



The Royal Academy  
of Engineering

# The Future of the Strategic Nuclear Deterrent: the UK manufacturing and skills base

House of Commons Defence Committee

October 2006

## **Introduction**

1. The Royal Academy of Engineering is pleased to respond to the House of Commons Defence Committee's second-stage inquiry into the future of the strategic nuclear deterrent focusing on the UK manufacturing and skills base. This response has been compiled from a number of contributions from Fellows of the Academy, all of whom have in-depth knowledge of the subject and many years' experience working in the field. In particular, it includes input from Fellows who were directly involved in the design and manufacture of nuclear powered submarines and input from Fellows involved in the civil sector who have provided support across both military and civil programmes.
2. The response concentrates on three main areas: the UK submarine construction industry; the Atomic Weapons Establishment (AWE), Aldermaston; and the relationship between civil and military nuclear fields.
3. The Academy would be pleased to provide oral evidence or supplementary evidence if this would be helpful to the Committee

## **UK submarine construction industry**

4. Submarine design, engineering, project management and construction represent an area of substantial complexity when compared with other engineering projects. There are particular challenges arising from the extremely constricted space of the hull envelope requiring particular skills in Computer Aided Design (CAD) and planning as well as advanced dimensional control issues resulting from the need for modular construction.
5. Thanks to a more or less continuous design and build programme of nuclear submarines from Dreadnought in the 1960s to the four Vanguards in the 1980s and early 1990s, almost all our submarines were built to time and cost. However, a change in government policy in the late 90s, which led to contracting out the design and build of submarines, along with a gap in the submarine programme, has resulted in a major decline in the skills required. Although many of the decisions taken during the 90s were well intentioned, the reality is that they failed to address the steps required to build on Vanguard expertise and maintain a national nuclear submarine capability and they resulted in very large financial overspends and delays. The important lesson is that continuity of both design teams and construction activity is vital if major cost and time overruns are to be avoided. This lesson is also valid in the civil sector where both utilities and vendors recommend construction of a series or fleet of one design to maintain capability and reduce costs. It is reported that the current issues with Finland's fifth nuclear reactor under construction at Olkiluoto are at least in part due to the industry relearning key project management and nuclear specific construction skills. France is choosing to proceed with the new follow on unit at Flamanville as a means to maintain skills and continuity of expertise.
6. In order to deliver affordable submarines to the Royal Navy within a sustainable business environment it must be recognised that the complexities of a nuclear submarine programme require a strategic approach from the MoD. This strategy should cover all aspects of design, procurement and manufacture with particular attention paid to the system integration capabilities, management and skills specific to submarine design such as CAD and safety. All these aspects have their own associated problems and considerations but they are all equally

important as well as being interdependent on each other. Competition alone is not sufficient to achieve results. What is needed is an integrated strategy involving all the interested parties from government and industry.

7. The recent decision to adopt a Defence Industrial Strategy (DIS) is a positive move towards addressing these issues and is welcomed. However care must be taken to avoid some of the mistakes made in the 1990s. In particular, efforts must be made to ensure the UK has the intellectual capabilities to undertake the necessary research along with the ability to manage such large scale and complex projects.
8. The DIS is also crucial if the UK is to maintain a strategic nuclear deterrent. However, if a decision is taken not to replace Trident, this would call into question the future of all the nuclear submarines in the fleet
9. It is also important to continue our collaboration with the US Department of Defense on the missile-related aspect of the submarine design, although increased industrial involvement may cause some security concerns. This must primarily be a government to government activity which has the potential to help in all aspects of the submarine programme.
10. With regard to the rationalisation of nuclear capabilities, it is important that expertise is maintained in the various centres currently active in the UK. These include the new build facility at Barrow, the refit facility at Devonport and the Royal Navy docks at Faslane as well as related sites such as the Rolls-Royce nuclear reactor establishment at Derby and the experimental centre at Haslar. It is possible that future submarine designs will not require specialised refit facilities, however, for the present these must be retained in order to maintain the Vanguard class submarines.

### **AWE, Aldermaston**

11. The Government's investment programme at the Atomic Weapons Establishment (AWE) Aldermaston is welcomed. It is seen as essential if we are to maintain the UK's nuclear weapons design and manufacturing capability not only for future systems but also for the maintenance and stewardship of our existing weapons stockpile.
12. It is recognised that the design and manufacture of nuclear weapons is a particularly specialised field and limited to a small number of countries. Continued investment is therefore seen as important to maintain the UK's political position within the UN.
13. The importance and success of UK/US collaboration on AWE programmes is also recognised and needs to be continued on the basis of scientific and technical knowledge in a wide range of capabilities.

### **Nuclear skills base**

14. Over the last 20 years there has been a massive reduction in the R&D associated with the civil nuclear sector. The privatisation of the electricity supply industry and the demise of the UKAEA as a research organisation removed a cornerstone of the R&D supply chain which impacted heavily on the academic sector in the UK. This affected the skill base available to serve both military and civil sectors

particularly in the area of reactor technology where skills are most at risk. The problem is compounded by Government's failure to deliver on its commitment to fund modest UK participation in relevant international R&D projects such as Generation IV, an initiative specifically designed to bolster both industry and academic skills. Capabilities most at risk and relevant to both civil and military sectors include, core physics and fuel technology, materials performance, water chemistry, criticality, thermal hydraulics and transient analysis, systems engineering and safety performance. Links between the civil and naval sector need to be encouraged through enhanced funding of generic research. This is particularly relevant in academia where important work on the fundamental understanding of mechanistic processes such as irradiation assisted corrosion and radiation damage can be carried out.

15. As a result of the aforementioned decline, the skills required in the design, build, operation and disposal of Naval Nuclear Propulsion Plant (NNPP) are in short supply and increasingly expensive. Similarly, the number of Suitably Qualified and Experienced People (SQEP) is limited and seen as a concern within the nuclear defence industry, although efforts have been made to counteract this situation. Overall, the decline of the civil nuclear programme has forced the military nuclear programme, and in particular the nuclear submarine programme, to develop and fund its own expertise and personnel in order to remain operational.
16. Ultimately, a strong civil industry is very much in the interests of the military, and this may become the case in the future. However, with the prospect of a new generation of nuclear power plants it is possible that skills and knowledge from the military nuclear field, already in short supply, will be lost to the civil nuclear industry in the short term.
17. Therefore, if we are to maintain the civil and defence capabilities of the UK, it is vital that we increase the level of investment for education in nuclear engineering and safety and recognise the interdependence of universities, industry and defence establishments.

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