



# Air Independent Propulsion for Diesel Electric Submarines

## Why in News

The [Defence Research and Development Organisation \(DRDO\)](#) has conducted the final development test of [Air Independent Propulsion \(AIP\) System](#), crucial for diesel electric submarines.

## Key Points

### ▪ Air Independent Propulsion (AIP) System:

- 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 Air Independent Propulsion (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)**, is considered one of the ambitious projects of the DRDO for the Navy.
  - The project aims at **fitting the technology on** India's Scorpene class submarine [INS Kalvari](#) around 2023.

### ▪ Advantages of AIP:

- The AIP system based submarines will be required to surface much less frequently, thus **increasing their lethality and stealth multifold**.
- Diesel-electric submarines require them to come to the surface frequently to charge their batteries, thus their underwater endurance time is less.
  - 'Air-independent' propulsion technology helps to **make the diesel generator less dependent on surface air**.
- While there are different types of AIP systems being pursued internationally, **fuel cell-based AIP of NMRL is unique** as the **hydrogen is generated onboard**.

### ▪ 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 emissions of sound**.

## Naval Materials Research Laboratory

- Naval Materials Research Laboratory (NMRL) is **one of the laboratories functioning under DRDO**, pursuing basic research as well as application-oriented technology development in several areas viz. Metallurgy, Polymer, Ceramics, Coating, Corrosion and Electrochemical Protection, Marine Biotechnology, Environmental Sciences.
- It's mission:

- To develop Air Independent Propulsion (AIP) systems for Naval Submarine & Fuel Cell technologies.
- To provide scientific solutions for all categories of materials & related technologies for Indian Navy.
- To undertake research projects on strategic materials for Indian Navy.

### **Nuclear Submarines versus Conventional Submarines**

- The main difference between conventional submarines and nuclear submarines is the **power generation system**. Nuclear submarines (e.g. [INS Arihant](#), [INS Akula](#)) employ nuclear reactors for this task and conventional submarines (e.g. [Project-75](#) and [Project-75I Class Submarines](#)) use diesel-electric engines.
- While **nuclear-powered submarines** are considered as key assets for **deep sea operations**, the **conventional diesel electric** ones are vital for **coastal defence and operations close to the shore**.

**Source: IE**

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