



# Air Independent Propulsion Technology

## Why in News?

Recently, France's Naval Group declined the bid for the [P-75I Project](#), citing it does not use [AIP \(Air-Independent Propulsion\) Technology](#) yet.

- Around 10 countries have developed or are close to building AIP technology, and almost 20 nations have AIP submarines.

## What is the P-75I project?

- In June 1999, the Cabinet Committee on Security approved a 30-year plan for the Navy to indigenously build and induct 24 submarines by 2030.
- In the first phase, two lines of production were to be established — the first, P-75; the second, P-75I. Each line was to produce six submarines.
  - While the six P-75 submarines are diesel-electric, they can be fitted with AIP technology later in their lives.
- This P-75I project envisages indigenous construction of submarines equipped with the state-of-the-art Air Independent Propulsion system at an estimated cost of Rs. 43,000 crore.

## What is AIP?

- About:
  - AIP is a technology for **conventional non-nuclear submarines**.
  - Submarines are essentially of **two types: conventional and nuclear**.
  - The **conventional submarines use diesel-electric engines**, which require them to surface almost daily to get atmospheric oxygen for fuel combustion.
  - If fitted with an AIP system, the **submarine will need to take in oxygen only once a week**.
  - The indigenously developed AIP, which is one of the key missions of the Naval Materials Research Laboratory (NMRL - DRDO), is considered one of the ambitious projects of the DRDO (Defence Research and Development Organisation) for the Navy.
- **Fuel Cell Based AIP system:**
  - In a [fuel cell](#)-based AIP, an electrolytic fuel cell releases energy by combining hydrogen and oxygen, with only water as the waste product ensuring less marine pollution.
  - The cells are highly efficient, and do not have moving parts, thus ensuring that the submarine has a low acoustic emission of sound.

## What are the Advantages and Disadvantages of AIP?

- **Advantages:**
  - AIP has a **force multiplier effect on lethality of a diesel electric submarine** as it enhances the submerged endurance of the boat several fold.
  - Fuel cell-based **AIP has merits in performance** compared to other technologies.

- AIP technology allows a conventional submarine to remain submerged for much longer than ordinary diesel-electric submarines.
  - All conventional submarines have to surface to run their generators that recharge the batteries that allow the boat to function under water.
  - However, the more frequently a submarine surfaces, the higher the chances of it being detected.
  - AIP allows a submarine to remain submerged for more than a fortnight, compared to two to three days for diesel-electric boats.
- **Disadvantages:**
  - Installing AIP **increases the length and weight of the boats**, requires pressurised liquid oxygen (LOX) storage on-board and supply for all three technologies.
  - MESMA (Autonomous Submarine Energy Module) and the Stirling engine have some acoustic noise from moving parts; and the **submarine's unit cost increases by around 10%**.

## **What submarines does India have now?**

- India has **16 conventional diesel-electric submarines, which are classified as SSKs**. After the last two Kalvari Class subs are commissioned under P-75, **this number will go up to 18**.
- India also has **two nuclear ballistic submarines, classified SSBN (Submersible Ship Ballistic Missile Nuclear)**.
- By the time P-75I is completed under the 30-year project, **India is projected to have six diesel-electric, six AIP-powered, and six nuclear attack submarines**.

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| Diesel-Electric Submarines (SSK)  | Nuclear-Powered Attack Submarine (SSN)   | Nuclear-Powered Ballistic Missile Submarine (SSBN)   |
|---|--|--|
| <ul style="list-style-type: none"> <li>▪ Diesel-electric submarines use electric motors charged by diesel engines to move. These engines require air and fuel to operate, which means they <b>need to resurface more frequently</b>, making them easier to detect.</li> <li>▪ Of the SSKs, <b>four are Shishumar Class</b>, which were bought and then built in India in collaboration with the Germans starting in the 1980s.</li> <li>▪ <b>Eight are Kilo Class or Sindhughosh Class</b> bought from Russia (including erstwhile USSR) between 1984 and 2000.</li> <li>▪ Four are Kalvari Class built in India at MDL.</li> </ul> | <ul style="list-style-type: none"> <li>▪ SSNs can stay and operate under water almost indefinitely; their endurance is limited only by food supplies for the crew. They are also equipped with a range of tactical weapons, such as torpedoes, anti-ship cruise missiles and land-attack cruise missiles.</li> <li>▪ <b>India is among six nations that have SSNs</b>, alongside the US, the UK, Russia, France and China.</li> <li>▪ Chakra-3, currently being refitted at a Russian shipyard, will be inducted by 2026.</li> </ul> | <ul style="list-style-type: none"> <li>▪ A <b>slow-moving 'bomber' and a stealthy launch platform</b> for nuclear weapons.</li> <li>▪ The <b>Arihant and three more SSBNs</b> under construction are part of the <b>Strategic Forces Command</b>.</li> </ul> |

### UPSC Civil Services Examination, Previous Year Questions

**Q. Which one of the following is the best description of 'INS Astradharini', that was in the news recently? (2016)**

- (a) Amphibious warfare ship
- (b) Nuclear-powered submarine
- (c) Torpedo launch and recovery vessel
- (d) Nuclear-powered aircraft carrier

**Ans: (c)**

**Source: IE**

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