AFRICA
1980 1984	Secretly agrees to supply a nuclear research reactor	Sells over 60 tons of heavy water Sells uranium concentrate and low-enriched uranium hexafluoride		Sells at least 130-150 tons of heavy water	Nuclear bomb design supplied to Pakistan makes its way to Iraq				Supplies 60 tons of enriched uranium, undercut-ting U.S. pressure on South Africa
1985 1989	Trains Algerian scientists and technicians; starts building reactor	Sells enriched uranium	Sells enriched uranium Agrees to provide liquid-fuel and guidance technology for missiles in exchange for solid-fuel technology		Helps make magnets for centrifuges to enrich uranium Sells "Silkworm" anti-ship missiles		Contracts to sell M-9 nuclear capable missiles	Sells CSS-2 medium range, nuclear capable missiles	
1990 1998	Completes reactor and supplies heavy water and uranium fuel Agrees to aid plutonium research			Agrees to supply Tarapur reactors with enriched uranium	Agrees to sell lithium hydride useful for nerve gas, missiles and nuclear weapons Sells "illegal chemicals" to produce missile fuel	Agrees to fund develop-ment of a cruise missile with a range of 400 kilometers	Sells ingredients for missile fuel Agrees to supply Syria's first nuclear reactor and train nuclear technicians		

CHINA'S DANGEROUS EXPORTS

PAKISTAN

1980-1984	Supplies nuclear bomb design and its fuel
	Helps build Hatf missiles
	Helps with gas centrifuges to enrich uranium
1985-1989	Agrees to sell tritium gas to boost the yield of fission bombs
	Ships equipment for M-11 nuclear-capable missiles
	Starts building a 300 MW nuclear reactor at Chashma in spite of de facto international supply embargo
1990-1998	Provides research and training in remote sensing for uranium exploration
	Secretly delivers more M-11 missile components
	Trains Pakistani nuclear technicians in China
	Continues to deliver components for M-1 1 missiles
	Supplies more than 30 M-11 missiles now in crates at Sargodha Air Force Base near Lahore
	Helps build a secret 50-70 MW plutonium production reactor at Khusab, and a nearby fuel fabrication or reprocessing plant
	Supplies blueprints and equipment for a missile factory near Rawalpindi, now under construction
	Supplies ring magnets used in gas centrifuges to enrich uranium
	Supplies heavy water to Kanupp nuclear reactor
	Sells a high-tech furnace and diagnostic equipment with military applications
	Ships rocket fuel seized en route in Hong Kong
	Agrees to build Chashma-2, a second 300 MW nuclear reactor
	Ships major components for the Chashma nuclear reactor
	Promises to provide the first uranium core and three reloads for Chashma

CHINA'S DANGEROUS EXPORTS

IRAN

1980-1984	Sold production capability for the Oghab short range rocket
1985-1989	Trains Iranian nuclear technicians in China
	Sells Silkworm anti-ship missiles
	Supplies a miniature reactor, a subcritical facility, and tributylphosphate useful in plutonium extraction
	Supplies CSS-8 missiles modified for surface-to-surface missions
1990-1994	Supplies a calutron and a copper-vapor laser that could be used for uranium enrichment research
	Contracts to sell 25-30 MW research reactor
	Helps prospect for uranium in Iran
	Contracts to sell nuclear reactor and isotope separator
	Provides research and training in remote sensing for uranium exploration
1995-1998	Supplies a nuclear fusion research facility and scientists and engineers to help install it
	Delivers poison gas ingredients
	Delivers missile guidance systems and computerized machine tools
	Sells virtually complete chemical weapon factories including precursor chemicals and glass-lined vessels
	Hosts Iranian nuclear specialists to study a uranium hexafluoricle plant for export to Iran
	Delivers components for missile guidance and ingredients for rocket propellant
	Supplies 400 tons of poison gas ingredients
	Agrees to sell gyroscopes, accelerometers and equipment to build and test missile guidance components

CHINA'S DANGEROUS EXPORTS

IRAN

Supplies two tons of calcium hypochlorate, used in chemical decontamination

Continues to supply chemical precursors

Supplies C-801 and C-802 ship-based anti-ship cruise missiles

Supplies through Hong Kong high-grade seamless steel pipes used to make chemical weapons or explosives

Contracts to supply hundreds of tons of anhydrous hydrogen fluoride, a key ingredient needed to process natural uranium to nuclear weapon grade

Negotiates a deal worth $4.5 billion, pending funding, to supply combat aircraft, missiles, missile launchers, armored vehicles and warships

Building a factory to make special metal sheaths (zirconium cladding) for nuclear fuel rods.

THE WISCONSIN PROJECT ON NUCLEAR ARMS CONTROL

The Wisconsin Project on Nuclear Arms Control carries out research and public education designed to inhibit the spread of nuclear weapons, chemical/bio logical weapons and long-range missiles. It is a non-profit, non-partisan foundation that operates in Washington, D.C. under the auspices of the University of Wisconsin.

The Project's main goal has been to reduce the risk that exports will be used to make nuclear weapons and the means to deliver them. The Project has worked to get countries to enforce the export controls contained in international agreements, and to comply with the export restrictions of the Nuclear Non-Proliferation Treaty. Through its research reports, testimony, articles and work with the press, the Project has influenced the export policies of major supplier countries.

In 1996, the Project began to publish the *Risk Report*, an electronic database which is updated six times per year. The *Risk Report* provides governments and exporters an unclassified list of "suspect" buyers worldwide --- buyers linked to the spread of nuclear weapon, chemical weapon and long-range missile technology.

The Project has been investigating sales of nuclear- and missile-related technology since 1986 and has identified nearly 2,000 companies and projects linked to proliferation. By listing suspect buyers in sensitive emerging markets, the *Risk Report* helps exporters and governments keep dangerous products out of the wrong hands.