



UKNEST response to HCDC

This paper is offered in response to The House of Commons Defence Committee news release No. 61 - **THE FUTURE OF THE STRATEGIC NUCLEAR DETERRENT: THE UK MANUFACTURING AND SKILLS BASE**. It provides a position statement on behalf of the **UK Naval Engineering, Science and Technology Forum** (UKNEST) following the request for evidence by the HCDC and focuses specifically on the intellectual resource base that supports this industry.

Introduction

1. This submission is made by the UKNEST forum. UKNEST was formed in 2005 with the overall objective *to provide a forum for the UK's professional naval engineering, science and technology community for addressing issues of common concern, fostering specific professional development needs, and giving a focal point for interaction with, and influencing the wider Government and industrial community.*
2. UKNEST comprises 19 organisations¹ representing most of the principal contractors and major suppliers to the UK submarine industry as well as MOD and professional bodies. UKNEST is independently chaired by Sir John Parker (former chairman and CEO of Harland & Wolff and Babcock International and currently chairman of National Grid plc). In the last year UKNEST working groups have focused on skills development and sustainment, science and technology pull-through, and design processes.
3. The vision of UKNEST is to *develop and sustain the vision and implementation of a world-class naval engineering, science and technology intellectual base in the UK.*
4. The views contained in this submission represent a collective view from UKNEST and do not represent the specific views of any one of the member organisations.

UK submarine design, build and through life support

5. UKNEST member organisations employ the vast majority of people engaged in the UK submarine design, build and through life support communities, both industry and government, white collar and blue collar. These same organisations (including MoD) are also the owners and operators of the UK submarine infrastructure including facilities, tools and processes. Hence UKNEST can be seen to represent the major elements of the UK submarine industry.

The Nuclear Submarine Challenge

6. A nuclear submarine is unique in its technological and engineering challenges. The combining of a nuclear reactor, highly sophisticated sensors and weapons, a large crew self-supported for months, operating underwater within a pressure hull sustaining high external pressures, undetected by others, and in a corrosive environment, is a massive challenge. The engineering design, production and through-life capability management of a submarine, especially to achieve an affordable product, which can be sustained economically through its 25-year service life, during which the central technologies will upgrade and the operational requirements will change, requires the application of a wide span of scientific, technological and engineering disciplines with practical domain experience. These include naval architecture, marine mechanical and electrical

¹ BAE Systems Naval Ships, BAE Systems Submarines, Rolls Royce, Devonport Management Ltd., QinetiQ, BMT Defence Services, Systems Engineering and Assessment, Ministry of Defence, Institute of Marine Engineering Science and Technology, Weir Strachan and Henshaw, Aveva Solutions, Babcock, Royal Institution of Naval Architects, Converteam, VT Shipbuilding, Lloyds Register, Thales, L3, Atkins.



engineering, systems engineering, electronics, acoustics, nuclear engineering, metallurgy, atmosphere chemistry and many others. Much of this technical expertise and associated domain experience in the UK is provided by UKNEST member companies.

7. Whilst some aspects of submarine engineering utilise general fields of engineering and production, there remain a number of specialist skill sets only utilised fully in the submarine business. Examples include nuclear shielding (a problem not shared to anything like the same extent as civil nuclear), pressure hull technology, survivability in an underwater attack, atmosphere control engineering, underwater communications, special acoustic and optical sensors etc. The engineering challenge is further compounded by the highest safety demands for maintaining these underwater vehicles safe to operate throughout their long service life thus dictating the need to design for support at the outset and the requirement for additional unique skills and competence for the specialist down-stream maintenance, update and upgrade activities.
8. The challenge outlined above is captured well by the Defence Industrial Strategy (DIS)² and is a key part of the specific Maritime Industry Strategy. We have learnt expensive procurement lessons recently from the development of the new Astute submarine following an extended period of low activity after completion of the Vanguard submarine programme. Many of those involved in the latter retired or left the industry prior to the Astute project and many of those remaining had little opportunity to maintain their domain experience. Perhaps of most concern was the lack of opportunity to develop the next generation of submarine scientists and engineers to sustain the UK capability in this area. The Astute project coupled with the on-going support and upgrade of the in-service flotilla has precipitated significant regeneration of UK sovereign capability over the past few years. Now, with the Astute submarine in mature design and production the future sustainment of our sovereign capability is a focus of serious attention. This capability must not only provide a basis for maintaining military superiority through technological advantage, and satisfy the safety demands, but is now fundamental to reduction in submarine costs to allow the UK to continue to run an affordable submarine programme for the deterrent.
9. It is important to understand that all of the above comments apply across the supply chain, from the platform designers and manufacturers to the organisations providing the major submarine bespoke systems and down to specialist 2nd/3rd tier equipment suppliers, and the MOD customer communities. Success can only be assured through sustainment of sovereign capability across the submarine enterprise.

Submarine Technology

10. The Defence Technology Strategy (DTS), produced as part of the DIS in the maritime sector with maritime industry input from UKNEST, has recognised the key enabling technologies for UK submarine design, build, operation and support and these are captured in the following table:

Combat and platform systems integration	Design and systems integration skills. Includes manufacturing, assembly and testing technology for submarines and their disposal
Atmosphere control	Design and systems integration, performance assessment and understanding of civilian legislation applied in a submarine context.

² "It is a high priority for the UK to retain the suite of capabilities required to design complex ships and submarines, from concept to point of build; and the complementary skills to manage the build, integration, assurance, test, acceptance, support and upgrade of maritime platforms through life"



Signatures	Design and systems integration skills; threat analysis; design and manufacture of acoustic signature materials and other quietening techniques.
Hydrodynamics	Design, and in-service support for submarine propulsors and the safe operation of underwater systems.
Sonar	Design and systems integration skills, signal processing,
NSRP	Design and systems integration skills; manufacturing
Underwater networks	Design and systems integration; signal processing, security, architectures

Sustainability

11. To retain the key skills necessary to ensure UK sovereign capability requires investment to regularly exercise these skills, to fund innovation and experimentation, to recruit new blood and develop existing professionals. The DTS acknowledges the following requirements for sustaining UK sovereign capability in submarine design and build:
 - Maintain the skills needed to design, build, maintain and upgrade ... submarines, cost effectively;
 - Maintain the skills required for upgrade and integration of the many associated mission systems;
 - Technical skills to be regularly exercised. Areas of particular importance include atmosphere control, hydrodynamics, propulsion systems, torpedo detection, characterisation, location and countermeasures, sonar and signature control.
12. MoD funding on future submarine design (i.e. beyond Astute Class) has been limited in the last five years. Whilst there has been some recent activity which has offset this trend it is the case that UK-based skills have not been exercised adequately this century to sustain capability. There are clear signs that knowledge and experience required for a new submarine programme are now short in supply. Some of this is in the detailed technology areas indicated in the earlier table and in the employ of UKNEST members. Some of these skills have been retained only by company self-investment, either alone or as additions to MoD-funded work. There is no lack of willingness in UK industry to sustain the necessary skills, provided sustainable business opportunities are forthcoming. It is recognised by UKNEST that sustainability may be achieved better through improved integration and exchanges between the build, manufacture and through life support delivery teams.

Workload

13. Critical to providing the above requirements is a need for predictable and regular workload across the entire research, design, build and through-life support lifecycle, recognising the opportunity for transferable and transversal skills. Significant gaps in work are likely to lead to under-utilisation of skills and commercial business pressure for redeployment or redundancy. The economic effects of such action will be felt by both industry and government. There is evidence that the downturn in work between the Vanguard and Astute Class submarine programmes led to a shortage of some key skills which has still not been fully recovered and which, as a consequence, impacted the Astute project costs and timescales. This situation can be overcome by a more level and visible base workload or regular design and build "drumbeat", as proposed by the DIS. Within this it is necessary to determine the base workload as distinct from the total volume. It is also necessary to



ensure adequate balance across all elements in the submarine enterprise; for example, there is no point in having 200 people busy in manufacturing and yet nothing in sonar, signatures, escape & rescue, hydrodynamics, etc. In short, the message is that a small investment cost per annum in levelling the workload for sustainment reasons will save a significant re-instatement cost in recovering key skills and competence through a more sporadic workload approach.

Innovation and Wealth Creation

14. UKNEST views submarine design, build and through-life support holistically as being part of all the lifetime activities from research through to disposal – this is the responsibility of the collective submarine enterprise. Recent work by the UK MOD Research Acquisition Organisation in developing the UK Defence Technology Strategy has identified a strong link on how spending in Research and Technology (R&T) has a direct impact on delivered military capability. This reinforces the holistic view and that submarine capability is a continuum from R&T through to the practical engineering for realising and sustaining deployed submarines with a long service life. The real reductions in government spend on underwater R&T (70% over 10 years) must be reversed if the UK is not to lose any military advantage.
15. Innovation to enhance capability arises from R&T, Academia, professional engineers working in design and support, etc, in other words the intellectual capability within companies and Government. One must be careful to avoid missing the key innovators and engineering experts who can realise an affordable product (measured in low hundreds of people) when considering the whole submarine enterprise (measured in high thousands).
16. Submarines depend on a number of domain specific niche technology areas, which are not shared easily internationally and with other industrial domains. It has been suggested that the total “intellectual” core capacity necessary to sustain the necessary UK submarine enterprise sovereign capability is in the region of 250 to 500 professional engineers and scientists. This represents a small proportion of UK defence enterprise resource but one which is strategically important in the context of this inquiry and in its ability to provide greater wealth creation for the UK.

Other UKNEST member company engagement in the future of the strategic nuclear deterrent

17. UKNEST is aware that the MoD Chief Scientific Advisor has assessed the structure, technology and viability of the UK nuclear propulsion programme and industrial base in the context of maintaining the capability to procure a successor submarine strategic nuclear deterrent if required. We understand that he aims to enhance and maintain the UK nuclear capability via the Nuclear Propulsion Capability Programme (NPCP) and that this will be the subject of a separate submission by Rolls-Royce.
18. Other UKNEST member companies may also submit their own responses to this enquiry.

Further Contact

UKNEST would be pleased to provide further support to the Committee in respect of this inquiry. Contact details are provided separately.



Additional Information

Publication

UKNEST requests that this evidence is **not** published.

Originality

UKNEST confirms that this submission is original work by UKNEST and has not been previously published or circulated elsewhere. No public use will be made of this submission without the prior permission of the Clerk to the Committee.

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