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# Missile Development

# Paper-3

## Foundation PT CUM MAINS WORK-SHEET

Part - 14

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## India successfully conducted night trial of Agni-I ballistic missile

**Theme: Agni-I Ballistic Missile (The Hindu) (Economic times, Indian express, The Wire ETC)**

**Helpful:** PT & Mains (S&T)

**In news:**

- India has successfully carried out night user trial of agni-I short-range nuclear-capable ballistic missile.
- The test flight was conducted by Indian Army's Strategic Forces Command off Abdul Kalam Island, formerly known as wheeler Island, in Bay of Bengal, off the coast of the Indian state of Odisha
- The test was second Known trial of agni-I since its first such successful test in April 2014.

**Agni-I Missile:**

- Short range nuclear capable surface-to-surface ballistic missile.
- It is first missile of the agni series launched in 1983.
- It was developed by premier missile development laboratory of DRDO in collaboration with Defence Research Development Laboratory and Research Centre Imarat and integrated by Bharat Dynamics Limited, Hyderabad.
- It weighs 12 tonnes and is 15-metre-long.
- It is designed to carry payload of more than one tonne (both conventional and nuclear warhead).
- It is single stage missile powered by solid propellents.
- It can hit a target 700 km away.
- its strike range can be extended by reducing the payload.
- It can be fired from road and rail

mobile launchers.

- It is equipped with sophisticated navigation system which ensures it reaches the target with a high degree of accuracy and precision.
- The missile already has been inducted into armed forces. since its induction it has proved its excellent performance in terms of range, accuracy and lethality.
- It is also claimed to be a part of India's minimum credible deterrence under No first to use policy.

## FORMIDABLE ARSENAL


The Integrated Guided Missile Development Programme, now known better by its abbreviation IGMDP, is perhaps the first programme in India

which brought together a large number of R&D laboratories, government departments, industries and academic institutions in the country within an integrated structure involving all the groups in a functional network. The Programme was visionary and ambitious, aiming at the same time, deliveries to the Services as the end goal in a reasonable time frame.

The Integrated Guided Missile Development Programme (IGMDP) was an Indian Ministry of Defence programme for the research and development of the comprehensive range of missiles. The programme was managed by the Defence Research and Development Organisation (DRDO) and Ordnance Factories Board in partnership with other Indian government political organisations. The project started in 1982–83 with popular political support from the successive governments and bestowed under the leadership of Abdul Kalam who oversaw its ending in 2008 after these strategic missiles were successfully developed.

On 8 January 2008, the DRDO formally announced the successful completion of the IGMDP. It added that the strategic integrated guided missile programme was completed with its design objectives achieved since most of the missiles in the programme had been developed and inducted by the Indian armed forces.

By the start of the 1980s, the DRDL had developed competence and expertise in the fields of propulsion, navigation and manufacture of aerospace materials based on the Soviet rocketry technologies. *Thus, India's political leadership, which included Prime Minister Indira Gandhi, Defence Minister R. Venkataraman, V.S. Arunachalam (Political Advisor to the Defence Minister),* decided that all these technologies should be consolidated.

This led to the birth of the Integrated Guided Missile Development Programme with Dr. Abdul Kalam, who had previously been the project director for the SLV-3 programme at ISRO, was inducted as the DRDL Director in 1983 to conceive and lead it. While the scientists proposed the development of each missile consecutively, the Defence Minister R. Venkataraman asked them to reconsider and develop all the missiles simultaneously. Thus, four projects, to be pursued concurrently, were born under the IGMDP:

Short range surface-to-surface missile (code-named Prithvi)

Short range low-level surface-to-air missile (code-named Trishul)

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Medium range surface-to-air missile (code-named Akash) and
Third-generation anti-tank missile (code-named Nag).
The Agni missile was initially conceived in the IGMDP as a technology demonstrator project in the form of a re-entry vehicle, and was later upgraded to a ballistic missile with different ranges. As part of this program, the Interim Test Range at Balasore in Orissa was also developed for missile testing.

**TIME-LINE**

**1. Prithvi I**

Prithvi I was one of the first missiles developed under Government of India's IGMDP. Launched in February 1988, Prithvi I is a single-stage, liquid-fuelled missile. A surface-to-surface missile, it has a range of 150 km and a mounting capability of 1000 kg. It was inducted into the Indian Army in 1994.

**2. Agni I**

A nuclear-capable ballistic missile, Agni 1 is the first of the five-missile Agni series launched in 1983 by the Defence Research and Development Organisation. It has a range of 700 km.

**3. Akash**

Akash is a surface-to-air missile with an intercept range of 30 km. It has multi-target engagement capability and is in operational service with the Indian Army and the Indian Air Force.

**4. Nag**

Nag is a third-generation hit-to-kill anti-tank missile that was first tested in 1990. The two-stage solid propellant weapon uses the lock-on before launch system where the target is identified and designated before the weapon is launched.

**5. Trishul**

Trishul is a short-range surface-to-air missile equipped with electronic measures against all known aircraft jammers. It has a range of 9 km and is used as anti-sea skimmer from ships against low-flying attacks.

**6. Agni II**

An intermediate-range ballistic missile, the Agni-II was first test fired on April 11, 1999. The surface-to-surface missile has a range of 2000 to 2500 km and can carry conventional or nuclear warheads.

**7. Prithvi III**

Prithvi III is the naval-version missile with a range of 350 km. A two-stage surface-to-surface missile, Prithvi III was first tested in 2000.

**8. Brahmos**

BrahMos is a supersonic cruise missile that is first test-fired on June 12, 2001. It was developed as a joint venture between India and Russia and is the world's fastest anti-ship cruise missile in operation.

**9. Prithvi Air Defence (PAD)**

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India's ballistic missile defence got a fillip with the development of PAD, which has been given the moniker Pradyumna. The system was tested with a maximum interception altitude of 80 km, and has been designed to neutralise missiles within a range of 300-2000 km up to a speed of Mach 5.0. The technology employed in the PAD was the precursor to the indigenously developed Advanced Air Defence (AAD) interceptor missile which was tested in 2007, as well as the Barak-2 which was developed in collaboration with Israel.

**10. K-15 Sagarika**

The successful test of the Sagarika marks an inflection point in India's military history. It forms the crucial third leg of India's nuclear deterrent vis-à-vis its submarine-launched ballistic missile (SLBM) capability. The K-15 Sagarika, which has a range of 750 km, was successfully tested in February 2008, and was subsequently integrated with India's nuclear-powered Arihant class submarine.

**11. Dhanush**

Dhanush is a liquid propelled sea-based missile that was envisaged as a short-range version of the Prithvi II ballistic missile. It has a range of 350 km and is capable of carrying nuclear warheads. It was successfully test-fired from a naval warship in March 2011, and carries forward the legacy of the K-15 Sagarika.

**12. Agni III**

Agni III is an intermediate-range ballistic missile developed as the successor to the Agni II. It is an improvement over its previous iteration, and has a range of 3,500-5,000 km, making it capable of engaging targets deep inside neighbouring countries. It was inducted in to the armed forces in June 2011, enhancing its strike capability.

**13. Agni IV**

Carrying forward the success of its predecessor, the Agni III was developed to strike targets within a similar range but with a significantly shorter flight time of 20 minutes. The Agni IV, which has a two-phase propulsion system is designed to carry a 1,000 kg payload.

**14. Shaurya**

It was initially conceived as a surface-to-surface ballistic missile (SSM) variant of the K-15 Sagarika, that can be stored in underground silos for extended periods and launched using gas canisters as a trigger. The nuclear capability of the missile enhances India's second strike capability reduces the dependence on the K-15 ballistic missile which was built with significant Russian assistance.

**15. Nirbhay**

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Nirbhay is a subsonic missile which is ancillary to the BrahMos range. It uses a terrain-following navigation system to reach up to 1,000 km. Nirbhay is capable of being launched from multiple platforms on land, sea, and air.

**16. Prahaar**

Prahaar is a surface-to-surface missile with a range of 150 km that was successfully tested for the first time in July 2011. Stated to be a unique missile, the Prahaarboasts of high maneuverability, acceleration and accuracy. Primarily a battlefield support system for the Army, the missile can be fired from a road mobile launchers and is extremely mobile in battle situations owing to its lighter build.

**17. Astra**

Astra is a beyond-visual-range (BVR) air-to-air missile (AAM) that was tested successfully in May 2011. In terms of size and weight, the Astra is the smallest missile developed by the DRDO. It was envisaged to intercept and destroy enemy aircraft at supersonic speeds in the head-on mode within a range of 80 km.

**18. Agni V**

Agni is India's first inter-continental ballistic missile (ICBM), with high road mobility, fast-reaction ability and a strike range of over 5,000 km.

**Hurdle**

After India test-fired the first Prithvi missile in 1988, and the Agni missile in 1989, the Missile Technology Control Regime (then an informal grouping established in 1987 by Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) decided to restrict access to any technology that would help India in its missile development program. To counter the MTCR, the IGMDP team formed a consortium of DRDO laboratories, industries and academic institutions to build these sub-systems, components and materials. Though this slowed down the progress of the program, India successfully developed indigenously all the restricted components denied to it by the MTCR.

**MTCR**

MTCR is the acronym for Missile Technology and Control Regime. MTCR was recently in the news as India got membership in the group (contrary to NSG where India was denied membership).

**Benefit to India?**

India has joined MTCR as a full member and also agreed to join the Hague Code of conduct made it bolster its position as a responsible nuclear

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state and strengthen its case for the membership of other multilateral export control regimes like Nuclear Suppliers Group, Australia Group, and Wassenaar arrangement.

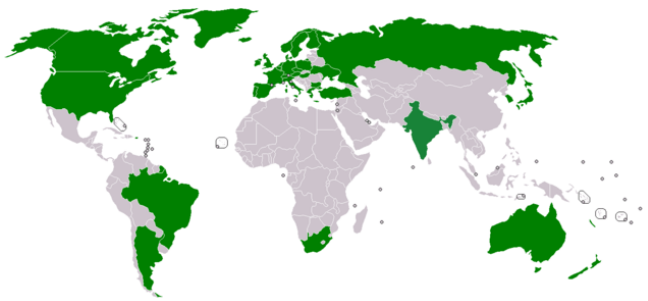
India can buy high-end missile technology and run joint programmes for development of unmanned aerial vehicles with other countries. eg. Procurement of theater missile interceptor "Arrow II" from Israel, military drones like "Avenger" from the USA etc.

India can sell its missiles to other non-member countries with comparative ease.eg. Supersonic cruise missile, "BrahMos", to Vietnam.

ISRO can access the forbidden cryogenic technology from Russia which is required for the space exploration operations.

MTCR membership can be used as a bargaining chip against China which is not a full member of the regime and aspiring to be one as it has blocked India's way to NSG.

**About MTCR**



It is a multilateral, consensus – based grouping of 35 member countries who are voluntarily committed to the non-proliferation of missiles capable of carrying chemical, biological and nuclear weapons of mass destruction (WMDs).

It controls the export of the technologies and materials involved in ballistic missile systems and unmanned aerial vehicles particularly capable of carrying nuclear warheads of above 500kg payload for more than 300 km.

This is a non–treaty association of member countries with certain guidelines about the information sharing, national control laws and export policies for missile systems and a rule-based regulation mechanism to limit the transfer of such critical technologies of these missile systems.

**Rules**

It was established in April 1987 by G-7 countries – USA, UK, France, Germany, Canada, Italy, and Japan, to check the spread of unmanned delivery systems capable of carrying nuclear weapons of above 500kg for more than 300km. In 1992, it was extended for all types of weapons of mass destruction.

Now, it has 35 full members including India and 4 "non-adherent members"

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– Israel, Macedonia, Romania, Slovakia.
China is not a member of this regime but it had verbally pledged to adhere to its original guidelines but not to the subsequent additions.
These efforts of non-proliferation of ballistic missile systems had further been strengthened by "The International Code of Conduct against Ballistic Missile Proliferation", also known as the Hague Code of Conduct (HCOC), which was established on 25 November 2002 as an arrangement to prevent the proliferation of ballistic missiles with 136 UN member countries including India.

**Analysis**

*Positive:* It has significantly contributed to curbing or slow down the nuclear programmes of some countries.
Argentina dropped its joint ballistic missile programme" Condor II" with Egypt and Iraq.
Poland and the Czech Republic vanished their ballistic missiles in an effort to join the regime.
Brazil, South Africa, South Korea, and Taiwan also withdrew or curbed their missiles or space launch vehicle programs.
Recently, it played a major role to hamper Libyan and Syrian missile efforts.

**Negative:** It is not a legally-binding treaty. Hence, no punitive measures could be taken against non-compliance to the guidelines of the regime.
It has only 35 member countries as full members. Whereas, countries like North Korea, Pakistan, Iran which have significant missile systems which could deliver WMDs, are not adherent to the regime.
Some of such countries are exploring long – range intercontinental missiles and they are also sellers in the arms market.
There are incidences of violation of the rules by MTCR countries. In 2007, China secretly sold solid-fuel, medium-range ballistic missiles," DF 21", to Saudi Arabia. France sold the Storm Shadow/SCALP cruise missile to the UAE (Black Shaheen) in the 1990s.
The USA had bent some rules to give concessions to some Non -member countries aspiring to join the regime. Eg. Ukraine was allowed to retain its Scud missiles irrespective of the rule of destroying ballistic missiles (capable of carrying a 500kg payload for 300km) for the non-recognised nuclear state. Similarly, USA also allowed South Korea to develop ballistic missiles of

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the range of 800 kilometers with a 500-kilogram payload.
With a technological advancement, it is also possible to adapt and develop the existing missiles with a range shorter than 300km and carrying WMDs less than 500kgs to escape the regulations imposed by the regime.

**Limitation for India**

MTCR membership does not guarantee any special technological entitlement from other members or adherent countries.
India needs to align its national laws dealing with development, transfer, and procurement of the nuclear technologies and export policies as per the guidelines of the MTCR regime which could be stricter and stringent as compared to the existing ones and likely to have implications for the stakeholders.
It is unlikely to give an immediate boost to the export of the India missiles.
India being a member of the regime will have some obligations like sharing critical information about its military and technological assets, consulting other member countries regarding the export of any MTCR items, especially those notified or denied by another partner.

**BENEFITS:**

Benefit to ISRO: During the cold war years, Russia denied cryogenic technology to India. However, in a welcome change ISRO will now have access to restricted high-end technologies for developing its cryogenic engines in order to enhance space exploration.
Sale of BrahMos: India will be able to sell the Indo-Russian supersonic cruise missile BrahMos to Vietnam and other countries in a development that would make India a significant arms exporter.
Procurement of Israel's Arrow II missile: In its bid to develop indigenous Ballistic Missile System, India wanted to procure Arrow II theatre missile defence interceptor from Israel but was denied due to the MTCR sanctions. The newly-forged membership will help India in the procurement of Arrow II, which will further help India defend itself against Pakistani or Chinese ballistic missiles.

Buying surveillance drones: India will be able to buy surveillance drones from other countries like the American Predator drones (e.g. the Avenger drone). The US might also consider exporting UAVs, Reaper and Global Hawk, which have been key to counter-terrorism efforts in countries like Afghanistan, Pakistan and Yemen.

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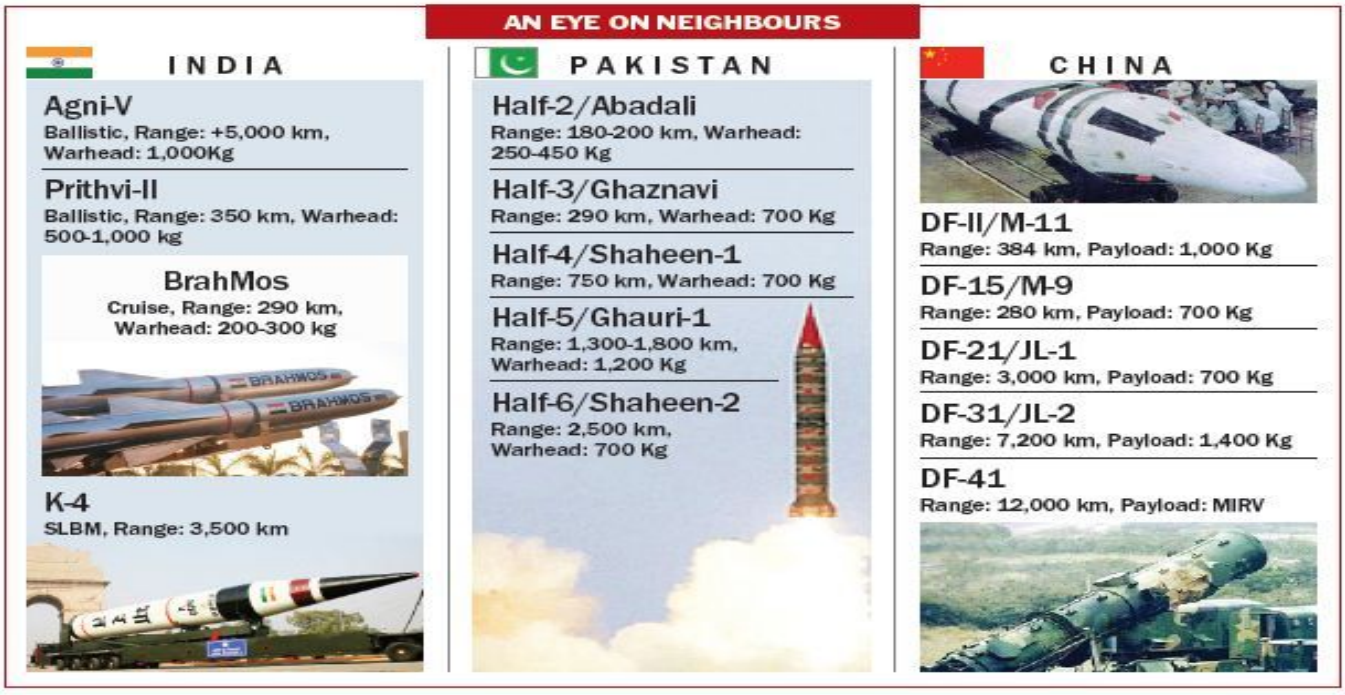
Boost to Make in India: Indian technology that will be developed or made under the flagship of Make in India will see free movement out of the country, which in turn will contribute to the success of the programme.

Step closer to NSG: The accession to MTCR is one step closer to India's membership to the 48-member NSG (Nuclear Suppliers Group). It also gives India a chance to engage with other global non-proliferation players.

One-upping China: Significantly, China, which opposed India's entry into the Nuclear Suppliers Group at the just-concluded Seoul plenary, is not a member of 34-nation MTCR.




**Defence Procurement Policy**

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Defence Procurement Procedure (DPP)-2016, which has come into effect from April 2016, focuses on institutionalising, streamlining and simplifying defence procurement procedure to give a boost to "Make in India" initiative of the Government of India, by promoting indigenous design, development and manufacturing of defence equipment, platforms, systems and sub-systems. The key features of revised DPP, promoting 'Make in India' inter alia include:-

• A new category of procurement 'Buy {Indian-IDDM (Indigenously Designed, Developed and Manufactured)}' has been introduced in Defence Procurement Procedure-2016 and the same has been accorded top most priority for procurement of capital equipment.

• Preference has been accorded to 'Buy (Indian)' and 'Buy and Make (Indian)' categories of capital acquisition over 'Buy (Global)' & 'Buy & Make (Global)' categories.

• Requirement of Indigenous content has been enhanced / rationalised for various categories of capital acquisition.

• The 'Make' Procedure has been simplified with provisions for funding of 90 % of development cost by the government to Indian industry and reserving projects not exceeding development cost of Rs. 10 crore (government funded) and Rs. 3 crore (industry funded) for MSMEs.

The following achievement have been made by the Government under this programme:-

• Defence Acquisition Council (DAC) accorded approval of 136 capital procurement cases at an estimated cost of Rs. 4,00,714/- crore during the last two financial years (2014-15 and 2015-16) and current year 2016-17 (upto January 2017), out of which 96 cases involving Rs. 2,46,417/- crore are under the 'Buy (Indian-IDDM)', 'Buy (Indian)', 'Buy & Make (Indian)', 'Make' categories.

• 141 contracts with total value of Rs. 2,00,010/- Crore (approx.) were signed during the last two financial years (2014-15 and 2015-16) and current year 2016-17 (upto December 2016), out of which 90 contracts involving a value of Rs. 83,344/- crore (Approx) were signed with Indian vendors.

• Capital expenditure of Rs. 1,75,420/- Crore (approx.) was

incurred on purchase of defence items for Armed forces during the last two financial years (2014-15 and 2015-16) and current year 2016-17 (upto December 2016), out of which of Capital expenditure of Rs. 1,05,030/- Crore (approx.) was incurred on purchase from Indian vendors.

The responsibility of quality assurance of raw material used in defence products rests with Organizations such as Ordnance Factory Board (OFB), Defence Public Sector Undertakings (DPSUs), Directorate General of Quality Assurance (DGQA), etc. At present, there is no proposal to open any new lab in the country to check / investigate the defence products. However DGQA, DRDO, OFB, DPSUs and Armed forces already have their own laboratories or test facilities at various locations across the country to check / investigate the defence products.

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**All the best**
**JAI HIND**

## Class explanation- mind map

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