U.S. ISRAEL COOPERATION WITH INDIA IN SPACE & MISSILE TECHNOLOGY

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Abstract

US-India bilateral cooperation of civilian space activities, civilian nuclear programs, and high-technology trade and to expand discussions on missile defense is the corner stone of the New Step in Strategic Partnership (NSSP) launched in January 2004. Indian quest for acquiring ICBM capability is spanned over more than four decades and is largely based on space launched technology acquired through the foreign sources. Though the United States has taken different steps over the last several decades to restrict missile proliferation, but in case of India, the sincerity and inconsistent application of nonproliferation policies have always been criticized at all levels. The ongoing US-Israel space cooperation with India indirectly aims at strengthening and improving its ICBM capabilities-a step necessary for transforming India to a global power and tilt the balance of nuclear power in the region.

The landmark agreement reached on July 18, 2005, between President Bush and Indian Prime Minister Manmohan Singh on civilian nuclear energy cooperation also contained an other element i.e. cooperation in the areas of civilian space activities.[1] The deal, besides lifting the U.S. moratorium on nuclear trade with India, also promises to provide U.S. assistance to expand U.S.-Indian cooperation in energy and satellite technology. Critics observe that US provision of civilian nuclear and space technology would facilitate India further in developing nuclear weapons and missiles to deliver them with more precision having

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qualitative and quantitative edge. They argue that in 1974, India became the first and only country in the world to explode an atomic bomb made from materials imported for peaceful nuclear purposes. India made the bomb with plutonium extracted from spent reactor fuel. Canada supplied the reactor and the United States provided the heavy water needed to run the reactor. India had promised to use the reactor and the heavy water for peaceful purposes only; thus it insisted on calling its bomb a peaceful nuclear device. Similarly India has consistently used foreign help to convert its space rockets to nuclear-capable missiles. Imports, some clandestine, some overt, have nourished India's nuclear and rocket efforts from the start.

INDIAN SPACE AND MISSILE PROGRAM: HISTORICAL PERSPECTIVE

India's Space Program

India's space program has passed through two stages of development - a twenty-year initial stage devoted to acquiring basic infrastructure and experimenting with low-capability systems, and a second stage devoted to building and flight-testing higher capability systems. India's space program has passed through two stages of development - a twenty-year initial stage devoted to acquiring basic infrastructure and experimenting with low-capability systems, and a second stage devoted to building and flight-testing higher capability systems. The first stage of India's space program, began in the 1960s, involved the setting up of an administrative framework and the gaining of experience with elementary rocket operations. The second phase of the first stage of India's space program focused to allow Indian scientists to gain experience in the construction and operation of satellites and launch vehicles. The second stage of

India's space program focused on more capable, mission-specific systems. This stage commenced in the mid-1980s, and involved building the PSLV and its successor, the GSLV, which were designed to launch the developed Indian Remote Sensing (IRS) satellite and a meteorology and telecommunications "Indian National Satellite" (INSAT), respectively. With the PSLV commencing operational launches in 1997 after three demonstration tests, and the GSLV project nearing its first flight test, India's space program now stands poised to join the ranks of the world's five advanced space agencies. The Indian space program has a number of launch vehicles, which were developed as both a scientific necessity for a large nation, and acquiring reliable means of delivery of their nuclear pay loads to target sites. Brief overview of Indian Space Program vehicles is presented below to set the stage for understanding the future implication:

- SLV: The SLV satellite launch vehicle was developed between the start of the sounding rocket program in India (1960s) and the first launch, which took place in 1979. This launch vehicle was based on the American 'Scout' launcher.

- ASLV: The ASLV augmented satellite launch vehicle was a succession of the SLV, developed alongside the PSLV. The aim of ASLV was to examine the performance of strap-on boosters such as more advanced navigation, etc. It was basically an SLV with two SLV main stages strapped on as boosters similar to early two-stage V2 rocket variants produced by America and Russia. Though the first attempts at launching this rocket failed in the late 80s and early 90s.

- PSLV: The PSLV polar satellite launch vehicle, like the ASLV, which had been developed right after satellite launch capabilities proven by the SLV, and so the PSLV was envisioned as a true large launch vehicle that could lift substantial satellites into orbit where before, the SLV and ASLV were mainly for low earth orbit testing. The French Viking engine was used in it. The first launch occurred in 1993; it can lift as much as 3250kg and has successfully launched a lot of Indian communication and remote sensing satellites.

- GSLV-I/II: The GSLV Geosynchronous launch vehicle was envisioned as a modern powerful launch vehicle for geostationary satellites of about 2500kg. It was first launched in 2001. America has imposed sanctions on India and so a deal that would have transferred a Russian cryogenic engine technology to India was halted.

- GSLV-III/IV: The GSLV-III, and its variant the GSLV-IV which would have two extra large boosters, will carry any payload between 4000kg to 20000kg. The maiden flight for this vehicle is expected to be around late 2007.

- RLV: India has also engaged in developing a cheap scramjet-based reusable launch vehicle. Although it is still mainly conceptual, the theory is that even a small scramjet-based launch vehicle that would be too small for human flight, could still remotely put satellites in orbit for something like 1/20 the cost of existing small satellite launch systems.

India's Missile Program

India's missile programs can be divided into five phases. The first phase (1958 to 1970), remained focused on building an anti-tank missile (ATGM) and developing a three-ton thrust, liquid-fueled rocket engine most likely based on the Soviet SA-2 sustainer motor. Both projects resulted in the failure and were terminated ultimately.[2] The second phase spanning the decade of the 1970s consisted of two significant projects; Devil and Valiant. The Devil was to "reverse-engineer" the Soviet SA-2 surface-to-air missile (SAM) and the Valiant, was aimed at developing a 1500km-range ballistic missile. The Valiant was terminated without attaining any success, whereas the Project Devil got a partial success and succeeded in developing two solid-fuel boosters and a three-ton, liquid-sustainer engine for the missile.[3] The successful development of the Prithvi-1 (150 km) and successful flight-tests of Agni missile (1400 km) are the achievements of the 3rd phase of the program. The Agni provided a way to development of longer-range ballistic missile systems--systems that would provide India with a nuclear strike capability against China in the future.[4]

The fourth phase (1995-2000) succeeded in developing shorter- and longer-range versions of the Agni (Agni-1 and Agni-III), a supersonic cruise missile (BrahMos) with Russian collaboration, and a naval variant of the Prithvi (Dhanush). In addition, India has sought U.S., Russian and Israeli collaboration in the development of an anti-tactical ballistic missile (ATBM) system.[5] The fifth phase stretching from 2001 aims to improve the "hit to kill" performance of the ballistic missiles already developed and the use of newer and lighter materials in the construction of the missile systems.[6]

A brief introduction of the Indian Missiles developed so for is given below:

- PRITHVI: A Pakistan-specific missile system, reportedly been configured for nuclear delivery can use variety of conventional warheads as well. To improve accuracy the missile is reportedly being equipped with global positioning systems (GPS).

- AGNI: A two-stage (solid-motor/liquid-engine) Agni is a medium- and intermediate-range ballistic missile system capable of carrying all types of pay loads.

- BRAHMOS: Project of reversed engineering from the Russian anti-ship missile ‘Yakhont’. The Brahmos is a dual-mode cruise missile, with its primary mode as an anti-ship missile, with a backup capability to attack shore-based, radio-contrast targets. The Air Force version of the BrahMos will have reduced length and weight, employ a new booster and a cap nose. It will reportedly be deployed on board the SU-30MK1 that the IAF is acquiring from Russia.[7]

- SAGARIKA: A submarine-launched missile with engineering assistance from Russian scientists[8] is generally described as a cruise missile program.[9] The range, propulsion, payload, and other technical parameters of this missile remain unknown, except that it will probably arm India's nuclear submarine, the Advanced Technology Vessel (ATV).[10]The missile is not expected to become operational before 2010.

- SURYA: The Surya, India's first likely ICBM is an intercontinental-range, surface-based, solid- and liquid-propellant ballistic missile, still in development stage. The missile is based on the civil space launch technologies of the PSLV/GSLV programs, which will extend India's nuclear deterrent to targets deep into Europe and America. The Surya-1 is expected to reach of 8,000 km using three stages and Surya-2 is planned to range 12,000 km.[11]

Connectivity of Space and Missile Programs:

The history of missile development in India illustrates the close connection between space launch and missile technology. The lesson from the history of Indian rocketry are that space launch vehicle technology developed under the guise of peaceful scientific development has been the basis for the Indian ICBM, and that India obtained the technology with foreign help.[12] Thus, India's biggest nuclear-capable missile is an international product. Under the mantle of peaceful space cooperation, the United States, France and Germany all helped create the most advanced nuclear missile in South Asia. The unfolding of the development and interconnectivity of the Indian space and missile program is presented below in brief chronological snap shots:

In 1963, NASA began the Indian rocket program. NASA launched a U.S. sounding rocket from India's first test range, which the United States helped design. US also trained the first groups of Indian rocket scientists by inviting them to NASA's Wallops Island test site located southeast of Washington, DC in Virginia.[13] A.P.J. Abdul Kalam, head of the Indian Space Research Organization (ISRO), in charge of developing space launch vehicles in 1963-64 worked at Wallops Island where the Scout space launch vehicle (an adaptation of Minuteman ICBM solid-fuel rocket technology) is flown.[14]1969-70: U.S. firms supply equipment for the Solid Propellant Space Booster Plant at Sriharokota[15] and in 1974 India tests a "peaceful nuclear explosion".

In 1980, ISRO decided to acquire the Viking liquid-engine technology from France[16] and Ved Prakash Sandlas replaces A.P.J. Abdul Kalam as project director of the satellite launch vehicle (SLV) program[17] and latterly Kalam appointed director of the Defense Research & Development Laboratory (DRDL) in Hyderabad, which was involved in developing indigenous missile systems.[18] In July 1980, Rohini satellite SLV-3 is experimentally launched in the orbit. Prime Minister Indira Gandhi informs parliament "the four-stage, all-solid propellant vehicle has been developed in India by Indian scientists and engineers[19]and ISRO Chairman Prof. Dhawan claimed that India has become capable of developing intermediate-range ballistic missiles (IRBMs) as, "any country which can place a satellite in orbit can develop an IRBM."[20]

In 1981, ISRO with the collaboration of Federal German Aerospace Research Establishment (DFVLR) conduct a joint test-flight of an Indian sounding rocket carrying Indian and West German payloads. The rocket carried an interferometer and a radio receiver with a short wave band developed by ISRO and an onboard computer, camera, and other devices provided by the DFVLR.[21] In May 1984, the United States and India sign a memorandum of understanding on high-technology transfers to India. However, United States insisted that India should prevent technology leakages to the Soviet Union and East European countries and assure that the technology will not be used for making nuclear weapons.[22] Finally, the Reagan administration agrees to sell advanced military technology and weaponry and high-technology transfers to India.[23]

On seeing the intensive testing and development of missile programme of India United States and its G-7 allies present almost identical demarches to India's foreign ministry urging India to suspend the Agni program[24] because they believed that ballistic missile programs in areas where they are chronic regional tensions undermine rather than enhance regional security.[25] Instead, Prime Minister Narasimha Rao secretly authorizes the ISRO to design new solid-fuel dotor to replace the Agni's liquid-fuel second-stage.[26]

In May 1993, the *Hindustan Times* reveals that the Prithvi has been inducted into the Army's 11th Corps and deployed at a forward ammunition depot in Punjab, from where key Pakistani towns and military installations along the Punjab border will be within the reach of the missile system.[27]

Encompassing the emergence of likely missiles race in the region, the United States calls the Agni a "destabilizing weapon" and mounts intense diplomatic pressure on India to suspend further Agni tests.[28] Indian officials dismiss US concerns that India is building ballistic missiles to deliver nuclear warheads.[29] Instead, India embarks to develop an anti-missile system in the wake of Pakistan's acquisition of ballistic missiles[30] and developing a 12,000km-range intercontinental ballistic missile (ICBM) named Surya.[31]

In June 1996 Dr. Abdul Kalam makes a secret visit to Israel and expresses an interest in purchasing missile launchers for India's Prithvi and Agni surface-to-surface missile programs. Reportedly, Kalam also studies Israel's Arrow antimissile program.[32]
In February 1997, an Indian defense team led by Defense Secretary

Taposh Banerji visits Israel to explore the prospects of defense cooperation.[33] Banerji initials an agreement for the purchase of 12 Searcher unmanned aerial vehicles (UAVs) for the Indian Army. The Searcher is manufactured by the Israel Aircraft Industries. Each aircraft costs $1.5 million and the entire deal is estimated at $18 million. During his meeting with Israeli officials and industrialists, Banerji explores the possibility of purchasing missiles and missile-related technologies from Israel. In the past, India has expressed interest in purchasing the Arrow anti-missile system and related-technologies from Israel. Several Israeli firms offer to sell India command, control, and communication systems, and global positioning system (GPS) satellite navigation equipment. India signs an agreement to purchase the Barak point air defense system designed to defeat anti-ship missiles from Israel.[34]

India conducts five underground nuclear tests at Pokhran, ranging in yield from less than 1 kiloton to about 45 kilotons. Defense Minister George Fernandes reportedly says that India will "inevitably" arm itself with nuclear warheads. The United States proceeds to implement sanctions, in place by November 1998, on a large number of research, development, and production entities relating to space and missile technology. After exploding nuclear weapons, Indian government tasks DRDO to integrate a number of high-end Russian anti-aircraft/anti-ballistic missile systems such as the S-300V and S-300P with Israeli fire-control radar and battle management systems to create a limited anti-ballistic missile system. The proposed Indian anti-ballistic missile system will be designed to intercept Pakistani M-11 type missiles; but it will not have the capability to intercept longer-range missiles such as the Ghauri, which have a peak velocity of 4km/second.[35] India and Russia signed a new 10-year defense cooperation accord on 21 December 1998 and pledged to assist India in the development of the Sagarika missile; armed with nuclear warheads.[36]

India in 1999 launches the Agni II missile with the PSLV programme to create an ICBM"[37] During the same year Kalam desired to "neutralize" the "stranglehold" some nations have over the MTCR, which had tried but failed to "throttle" India's missile program. [38]"I would like to devalue missiles by selling the technology to many nations and break their stranglehold."[39]

On September 22, 2001 U.S. lifted many of the technology sanctions imposed in 1998 and in June 2002 Central Intelligence Agency (CIA) in its Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions states that India "still lacks engineering or production expertise in some key missile technologies."[40] The report adds that during 2001 Russia and Western Europe remained the main sources of missile-related and dual-use technology to fill these gaps. In July 2002 Jane's Defense Weekly, claimed that India has acquired two Green Pine radar systems from Israel, but say they have had little success in developing a missile defense capability against a possible Pakistani attack.[41] The radar system, which is mainly used on an airborne platform as an early warning and control system, will be utilized for "advanced research purposes."[42]

In December 2002 CIA stated to Congress that India was among the countries supplying assistance to Libya's ballistic missile program.[43] However, US official objected and said that Israeli sale of Arrow anti-missile systems to India could violate the Missile Technology Control Regime (MTCR). Citing the US-Israeli developed Arrow system as a category one missile; he says that Israel "probably can't do it." Israel is

India's second largest arms supplier after Russia.[44] The United States has neither denied nor approved the sale. The Arrow anti-missile system is jointly developed by Israel and the United States. The sale of the Arrow anti-missile system requires the approval of the United States. The White House and the Pentagon are believed to support the sale whereas the Department of State and the non-proliferation lobby in Washington DC oppose the sale.[45] Pakistan has also expressed its concerns over the possible sale of the anti-missile system to India.

In February 2003 source from India's Ministry of Foreign Affairs stated that India has agreed to invest approximately $150 million in Israel's Arrow-2 anti-missile system. The proposed investment must still be approved by the United States. Aerospace Daily claims that Israel has emerged as the second-largest supplier of weapons and equipment to India.[46] In March same year, The Times of India reported that British Prime Minister Tony Blair's dossier on Iraq alleged that India's NEC Engineers Private Limited had "extensive links in Iraq," including Iraq's Al-Mamoun missile production plant, and had illicitly supplied ammonium per chlorate to Iraq.[47] In July 2003, The Washington Post reported that a coalition of pro-India and pro-Israel lobbyists, including the U.S.-India Political Action Committee (USINPAC), America Israel Political Action Committee (AIPAC), and American Jewish Committee (AJC), have joined forces to gain U.S. approval for the sale of Israel's Arrow ballistic missile defense system to India.[48]

India and Israel negotiate on developing closer relationships in defense production especially in the areas of missiles, surveillance, and anti-terrorism warfare technology. Israel’s High level delegation led by Major General Amos Yaron had met senior level talks with Indian defense officials. The talks focused on several Indo-Israeli projects including the Phalcon Airborne Radar, missile development, radar avionics, and anti-terrorism warfare equipment. Defense sources also indicate that cooperation in the area of missiles only included missiles that do not fall under the purview of the Missile Technology Control Regime (MTCR).[49]

In January 2004 President Bush agreed to expand cooperation with India under the initiative "Next Steps in Strategic Partnership".[50] On July 18, 2005 President Bush agreed to cooperate with India on satellite navigation and launch, to expand cooperation in civilian nuclear programs, civilian space programs, and high-technology trade, including expanded dialogue on missile defense.[51] This agreement initiated three major steps: removal of ISRO from the Department of Commerce Entity List, removal of export license requirements for items subject to Export Administration Regulations EAR99, and establishment of a presumption of approval for all items not controlled for nuclear proliferation reasons.

December 2004: India and Russia sign 10 agreements on space, defense, and aviation, including an agreement to jointly cooperate on satellite manufacture and launch under the Russian Global Navigation Satellite System (GLONASS). Russia's Federal Space Agency head, Anatoly Perminov, states that India's military use of the GLONASS system, which could help improve the accuracy of Indian missiles, has not been ruled out.[52]

In June 2005: As part of the "New Framework for the U.S.-India Defense Relationship," signed by U.S. Defense Secretary Donald Rumsfeld and Indian Defense Minister Pranab Mukherjee, the United States has offered India a briefing on the Patriot PAC-3 missile system, as well as increased opportunities for technology transfer, collaboration, co-production, and research and development with the understanding that

U.S. technology-related sanctions on India will be lifted.[53] India is reportedly working on integrating its Rajendra phased array radar with the Green Pine radar developed by the Israeli firm Elta and used by Israel's Arrow missile defense system. Both the Indian Air Force and the DRDO are reportedly involved in the project. In July 2005, the joint venture between Russia's Mashinostroenie Scientific Industrial Association and India's DRDO has begun mass production of the BrahMos cruise missile. [54] The U.S.-India bilateral agreement (lunar exploration) permitting India to launch third-country satellites containing U.S. components or technology stands out as a potential breakthrough in high-technology collaboration between the two countries.[55] In November 2005, the U.S. Department of State signed two Technical Assistance Agreements (TAAs) - the relevant U.S. export licensing documents authorizing two U.S. scientific instruments to be carried as payloads on the Indian Chandrayaan-I Lunar Mission. The two U.S. instruments are the M3 (Moon Mineralogy Mapper) and the Mini SAR (Miniature Synthetic Aperture Radar).

Analysis of The Foreign Collaboration

The deal rewarded the bad behavior of India, which was already in race for preparing the ICBM.[56] Indian missiles Agni and Surya have space launch vehicle dimensions of ICBM[57] specifications[58] and the Surya has the option of a nuclear payload with multiple nuclear warheads. It is three-stage missile with the first two stages derived from PSLV's (Polar Space Launch Vehicle) solid-fuel rockets technology, which was obtained from the U.S. in the 1960s.[59] Reportedly the Surya program, like the Agni program, will have missiles with various ranges. Surya-1 will have a range of about 5,000 kilometers, Surya-2 from 8,000 to

12,000 kilometers and Surya-3 up to 20,000 kilometers. However, a missile of "ICBM" range is not needed to India for Pakistan. The 5,000 kilometers missile range seems to be more rational and appropriate for military operations against distant targets in China, Japan, and Australia. However, with further quality enhancement it may be used against America or Europe as the distance from New Delhi to London is 6,800 kilometers, to Madrid 7,400 kilometers, and Washington, D.C., 12,000 kilometers[60] and such intentions were declared by the officials of India's Defense Research and Development Organization (DRDO), "Surya's targets will be Europe and the US".[61] Brahma Chellaney also confirms these views when he mentions two reasons for acquiring such an ICBM: firstly; to project India as a global power and to enable her to deal with "high-tech aggression" of the type demonstrated in the wars with Iraq.[62]

The *Wisconsin Project on Nuclear Arms Control's* "Risk Report"[63] alleges that, "...India has consistently used foreign help to convert its space rockets to nuclear-capable missiles. Imports, some clandestine, some overt, have nourished India's nuclear and rocket efforts from the start. India built the medium-range Agni missile by taking a first-stage rocket from a small space launcher and combining it with guidance technology developed by the German space agency...one of India's ablest students was A.P.J. Abdul Kalam. While training in the United States, he visited the space centers where the US Scout rocket was conceived and was being flown. Kalam returned home to build India's first space rocket, the Satellite Launch Vehicle—SLV-3—a carbon copy of the Scout. NASA made Kalam's task easier by supplying unclassified technical reports on the Scout's design. But aid from America...was soon dwarfed by aid from Germany. In the late 1970s and throughout the 1980s, Germany helped India with three indispensable missile technologies: guidance, rocket-testing, and composite materials. Earmarked for the space program, all were equally useful for building missiles. In 1978, Germany installed an interfero-meter on an Indian rocket to measure, from the ground, a rocket's angle of flight. Four years later, India tested its own version. From 1982 to1989, Germany helped India build a navigation system for satellites based on a Motorola microprocessor. During the same period, and following the same steps, India developed its own navigation system for missiles and rockets based on the same microprocessor. Germany also...helped India build its own rocket test facility; and it trained Indians in glass and carbon fiber composites at Stuttgart and Braunschweig. These lightweight, heat-resistant fibers are ideal for missile nozzles and nose cones. To help India use the fibers, Germany provided the documentation for a precision filament winding machine...an item...now controlled for export by other countries, including the United States.... In 1993,a Massachusetts company was charged with violating US export laws by selling India components for a hot-isostatic press. The press, which India obtained through the company's Scottish subsidiary, can be used to shape advanced composites for missile nose cones... But India still needs crucial help. A recent Pentagon study cites composites, electronics, computers, sensors and navigation equipment as some of the technologies in which India is still weak.

Findings & Comments

Foregoing historic perspective of Indian missiles & space technology development in view, one can conclude that it was not an indigenous effort, rather an outcome of a number of helpers. India did not build its missiles alone. The world's leading rocket producers gave essential help in research, development and manufacture. Few of the outsiders and their help is mentioned as follow:[64]

- **France**

  Licensed production of sounding rockets in India

  Supplied the liquid-fuel Viking rocket engine, now the "Vikas" engine of the Polar Satellite Launch Vehicle (PSLV) second stage

  Tested Indian-produced Vikas engine in France

- **Germany**

  Delivered measurement and calibration equipment to ISRO (Indian Space Research Organization) laboratories

  Trained Indians in high-altitude tests of rocket motors and in glass and carbon fiber composites for rocket engine housings, nozzles and nose cones

  Designed high-altitude rocket test facilities

  Conducted wind tunnel tests for Satellite Launch Vehicle - SLV-3 rocket

  Developed radio frequency interferometer for rocket guidance

  Developed computers for rocket payload guidance based on U.S. microprocessor

  Supplied documentation for a filament-winding machine to make rocket engine nozzles and housings

  Helped build Vikas rocket engine test facilities

  Designed hypersonic wind tunnel and heat transfer facilities

  Supplied rocket motor segment rings for PSLV

- **Russia**

  Supplied surface-to-air missiles which became the models for the

Prithvi missile and the second stage of the Agni medium-range missile
Sold seven cryogenic rocket engines

- **United Kingdom**
  Supplied components for Imarat Research Center, home to the Agni missile
  Supplied magnetrons for radar guidance and detonation systems to Defense Research and Development Laboratory

- **United States**
  Launched U.S.-built rockets from Thumba test range
  Trained Dr. Abdul Kalam, designer of the Agni
  Introduced India to the Scout rocket, the model for the Satellite Launch Vehicle - SLV-3 rocket and the Agni first stage
  Sent technical reports on the Scout rocket to Homi Bhabha, the head of the Indian Atomic Energy Commission
  Sold equipment that can simulate vibrations on a warhead

- **Dual Use Technology**: Although the Indian government maintains that its space program is for purely peaceful purposes, history testifies that the rockets could be used for military purposes. All satellite launch vehicles (SLVs) have the potential to be missiles. Indian Space Research Organization (ISRO) chairman Professor S. Dhawan insists, "The government of India's policy is that its space program is a peaceful effort...but the rocket is like a knife in the kitchen. It could be a murder weapon or a thing to cut vegetables. The rocket doesn't know the difference. It's the hand that uses it." Dhawan reiterates that ISRO is not working on a missile program. He says, "we can get a payload into orbit. To bring down a payload from orbit to a specified point on the ground, which is a military target, requires another form of technology, which I hasten to add can be developed by the space engineers."[65]

It is true that India has already developed nuclear weapons and long-range missiles. But India has a long way to go to improve their performance, and it has a history of using nuclear and space launch assistance to do just that. Some areas in which India can still improve its missiles are:

- ***Accuracy***. For a ballistic missile, accuracy deteriorates with range. India's ICBM could make use of better guidance technology, and it might obtain such technology with high-tech cooperation with the U.S.
- ***Weight.*** Unnecessary weight in a missile reduces payload and range. Or it forces the development of gigantic missiles such as India's PSLV-derived ICBM. India is striving to obtain better materials and master their use to reduce unnecessary missile weight.[66]
- ***Reliability***. India's space launch vehicles and medium range missiles have suffered their share of flight failures. Engineering assistance in space launches could improve India's missile reliability as was demonstrated with unapproved technology transfers incident to launches of U.S. satellites by China.[67]
- ***Multiple warheads.*** India's reported interest in missile payloads with multiple nuclear warheads means that certain elements of satellite technology may get diverted to military use. Deliberate or inadvertent transfers of technology

associated with dispensing and orienting satellites could, as in the Chinese case, make it easier to develop multiple reentry vehicles.

- ***Counter Responses against missile defenses.*** Assistance to India in certain types of satellite technology, such as the automated deployment of structures in space, could aid the development of penetration aids for India's long-range missiles. Given that the U.S. is the obvious target for an Indian ICBM, such countermeasures could stress U.S. missile defenses. Similarly, Pakistan the only victim of Indian aggression so far, must feel threatened and acquire the matching response at all cost.

In seeking to become a global power by acquiring a first-strike weapon of mass destruction the Indian government is succumbing to its most immature and irresponsible instincts. The U.S. government, by offering India the "Trinity" of cooperation, is flirting with counterproductive activities that could lead to more proliferation.

The story of India's ICBM illustrates short-sightedness on the parts of both India and the United States. If India completes the development of an ICBM, the following consequences can be expected:

- An incentive to preempt against India in times of crisis (especially if the ICBM is of PSLV dimensions and, consequently, is easily targeted),
- A diversion of India's military funds away from applications that would more readily complement "strategic partnership" with the U.S.,
- Increased tensions and dangers with Pakistan and China

- Confusion and anger on the part of India's friends in Europe and the United States,
- A backlash against India that will hinder further cooperation in a number of areas,
- A goad to other potential missile proliferators and their potential suppliers to become more unrestrained

It may be true that there is considerable value for US to strategic cooperation with India but, nuclear and space launch cooperation are not the only kinds of assistance that India can use. It has a greater use for conventional military assistance, development aid, and access to economic markets. Moreover, nonproliferation has a strategic value at least as great as that of an Indian partnership. A little proliferation goes a long way. It encourages other nations (such as Pakistan, Brazil, Japan, South Korea, and Taiwan) to consider similar programs. And the example of U.S. cooperation encourages other suppliers to relax their restraint.

History raises questions whether such friendship would continue through an adverse change in India's ruling party or through a conflict with Pakistan. And India's interest in an ICBM, which only makes sense as a weapon against the U.S., raises questions whether the friendship is mutual. Moreover, nonproliferation policy is often directed against programs in friendly nations. Argentina, Brazil, Israel, Pakistan, South Africa, South, Korea, Taiwan, and Ukraine are all friendly nations for which the U.S. has attempted to hinder WMD and missile programs without undermining broader relations. An exception for India is certain to be followed by more strident demands for exceptions elsewhere. Is the space-launch component of "friendship" worth a world filled with nations with nuclear-armed missiles?

Review carefully any cooperation with India's satellite programs. India is reportedly developing multiple nuclear warheads for its long-range missiles. The acquired Satellite technologies can help India in developing ICBM, to develop countermeasures to penetrate U.S. missile defenses and develop anti ballistics missile system to be used against Pakistan, China and even USA. Therefore, U.S. should review its satellite cooperation to ensure that it does not possess any one of the above capabilities. Owing to its poverty level and poor state of social infrastructure India needs many other forms of economic and social cooperation more than it needs nuclear and space technology. The display of friendship through technology cooperation should be limited to areas that do not contribute to nuclear weapons or their means of delivery rather directed on the welfare of populace, fighting to the menace of poverty, control over HIV AIDs and peace and stability in the region.

After seeing India's interest in an ICBM over decades and US intelligence reports on India's ICBM capability there should be no illusions that India's ICBM will be derived from its space launch vehicle technology. It is not possible to believe that India will keep its civilian space launch program from its long-range missiles / military program. There should be no illusions about the target of the ICBM. It is for the far of targets like the United States and Europe to protect India from the theoretical possibility of "high-tech aggression". It would be a cruel irony if, in the hope of becoming strategic partners, US and India become each other's strategic targets.

Do not assist India's space launch programs. Since, there is no meaningful distinction between India's civilian and military rocket programs, the U.S. should explicitly or de facto place ISRO back on the "entities" list of destinations that require export licenses.[68] The U.S. should not cooperate either with India's space launches or with satellites that India will launch. India hopes that satellite launches will earn revenues that will accelerate its space program including rocket development. U.S. payloads for Indian launches such as the envisioned cooperative lunar project risk technology transfer and invite other nations to be less restrained in their use of Indian launches. The U.S. should resume discouraging other nations from using Indian launches, while encouraging India to resume the practice of launching satellites on other nations' space launch vehicles.

Conclusion

The path to India's ICBM capability is spanned over more than four decades and is largely based on space-launch vehicle technology obtained from foreign sources. Though the United States has taken measures over the last several decades to restrict missile proliferation, but the policies took effect only after India's missile program had begun. Moreover, U.S. nonproliferation policy has also not been consistently applied, particularly in India's case. Indeed, the relationship between space launch vehicles and missile proliferation seems to have been obscured.

End Notes

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