THE EMERGING BALLISTIC MISSILE THREAT TO THE UNITED STATES

Report of the

PROLIFERATION STUDY TEAM

February 1993

Executive Summary

Those countries currently possessing ballistic missiles[1] capable of reaching the United States are China, Great Britain, France, Russia, and possibly Belarus, Kazakhstan, and Ukraine. Only Brazil and India in the developing world, and Italy, Israel, Germany, Japan, and Sweden among industrialized states have the potential to achieve such a capability during this decade. There is no indication at this point of any intention on the part of these countries to engage in such an offensive missile program.

If current trends continue, then the probability of new long-range ballistic missile threats to the United States appearing during the 1990s or very early years of the next decade is quite low.

Such a conclusion, based as it is on a simple extrapolation from current conditions, however, cannot be maintained if several plausible developments are considered—developments that could lead to new ballistic missile threats during the remainder of this decade. These developments entail plausible routes to the emergence of additional long-range threats and must undermine confidence in a conclusion based solely on current trends. Those plausible, if essentially unpredictable developments include:

- Acquisition from a foreign supplier of long-range ballistic missile components or technologies by proliferant countries hostile to the United States such as Iran, Iraq, or Libya—countries that could not otherwise field long-range missiles within this decade or early in the next. This development could occur as a result of transfers from China, and enterprises in the former Soviet Union operating independently and essentially without the consent of Moscow or Kiev.
- Indigenous development or acquisition from a foreign supplier of space launch vehicle (SLV) technology or complete systems by proliferant countries, and their subsequent conversion to long-range missile capabilities.
- The relatively rapid deterioration of political relations with countries now possessing long-range missiles or capable of promptly fielding long-range missiles if the political decision were made to do so.
- The acquisition of missiles with *less than* intercontinental range by Latin American or Caribbean countries hostile or prospectively hostile to the United States, or the fielding of missiles on the territory of such countries by a hostile third party.

Of particular concern is the potential for the transfer and conversion of SLVs for use as surface-to-surface missiles. The conversion of an indigenously developed SLV would require relatively modest effort. India, Israel, and Brazil will likely have such a capability before the end of the decade, followed by South Africa, South Korea, and Taiwan early in the next. With the collapse of the Soviet Union, both Russia and Ukraine have become potential SLV suppliers—as are enterprises in those states possibly acting independently. There may be powerful economic motives affecting these states and enterprises to engage in the transfer of SLV or even specific ICBM technologies.

A self-expressed motive on the part of some leaders and commentators in proliferant states indicates that a rationale for the acquisition of long-range missiles is the establishment of a deterrent against Western power projection. Consequently, the incentive for acquisition of such systems need not be negated by the obviously severe risks involved in actually launching a missile at the United States or engaging in an explicit threat to the United States. As the basis of a policy of deterrence to Western intervention, the value of long-range missiles would essentially be in their "non-use."

In summary, based on current trends no combination of current animus against the United States, technological capability and motive, wealth, and opportunity can be identified to constitute a long-range missile threat likely to emerge during this decade or early in the next. Extraordinary routes to missile proliferation and additional missile threats, however, could shape the situation during and after this decade. Either independently or in combination, these could lead to the emergence of additional missile threats. In these circumstances, the conclusion that the probability is quite low for the emergence of new ballistic missile threats to the United States during this decade or early in the next decade can be sustained only if plausible but unpredictable developments, such as the transfer and conversion of SLVs, are dismissed or considered of negligible consequence.

1. Unless otherwise specifically stated, the use of the term "missile(s)" refers to *ballistic* missile(s).

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Table 1. Current Long-Range Ballistic Missile and SLV Capabilities[6]

COUNTRY	OPERATIONAL ICBMs	OPERATIONAL SLVs	SLVs IN DEVELOPMENT
Belarus[7]	SS-25		
Brazil			VLS
China	DF-5 DF-4 JL-1 (SLBM)	CZ-1D CZ-2C CZ-2E CZ-3 CZ-4A	CZ-3A
France	M-4 (SLBM) M-5 (SLBM)	Ariane 4	Ariane 5
India		SLV-3 ASLV	PSLV GSLV
Israel		Shavit	
Japan		M-3SII H-I	M-5 H-II
Kazakhstan[8]	SS-18		
Russia	SS-11 M2/M3 SS-13 SS-17 SS-18 M4/M5 SS-19 M3 SS-24 SS-25 SS-N-6 M1/M3 (SLBM) SS-N-8 M1/M2 (SLBM) SS-N-18 M1/2/3 (SLBM) SS-N-20 (SLBM) SS-N-23 (SLBM)	SL-3 SL-4 SL-6 SL-8 SL-12 SL-13 SL-14 SL-16 SL-17 Energiya SL-17 Buran SL-11	SS-19 SLV Sawfly (SS-N-8) Volna (SS-N-18) Shetal (SS-N-23)
Ukraine[9]	SS-24 SS-19	SL-16 SL-7 SL-8 SL-14	Space Clipper (SS-24) SS-18K
United Kingdom	Polaris A-3TK (SLBM)		

range missile threats from Latin America or Caribbean countries.

History demonstrates that rapid change in political relations does occur. The fall of the Shah of Iran—moving that state very rapidly to hostile relations with the United States—and the political changes in the Soviet Union—leading quickly to much more cordial relations with the United States—are two recent examples. While such change, occurring within the span of 5 to 7 years, is not the norm in international relations, it does take place—and often is associated with conflict. Historically, over a longer period of 10 to 20 years, this type of major reorientation of political relations is much more common. In a period of political uncertainty and instability, the prospect for political relations to deteriorate rapidly with states possessing long-range missiles, or capable of fielding such systems promptly, must be considered.

6. Long range is defined as intercontinental.

7. While Belarus retains its ballistic missiles, it does not, according to the Russian public reports, have the capability to launch or produce new missiles. Within the next 10 to 20 years, however, this may change.

8. While Kazakhstan retains its ballistic missiles, it does not, according to the Russian public reports, have the capability to launch or produce new missiles. Within the next 10 to 20 years, however, this may change.

9. While Ukraine retains its ballistic missiles, it is questionable whether such missiles are operational.

An Overview of Proliferation

MOTIVES FOR BALLISTIC MISSILE ACQUISITION

For developing states, the acquisition of ballistic missiles may be desirable for a host of reasons. Much like the dreadnought at the beginning of this century, ballistic missiles are seen as symbols of power and prestige. Because the great powers have such delivery systems, less-developed countries aspire to them as well.

In addition to prestige, ballistic missiles provide nations with the premier means of deterrence and may be sought for their ability to provide coercive leverage against regional rivals and to act as a deterrent to outside intervention in local conflicts. Ballistic missiles—and increasingly, cruise missiles—are viewed as a means to defeat the sophisticated defenses of more advanced countries such as Israel or South Korea. Ballistic missiles are fast, immune to pilot error, pose limited logistical and manpower requirements, can be based on sovereign territory, and, as yet, are largely invulnerable to current means of defense. This last factor renders missiles an excellent means of demoralizing an enemy, as was demonstrated by the Iran–Iraq "war of the cities." In addition, their range allows states with otherwise limited power projection capabilities to exert regional or global influence.

Even though delivering ordnance using manned aircraft may be relatively cost effective, it also entails some disadvantages compared to missiles, and money in many cases is not the overriding concern to a proliferant country. The latter is demonstrated by the fact that these countries—some of which are poor—are willing to pour billions of dollars into their weapons programs. Indeed, many are willing to suffer economic sanctions to continue their high-priority programs (e.g., the cutoff of U.S. assistance to Pakistan for its nuclear weapons program).

The ability of the United States to achieve total air supremacy during Desert Storm, but not to counter Saddam's ballistic missiles decisively, demonstrates why, for some proliferant states, missiles represent a weapon of choice. The concerns about Saddam's missiles expressed in the United States and Israel, the inability of the United States to reliably find mobile missiles in Iraq during the war—and U.N. inspectors to find them subsequently—are all likely to reinforce the view of proliferants that missiles represent a capability well worth having.

Specifically, a developing state could seek ballistic missiles for use in three types of contingencies:

- As a military instrument, deterrent, or conventional terror weapon against regional foes.
- With conventional, nuclear, chemical, or biological weapons, for use against great power intervention forces, their bases, or their hosts' cities (or against states friendly to big powers intervening in regional conflicts).
- As a threat against existing great powers, in connection with regional crises, or perhaps other circumstances where deterrence or coercive leverage is sought.

In addition, ballistic missile technology serves as more than a means to prestige and military might. The development of a missile production base may be seen as a way to generate revenue through arms exports or to expand a nation's science and technology infrastructure. In particular, a number of states are seeking to develop and launch their own reconnaissance and communications satellites, and the technology required to develop a ballistic missile is almost indistinguishable from that needed for a space launch vehicle (SLV). Israel and India both have been reported to have programs to develop observation satellites, while Argentina voices the same ambition. While the increasing availability of satellite imagery from France and Russia may satisfy the appetites of countries for overhead photography, the precedent of the Gulf War, in which satellite imagery of Southwest Asia was embargoed due to U.N. sanctions, could easily motivate states to acquire an independent capability.

MOTIVES FOR MISSILE USE AGAINST THE UNITED STATES

Many commentators have suggested that the U.S. nuclear deterrent will essentially preclude the use of ballistic missiles against the United States by removing the net incentive for any state to strike the

CAPABILITIES

The Director of Central Intelligence has estimated that by the end of the decade 15 developing states will possess ballistic missiles, and 6 of them will have intermediate-range ballistic missiles (IRBMs).[16] While the weapons employed to date, such as Iraq's modified Scuds, are highly inaccurate and carry relatively small high-explosive warheads, their use has nonetheless had a significant impact on civilian morale and military operations, and had significant political effect. Moreover, a new generation of missiles with greater range, higher accuracy, and carrying more destructive payloads is appearing on the world market.

It has been estimated that eight third-world nations will be capable of producing nuclear weapons by the end of the decade.[17] At least 14 developing states have an offensive chemical warfare capability, and 10 more are either believed to be developing or are suspected of seeking such a capability. With regard to biological weapons, Syria possesses such a capability, as did Iraq before coalition forces disabled its weapons infrastructure; and at least five other countries have such programs in various stages of development.[18]

ALTERNATIVE PATHS TO PROLIFERATION

In seeking a ballistic missile capability, proliferant states have three alternatives: indigenous development, modification, or purchase. While indigenous development of ballistic missiles will likely be limited to states possessing a substantial science and technology infrastructure, the purchase or modification of systems provides a viable option for a wide range of states.

Indigenous Production

A number of states have pursued indigenous efforts to develop ballistic missiles, several involving the development of missiles with a range of 1,000 km or more, both for security purposes and for export. However, the development of an indigenous missile infrastructure poses a daunting challenge.[19] As a result, indigenous development of missiles with ranges over 1,000 km is an option for only more advanced developing states, such as Argentina, Brazil, India, South Africa, South Korea, and Taiwan. None of these, under currently expected conditions, is likely to field a dedicated ballistic missile capability to strike the United States by the end of the decade. Israel, Germany, Italy, Japan, and Sweden could field a dedicated, long-range missile within the decade if they so choose. There is no indication, however, of an intention on the part of these more mature industrialized countries to field such a capability.

Some of the requirements for an indigenous program are outlined below.

Financial Resources

The development of an indigenous ballistic missile capability requires a significant investment of time and resources.[20] The U.S. Air Force's effort to develop, test, and deploy the first intercontinental ballistic missile cost almost $19 billion.[21] However, there is no reason that a program launched by a proliferant state at this point would be so costly. Much of the U.S. missile program involved developing, testing, and fielding what were essentially new technologies.[22] By contrast, states seeking a comparable capability today have the benefit of four decades of

16. *Statement of the Director of Central Intelligence before the Senate Armed Services Committee*, January 23, 1990, p. 15.

17. Ibid., p. 15.

18. *Statement of Rear Admiral Thomas A. Brooks, USN, Director of Naval Intelligence, Before the Seapower, Strategic, and Critical Materals Subcommittee of the House Armed Services Committee on Intelligence Issues*, March 14, 1990, p. 58.

19. For the most part, the ability to pursue sophisticated ballistic missile technologies is very limited among most developing countries. However, according to the U.S. Air Force Arnold Engineering Development Center: "The U.S. went from airplanes to intercontinental ballistic missiles in the time period from 1945 to 1958, building on the airplane, inertial navigation, sounding rocket, SRBM, and IRBM infrastructure. Since most, if not all, of that technology has been published in the open literature, a third world country could now develop an SRBM indigenous capability in 10 years and, with hired help, do the job in 6 years." Therefore, although few countries can build missiles with ranges over 1,000 km, the ability to develop relatively crude ballistic missile systems indigenously is not beyond the reach of many countries today. See U.S. Air Force, Arnold Engineering Development Center, *Short Range Ballistic Missiles (SRBM) Infrastructure Requirements for Third World Countries*, September 1991, p. 13.

20. For a case study of China's ballistic missile program, see John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security*, Vol. 17, No. 2 (Fall 1992), pp. 34–35.

21. Ernest G. Schweibert, *A History of the United States Air Force Ballistic Missiles* (New York: Praeger, 1965), p. 139.

22. Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960* (Washington: Office of Air Force History, United States Air Force, 1990).

has been reported that North Korea has produced the 500-km Scud C, based on the Soviet Scud B, which has been sold to Iran and Syria.[33] Other states, such as China, India, and South Korea, have modified surface-to-air missiles to produce ballistic missiles.[34] Pakistan has converted sounding rockets to produce the Hatf surface-to-surface missiles,[35] while a number of other states have converted space launch vehicles for use as ballistic missiles.[36]

The requirements for producing ballistic missiles through modification are much less stressing than those for developing a new system indigenously. First, such an approach is likely to be significantly less costly than developing and producing a missile. Second, modification of an existing missile design is likely to demand less sophisticated technology than a complete development effort. In some cases, however, a modification program may involve refitting an older system with more advanced guidance and control systems or warheads. The amount of testing required by a modification program will be a function of the type of modification performed. For example, changes in guidance packages and warheads may only demand ground tests, whereas major structural changes would likely require flight testing.

In addition to the states capable of developing missiles indigenously, North Korea and perhaps Pakistan and Iran have the ability to modify an existing system to produce a missile with a range of over 1,000 km by the end of the decade. Over the next 20 years, Syria, Egypt, and Libya could be added to this list, depending on the level of foreign assistance that they can obtain. None of these countries is expected under current conditions to have the capability to field a long-range missile threat to the United States during the 1990s or early in the next decade.

PURCHASE

Another option for acquiring ballistic missiles is purchase. To date, the vast majority of ballistic missiles in the developing world have been purchased from suppliers such as the Soviet Union, China, and North Korea. Should less developed states desire a long-range capability, they will be forced to purchase systems from states that possess them. Despite technology-transfer controls, more advanced states will continue to be a major source of ballistic missile technologies.

The Missile Technology Control Regime (MTCR), established in 1987, has had some success in controlling the spread of ballistic missiles.[37] The record of controlling exports of dual-use technologies, however, is mixed largely due to difficulty in controlling and monitoring end use. Also the MTCR is not a treaty, but guidelines for national control of exports; nor does it have enforcing mechanisms. The MTCR specifically states that it is "not designed to impede national space programs or international cooperation in such programs as long as such programs could not contribute to nuclear weapons delivery systems." However, the MTCR Annex makes it clear that the same restrictions apply to SLVs as to ballistic missiles. Because SLVs can be converted for ICBM use, the potential for proliferation of ballistic missile technology remains high.

While the MTCR will reduce the number of states willing to export ballistic missiles, a number of countries will continue to sell missiles and associated technology both to increase their influence in regional affairs and to earn hard currency. According to public sources, the Chinese M-9 missile appears to be an attempt to produce a missile superior to the Scud B to meet the demands of foreign customers;[38] North Korea has reportedly offered the 1,000-km No Dong I for sale, and may be developing an even longer-range missile for export.[39] Some unofficial reports have indicated that Egypt, Syria, and Iran either have received or are in the process of acquiring

33. Joseph S. Bermudez Jr., and W. Seth Carus, "The North Korean 'Scud B' Programme, *Jane's Soviet Intelligence Review*, Vol. 1, No. 4 (April 1989), pp. 180-181; Joseph S. Bermudez, Jr., "Syria's Acquisition of North Korean 'Scuds'," *Jane's Intelligence Review*, Vol. 3, No. 6 (June 1991); Joseph S. Bermudez, Jr., "Ballistic Missiles in the Third World—Iran's Medium-Range Missiles," *Jane's Intelligence Review*, Vol. 4, No. 4 (April 1992).

34. Lewis and Di, *op. cit.*, p. 37.

35. W. Seth Carus, "Long-Range Rocket Artillery in the Third World," *Jane's Intelligence Review*, Vol. 3, No. 10 (October 1991), p. 476.

36. For example, India's Agni IRBM utilizes a first stage derived from its SLV-3 space launch vehicle, while Brazil has converted its Sonda series of sounding rockets into artillery rockets. See Thomas G. Mahnken and Timothy D. Hoyt, "The Spread of Missile Technology to the Third World," *Comparative Strategy*, Vol. 9, No. 3 (July-September 1990), pp. 245-263.

37. The MTCR restricts the transfer of ballistic missile systems, components and technology for vehicles capable of the unmanned delivery of a 500-kg payload to a distance of 300 km. The regime does not limit itself to ballistic missiles, but applies to all missile systems including SLVs since their rocket stages and other components are virtually interchangeable with those of ballistic missiles.

38. See Lewis and Di, op. cit., pp. 5-40.

39. "Defense Ministry Cites DPRK Missile Upgrades," (Seoul), *The Korea Herald* in English, September 9, 1992, p. 3.

both reconnaissance and communications satellites.[47] Brazil also has an ambitious SLV program which builds upon its substantial experience in sounding rockets. Brazil also has an active program of space cooperation with China, an established space power. The Brazilian launcher, the VLS, is expected to be tested within 5 years. However, according to the VLS program director, export restrictions imposed on the program because of the MTCR are creating delays in, and increasing the cost of, the program.[48]

While Argentina's Condor II IRBM program has been suspended, there has been some discussion of converting it for SLV use under Argentina's civil space agency. In addition, a number of other states, such as South Africa, South Korea, Pakistan, and Taiwan, have expressed an interest in pursuing space launch vehicle programs. However, such efforts are not believed to be very advanced, and none of these is currently expected to have an operational SLV by the end of the decade. Depending on their respective commitments to an SLV program, they could develop such a capability within two decades.[49]

Converting SLVs Into ICBMs

There are two circumstances under which a nation could use an SLV program to develop a long-range missile. A state could surreptitiously develop a long-range surface-to-surface missile under the guise of an SLV program in order to gain access to technology that might be denied a military program. Alternatively, a state could seek to develop an SLV and subsequently produce a ballistic missile through relatively minor technical modifications. The path chosen to acquire ballistic missiles will influence the force which will result. For example, a dedicated missile force would likely accent readiness and survivability. As a result, states seeking such a capability would favor solid-fuel missiles in hardened or mobile basing modes. A state converting an existing SLV into a military missile on short notice may be satisfied with a less effective system. If a state is only concerned with the ability to strike an opponent, and not more stressing criteria, it may settle for a system using cryogenic propulsion deployed in a vulnerable basing mode. In fact, the first U.S. and Soviet ICBMs met just such a description.

Converting an SLV into a long-range ballistic missile involves replacing the SLV's payload with a warhead and reentry vehicle and modifying the instructions in its guidance system. In order to develop an operational ballistic missile capability, a state must possess a warhead that is small and light enough to be carried by missile (i.e., between 500 and 1,000 kg). While creating a chemical or biological warhead of such dimensions is not difficult, fielding a compact nuclear weapon may be more difficult.

In addition, the space launch vehicle needs to be equipped with a reentry vehicle to shield its warhead from atmospheric heating. A high-drag/low-accuracy warhead would not require a high-technology heat shield. Reentry vehicle technology is commercially available: sounding rockets configured to conduct microgravity experiments possess their own heat shields. In addition, a developing state might be able to construct a fiber/resin heat shield, such as those fielded by the United States and Soviet Union, using commercially available technology and design information presented in open literature. Such a design would add between 75 and 100 pounds to the weight of the warhead and would be capable of protecting nuclear, biological, and chemical payloads.[50]

Most SLVs possess guidance systems sufficient to allow them to strike a large area target. An ICBM would not require high accuracy to be useful. Rather, all that may be required is the ability to strike an urban area—in other words, accuracy on the order of 10 km. Such accuracy is feasible with commercially available inertial navigation systems, even at intercontinental ranges. In addition, other means of location, such as data from the GPS, could be used both to accurately locate launch positions and to guide missiles. The testing required of such a system will be determined by the reliability and effectiveness required. While much testing can be accomplished on the ground, flight tests would be desirable for some components, including the reentry vehicle. Much of this could be conducted under the guise of civilian space launches.

A state seeking a more sophisticated long-range ballistic missile force would face more extensive hurdles. For example, the desire for a survivable force might dictate reliance upon solid-fueled missiles, mobility, or hardened launch sites.

47. Mahnken, op. cit., p. 572.

48. "Brazil Chafes at Missile Curbs," *Space News*, October 14–20, 1991, p. 1.

49. Mahnken, op. cit., p. 573; *Decision Maker's Guide to International Space* (Arlington, VA: ANSER, 1992), pp. 165–167.

50. Graybeal and McFate, op. cit., pp. 7–8.

Table 2. Capabilities of Converted SLVs: Some Illustrative Examples[51]

SYSTEM	DESCRIPTION	STATUS	POTENTIAL CAPABILITIES AS A BALLISTIC MISSILE
Augmented Satellite Launch Vehicle (ASLV) (India)	Based on SLV-3 launcher with two solid strap-on engines added for additional thrust	Operational (tested three times with one successful launch)	1,000-kg payload to a range of 4,000 km
Polar Satellite Launch Vehicle (PSLV) (India)	Four-stage solid and liquid system intended to place approximately 1,000 kg into Sun-synchronous orbit	In development	At least 5,000-kg payload to intercontinental ranges
VLS (Brazil)	Evolutionary design incorporating technology from the Sonda IV sounding rocket	In development	1,000-kg payload to a range of over 3,500 km or 500-kg payload to approximately 5,000 km
Shavit (Israel)	Solid-fuel booster could easily be converted into a two-stage ballistic missile by replacing the SLV's third stage and satellite payload with a warhead and reentry vehicle of equal mass	Operational, has been used to place two experimental Ofeq satellites weighing approximately 200 kg into low Earth orbit	1,100 kg to a range of 4,500 km or 500 kg to a range of 7,500 km[52]

Potential Indicators and Warning

Any state capable of fielding an indigenous SLV would be able to convert that launcher into a long-range missile rapidly and with minimal effort. The needed technology is widely available, and the skills required are those which would be present in an SLV or satellite development program. India, Israel, and Brazil would likely be capable of such a conversion and a capability to target the United States by the end of the decade if they so choose. If South Africa, South Korea, and Taiwan pursue SLV programs aggressively, and receive foreign assistance they too could achieve a capability to reach the United States within the next 20 years. There is no indication now, however, that any of these countries have an intention to threaten the United States.

A program to convert SLVs into missiles may be more difficult to detect than an effort to develop missiles indigenously. Because the components that distinguish a surface-to-surface missile from an SLV are relatively few (i.e., guidance, RV), a state with an operational space launch capability may be able to deploy a long-range missiles rather quickly. Still, there are a number of indicators of the capability to field such a system.

First, the state seeking such a capability would have to acquire or develop needed guidance and RV technology. While guidance components may be sought for a variety of purposes, including short-range ballistic missiles and aircraft, RV technology is primarily useful for long-range missiles and the return of satellite payloads from space. As a result, activity in this area may provide an indication that a nation is seeking a long-range missile capability.

Second, although much of an ICBM may be tested covertly, either on the ground or in the form of space launches, a nation may want to flight test its missile to verify the ability of the RV to protect the warhead or to determine its accuracy. Indeed, this was the purpose of the first test of India's Agni IRBM.[53] Such

51. Based on information provided in Andrew Wilson (ed.), *Interavia Space Directory, 1992–1993* (Alexandria, VA: Jane's Information Group, 1992). The range of a surface-to-surface missile resulting from the conversion of an SLV would be a function of a number of factors, including the type of propellant used, propellant performance, size of the booster, number of stages, and mass of the payload.

52. Steven E. Gray, "Israeli Missile Capabilities: A Few Numbers To Think About," Lawrence Livermore National Laboratory, October 7, 1988.

53. "Help to Space Research," Calcutta *The Telegraph* in English, June 16, 1989, p. 5.

Table 3. Major Space Launch Vehicle Producers[57]

SPACE LAUNCH VEHICLE	OPERATIONAL	OPERATIONAL PAYLOAD (kg)
Russia/Ukraine(*)		
SL-3 (Vostok)	1959	4,730 Low Earth Orbit (LEO) 1,840 Sun-Synchronous Orbit (SSO)
SL-4 (Soyuz)	1963	7,240 LEO
SL-6 (Molniya)	1961	1,800 Semi-Synchronous Elliptical Orbit (SSEO)
SL-8 (Kosmos)*	1964	1,500 LEO
SL-12 (Proton)	1967	2,500 Geosynchronous Orbit (GEO) 5,700 Moon/5,300 Venus/4,600 Mars
SL-13 (Proton)	1968	20,600 LEO
SL-14 (Tsyklon)*	1977	4,000 LEO
SL-16 (Zenit)*	1985	1,370 LEO/11,380 SSO
SL-17 (Energiya)	1987	105,000 LEO/32,000 Moon 28,000 Mars/Venus/19,000 GSO
SL-17 (Buran)	1988	30,000 LEO
SL-7/B-1 (Kosmos)*[58]	1962	600 LEO
France		
Ariane 4	1988	7,000 to LEO/6,000 to Polar/2,290 to GEO
Ariane 5	1995	14,830 to LEO/12,020 to Polar/4,320 to GEO
Japan		
M3S-II	1985	615 to LEO/200 to GEO
M-5	1995	2,000 to LEO/680 to GEO
H-I	1986 (retired 1992)	2,200 to LEO/550 to GEO
H-II	1993-1994	8,980 to LEO/2,200 to GEO
China		
CZ-1D	1991	750 to LEO
CZ-2C	1975	2,000 to LEO/750 to Polar 500 to GEO/750 to SSO
CZ-2E	1992	8,800 to LEO/7,200 to Polar
CZ-3	1984	5,000 to LEO/2,540 to Polar/1,390 to GEO
CZ-3A	1993-1994	8,500 to LEO/2,500 to GEO
CZ-4A	1988	4,000 to LEO/1,500 to Polar/1,200 to GEO

57. *Decision Maker's Guide*, pp. 165-167, *Interavia Space Directory*, 1992-1993.

58. Although no longer operationally available, the SL-7 Kosmos could be produced for commercial sale.

Since the early 1980s, Brazil has had an objective of developing an indigenous orbital launch capability. In 1989, Arianespace bid successfully to provide second-generation launch services for Brazilsat, including offers to sell satellite thrusters, gyros, and other satellite technology, as well as Ariane Viking rocket motor technology. The French offer provided a valuable boost to its program. It was reported later, however, that under U.S. pressure, the French offer to transfer these technologies was withdrawn after frequently acrimonious exchanges on grounds of being in conflict with MTCR constraints. The Brazilian program was forced into redesign as a result, delaying estimated initial launch under its VLS system program to 1995 or later.

In another case involving Brazil, the United States reversed a position it had previously taken in 1989 licensing a U.S. firm to perform heat treatment on rocket motor casings manufactured in Brazil and intended as components for an indigenous SLV capability. The license was partially fulfilled but then revoked following the judgment that this cooperation with Brazil's SLV program was inconsistent with the MTCR.

In November 1990, India reached a $100 million agreement with Glavkosmos in Russia for development of a cryogenic rocket motor to be incorporated into the next-generation Indian GSLV launcher. Despite strong U.S. objections on MTCR grounds and sanctions against the Russian and Indian firms involved, Russia has refused to withdraw from the agreement. Economic considerations appear uppermost in the Russian position.

Prospects for Future Sales

As long as MTCR or similar restraints are viable, pressures to sell SLVs can be moderated among participants to the guidelines. However, as noted earlier the MTCR is not designed to impede national space programs or international cooperation in such programs. The degree of commitment to the current regime by Russia or Ukraine is uncertain today and could weaken in the face of hard currency requirements and ample sales opportunities. Both countries are pressing to gain a foothold in the commercial space launch services market. But as in the case of the Russian–Indian deal, direct transfers can offer a lucrative alternative. In the case of the Ukraine, if it cannot gain access to launch facilities, it may have no alternative but to sell SLV components, technologies, or the boosters themselves.

In addition, surplus ballistic missiles could produce proliferation dangers if parties to the START I and II agreements violate nontransfer provisions in order to reap commercial benefits. Except for the SS–18s, the agreements do not require the destruction of missiles that are reduced from deployed status. Such missiles can be used by the parties to the agreement for space launch, military testing, or other purposes. Ukraine has loosely talked of selling surplus missiles instead of moving them to Russia which it has otherwise undertaken to do by 1994.[62] The possession of surplus missiles or missile production capacity contribute to a latent risk of proliferation. These circumstances coupled with economic necessity could create incentives to exploit potential markets. The direct transfer of such missiles, however, would represent a material breach of the START I agreement and as such would be likely to reflect a larger breakdown in relations. More difficult cases could involve the transfer of components or subcomponents from surplus ballistic missiles, which would be harder to detect or may be presented as not inconsistent with missile proliferation guidelines.

Even should the governments of the FSU states enforce the MTCR and refuse to sell ICBM/SLV components or subcomponents, the prospect for illegal sales cannot be discounted. Following the 1989 coup attempt, the then-Soviet leadership decided that the defense industry would "bring in [its] own income."[63] The pressure on the defense industries to self-finance has dramatically increased their incentives for foreign sales of military equipment—including possibly illegal sales or sales that might be opposed by the national governments for political reasons. As the economic and political crises have deepened in Russia and the former Soviet states, the ability of the governments to control military sales has become increasingly tenuous. The lack of direct state control and the pressures on the industries to generate income, coupled with the deepening economic crisis that will likely lead to a drop in government orders for new equipment, will probably result in increased activity in the sale of black market arms abroad. As demand for SLV and ICBM components or subcomponents matures, it is not difficult to

62. See for example, "Ukraine says missiles are its to sell," *Washington Times*, 6 November 1992, p. A2.

63. N. Zhelnov, "Specialists Examine Proposals for Financing Defense After This Year," *Pravitelstvennyy Vestnik*, No. 46 (November 1991), in Foreign Technology Center, *Daily Snap*, December 10, 1991.

Possibilities of Changing Intentions

Continuity and change in political relations are endemic parts of the international system. Factors that can be associated with relatively rapid change in the modern era include dramatic and sometimes unpredictable events such as war, the rise and fall of great powers/empires and the power systems based on them, the gradual or sudden shifting or fragmentation of alliances, revolutions and the disintegration of nation-states, changes in regional power balances, and changes in ideological orientation.

What is the likelihood that the ballistic missile threat to the United States could increase as a result of major shifts in the current relations between the United States and those countries with long-range ballistic missiles or the clear potential to acquire such missiles during this decade or the next? This section examines the historical precedent for relatively rapid and dramatic change in political relations and suggests, based on historical evidence, that such change is plausible, if frequently unpredictable far in advance.

It is possible to examine these questions from a historical case study perspective in two time frames: sudden changes in 5 to 10 years or more gradual change in 10 to 20 years. Because this is designed to help inform judgment about proliferation, only relatively modern historical examples from the 19th and 20th century are reviewed.

FIVE- TO TEN-YEAR PRECEDENTS

In historical terms, the 5- to 10-year time frame offers some notable examples of radical change in alliance or alignment. Such change, while not occurring frequently, does occur, and in most cases is fostered by truly cataclysmic events, usually war or revolution. Some examples serve to bear this out.

The Cold War Begins

One example of sudden change in alignment can be found in the onset of the cold war. From the often strained, but nevertheless cooperative alliance relations at the end of World War II, it took only a few short years (and the death of President Roosevelt) for wide agreement in the United States to develop that the Soviet Union was a genuine threat to Western peace and security. By 1948, this had become the cornerstone of U.S. national security policy.[64]

The Cuban Revolution

U.S. relations with Cuba in the late 1950s and early 1960s—where a rapid reorientation of a nation's political alignments came to threaten the United States—offer another example of rapid change. In short, the United States was slow in assessing the Cuban threat between early 1957 (Castro's move back to Sierra Maestra) and late 1959 (the ousting of anti-Communists in Castro's movement, such as Huber Matos). Indeed, some significant elements of the U.S. government favored aiding the overthrow of the Batista regime, thinking Castro to be a democratic "agrarian reformer" and not a convinced Marxist–Leninist. Castro's ultimate resort to a strategic tie with Moscow was not adequately anticipated and led subsequently to the abortive Bay of Pigs operation and the Cuban Missile Crisis.

The Iranian Revolution

A more recent example of war and revolution as the principal catalyst to sudden diplomatic change is Iran. In retrospect, it is quite possible to see the seeds of revolution in the Shah's Iran far before the revolution actually occurred. The major Iranian foreign policy realignment, however, came suddenly and "surprised" the United States, or at least the U.S. political leadership.[65] At its root, this change was caused by an ideological and religious revolution that inspired an anti-Western, viscerally anti-American, and non-status-quo foreign policy that has yet to run its course. The implications of this realignment had, and continue to have, serious ramifications for American Middle East and Persian Gulf policy.

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64. There is a wealth of literature on the origins of the cold war, some of which is descriptive and some of which seeks to cast blame on either the United States or the Soviet Union. What is important here is to recognize that the United States was required to reorient its foreign policy completely once the "reality" of the cold war became accepted. For an exellent description of the transition from Roosevelt to Truman, and from cooperation to confrontation, see the recent biography by David McCullough, *Truman*, Simon & Schuster, 1992, esp. chapters 9 & 10.

65. For a good review of the ineptitude of U.S. policy during this period, see Michael A. Ledeen and William H. Lewis, "Carter and the Fall of the Shah," *Washington Quarterly*, Summer 1980.

Conclusions

Those countries that currently possess ballistic missiles capable of reaching the United States are China, Great Britain, France, Russia, and possibly the Ukraine, Kazakhstan, and Belarus. Extrapolating from current conditions, it appears that very few additional states could field a long-range missile capable of targeting the United States within the decade—whether based on an *indigenous* ICBM or an SLV program. Only Brazil and India in the developing world and Italy, Israel, Germany, Japan, and Sweden from the industrialized countries have the potential to achieve such a capability. There is no indication at this point of any intention on the part of these countries to do so.

Projecting into the next decade—and again extrapolating from current conditions—the number of countries capable of targeting the United States with indigenous long-range missiles increases only modestly to include South Africa, South Korea, and Taiwan.

Based on a review of current conditions, the prospects for an increase in ballistic missile threats to the United States during this decade are limited. This assessment, however, must be tempered by the fact that plausible yet unpredictable developments could occur that may change this assessment. Future ballistic missile threats within this decade and later could increase if there is a proliferation of IRBMs/MRBMs located relatively close to the United States or if long-range missiles proliferate beyond current expectations.

In addition, the threat from long-range missiles during this decade and later could increase beyond the level identified above in the context of two additional plausible developments: (1) the transfer of ICBM or SLV capabilities by producers to countries currently or potentially hostile to U.S. interests; or, (2) the relatively rapid change in existing political relations with one or more of those countries capable of indigenous missile development.

With regard to the potential for ICBM or SLV transfer, under current political conditions the prospects for the transfer of ICBMs by producer states appear minimal. The potential appears to be higher, however, for the transfer of ICBM components by independent enterprises and the transfer of SLV systems that could be converted to a long-range missile threat.

It is not possible to predict with any certainty the likelihood of a dramatic deterioration in U.S. political relations with countries capable of fielding long-range missiles during this decade. Moreover, assumptions about the character of relations into the next decade become increasingly tenuous. Nor is it possible to predict with certainty whether the transfer of convertible SLV capabilities or ICBM components to countries currently or potentially hostile to the United States will occur during this decade. Both cases represent plausible but unpredictable avenues to the expansion of long-range missile threats to the United States during this decade and beyond.

If the prospect for plausible but necessarily unpredictable developments is dismissed or considered negligible, it must be concluded that the potential for an increase in missile threats to the United States during this decade is very limited. Such a conclusion, however, is not warranted and could not be sustained if the potential for rapid change in political relations, the proliferation of IRBM/MRBMs to a country relatively close to U.S. shores, or the transfer/conversion of SLV/ICBM technologies is considered in the assessment.

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