



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"> ▪ Diesel-electric submarines use electric motors charged by diesel engines to move. These engines require air and fuel to operate, which means they need to resurface more frequently, making them easier to detect. ▪ Of the SSKs, four are Shishumar Class, which were bought and then built in India in collaboration with the Germans starting in the 1980s. ▪ Eight are Kilo Class or Sindhughosh Class bought from Russia (including erstwhile USSR) between 1984 and 2000. ▪ Four are Kalvari Class built in India at MDL. 	<ul style="list-style-type: none"> ▪ 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. ▪ India is among six nations that have SSNs, alongside the US, the UK, Russia, France and China. ▪ Chakra-3, currently being refitted at a Russian shipyard, will be inducted by 2026. 	<ul style="list-style-type: none"> ▪ A slow-moving 'bomber' and a stealthy launch platform for nuclear weapons. ▪ The Arihant and three more SSBNs under construction are part of the Strategic Forces Command.

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)

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