Incorporating MIRV Technology

This editorial is based on **"The MIRV leap that fires up India's nuclear deterrence"** which was published in The Hindu on 19/03/2024. The article explores how the integration of Multiple Independently Targetable Re-entry Vehicles (MIRVs) with the Agni-5 variant enhances the effectiveness of India's nuclear deterrent.

For Prelims: **Defence Research and Development Organisation (DRDO)**, Divyastra, **Agni-5**, Multiple Independently Targetable Re-entry Vehicles (MIRVs), Hongqi HQ-19, **Intermediate Range Ballistic Missiles (IRBMS)**, Post Boost Vehicle (PBV), Terminal Ballistics Research Laboratory (TBRL), Advanced Systems Limited (ASL), **Bhabha Atomic Research Centre (BARC),** Atomic Energy Commission of India (AECI).

For Mains: Significance of MIRV Technology in Boosting Defence Capabilities of India.

The recent test of the **Agni-5** ballistic missile, under **"Mission Divyastra"**, by the **Defence Research and Development Organisation (DRDO)**, holds significant strategic importance. Boasting a range exceeding 5,000 kilometres, the Agni-5 stands as India's longest-range missile tested to date. However, its significance extends beyond its range; the missile's potency marks a pivotal moment for India's nuclear deterrence capability. This potency is further augmented by its integration with **Multiple Independently Targetable Re-entry Vehicles (MIRVs).**

Note

Mission Divyastra:

- The DRDO's successful launch of Mission Divyastra marks a significant achievement for India's nuclear capabilities.
- It represents the inaugural flight test of the domestically developed Agni-5 nuclear missile with a 5,000-km range, featuring MIRV technology.
    - The flight test, named Mission Divyastra, was carried out from Dr APJ Abdul Kalam Island off the Odisha coast.
- This technology enables the missile to deliver multiple warheads to various or the same locations in a single launch, potentially including decoys to mislead enemy ballistic missile defences.

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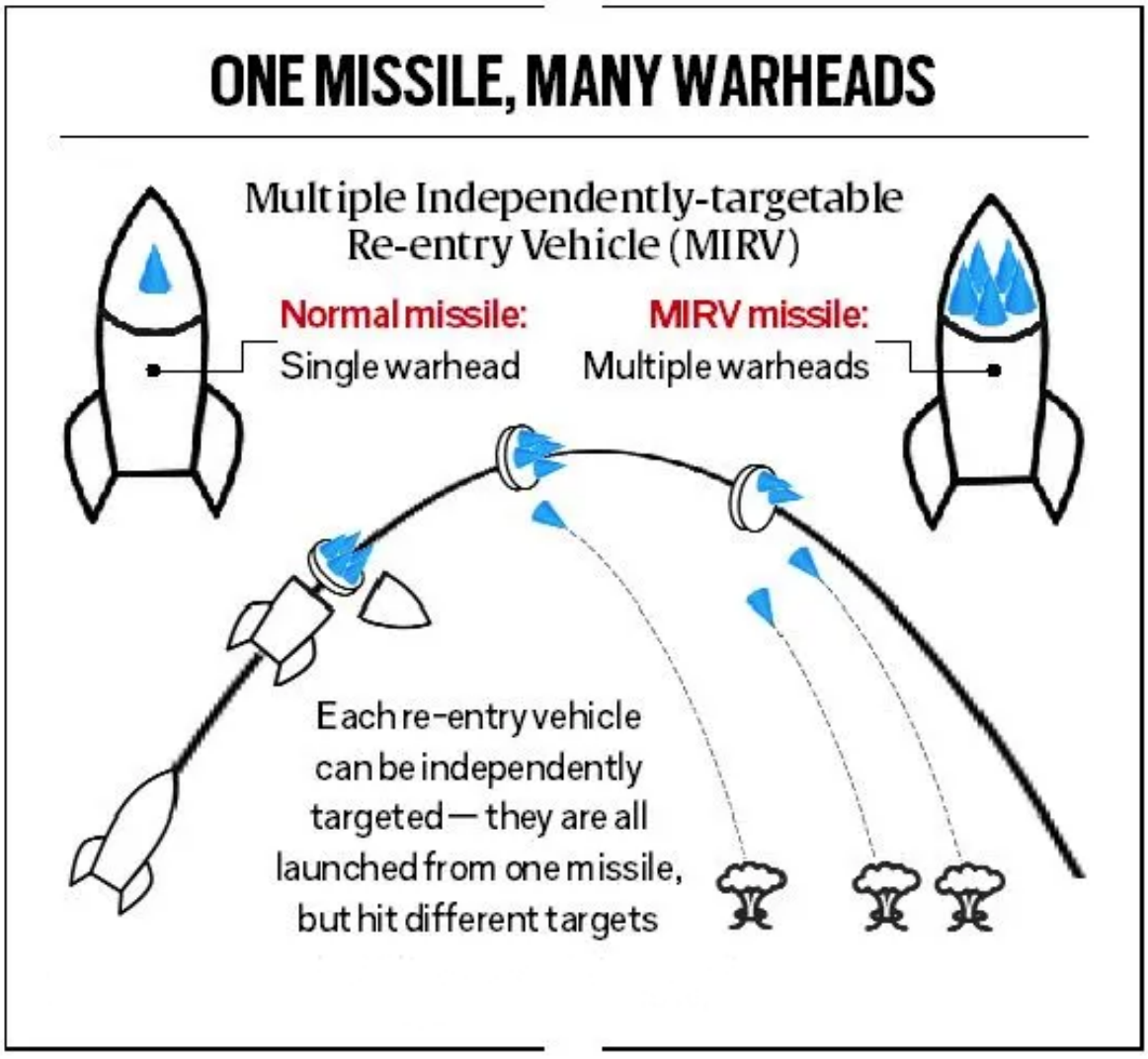
What is MIRV Technology?

- **About:**
  - MIRV technology originated in the United States, with the deployment of a MIRVed Intercontinental Ballistic Missile (ICBM) in 1970.
  - MIRV allows a single missile to carry multiple warheads (4-6), each capable of targeting different locations independently.
  - MIRV technology enhances the missile's effectiveness by increasing the number of potential targets it can engage.
  - MIRVs can be launched from both land-based platforms and sea-based platforms, such as submarines, expanding their operational flexibility and range.
- **Global Adoption and Proliferation:**
  - Nations possessing MIRV technology include major nuclear powers such as the United States, the United Kingdom, France, Russia, China, and India, while Pakistan tested the technology (Ababeel Missile) in 2017.
  - The test flight of Agni-5 marked the first time that the MIRV technology was tested in India, which aims to deploy multiple warheads at different locations in a single launch.
  - The Agni-5 weapon system is equipped with indigenous avionics systems and high-accuracy sensor packages, which ensured that the re-entry vehicles reached the target points within the desired accuracy.



What is the Significance of MIRV Technology?

- **Launching Satellites Into Orbits:**
  - MIRV technology is being perfected and tested on workhorse rockets of the **Indian Space Research Organisation (ISRO)** in their commercial launches which were geared towards launching a single rocket that placed several satellites in orbit.
- **Many Target Options to the Attacker:**
  - Launching a MIRV-tipped missile – say an Agni-IV or Agni-V – offers several tactical and strategic advantages. It provides more target options to the attacker.
  - Meanwhile, the defender is forced to defend all of them simultaneously, with its anti-missile defences possibly being overwhelmed. Warheads on MIRVed missiles can be released from the missile at different speeds and in different directions.
- **Greater Operational Range:**
  - The Agni-V missile, equipped with MIRV technology, features a redesigned nose cone to accommodate multiple warheads. To maintain its 5000-5500 KM target range, the missile's weight was reduced by replacing older, heavier subsystems with lighter, more reliable ones, including components made from lightweight composite materials.
    - Switching from hydraulic to electro-mechanical actuators not only reduces weight by using lighter components but also addresses issues such as oil storage, leakage, and the need for an accumulator. Moreover, electro-mechanical actuators are more dependable and simpler to upkeep.
- **Evading Ballistic Missiles:**
  - MIRV-equipped missiles are deemed necessary due to their ability to target multiple objectives simultaneously and their effectiveness in circumventing ballistic missile defences.

- This necessity is further underscored by China's development of ballistic missile defences like the HQ-19 ground-based interceptors, which have undergone testing.
    - The HQ-19s are expected to possess the capability to intercept earlier versions of the Agni Intermediate-Range Ballistic Missile (IRBM), particularly if they are configured to carry a single warhead.
    - Now that India has integrated the Agni-5 with multiple warheads, greater balance has been restored in the Sino-Indian nuclear deterrent relationship.

What are the Different Challenges in Adoption of MIRV Technology?

- **Pushing Rivals To Adopt More Aggressive Postures:**
    - In strategic terms, the gains are not so obvious. There is good evidence and considerable discussion in strategic circles that possession of MIRV missiles is a double-edged sword.
        - On the one hand, MIRVs seemingly bestow greater deterrence. On the other hand, they push rivals to adopt more aggressive nuclear postures so as to counter this advantage. MIRVs may, therefore, also drive up the risks of nuclear conflict and increase security threats.
- **Requirement of Additional Fissile Material**:
    - A more problematic issue is the additional fissile material, chiefly plutonium, which would be required for the new MIRV missiles. India is already constrained by a shortage of plutonium from its BARC Dhruva reactor and a small quantity of waste plutonium from its power plants.
- **Highly Demanding Technical Criteria**:
    - Developing MIRV-capable ballistic missiles poses significant challenges due to stringent technical requirements. These include miniaturising nuclear warheads, ensuring lightweight receptacles for warheads, and precise configuration and separation of re-entry vehicles from the Post Boost Vehicle (PBV), which must be manoeuvrable.
- **Confusion Regarding Carrying Number of Warheads:**
    - The opacity surrounding this MIRV missile is about the number of warheads it can carry, which in all likelihood would remain classified. Going by speculation, it is improbable that it can carry more than three warheads.
        - Further, the yield of the nuclear warheads is likely to be limited due to the small number of atomic tests India has conducted. In addition, it is unclear whether the Agni-5 can carry decoys and chaff, especially during the boost and intermediate phase of the missile’s flight.

What are Steps Required to be Taken for Improving MIVR Technology?

- **Adding More Weight to India’s Nuclear Arsenal:**
    - The Atomic Energy Commission of India (AEC), especially the Bhabha Atomic Research Centre (BARC), which is directly responsible for core research and development (R&D) with respect to nuclear devices, have done a good job in designing sufficiently compact nuclear warheads for MIRV capability.
        - However, there is need of more to come from the DRDO and AEC with India adding more punch to its nuclear arsenal when it tests a long-range Submarine Launched Ballistic Missile (SLBM), which India’s nuclear ballistic missile submarines integrated with MIRVs can launch.
- **Maintaining Guidance and Accuracy of MIRV Missiles:**
    - Guidance and accuracy are a necessity as re-entry vehicles have to be spin stabilised during atmospheric re-entry. A MIRV-based missile can only strike multiple targets that are within its ambit or geographic footprint. With the subsequent tests, India must meet these demanding technical requirements precisely.
        - In India's situation, the development of MIRVs is particularly significant due to the substantial challenges faced by the country's missile and nuclear engineers. The guidance and accuracy of MIRV missiles will provide a significant boost, in addition to extending the strike range to 10,000 kilometres.
- **Ensuring Adequate Nuclear Testing:**
    - Inadequate nuclear testing by India compromised the extent to which it could miniaturise warheads and MIRV them to strike multiple targets.

    - The lack of sufficient testing also undermined the extent to which the re-entry vehicles could be designed to carry the warheads. Therefore, adequate testing becomes imperative to develop a full fledged technology.
- **International Agreements:**
    - Address global apprehensions by establishing agreements and treaties to oversee the advancement and deployment of MIRV technology.
    - This includes exploring alternatives beyond the **Missile Technology Control Regime (MTCR)** and **Wassenaar Arrangement** to acquire fissile materials from allied nations, citing emerging concerns and threats posed by China.

Conclusion

The successful testing of the Agni-5 ballistic missile, equipped with MIRVs, marks a significant milestone for India's nuclear deterrence capabilities. This development enhances India's strategic posture, particularly in response to the evolving challenges posed by China's nuclear and missile programs. The achievement also underscores India's technological prowess and resilience in overcoming previous challenges. Moving forward, India's continued advancements in missile technology, including the potential development of a long-range Submarine Launched Ballistic Missile (SLBM), will further strengthen its position as a credible nuclear power.

Drishti Mains Question:

Explain the concept of MIRV technology and its significance in modern warfare. Analyse the challenges posed by MIRV technology to global arms control and non-proliferation efforts.

UPSC Civil Services Examination, Previous Years Questions (PYQs)

Prelims:

Q1. What is “Terminal High Altitude Area Defense (THAAD)”, sometimes seen in the news? (2018)

(a) An Israeli radar system
(b) India’s indigenous anti-missile programme
(c) An American anti-missile system
(d) A defence collaboration between Japan and South Korea

Ans: (c)

Q2. With reference to Agni-IV Missile, which of the following statements is/are correct? (2014)

1. It is a surface-to-surface missile.
2. It is fuelled by liquid propellant only.
3. It can deliver one-tonne nuclear warheads about 7500 km away.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (a)

Mains:

Q. How is the S-400 air defence system technically superior to any other system presently available in the world? **(2021)**