RUSSIA'S MISSILE INDUSTRY AND U.S. NONPROLIFERATION OPTIONS

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Recent allegations that Russian firms are aiding missile programs in Iran and India have renewed fears that sensitive technology is leaking to countries of proliferation concern from the economically strapped Russian missile industry. Pessimists argue that the leakage of Russian technology could greatly reduce the time needed by potential proliferants to develop medium- and longer-range missiles with the capability to deliver warheads armed with weapons of mass destruction (WMD). In turn, the spread of such capabilities would increase instability in conflict-prone regions of the world like South Asia and the Middle East. A detailed analysis of the current situation in the Russian missile industry, however, reveals that these fears, while justified, are often exaggerated, and can be adequately addressed with creative policy initiatives.

This article presents a detailed examination of the threat of missile proliferation from Russia. First, it outlines the development of the national export control system in Russia. The article then sketches the current situation in the Russian missile and space industry. Despite the continuing economic turmoil in this sector of the Russian economy, the article argues that the greatest threat of missile proliferation stems from a relatively small group of "pariah" firms. These firms have not succeeded yet in developing international contracts to substitute for the drastic decline in military procurement in Russia since 1992, and, therefore, may still be tempted to sell missile technology to potential proliferants. In its conclusion, the article suggests several policy initiatives to minimize the threat of missile proliferation from Russia and the NIS, including: strengthening the bureaucratic position of Russian export control services and increasing efforts to educate Russian industry about the export control system; intensifying international collaboration in the Missile Technology Control Regime (MTCR); beginning development of a joint U.S.-Russian ballistic missile defense program; and broadening the involvement of the Russian missile industry in new and innovative international space launch programs.

THE DEVELOPMENT OF THE RUSSIAN EXPORT CONTROL SYSTEM

Russian officials and academics on tours abroad tend to portray an almost idyllic picture of an immature but still substantially developed system for controlling sensitive technologies. They are at least partly correct, since Russia has established the fundamental elements of a national export control regime. Significant steps were taken in 1992-1994 to introduce Western principles and mechanisms of export control. Russia, as the economically most developed and bureaucratically most sophisticated of the Soviet succes-

sor states, was the first of them to introduce a relatively comprehensive national export control system adapted from Western models.[2]

Under the provisions of the 1993 Russian Constitution, which assigns substantial legislative powers to the president, the Russian export control system was established quickly on the basis of presidential decrees and government resolutions. Major export control legislation has yet to be adopted by the Federal Assembly, however. In the meantime, individual articles of other laws, together with the decrees mentioned above, form the legal basis of the Russian export control system. According to Article 16 of the Law on State Regulation of Foreign Trade Activity, for example, control lists and registers of all sensitive hardware, raw materials, know-how, technologies, and scientific information that can be used for developing WMD, missile delivery systems, or other weapons that are subject to special export control are approved by presidential decree. The Russian Federal Assembly has no role in constructing or approving the lists. The resulting regulatory documents are normally published in governmental newspapers, but they are often neglected or overlooked by the relevant industry and elements of the government bureaucracy not specifically responsible for export control. This situation frequently results in protracted debates about the legality of specific export proposals.

Four presidential decrees issued in 1992, provide the initial legal foundation for the Russian export control system in the transitional period.[3] To ensure a unified policy on exports, the interagency Export Control Commission was created the same year. The Export Control Department of the Russian Federal Service for Currency and Export Control serves as the working group or permanent secretariat for the Export Control Commission. The commission is charged with making decisions on the most controversial applications for sensitive exports, including nuclear, chemical, biological, and general dual-use- technology.

The Interagency Commission on Military-Technical Cooperation was established in 1992 to review applications for conventional weapons exports, but it was disbanded two years later in a government reshuffle. It re-emerged only in 1997 under the chairmanship of the prime minister. Since 1992, Russia has also participated actively in the Nuclear Suppliers Group and the Zangger Committee, and has adopted nuclear materials control lists that correspond to the guidelines of these international bodies. Moscow was a founding member of the post-COCOM Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies. Russia is now also considering membership in the Australian Group which regulates international chemical exports.[4]

Some attention has also been paid to creating viable enforcement procedures for punishing those who violate export control regulations. April 1993 amendments to the Russian Criminal Code provided for criminal punishment (up to eight years of imprisonment) of those convicted of export control violations and illegal exports of proscribed items included on control lists. Articles 188 and 189 of the new Russian Criminal Code that entered into force in January 1997 stipulate similar penalties for export violations. However, it is interesting to note that although cases of export control violations are numerous, no one in Russia has yet been prosecuted and convicted under this legislation.

In the area of control over the export of missile technologies, Russia introduced its first missile control list under Presidential Directive No. 20 of January 11, 1993, even though Moscow did not officially become a full-fledged MTCR member until October 1995. The early establishment of a missile technology control list was in keeping with Russian government policies of 1992-93, which aimed to prove the "civilized" nature of the newly "independent" Russian state as it sought to become a respected member of the international community and of the G-7. Russia's move to join the MTCR was also spurred on by the ill-fated sale of cryogenic booster production facilities to India, which was strongly opposed by the United States. Following a compromise on the sale of the cryogenic technology to India, Russia was finally admitted to the MTCR in August 1995 and participated in its plenary meeting in Bonn in October 1995.

While Moscow bureaucrats may view these newly introduced export control structures and regulations as impressive, Russia is still unable to persuade some Western experts that her national export control system is sufficiently foolproof to prevent illicit exports, especially since Russia has a high level of trade and significant technological potential in critical areas. It is true that business competence, adequate funding, and state-of-the-art management may all be lacking. As a result, the Russian export control system often seems

to be little more effective than other structures recently founded by the ex-Soviet *nomenklatura*. One particular problem in the missile area is that the Russian defense manufacturing sector has many highly skilled experts with negotiating experience gained during the U.S.-Soviet arms control talks. These industry figures are actively lobbying the government for increased exports of missiles and space launcher systems. Among the most visible of these figures is Yuriy Koptev, director of the Russian Space Agency (RSA). Under Koptev's leadership, the RSA has developed from a mere interagency coordination board into a powerful ministry managing the missile-space industry, which owns or controls dozens of major missile and space production facilities and design bureaus and has established itself as the major supplier of missiles to the Russian Ministry of Defense.

Another problem is that missiles have an almost magical appeal to traditional Russian bureaucrats as a symbol of Russian power and technical prowess. Missiles are among Russia's most technically advanced and potentially lucrative export products, especially at a time when the bulk of Russian exports are raw materials, like oil and gas. As a result, it is sometimes difficult for export control officials to track or to stop, if intercepted in time, major deals involving transfer of missile technology. Nevertheless, in the past few years Russian export control authorities have managed to create a climate of restraint as industry officials have become increasingly aware of MTCR-related national export control legislation and have shied away from illegal exports owing to the fear of administrative sanctions. In addition, the Russian export control community can take credit for the fact that no major proscribed item on international control lists has been deliberately sanctioned by the Russian government for export since the imposition of national regulations controlling missile transfers.

RUSSIAN MISSILE EXPORTS AND THE MTCR: THE HUMAN FACTOR

Russian export controls are primarily aimed at other Russian governmental agencies involved in foreign trade in high technology items, including armaments. Russian experience shows that government bureaucrats are seldom proponents of illegal deals. All known cases involving smuggling of nuclear materials or missile technologies have been perpetrated by individual enterprise managers or the owners of private companies. The reckless escapade of Lieutenant General Anatoliy Kuntsevich, a former presidential aide on chemical and biological weapons issues who has been accused of trying to illegally export proscribed chemicals, is the exception that proves the rule.[5]

So who are the most likely potential proliferators of Russian missile technology? A close look at the Russian missile industry can provide some interesting insight into the most probable answers to this question. The Soviet missile complex, part of the military-industrial machine created by Stalin's Politburo after World War II, was designed to offset "the imperialist-launched" arms race specifically by forging a potent "missile shield of the socialist motherland." A group of competing specialized design bureaus, established under the tight control of designer Sergey Korolev, produced the first world's first ICBM and first space launcher in 1957.[6]

All of the giant Russian companies that eventually grew out of these initial efforts in the missile sector are splinters of the former Ministry of General Machine Building or the former Ministry of Defense Industrial Facilities. Most of them are now awaiting privatization and downsizing, which have been hampered by the lack of day-to-day control of these essentially state-owned enterprises by the government. Frequent reorganizations of the government departments responsible for oversight of these enterprises have exacerbated this problem. After the Ministry of Defense Industries was dissolved in March 1997, for example, its powers were transferred to the Ministry of Economics, an agency which lacks the necessary expertise to supervise or promote armaments design and production.

Russian missile-manufacturing facilities employ approximately one million scientists, designers, engineers and technicians, if the personnel of subcontractors and support facilities are included.[7] For analytical purposes, these facilities can be subdivided into three categories or tiers, corresponding to their current status and the potential proliferation risk they pose.

The first tier, the "leaders," are huge consortiums with thousands of employees, enjoying strong ties to the government and established patterns of international cooperation. All of them evolved from the leading Soviet missile design bureaus that had been engaged in military and space-related activities. The second tier, an intermediary layer of "aspirants," consists of facilities large enough to survive and to ob-

tain some new orders from the State, even in the cash-strapped current transition period. However, they do not enjoy the same influence in the corridors of power in Moscow and have fewer international contacts than the "leaders." The third category, which may be termed "pariahs," consists mostly of subcontractors for major missile design bureaus or highly specialized defense facilities. Most are located far away from Moscow or St. Petersburg, and thus they have much less access to the bureaucratic centers of power and almost no international connections.

The evolution of the "leaders" is generally a success story. This group of powerful front-runners includes such well-known Russian space enterprises as the Khrunichev State Research and Production Center, the Rocket Space Corporation Energia (RSC Energia), and Energomash. In the years after the demise of the USSR, they managed to successfully restructure, downsize, and at least partly privatize. Privatization in this sector of the Russian economy, as in the rest of the economy, has actually left much power in the hands of the state bureaucracy. Nevertheless, these giants of the Soviet space sector devised ingenious schemes for retaining at least some portions of their revenues. These schemes allowed them to raise or at least maintain salary levels, although they remain under pressure from high tax rates. Most of these industrial behemoths survive only because they quickly jettisoned military projects for which the Russian Ministry of Defense halted payments, and reoriented their activities toward space programs involving international cooperation. As a result, their position in the international space-launch market is quite solid. Some American experts estimate that the United States would need 10 years and $10 billion to catch up with Russian space propulsion technologies and experience.[8]

The Khrunichev State Research and Production Center is probably the leading Russian space facility, and its director Anatoliy Kisselev, has close ties to Russian President Boris Yeltsin. In the early 1990s, Khrunichev was the first Russian firm in the missile and space sector to create an elaborate framework of collaboration with U.S. companies such as Lockheed and Boeing. In 1995, it established International Launch Services, a joint venture with Lockheed Martin and RSC Energia, to market heavy-lifting *Proton* and Atlas launch services . Used successfully in 230 launches, *Proton* has an outstanding reliability record. On April 8, 1996, *Proton* launched its first Western commercial payload, the "ASTRA-1F" satellite, built by Hughes Space & Communications Company, for Luxembourg-based Societe Europenne des Satellites. This alliance with Khrunichev and RSC Energia has helped Lockheed to increase its market share of commercial payloads, now ambitiously projected to reach 50 percent in the year 2000, and has allowed it to expand into foreign markets. As a result, additional competitive pressure is being placed on the European firm, Arianespace, which currently conducts up to 60 percent of world commercial launches.

This competition will be further intensified by implementation of the bilateral space-launch agreement signed by the United States and Russia in January 1996.[9] This agreement increases the Russian quota of the world launch market to 16 to 20 launches into geostationary orbit through the end of the year 2000. This is an increase from the nine launches permitted under the previous 1993 agreement. Pricing restrictions are relaxed as well, allowing Russian prices to be 15 percent lower than those of Western providers. Partly as a result of this agreement, according to Yuriy Koptev, director of the RSA, Russian space and missile firms earned $700-800 million in 1997 from the sale of space launch services.[10]

Under the direction of the primary contractor Boeing, Khrunichev is also building a Functional Energy Block which is designed to become the first orbiting element of the International "Alpha" Space Station (ISS) and provide its initial propulsion and power. This unit is scheduled to be launched into orbit in June 1998 on a *Proton* booster. Although this project ran into an eight-month delay owing to inadequate government funding for the Russian Space Agency, the money was finally found through international loans, and the work continues. Another Khrunichev-made space launcher, derived from the SS-19 intercontinental ballistic missile, is used for the Eurokot Launch Services joint venture with the Deutsche Aerospace Agency.[11]

Another leading Russian space entity, the RSC Energia, can trace its origins to a research unit founded in 1946 to develop a long-range ballistic missile. RSC Energia designed the first Soviet ICBM, the SS-6 (R-7), and manufactured the Mir space station. U.S.-Russian cooperation in sending American astronauts to this ailing pioneer station provides $100

million in annual revenue to the Russian partner. Energia is a member of Lockheed-Khrunichev-Energia International (LKEI), a joint venture for marketing *Protons* internationally, and has foreign subsidiaries in the United States and Germany. RSC Energia has also joined forces with Boeing, the Ukrainian Yuzhnoye Design Bureau, and the Norwegian firm Kvaerner to found the Sea Launch Partnership devised to launch satellites to geostationary orbit on a modified *Zenit* booster (enhanced with a fourth stage from *Proton*) from a site in the Pacific Ocean. Hughes Space & Communications Co. and Space Systems/Loral have already ordered the first 18 launches planned by this system.

RSC Energia was also one of the first Russian companies to initiate a privatization plan in accordance with the Russian government regulations issued in April 1994. Difficulties that have emerged since then demonstrate the flaws of the existing privatization process in the Russian missile sector. RSC Energia was founded by presidential decree in 1994, and under a government decree issued that same year, 38 percent of its stock was retained by the state, while 25 percent of its stock (in preferred non-voting shares), was given to the "working collective" of the firm, including both workers and managers. According to the same 1994 government decree, after a two-year waiting period, that 25 percent of non-voting stock could be converted into common stock and put on the open market. After 1996, these shares were sold to various private investors, although nearly 20 percent was purchased by another firm controlled by RSC Energia management. The shares, which had originally been valued at 1,000 rubles (about 20 cents at the 1994 exchange rate), sold for as much as $400 each.

In this situation, the Ministry of State Property wanted to reduce the state share in the company to 25.5 percent, which would be sufficient to block any changes in RSC Energia that the government did not approve of. RSC Energia management, however, urged the government to retain its 38 percent share, which it has done. As a result, the board of directors of RSC Energia is appointed by government decree, not elected by the company's shareholders. Given the political influence of RSC Energia management, it is not surprising that of the 11 members of the board, eight are also top management officials at RSC Energia, while the government has only one seat on the board. Management's control of the board allows it to control the company's cash flow. Thus, although RSC Energia showed a profit of 358 billion rubles ($60 million) in 1997, the board decided not to pay out any dividends to shareholders. The Ministry of State Property is currently attempting to change RSC Energia's charter, in order to exercise control over a company in which the state theoretically has a controlling interest but really has little voice in the making of major decisions.[12]

NPO Energomash, another of the "leaders," is Russia's premier developer of liquid-fuel rocket engines. Lockheed Martin agreed in January 1996 to buy 101 Energomash-designed RD-180 kerosene-liquid oxygen engines for $1 billion from Energomash's North American marketer Pratt & Whitney. They are to be used for the advanced Atlas IIAR launcher and for the U.S. Air Force`s next generation space booster. The Russian engine was selected for its reliability and performance ratings as well as for its low cost and short assembly time. Pratt & Whitney plans to will build the engines to be used for American military launches in the United States under license. This contract marks the first use of a Russian-designed propulsion system on a U.S. launch vehicle. Prior to winning this contract, NPO Energomash was facing closure due to the lack of domestic orders.[13] In addition, California-based Aerojet is actively marketing NK-33 and NK-43 engines, made by another "leader," the Samara Central Specialized Design Bureau, which developed the unfinished Soviet lunar N-1 booster. Aerojet is selling these engines to Kelly Space Access LLC and Kistler Aerospace Corporation for a "war-surplus price" of $4 million each.[14]

Even the most successful Russian companies in the missile and space sector experience deep financial crisis from time to time. They continue to depend heavily on government subsidies. The Federal Space Program, adopted in 1993, does not provide adequate funding because of the general crisis of payments in the Russian economy. The partial privatization of these famous facilities has not produced economically viable independent entities that could compete with Lockheed Martin, Boeing, or Arianespace—either in amount of sales, or in management efficiency. This situation is the result of several factors, including the delay of Russian economic reform, ill-devised and corruption-stricken privatization, and the continuous tight control by the government of enterprises viewed as potentially important for military use. A critical problem has been created by con-

siderable decay of the Russian domestic market for space and missile technology. As a result of the continuing economic crisis in Russia, neither the Russian governent nor Russian firms are ordering many missiles or satellite launches. To make the situation worse, the leading Russian private banks seem to be reluctant to invest in the space sector, since it remains under traditionally stringent government control, and does not promise big and quick returns on invested capital. Futhermore, the bulk of the revenues generated by these relatively successful Russian space-oriented facilities is usually appropriated by the government.

More generally, the actual divestiture of state ownership in the Russian defense sector has never really begun. It was blocked by communist and nationalist forces under the pretext of preventing the sale to foreign interests of Russian national defense production capabilities. Many of Russia's major missile manufacturers are included on special lists, signed by President Yeltsin, that forbid their privatization. This reveals the strong intrinsic doubts about private ownership, which are still held by many Russians. They continue to ignore the fact that in the United States all primary defense contractors, such as Lockheed Martin, Raytheon, Boeing, or United Technologies, are privately owned. Even those Russian entities that are allowed to privatize remain under stifling government control. They also lack energetic, well-educated, entrepreneurial, and market-experienced managers with commercial agility and a broad international outlook. Their managers are generally holdovers from the Brezhnev era, who still think in terms of government defense orders (Goszakaz), and lament the by-gone days of Soviet military and space triumphs.

The engagement of thousands of workers in international space cooperation programs helps to provide employment for a vast army of Russian engineers and technicians, although their plight remains unenviable. Salaries remain quite low, while only a very thin layer of top managers receive high compensation packages. It is very difficult to calculate the exact average salary in the Russian aerospace industry. Much depends on an employee's position in his or her company and on the company itself, but it should be noted that wages in space and, especially, military missile enterprises are generally lower than those prevailing in aviation firms.

Practically all "leader" facilities have created small private enterprises. This results in the directors of enterprise being paid from many different contracts in addition to their regular salaries. To be more specific, a head of a department in a space enterprise whose official monthly salary might be in the $350-500 range may net $3,000 to $5,000 in additional compensation. At the same time, rank-and-file engineers, not to mention ordinary workers, make much less. They usually do not receive supplementary lucrative compensation packages and most live on a meager monthly salary of approximately $150-250. However, as major Russian missile-producing factories remain more like work communes than Western-type commercial entities, in the typical Soviet manner their workforce continues to enjoy some social privileges, such as cheaper food in factory canteens or special discounted shops and child care facilities.[15]

It is highly unlikely that the management of the enterprises among the "leaders," which are earning millions of dollars through international space-cooperation projects, would attempt to sell their know-how to potential proliferators (either on the state level or to individual black market purchasers). Nevertheless, there exists the possibility that dissatisfied, inadequately paid personnel from these entities, who have not benefited from the revenues generated by international space projects, could offer their special expertise or stolen blueprints to the agents of a proliferant state or rogue organization.

This possibility is significantly greater for personnel in the "aspirants" tier of enterprises, which have few if any international contracts. Such enterprises as Komplex NTT, which has been trying to market its *Start*-1 and *Start*-2 space launch vehicles, which are derived from the SS-25 mobile ICBM, or the Makeev Design Bureau with its numerous conversion projects based on submarine-launched ballistic missiles, still hope to land major foreign partners or customers, but have little prospect of finding domestic orders.[16] Komplex NTT, however, has managed to obtain orders for launches using *Start* vehicles from Canada and a potential exists for launches from Australia and Alaska.[17]

The Samara Central Specialized Design Bureau teamed with its Russian patron the Russian Space Agency in the STARSEM joint venture with leading French aerospace companies Aerospatiale and Arianespace to offer launch services on the Soyuz-class vehicles pro-

duced by the Samara facility. In another example, the Kosmostras joint stock company established from the remains of the Soviet Ministry of General Machine-Building by Moscow-based Rosobschemash ASKOND and the Ukrainian Yuzhnoye Design Bureau, entered into negotiations with Microsoft subsidiary Teledesic Corporation to offer its *Dnepr* launcher (converted from the Soviet SS-18 heavy ICBM) for up to 80 launches of commercial low-orbit communications satellites providing Internet access. However, while promising, these proposed deals are still only in the planning stages, leaving the "aspirants" in an uncertain financial position.

In stark contrast with the "aspirants" and "leaders," the "pariah" enterprises cannot count on Western money to fend off the collapse of the domestic procurement system. Lacking either foreign partners or domestic orders, these companies are in dire economic straits, which may push them to violate national nonproliferation legislation in search of new markets for their products. Examples of such firms are NPO Trud, located in Samara, which has been accused by the Russian Federal Security Service of trying to sell missile engine parts to Iran under the guise of gas pipeline compressors.[18] Another company which falls into this category is NPO Polyus, which has been accused of selling missile guidance components to Iran.[19] Another firm which could possibly fall into this category is the Mashinostroyeniya Design Bureau, located in Kolomna, near Moscow. This company designed the SS-21, *Tochka*, and *Oka* short-range missiles, but now has no buyers for its SS-X-26 missile, nicknamed "son of SCUD," or its other production. Of these firms, only NPO Trud, which is involved in the development and marketing of turbofan engines, has reasonable prospects of finding customers for its products.

Aside from trying to circumvent Russian export controls and selling their products to countries of proliferation concern, the only real hope for these companies is that a possible change of regime in Russia could lead to a revival of the frenzied militarization of the Soviet era, resulting in raised orders for armaments and in renewal of missile transfers to former client states such as Syria, Libya, Iran, and Iraq. This strategy is actively promoted by some radical nationalists in Moscow.

In 1996, Russia became the third largest exporter of armaments worldwide with sales of $3.5 billion, doubling from $1.7 billion in 1994. Revenues from arms exports constitute up to 75 percent of the total revenues received by the Russian defense industry. The defense industry is sustained on this money, because the domestic procurement budget has dropped to two or three times less than the minimum needed to keep the Russian defense industrial base intact. At the same time, because only a few export producers have access to Western markets, a mere 18 Russian defense enterprises account for fully 80 percent of total export revenue. The remaining defense facilities, including the "pariah" firms in the missile sector, cannot achieve an adequate level of income from exports.[20]

At the moment, then, the highly qualified personnel of "pariah" enterprises, whose capabilities are on a par with the engineers and highly skilled technicians from larger facilities, represent a reservoir of experienced labor and expertise that could theoretically be made available to the missile programs of potential proliferants. The community of Russian specialists in the missile R & D has not avoided the generally deplorable plight of scientists in Russia. Once the most revered part of the Soviet technological elite, on the same level with nuclear designers, missile constructors are now not paid for months, have almost no new orders or contracts, and see no realistic prospects for improvement in the near future unless they are employed by the most successful enterprises. According to some estimates, half of all Russian scientists have lost their jobs since 1991. During the period between 1991 and 1996, RSC Energia laid off 7,000 employees and the Ukrainian Yuzhnoe Design Bureau lost 5,000 people. Recent Russian government efforts to pool resources by organizing so-called financial-industrial groups consisting of major banks and some leading defense enterprises (such as the Makeev Design Bureau or RSC Energia), have produced few results because of diversity of interests among the members of the groups, poor management, and the absence of clear business programs identifying potential clients, resources, goals, and marketable products.

Such miserable conditions make Russian defense engineers easy prey for aggressive head hunters from the countries of proliferation concern. For example, Russian designers are reportedly instrumental in North Korea's missile program. In December 1992, Russian counterintelligence barely prevented 32 Russian scientists from the Makeev Design Bureau (which created Scuds) from leaving to work in North Korea.[21] According to other reports, in 1993,

hundreds of Russian scientists were working at various institutes under the Chinese Academy of Aeronautics, although Russian authorities have denied these allegations.[22] Examples such as the designers from the Makeev Design Bureau who attempted to defect to North Korea, or the efforts of Chinese intelligence agents to obtain drawings of the SS-18 ICBM in Ukraine, indicate that the threats of clandestine transfers is genuine.[23] In addition, the possibility that some of the thousands of impoverished Russian military personnel might steal or divert missiles in their custody, or attempt to use them for blackmail, cannot be totally dismissed. Fortunately, however, not a single case of such diversion from Russian military forces has yet been reported.

The danger that missile-related technology and know-how will leak from Russian firms to potential proliferants is magnified by the feeling of many discontented Russian designers that the present regime has betrayed them. That conclusion makes them sympathetic to various radical political groups in Russia, ranging from the traditional communists to ultra-nationalists. Assisting former Soviet clients to continue resisting the "neo-imperialist" foreign policy of the United States, by giving them access to modern technologies and weaponry for protection against possible American reprisal, comes naturally to these deprived Russian engineers' minds.

To date, however, there is little evidence of a mass exodus of Russian scientists, engineers, and missile designers to countries of proliferation concern. Even if a few Russian scientists end up in Iran or Libya, they are not likely to make a major difference by themselves. The experience of industrialized states indicates that massive transfers of expertise and sustained programs of infrastructure development and investments would be required to develop indigenous long-range missile programs in most Third World states. If access to scientific and technical information was all that was necessary, many more states would have developed indigenous ballistic missile programs because in today's information-saturated world, basic data regarding WMD and missiles is available from many sources.

What is much more crucial to combat missile development is the necessary technical and industrial infrastructure and specialized knowledge about certain critical aspects of missile engineering. For example, nosecone design, insulating thermal coatings, specialized propulsion data relating to rocket clustering and staging, tactical missile defense penetration aids and techniques, advanced guidance systems, and warhead design and fusing methods are all very difficult technologies for aspiring proliferants to master. Hiring Russian specialists who are expert in these areas could shorten a proliferant's time table for developing a long-range ballistic missile, but it would still require substantial technical infrastructure and massive investments to bring the program to fruition.

Another possible outcome for the Russian missile complex might be the initiation of a new arms race to employ the currently idle talents of Russian missile designers. Assuming the current democratic regime remains in power, Russia could start its own active arms build-up—prompted by either an improvement of general economic situation or, conversely, by its deterioration and the perception of vulnerability to emerging international threats. Even today, Russia is actively deploying a the new *Topol*-M ICBM (SS-X-27), a follow-on to the SS-N-20 SLBM called SS-NX-24/26 (D-31), a new SS-X-26/29 *Oka*-type short-range missile, and new types of airborne or antiaircraft missiles. The official state defense order allocations for R & D were approximately $2 billion in 1994 and doubled during each of the following two years, reaching $12.8 billion in 1997, although actual expenditures were probably lower.[24]

Grants recently made to Russian scientists by the American billionaire and philanthropist George Soros or the U.S. Civilian Research and Development Foundation are helpful in ameliorating these miserable economic conditions. However, they are often too miniscule and humiliating for some Russian scientists to accept. In interviews with the author, leading Russian scientists have expressed frustration that such grants often amount to no more than $100/month—less than the income of many Chinese peasants. Therefore, much more comprehensive solutions that could engage Russian missile scientists in long-term proliferation-safe design projects are urgently needed. Nevertheless, despite the dire financial conditions facing contemporary Russian missile designers, most of them do not regard the possibility of defecting to so-called "rogue states" as a real option.

POSSIBLE NEW POLICY AVENUES FOR THE WEST

Although it should be taken seriously, the threat of Russian missile

proliferation is not apocalyptic, and effective means and measures to avoid it in the future do exist. Possible policy options to address this threat include improving export control enforcement and cooperation; strengthening international collaboration through the MTCR; joint development of theater missile defenses (TMD); and enhancing Russian participation in international commercial projects.

Improving Export Control Enforcement and Cooperation

The most direct and logical way to seal Russian borders against illegal transfers of items that are prohibited by the MTCR and relevant Russian domestic regulations is to strengthen Russian national export controls, encourage compliance by Russian high-tech and military research and production facilities, and ensure effective enforcement of these controls when they are violated. Emphasis should be placed on providing more competent personnel to the export control services and equipping them with state-of-the-art technology in order to assure real-time exchange of data and information from Moscow to customs checkpoints. The Federal Service for Currency and Export Control that currently serves as a watchdog for the Interagency Export Control Commission has too little influence and often finds itself between a rock and a hard place in internecine bureaucratic struggles between various Russian agencies. To improve its effectiveness, its status and influence should either be increased, or it should be merged back into a more powerful bureaucratic structure, such as the Ministry of Economics or the Ministry of Finance.

U.S.-Russian cooperation along the lines of the 1994 U.S.-Russian Memorandum of Intent on Cooperation in the Area of Export Control should also be reinvigorated. The U.S. Department of Commerce could also more actively share its experience and technologies (such as specialized computers which are not useful for military purposes) used in enforcement and oversight of U.S. private industry with its Russian counterparts. Some activity in this direction is already underway. After the March 1998 session of the joint U.S.-Russian Commission on Economic and Technical Cooperation (formerly known as the Gore-Chernomyrdin Commission), U.S. Vice President Albert Gore announced that a joint Russian-American working group would monitor the implementation of a January 1998 Russian government decree tightening dual-use export controls.[25]

Intensify Multilateral Collaboration through the MTCR

The United States and Russia, long before Moscow officially joined the regime, discussed steps to improve and clarify the provisions of the MTCR and their implementation. As President Clinton noted in 1993, both countries share responsibility for gradually transforming the MTCR from a suppliers' group into an agreement that is widely adhered to within the international community.[26] Both nations support prudent expansion of MTCR membership to include additional countries that subscribe to international non-proliferation standards, the enforcement of effective export controls, and the abandonment of offensive ballistic missile programs, although Russian officials have doubts about the feasibility of the last objective. A realistic assessment of current regional powers having missile capabilities suggests that they are unlikely to give up their missile capabilities in the near future.

In this context, drastic changes in the current international environment are necessary in order to introduce an international regime which either bans ballistic missiles or globalizes the 1987 Intermediate-Range Nuclear Forces Treaty. Nonetheless, both Russia and the United States should work toward identifying a wide array of possible measures to allay the demand-side concerns that drive missile proliferation. For example, this could be done by building on the Bush administration's initiative to restrict advanced conventional arms sales to the Middle East. New initiatives could be devised for creating missile and advanced weapon-free zones in regions of high conflict potential. While it would be unrealistic to assume that they would immediately be accepted by states in the most conflict-prone regions, such a coordinated initiative by Washington and Moscow could help improve the image of the MTCR and could lay the groundwork for its gradual transformation from a supply-side cartel to a broader international arrangement.

Confidence and security building measures could also be promoted by Russia and the United States in order to reduce mistrust and minimize the risk of miscalculation or accidental launches in conflict-prone areas. To motivate some states not to procure missiles, Russia and the United States could extend broad security

assurances to them. Such mutual assurances were successful in convincing Ukraine to relinquish the Soviet-era nuclear weapons that were based on its territory. If such approaches were emphasized vigorously, they might produce positive results in South Asia, North Asia, and elsewhere. To be successful, however, such bilateral initiatives must take into account Russian prestige and treat Russia as an equal partner with the United States.

Cooperative Development of TMD/BMD

On January 29, 1992, Russian President Boris Yeltsin proposed that the United States and Russia jointly develop a "global defense system" for the world community. This global missile defense system would be based on a reorientation of U.S. research on ballistic missile defense, and would also "make use of high technologies developed in the Russian defense complex."[27] Yeltsin's proposal did not receive any practical response from the U.S. government, however. This proposal provides an opportunity for testing the commitment of both sides to establishing a new relationship that is free of Cold War rivalry and suspicions. The process of creating such a joint defense system should of course be gradual. First, bilateral talks on global strategic stability should be revived**.** The United States should then begin to share data from its early warning systems with Moscow. This step would not only help Russian defense networks compensate for the loss of air defense radar facilities that were based outside Russia in former Soviet republics, but would also enhance U.S. security by reducing the chance of miscalculation by Russian strategic missile forces.

If the potential for an accidental or unauthorized launch from Russia is one of the most important security challenges facing the United States today, discussions about how to allay such concerns, whether real or imaginary, should become a priority issue for both states. In the new security environment, both sides could jointly review the theoretical basis of strategic stability. It might even be possible for both nations to come to agreement that the infamous strategy of "mutual assured destruction" has outlived its usefulness. In the meantime, Russian engineers and designers could cooperate with their U.S. colleagues in the development of advanced theater missile defenses, sharing their joint experience accumulated over many years of research.

Of course, such a process would be neither quick nor smooth. It would obviously have many opponents in both Moscow and Washington. Some in Moscow would criticize it for undermining the ABM Treaty. In Washington, those who believe the United States has a technological edge in missile defense would object to giving Russia access to sensitive defense-related research. However, the alternative to a cooperative process is to continue a situation in which both countries remain locked in a mutual hostage relationship. Continuing this relationship means that a fundamental aspect of the Cold War security environment remains unchanged, despite the end of the Cold War. If, as one U.S. analyst has observed, "parochial interests are propelling missile defense systems forward to production" and "ideological agendas, potentially lucrative contracts, and genuine concern will continue to fuel proposals for at least a limited national missile defense system," then such systems should be developed with Russia, rather than imposed on it.[28]

Increased Russian Participation in Joint Commercial Efforts

Another promising way to stem the potential proliferation of missile technology from Russia would be to further develop U.S.-Russian cooperative projects in space launch vehicle design. This approach could bring tangible commercial benefits to both the U.S. and Russian aerospace sectors. To be most effective, this proposal would involve engaging designers from enterprises that have little or no government access or support in specific goal-oriented commercial projects, which could be kept largely free of bureaucratic meddling and government tutelage. Such projects should be focused on technology development rather than on political and diplomatic rigmarole. While benefiting both Russian and U.S. investors, the projects would also help prevent the spillover of critical technologies or "brain drain" across the borders of the former Soviet Union. Russian scientists and engineers, or perhaps even entire enterprises, might then be invited to participate in selected projects coordinated or managed by U.S. aerospace companies aimed at developing dual-use commercial hardware such as space boosters. The participants in such projects would be selected on the basis of their expertise and experience. If carefully constructed, such an approach could protect U.S. companies' sensitive information while providing flexibility and budgetary

savings.

This process of developing such projects could be staged so that they would initially focus on nonproliferation as the key objective, and later place more emphasis on commercial viability. The ultimate goal would be the creation of profitable joint enterprises in the aerospace sector. For example, in the first phase, the framework of a project would be defined, major participants identified, and a detailed business plan prepared, outlining initial funding and the incremental introduction of self-sustaining commercial operations. During the second phase, the Russian participants could be brought to a joint conference where information would be exchanged on export controls in the U.S. and Russia. This conference would also discuss the status of Russian aerospace entities and address the prospects for real privatization, economic restructuring, and defense industry conversion. At this conference, Russian scientists could interact with their U.S. counterparts, and ideas for practical collaborative projects that avoid government interference could be identified. Although all such projects would ultimately need to be sanctioned by the both the Russian and U.S. governments to avoid disclosure of classified information, the goal would be to develop projects, products, and services that are commercially marketable. This process would allow Russian scientists to bring their experience and the technologies developed in their enterprises to the attention of their U.S. counterparts. It would also help the Russian participants to learn about Western research, production, and marketing techniques. Such a cooperative program would help keep Russian scientific skills intact and reduce the likelihood that Russian scientific expertise might be diverted to the missile programs of potential proliferants.

CONCLUSION

The proliferation of missile technology and hardware from Russia and the NIS could follow one of three potential pathways: government agencies could export items proscribed by international and Russian export control regulations; disgruntled scientists could leave the NIS to work in countries seeking to develop or expand their missile capabilities; and, finally, technology and materials could be illegally exported from the NIS for sale on the international black market. If the Russian government adheres to a course of political and economic reforms, based on the principles of building a market economy, creating a democratic state, and expanding civil society, Russia's future will increasingly be tied to the global economy. Following this strategy of development will help stem WMD or missile proliferation activities. Even today, Russia is competitive in many international export markets for goods other than weapons and related technologies. The prospects for expanding these exports of technology and raw materials will only grow as the Russian economy is further liberalized.

In the short term, however, special attention should be paid to upgrading Russia's national export control system, disseminating information on export regulations throughout industry, and implementing effective enforcement and anti-corruption measures within customs and trade administration agencies. The battle against internal corruption can be won by introducing more effective legislation. An even more important step in this direction would be actually beginning the establishment, with the assistance of the world community, of a truly market-based economy built on genuinely private enterprises, not on a quasi-Soviet "Red directors-robber barons" model.

Over the longer run, the best way to prevent Russian missile scientists from seriously considering selling their expertise to rogue regimes is to actively involve them in cooperative developmental efforts with Western companies in which their work is mutually beneficial. American companies are already deeply involved in technological projects with some Russian entities, such as the Russian Space Agency. Precedents have thus already been set, but much broader and deeper partnership is needed. Such efforts will not only aid Russia in retaining it corps of missile specialists, it will also hasten the introduction and acceptance of private enterprise in the still rigidly conservative Russian defense and high-tech sectors. This possibility clearly offers a win-win outcome for both Russia and the West.

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