

Astute, Trident and SSGN: Land Attack for the Royal Navy Submarine Service



USS Florida firing
TLAM.

by Dr Lee Willett

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In January 2003, the USS *Florida* (SSGN-728) test-fired a pair of Tomahawk Land Attack Missiles (TLAM).¹ The test was the first TLAM test firing from an SSGN following the conversion of four of the United States Navy's *Ohio*-class Fleet Ballistic Missile Submarines (SSBNs) to land attack and special forces operations platforms, or SSGNs.² The US SSBNs previously carried *Trident* D5 Submarine-Launched Ballistic Missiles (SLBMs) for strategic deterrence. Now, with those four platforms available for other roles, the D5 missiles are to be replaced by combinations of special forces facilities (for a squadron of 66 troops) and TLAMs (in the longer term the new Block IV *Tactical Tomahawk*).³

From the UK perspective, the Block III TLAM variant is already in service across the UK's SSN flotilla, and has been fired by the UK in combat in Kosovo, Afghanistan and Iraq. The UK also will deploy the Block IV across the SSN flotilla, including in the *Astute*-class from build. The underwater battlespace brings unique virtues in delivering effect in support of the wider defence mission, and no more so in the modern era than a stealthy, invulnerable, nuclear-powered submarine. Yet the UK is facing something of a crisis in the affordability of its submarine programme. Nuclear-powered submarines have always appeared to be expensive platforms, and the Ministry of Defence finds itself forever caught in a vicious circle of

reducing submarine force levels and capability to save money on the submarines themselves and for other programmes, but then failing to reap the full benefit of the potential cost savings in economies of scale with a larger programme and of the unique virtues of stealthy, invulnerable platforms. While the *Astute* programme is now on track to meet a revised cost and time schedule, the programme is over two years late and is over budget on the original schedule, with the result that the Ministry of Defence has still to make a firm commitment to buy any more than the three hulls currently in build as it defines its capability requirements and as it waits to see how much the three boats will cost. There is also considerable competition in the defence budget with other programmes – not least, in naval terms, the Type 45 destroyer, the future carrier and (possibly) a *Trident* replacement programme.

With the addition of TLAM capabilities and significant improvements in Special Operations Forces (SOF) delivery and intelligence, surveillance and reconnaissance (ISR) contributions to Joint and Task Group operations, the Royal Navy Submarine Service has made significant strides since the end of the Cold War to shake off the tag of being

single purpose (anti-submarine warfare against the former Soviet Navy) platforms. While the Royal Navy and the MoD struggle with affordability issues, the Submarine Service can increase further still its enduring contribution to contemporary and future combat operations by augmenting its land-attack capability. Moreover, with questions raised about the UK's ability to afford two new classes of nuclear-powered submarine beyond *Astute* and *Trident*, and with public debates of capability choices for the successor to *Trident* including SSGN-style concepts as the future UK strategic deterrent, this paper will look at the land-attack contribution of the *Astute*-class SSN and UK capability choices beyond.

Land Attack from the Sea

While each platform and capability in modern military force structures may possess unique and enduring requirements, all assets are required to make a more significant contribution to the land campaign. For maritime forces this means, by definition, land attack – and, in the most part, long-range land attack.

The current UK Defence Strategic Guidance focuses on the need to deliver rapid, decisive responses in an unpredictable global geostrategic environment, generating strategic effects



to deter, contain or stabilise conflict, and to coerce, disrupt, destroy and defeat an adversary if necessary. To achieve this, the UK requires equipment capabilities that are coherent, balanced, versatile, straightforward, interoperable, survivable and affordable. The Royal Navy's own exposition of the requirements of the defence strategic guidance – the Future Maritime Operational Concept – focuses on the need to generate flexibility and agility – both across the spectrum of operations and across the globe – to deliver maritime security, access into theatre, force projection onto target and networked C4ISTAR.

Bringing an adjustable footprint in high-risk environments, maritime forces provide the capability to deliver access and to shape the battlespace through land-attack operations. The Royal Navy has a wide spectrum of land-attack capabilities in its current and future inventory, ranging from: SOF and brigade-sized naval infantry (which can be delivered ashore by air or by sea from platforms such as HMS *Ocean* or *Invincible*-class aircraft carriers re-roled for troop delivery); to surface ships with naval fire support and rotary-wing aircraft for troop delivery and C4ISTAR operations (although the Type 45 does not have a requirement for a long-range land-attack capability); to unmanned air and underwater vehicles; to the future aircraft carrier with its land-attack-focused Joint Combat Aircraft (JCA); and to underwater platforms that deliver land attack with the unique benefits of stealth and invulnerability.

SSNs are an enduring, core military capability at the cutting edge of naval and military concepts, doctrine, operations and technologies – particularly because of the long-standing traditions of the Submarine Service itself and because of the close nature of the relationship between the Service and its American counterpart. As part of a versatile maritime force delivering sustainable

expeditionary capability in Joint and Task Group operations, SSNs deliver the enduring virtues of speed, covert/overt access, poise, enduring presence, flexibility, mobility, stealth, reach, autonomy and punch, providing presence with purpose in support of wider defence tasks. With the strategic emphasis on delivering selective, invulnerable effect at distance, the enduring requirement for nuclear-powered submarines is clear.

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UK MoD future warfare studies have outlined that submarines will be undertaking the same roles in 15–25 years as they are now and have been doing for some time. During recent operations in the Gulf (Operation TELIC), only 3 out of 19 Royal Navy platforms had a long-range land-attack capability – and these three platforms were the three submarines deployed to the region.⁴ The future Carrier Strike capability, with JCA, will make a significant contribution to land attack from the sea. However, there is no land-attack requirement for the Type 45, and the Future Surface Combatant programme plans have been moved somewhat to the right. Moreover, the Storm Shadow air-launched cruise missile is not slated for a fit to JCA until the fourth tranche. Thus, much of the land attack burden for the Royal Navy will rest with the Submarine Service.

Land Attack Capabilities for the Astute-Class SSN

HMS *Astute* is scheduled for delivery into service in 2009, with HMS *Ambush* and HMS *Artful* scheduled to enter into service to an 18-month delivery drumbeat after that. The *Astute* class provides a suite of key offensive capabilities, all vital in the support of defence tasks – in particular in support of the Global War on Terrorism.

It provides much improved blue- and brown-water roles, including deterrent support, anti-submarine warfare (ASW)/anti-surface warfare (ASuW) and a more sustained contribution to Joint and Task Group operations. It provides significant improvements in C4ISTAR and overall communications capabilities for the Submarine Service, with the Submarine Command System (SMCS), the 2076 sonar, the Recoverable Tethered Fibre-optics (RTOF) sonar buoy and the Tactical Tomahawk Weapon Control System (TTWCS).⁵ Also, *Astute* will have a much improved ability to insert SOF ashore, with facilities including a Dry Deck Shelter (DDS). However, reflecting the requirement generated in the MoD's Directorate of Equipment Capability for Under Water Effect (DEC UWE), the real improvements are in delivering effect with long-range land-attack capabilities.

Astute has weapons stowage space for 38 rounds (missiles or torpedoes), a capacity 50% larger than on the current *Swiftsure*- and *Trafalgar*-class SSNs. The boats will be fitted from build with the Block IV Tactical Tomahawk (TacTom). TacTom itself has much improved mission planning and communication software to enable it to be re-targeted in flight – seen by the MoD as a vital characteristic in an overall network-enabled capability designed to generate the right effect at the right place at the right time. TLAM's own unique advantage has always been its enormous range of 1000 nautical miles or more. With TacTom to be fitted to the SSNs, the UK will soon have a truly networked capability able to deliver global coverage at sea and on land.

Astute will fire TacTom out of its six torpedo tubes. The US Navy (USN) originally developed TacTom for vertical launch system (VLS) firing only from its SSNs. However – particularly when the USN saw the increased capacity available in its SSNs and SSGNs with a torpedo-tube launch capability for TacTom – the US and the UK joined together to develop a

torpedo-tube-launched version. The declared UK TacTom inventory will remain as it was for Block III – 65 SSN-launched rounds to support a national strategic coercive capability. However, with the UK SSN flotilla to be reduced to eight hulls and with combat experience showing a far greater use of TLAM than originally envisaged – resulting in UK SSNs regularly needing to leave the gunline to re-load – there is an argument to increase the inventory to enable the UK to maximise the TacTom load-outs in *Astute*. In TELIC, the UK had three SSNs on station. Assuming the UK was able to put three boats on station in similar circumstances in the future, the UK does not have enough TacToms in its inventory to fill up to 75% of the stowage capacity with strike weapons.

With the emphasis on land-attack capabilities for all elements of the force structure, the land-attack capacity of *Astute* could be augmented with the addition of a VLS. This could be done in three ways. First, a bow-mounted VLS external to the pressure hull could be added – this would be similar to the Mk36 Capsule Launch System on US SSNs. Second, four *Trident* launch tubes could be fitted aft of the fin. Third, the MoD and industry are looking at new options for external stowage and launch of weapons in future underwater platforms. As far as the *Astute* programme itself is concerned, the design of Boat Four is too far developed to be able to consider a VLS fit of any description. However, beyond this the MoD and industry are still developing concepts and all options are open at this stage. It is worth noting, though, that a VLS system for a land-attack capability could be fitted to the Type 45 programme earlier than it could be for *Astute*. There is, however, no stated requirement for a VLS system in either.

Land Attack Beyond *Astute* and *Trident*: an SSGN for the UK?

As mentioned previously, the Royal Navy

and the MoD are facing significant funding challenges over several major programmes. The current Government appears to be committed to replacing the strategic deterrent, and debates are getting under way as to what that capability should be.⁶ Even without other programmes in the fiscal melting pot – such as the future carrier, Type 45 and even the British Army's Future Rapid Effects System (FRES) programme – in an era when defence budgets are about as big as they are going to get, it is hard to see where the UK is going to find the money to build two separate classes of nuclear-powered submarine. SSN force levels are also being reduced. The enduring requirement for a nuclear-powered submarine is clear: it meets the requirements for speed, global reach, stealth and invulnerability in support of conventional operations, and it provides the stealth and invulnerability essential to the assured capability of a secure strategic deterrent. But will the UK be able to develop a generic hull with modular capacities that would enable the Royal Navy Submarine Service to support both the national strategic deterrent mission and conventional submarine operations from a single pool of nuclear-powered submarine hulls?

Options for the US

The US SSGN concept is similar, with the SSGNs being retrofitted for modular SOF and land-attack capabilities. Under the 1994 Nuclear Posture Review, the US was



Tubes of USS Florida converted to carry Tomahawk Cruise Missiles.

able to reduce its SSGN levels from 18 to 14. Thus, it had the spare capacity at a time when increasing SSN operational requirements in other areas – particularly ISR operations – meant that the US had fewer land-attack platforms available. The conversion of the first four *Ohio* boats, under what is known as the Giant Shadow programme, is the USN's first step in the re-use and re-rolling of existing submarine hulls for new capabilities. The SSGN increases the USN's global poise and sustained precision land-attack strike capability. It adds, to a boat with the weapons-carrying capacity and dual-crew sustainability of an SSGN, the multi-mission flexibility and forward presence of an SSN – and all of this without buying a single new boat or missile.

With its large capacity, the SSGN concept

also affords an unprecedented opportunity to experiment with future system and weapons payloads – and thus with future capabilities and mission options.

The significant benefit of the SSGN concept, using the *Ohio*-class hulls, is the flexibility and volume of land-attack firepower that can be delivered. If fitted with the maximum TLAM load-out, one SSGN can deliver 154 TLAMs (an entire battle group's worth) in six minutes, quick reaction missiles that – as was seen in Kosovo and Afghanistan – could be put over target faster than an aircraft from a carrier deck and can, with TacTom, be re-targeted in flight. Re-configuring the *Ohios* has also seen a further 20 years of life expectancy added to the hulls which, along with the flexible capabilities, dramatically improves the platforms' value for money. The conversion programme is under way, with the four boats scheduled to enter into service from 2005 onwards. The cost is stated as around \$US3.8bn.⁷

The US is also having to consider options for its own next-generation strategic deterrent. In recent years, the US has worked to extend the life expectancy of its remaining 14 *Ohio*-class SSBN hulls, with the later boats in the class likely to be in service beyond 2040. Moreover, a decision on any replacement does not need to be made until after 2010, with platforms needing to be bought at a rate of one per year from 2023.⁸

However, the USN is also facing affordability challenges, again both across defence and within the Navy and the submarine service itself. Like the UK, it is faced with the question of whether it can afford two new classes of nuclear-powered submarine, beyond *Virginia* and *Ohio*. Not much is available in the public domain on its plans for a future SSBN flotilla.

Beyond *Virginia*, however, much is happening. For some time, the USN has been looking at options for extending the

class beyond the originally planned 30 boats to enable it to encompass technologies whereby boats can be fitted and re-fitted (with individual sections bolted in just behind the fin) with modular payloads relevant for each mission, whether special forces delivery, land attack or strategic deterrence. Even today, funding pressures have raised the question of whether the USN may look to start bringing in such concepts as early as Boat 10 in the 30-boat class itself.

Options for the UK

The UK is, indeed, maintaining a close watching brief on US developments in this area. However, the UK situation is somewhat different. The UK does not, at this stage, have a requirement for the kind of firepower delivered by the SSGN, nor does it have four spare boats. What is most relevant to the UK, though, is the use of a platform the size of a *Trident* submarine as a hull for carrying a variety of modular, flexible payloads at a time of reducing submarine force levels and increasing submarine costs. The UK currently has four *Vanguard*-class SSBNs to guarantee the national strategic deterrent with one boat seamlessly at sea on patrol, whilst the other three are alongside, in work-up or in long-term maintenance.

However, improved maintenance and availability processes, plus technological developments to improve the life expectancy of the reactor cores (and, thus, perhaps reduce the refit requirement) may increase options to make those three boats available for other roles. As yet, the UK has no stated requirement to replace its strategic deterrent. However, in the 2003 Defence White Paper, the Government stated that the discussion of the future of the UK strategic was a matter for the next Parliament. That Parliament is now here, and the debate in the media and in the MoD is well under way. The White Paper also mandated that UK SSN force levels will be cut to eight boats.⁹ Building a generic submarine hull would give the UK, based on current

planned force levels, a pool of 12 boats from which it could fit different boats for different roles for different times – including for strategic deterrence.

The development of modular payloads would mean that a boat or selection of boats could be fitted exclusively for the deterrent role, while others could be fitted for several roles concurrently. For either deterrent or conventional roles, the UK would have a larger pool of platforms available than it does now. A larger inventory for both SSBN and SSN roles would also maximise UK capabilities.

The size of an SSBN is dictated, broadly, by the size of the missile. The new *Astute* hulls have the same beam as the UK *Trident Vanguard*-class boats, which carry the D-5 missile. The US is currently working on a new version of the D-5, the D-5A and is also looking at options for fitting D-5 tubes into *Virginia*.¹⁰ Thus, it is reasonable to assume that *Astute* is big enough to carry strategic weapons if required, with the only changes to the hull coming in the form of the modular payloads. Perhaps *Astute* was designed with this eventuality in mind?

Developing an existing platform, such as *Astute*, for different uses would also certainly prove more affordable than building a new class of boat from scratch. Moreover, as with the US, there is no new class of submarine on the horizon beyond *Astute* and *Vanguard*. Nevertheless, the USN clearly believes it can fit strategic deterrent capabilities to *Virginia*. There is also the question of whether a common solution can be found between the two governments, navies and industries. Most intriguing of all is whether an altered deterrent posture and, perhaps, a reduced number of warheads and missiles might provide enough flexibility in the deterrent programme to consider a common hull.

There are, however, potential problems for the UK in a common hull, modular programme. First and foremost, to guarantee the surety of the strategic

deterrent, the security of the boat on deterrent patrol cannot be compromised. Thus, it cannot be dual-rolled on the same deployment for strike operations, for example, which would take it up-threat. There is also the question of signature detection: while each boat has a unique acoustic signature, boats in a particular class will have many commonalities in their signatures. Thus, the detection of any boat in the class, while undertaking conventional operations, risks compromising the signature of the deterrent boat. Any such re-rolling is not a simple matter, with significant technological and engineering issues to be addressed and work needing to be carried out either in home port or at select overseas ports.

There are also other ways to generate the volume of conventional capability demonstrated by the US SSGN concept, volume that the UK may require in the future. Such options include Unmanned Under Water (UUV) concepts such as mobile or pre-positioned underwater 'arsenal' ships loaded with strike weapons, or mother ships able to deploy smaller unmanned payloads. However, as with the US SSGN concept, the implications for a land-attack capability in using a *Trident*-sized platform are clear.

Conclusion: the Challenges to the UK Submarine Flotilla

The future underwater battlespace will need to provide a raft of capabilities able to meet different roles and deliver different effects. It is clear that affordability of future capabilities presents a major challenge for the MoD, and for the Royal Navy as they look to exploit the unique virtues of the underwater battlespace in delivering effect in support of the defence mission. However, one conclusion (amongst, clearly, many) surrounding the implications of declining force levels, a limited inventory in an expensive hull, the costs of nuclear ownership and the affordability of two new classes of nuclear-powered submarine is that a generic hull with modular payloads

might serve to minimise costs while maximising capability and, in particular, value for money.

Perhaps the real challenge for the Royal Navy Submarine Service, however, is the very nature of its job, being unable to talk much about operations about which little is understood. Yet, the underwater battlespace is an environment from which effect can be delivered which is unique, and which is important in both political and military terms. Moreover, in the contemporary and perceived future environments, the flexibility and firepower in nuclear-powered submarine clearly fit the bill when it comes to delivering effect and value for money. ■

NOTES

1. The first missile was a dummy round, but the second one was a Block III.
 2. Four US SSBNs – *Ohio*, *Michigan*, *Florida* and *Georgia* – are being converted. The USN has fitted SSBNs previously for special forces operations, when the *Benjamin Franklin*-class *Polaris* boats USS *Kamehameha* and USS *Polk* were retrofitted.
 3. The 'Giant Shadow' SSGN conversion programme permits different payload configurations that can be changed out either in home port or in selected overseas ports. All boats are to be fitted with SOF facilities, and two tubes in each are permanently modified for five-man lock-in/lock-out (LILO) SOF chambers
4. The three British submarines were HMS *Splendid*, HMS *Turbulent* and HMS *Triumph*.
 5. Indeed, in previous operations, the Navy found that the Advanced Tomahawk Weapon Control System (ATWCS) doubled up as a broader communications net.
 6. See, for example: Barrie, D. 'Going Nuclear: British Review Options for *Trident* Follow-on as Services Jockey for Position', in *Aviation Week & Space Technology*, 16 May 2005, page 35; Stephens, P. 'We Must Update the Nuclear Debate', in *Financial Times*, 24 May 2005, page 19.
 7. Polmar, *Op. Cit.*, page 72.
 8. 'Modified *Virginia*-class Subs Eyed to Replace Ohio-class SSBNs', in *Inside the Navy*, 18 October 2004, page 1.
 9. However, with only four *Trafalgar* boats to be retained and only three *Astutes* on order to date, there must be some concern that SSN force levels may drop as low as seven.
 10. 'Navy Studies Future Payloads for Later *Virginia* Submarines', in *Inside the Navy* (date unknown).

SSN	(Sub-Surface Nuclear submarine) – nuclear-powered (not nuclear-armed) fast attack/hunter killer submarine. Intended for conventional submarine roles
SSBN	(Sub-Surface Ballistic Nuclear submarine) – nuclear-powered and nuclear-armed submarine (for US and UK, armed with Trident D5 Submarine-Launched Ballistic Missiles – SLBMs). Intended for strategic deterrent roles
SSGN	(Sub-Surface Ground Attack – or Guided, depending on which definition you believe – Nuclear submarine) – a submarine with a dedicated conventional land attack role. The Soviets had SSGNs – Oscar-class. The US is now developing four of its retired SSBNs for this role
VLS	(Vertical Launch System) – a system which fires pre-loaded missiles vertically from the submarine. This can either be in an SSGN, through re-configured Trident tubes, or as with the Mk36 Capsule Launch System currently fitted to US SSNs
TTWCS	(Tactical Tomahawk Weapon Control System) – the fire control system for planning, executing and managing Tomahawk missiles and their missions
DDS	(Dry Deck Shelter) – a capsule fitted externally to the submarine casing the Special Operations Forces (SOF) use for exiting and returning to a submarine