

## The Astute Class Submarine

by Simon Purvis, In-Service Technical Authority – Astute Class, BAE Systems Maritime - Submarines

### 1. Company Overview

BAE Systems Submarines has approximately 3800 employee located on 6 sites in the UK with the majority of its employees being located at Barrow-in-Furness, the site of the UK's only nuclear shipyard.

Previous vessels built at this shipyard include the Type 42 Class destroyers, the Invincible Class aircraft carriers and Ocean and Albion Class fleet support vessels. In addition the Swiftsure, Trafalgar, Upholder and Vanguard Class submarines have all been built in the same yard. Some of the technology from these submarines has been carried over into the Astute Class submarines.

### 2. Astute Project

The UK Ministry of Defence (MoD) issued the Invitation to Tender (ITT) for the Astute Class Submarine in July 1994 and the contract was awarded in March 1997. This contract was for 3 submarines together with support for the initial 8 years of service life.

Unusually, the Prime Contractor was made the overall design authority for the project and were therefore responsible for the "whole boat" design and performance. Subsequently a contract was awarded for a further 4 submarines but here the MoD took back some of the responsibility for major design decisions thereby reducing the risks (and hence costs) to the Prime Contractor.

### 3. Roles for the Astute Class Submarines

These include:

- The detection and prosecution of other submarines and surface vessels using Spearfish torpedoes. This may be either acting autonomously or in support of a Task Force;
- Land attack using tube launched TLAM Block 4 (Tomahawk Land Attack Missiles) 'Cruise' missiles;
- Surveillance, Reconnaissance and other Intelligence gathering activities using Radar & Communications Electronic Surveillance Measures, sonar, visual and other systems;
- Support to the UK's Continuous At-Sea Deterrent (Trident);
- Sea region denial;
- Other capabilities (not specified during the lecture).

### 4. The Programme

The submarine delivery programme is as follows:

Name	Boat	Pennant No.	Status	Laid down	Launched	Commissioned
<i>Astute</i>	1	S119	On Sea trials	31/1/01	8/6/07	27 Aug 2010
<i>Ambush</i>	2	S120	On Sea Trials	22/10/03	6/1/11	Early 2013
<i>Artful</i>	3	S121	In build	11/3/05	2015	
<i>Audacious</i>	4	S122	In build	23/3/09	2018	
<i>Agamemnon</i>	5	S123	Initial build	13/10/11	2020	
<i>Anson</i>	6	S124	On order; long-lead items ordered			
<i>Ajax</i>	7	S125	Planned (confirmed SDSR 10/10)			

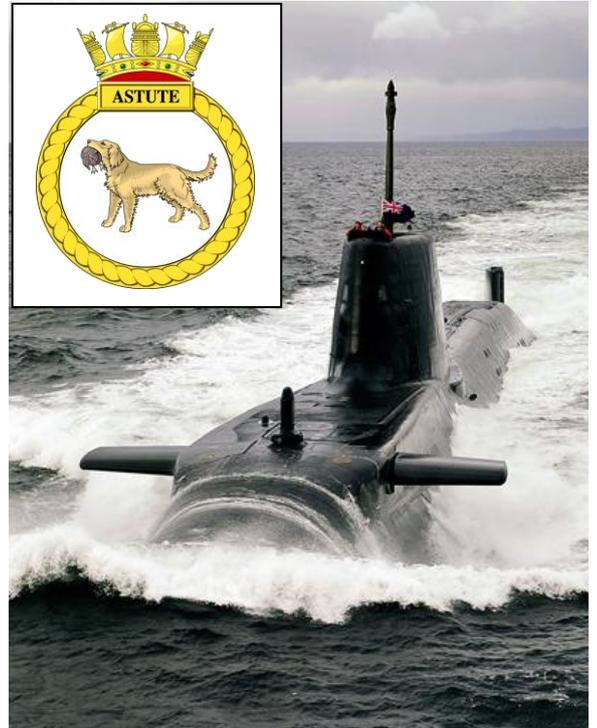


Fig. 1 – HMS Astute, first of Class, on trials

## 5. Key Design Features

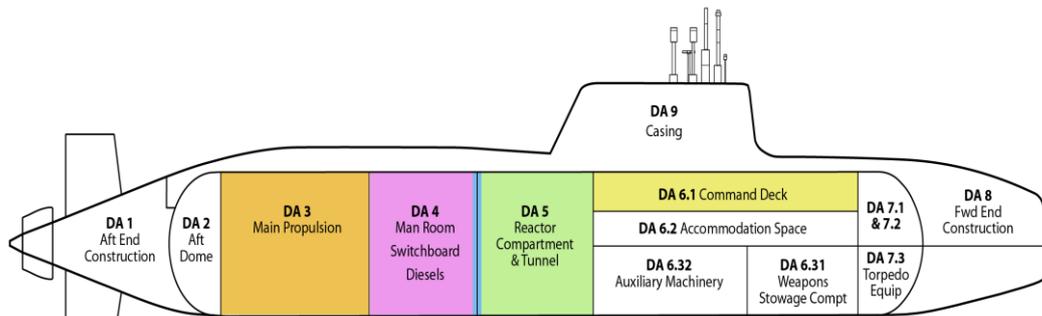
These include:

- New Combat System including a new state-of-the-art 2076 Sonar
- Distributed Control & Instrumentation
- Improved quieter gearbox (over previous submarine types)
- Static converters instead of motor-generators (this saves space and reduces acoustic noise)
- Additional torpedo tube and reloads (over previous submarine types);
- Non-penetrating Optronics Masts (unlike previous submarines where the periscopes penetrate down to the Command Deck. This dramatically improves the flexibility of laying out the Command Deck.)
- External control surface actuation (again reduces the number of hull penetrations)
- Split aft hydroplanes planes (increases reliability)
- Composite control surfaces & Propulsor (reduces the submarines acoustic signature)
- Reverse Osmosis plant for fresh water production
- Electrolysers (O<sub>2</sub> generation) and CO<sub>2</sub> Scrubbers for atmosphere control
- No overboard discharge of garbage – processed, packaged and stored on board for duration of patrol.

The Astute Class compares with its predecessor, the Trafalgar Class, as follows:

	Trafalgar	Astute
Length	86	97
Beam	9.8	10.7
Dived Displacement (tonnes)	5200	5200
Complement	130	122
Weapons	Baseline	+50%
Speed*	Baseline	- 1.5 knots

\*It is important to note that absolute speed is not the most significant factor. Stealth is far more important.



**Fig. 2 – Astute Class Submarine - Configuration**

## 6. Modular Build Process

Each submarine is being built by a modular build process. Firstly the pressure hull is constructed. Brackets are then welded to the hull to support the internal modules (Fig. 2 above). The various sub-assemblies designed to remain in-situ for the life of the submarine are then added.

All of the main modules such as the Command Deck, Reactor Compartment, Main Propulsion etc. (Fig. 2) are fully assembled before being brought to the overall submarine assembly line. These modules are then “slid into” and attached to the main hull. Finally the Bridge Fin and Casing are added to the top of the hull.

The submarine is then ready for launching and sea trials before being handed over to the Royal Navy.

**The lecture was attended by 155 people.**

**Joint meeting with IMechE**

*Notes written by Colin Moss, RAeS Loughborough Branch*