

**Replacing Trident**

October - Scottish Govt Summit Scotland without nuclear weapons - Neil Smith - Faslane Press Officer - "only replacing sub" - MoD line to play down - but plans affect all aspects of the system

*Submarines - Missile - Warheads - + Targeting*

**Submarines**

At a recent presentation BAe showed a

**Timeline for first of class**

*Concept Design (2007- 2009)* - In concept phase should consider mission and look at a number of options to meet this mission. This suggests that the MoD should not just be looking at practical options, but refining the mission, refining their role for NW.

*Initial Design (2009 - 2012)* - work on selected option

*Initial Gate (2009) -*

Des Browne: progress report to Parliament after the Initial Gate

Initial Gate is at end of concept phase; Autumn

*Detailed Design (2012-2016); Production Outputs; Build & Commission (2014-2022);*

Government have said *Main Gate (2012-2014)* - Substantial spend is after main gate - major chance to raise in Parliament; but should also try to have the issue properly discussed next year

**The replacement for Trident is part of a Wider nuclear-powered submarine programme**

*Astute* build programme - 3 on order, plans for 3 or 4 more

*Future Maritime Underwater Capability* - to be nuclear - build 2030 + nuclear-powered sub force is shrinking: 1989 -16, today-13; 2018-12.

Economies of scale - smaller force is more expensive per vessel.

The Options **for successor** are- *PWR2 or NNGPP*

RR Steve Ludham, President Nuclear Business, RR, argued for NNGPP at Def Com 7 Nov 2006

Navy Rear Admiral Matthews DGSM has argued for new reactor at presentations in June 2007 and Jan 2008.

**New Generation Nuclear Propulsion Plan**

- "a new design of reactor would aim to avoid pumped flow systems"

Steve Ludham RR operate without coolant pumps

"a modern and much simpler plant" Rear Admiral Matthews

NNGPP for Successor & FUMC

The first sub with a passive cooling system was USS **Narwal**

USS Narwhal commissioned 1969, quietest sub in Navy; operate without coolant pumps. In looking 50 years ahead MoD will be concerned about potential for subs to be detected - making quieter will be important - new reactor

Prototypes - HMS Vulcan Dounreay, PWR 2 6 yrs before VAN in service - NNGPP programme will be earlier than sub

### US help with successor

BAe systems – “we are keen to work with the US in all appropriate areas”

The Royal Navy are not just planning to have the new nuclear armed submarines but to maintain **Continuous nuclear Patrols at sea**

*On on patrol; alert measured in days; non-verifiable (not Russia but US)  
Admiral Matthews – “our planned future programme should take us up to 750.”*

The Navy have maintained CASD with 300 patrols over 40 years, they plan to continue this with a further 450 patrols, suggests 2060 +;

Dealerting is one of the calls of Perry, Shultz, Kissinger, Nunn etc-

If subs not on constant patrol – could remove some warheads – postpone replacement decision – wide range of options would become possible – would be a major move on the path towards disarmament.

UK Lowered alert state – several days - alert state can be increased to 15 minutes at any time; & only US can verify; Russia will assume 15 minutes  
Des Browne’s plan for UK to be a disarmament laboratory – should look at dealerting nuclear submarines;

The nuc powered sub fleet requires a shore based **Infrastructure**

*Devonport*

Will be doing refits, but not refuelling.

*Derby*

Fuel core fabrication plant due for decommissioning in 2017 – replacement expensive, Admiral Matthews indicates that this can’t be justified by successor alone.

Sub numbers have been reduced – but not infrastructure costs –

Admiral Matthews – “we must drive down infrastructure costs, if we are to have an affordable future”.

*Faslane; shiplift*

possibility of replacing shiplift with dry dock raised – but subject to Scottish Government planning controls – and Scottish Government could block, if there were legitimate planning grounds.

*Coulport EHJ* – handling missiles and warheads- accident risk

*Dounreay* - New prototype ? – planning – Highland Council & Scot Govt - & might need to start soon.

This raises the **Scottish Question**

*14 June 2007 the Parliament ... calls on the UK Government not to go ahead at this time with the proposal in the White Paper, The Future of the United Kingdom’s Nuclear Deterrent”*

For – SNP, Lib Dem, Labour rebels – 71; against Cons 16; 39 (Lab) abstained, 2 did not vote. – clear position by clear majority.

Scottish Government Working Group

*If not Scotland where* – Falmouth 1963 option. Expensive and controversial. Navy concentrating all submarines at Faslane, not thinking of moving. White Paper ruled out all options except submarine force. No nuclear weapons in Scotland – no British nuclear weapons.

Next area is **Missiles**

### **US Underwater Launched Missile System**

*New missile for new submarine – in service 2029.*

*Systems Analysis [?] concept studies since [?] 2007.*

*Strategic Advisory Group* established a “Next SSBN Task Force” the full group was briefed by this task force in November 2007, but it would appear that this meeting did not set the specification for ULMS – it called for further studies and research.

### **(Missile Options)**

new Br sub 2024-60 ?

Trident USN to 2042 when last Ohio class decommissioned

ULMS USN 2029 on; in time for 4<sup>th</sup> new British sub, if ordered.

### (UK options)

Blair letter to Bush – option keep Trident throughout life of new sub

But – USN plans to decommission Trident in 2042

If Royal Navy kept Trident beyond then then UK would have to pay for substantial infrastructure in US.

In 1982 UK opted for Trident D5 rather than C4 to avoid having a missile in service beyond US Navy.

So Navy will want ULMS. If they are going to buy it there will be an argument to do this sooner rather than later. White Paper “2030s” may be misleading. Could have ULMS for fourth successor submarine when it enters service.

There is an Anglo-American Joint Task Group which oversees the Polaris Sales Agreement, it meets three times each year. ULMS was on the agenda at all of their meetings in 2007.

### **Will ULMS fit ?**

*Bush to Blair Dec 06 – “any successor to the D5 system should be compatible with, or be capable of being made compatible with, the launch system for the D5 missile”*

*Contract for test bed for ULMS –*

*“concepts for future submarines may have missile tubes larger than 87 inches in diameter”*

Missile diameter up to 120 in /Trident 83 in; weight up to 200,000 lb / Trident 130,000 lbs (Request for Information from Industry for a Launcher Test Stand – 7 Nov 07). Could relate to RV, Bus & range.

### Features of new missile

Poss inflight retargeting. Loitering inflight ?

## **Future RV**

*MaRV* - flaps to manoeuvre to make more accurate

*E2 for nuclear Trident* – 1 flight test; Congress didn't fund;

*revived for Conventional Trident*; 1 flight test at short range; Congress didn't fund;

*option for ULMS* Effect is to increase accuracy

*(operational independence)*

Whether Trident or ULMS Britain is tied to having a US missile system with restrictions that this brings -

Top Secret Annex to Minute of Chiefs of Staff Committee meeting 9 March 1971 about nuclear weapons policy, 5 copies only, to heads of each branch of services, Sir Charles Ellsworth is minuted as saying that without US cooperation "our Polaris deterrent force would become ineffective after only a few months".

## **Warheads**

*(1958 Mutual Defence Agreement)* In 1958 Br gained access to information on the design of US NW

mid 1960s Stocktake, *Solly Zuckerman*, Chief Scientific Adviser to MoD, told US nuclear scientists that UK was not interested in developing new warheads after Polaris, this led to a shut off of new information from US for several years,

*Polaris upgrade* – one factor was desire to design a UK system to unlock access to US information

*Peter Jones* – With regard to obtaining information from the US the criterion was whether the UK had done it themselves.

An early example of how the Special Nuclear Relationship works is the

### **First UK thermonuclear bomb**

*Grapple Y test* 28 April 1958 >1 Mt

However

*Grapple design not deployed*. Instead the Red Snow warhead was a copy of the *US Mk28*. (Primary - Peter (anglicised Python))

There is a Parent/child relationship between the US and Br– if scientists at Aldermaston do their homework then they will be given a treat – access to new US design. This is the "great prize". UK has to show we can do it before US hands over blueprints. Much UK design effort is only for proof, not production.

### **(Polaris, Chevaline, WE177 family of warheads)**

Research into archives by Brian Burnell (nuclear-weapons.info) and Richard Moore shows that Polaris, Chevaline & the RAF WE177 were all parts of a family of warheads, with similar key components.

*Polaris* (options Tsetse or Tony (Tseste with UK HE))  
*Polaris* deployed Jennie (US NG)  
 (Plus two *Polaris* primary tests to reduce Pu in 1964/65)  
*Secondary* Reggie based on *US W59 – Skybolt* (200 kt)  
 UK warheads – primary female names, secondary male names  
*WE 177B* Katie *Simon* 450 kt  
*WE 177A* *Katie A*(no secondary) 0.5 – 10kt RAF and Navy  
*Chevaline* *Harriet* hardened *Reggie*  
*Polaris* 3 warheads, *Chevaline* 2 200 kt  
*WE 177C* Surplus *Reggie* plus converted *Katie A* 200 kt

### Origin of UK Trident design

*"The UK produced a new design of nuclear weapon to coincide with the introduction into service of the Trident system. The warhead was designed and manufactured in the UK by AWE, Bob Ainsworth 26 March 2008*

National Archives "the warhead was *Anglicized* at AWE"  
 Historical record shows that Anglicization is adapting a US design for British production – issues have been warhead safety – substituting British explosive. Also in past Anglicization has meant modifying design to suit the smaller scale British production system.

*Four tests* of UK Lightweight warhead design 1978 – 1980  
 Yield c 50 kt, similar to W68 Poseidon warhead  
 Lightweight option for *Chevaline* + future system

Vik Macklen AWRE 23 Nov 1978 Lightweight warhead test 1979 – "If successful .. it would certainly *open the door* to far more exchanges with the Americans on their devices of a similar nature"  
 So the programme of tests gave UK access to information on US W76 design – which had higher yield 100 kt, than UK design.  
 1980 – 87 – 11 tests - bulk of these were for Trident (Def Com).  
 ie at least *6 tests for Trident*; suggests a different design

*UK HE*; *Polaris* family suggests *US secondary*

*although it was decided on cost-effectiveness grounds to procure certain non-nuclear warhead components from the United States."* Bob Ainsworth 26 March 2008

*US Components in UK Trident warhead* US AF&F US NG (sandia 2003 – supplied to UK); prob Gas Transfer System

Coming up to date -**Future of US nuclear stockpile**

*LEP or RRW*

Principle – replace some components, keep basic primary and secondary design, redesign components outside Nuclear Explosive Package

LE programs were established for several warheads –  
*B61 (freefall & 11 bunker buster);*  
*W80 (Cruise);* cancelled funding diverted to RRW  
*W76-1 [cost timescale]* This will be complemented by RRW if/when it comes on stream. W76-1 would be cut short when new warhead is available.

Advocates of **RRW** say -  
*Increased reliability ?* – therefore fewer (not UK)  
*Increased safety* – eg IHE – reduce consequences of accident  
*Increased security* – use control  
*Increased weight and size*

### **US RRW**

March 2007 *Livermore WR1 design selected [date]*  
*Congress – 2007 – no funding for FY 2008*  
*but Advanced certification* – to deal with issues raised in report by JASONs  
*Admin – request for FY2009 – STRATCOM and NNSA both committed to new warhead*  
Likely to be some ongoing work, but not full scale programme.  
Push decision beyond Presidential election

*Reviews – Congress 2008; Policy 2009; Posture 2010*  
Therefore US decision delayed possibly until 2010.  
As Britain will follow US lead + tied to US policy – these reviews will have a significant impact on Br Nuclear weapons policy.  
How can we have an impact on this process ?  
How can the question of US support for Br NW be brought into these reviews – one element in Congressional review is impact of US nuclear policy on its allies.

### **Options for British warheads**

“Decisions on whether and how we may need to refurbish or replace this warhead are likely to be necessary in the next Parliament” White Paper

UK is working in parallel with US , “High Surety” phrase used and possible name for warhead.

*Life Extension or High Surety Warhead*

**But** *there is a current Refurbishment programme since 2000, 2001 UK statement* – the overarching objective of the UK NW programme was to keep the Trident warhead in service over a period much longer than its originally intended service life.

Britain will follow US lead

## **UK High Surety Warhead**

*Features – IHE, Fire Resistant Pit, No Beryllium*

*Options – Modified Trident,  
Modified TD127 (TASM),*

In 1980s in addition to developing Trident AWE also conducted several tests for an RAF weapon. This design had its origins in the late 1970s. It may have been adapted from the lightweight warhead design.

*Anglicised WR1*

For next warhead Aldermaston has particular problems. US design competition. Tom D'Agostino, head of NNSA, said he chose the LLNL design because it had been tested. While certification of the new warhead would be using computer simulations based on new research facilities – there remain questions over this – so a relevant historical testing basis is crucial.

*Test record – None, ??, US W89*

Anglicised US warhead s most likely

– depends on US decisions, poss not till 2010.

Prob – AWE new design but not build – so US offers WR1 design – if US offers UK would not reject, because they might not offer in future.

- UK effort will be driven by the notion that US nuclear assistance is the great prize and by fear that this might be lost.

**(warhead components)** An NW is a complex assembly – look at how some of the main components would be affected by LE & new warhead programs

**RV casing** *LEP Mk4 New Mk5 larger heavier fewer per missile [nos]*

### **PU pit**

JASON's pit life 60 years plus

New – Fire Resistant Pit

### **Pit tube**

Replace stainless steel pit tube.

### **Tamper & reflector**

*LEP Be – light and rigid but toxic, New substitute heavier*

### **High Explosives**

US – PBX9501 – proven 30 year life

UK – EDC 37 – poss 16 years; several refurb

New – IHE larger & heavier

**Detonators** *LEP replace New Optical initiated firing system (laser)*

## **HEU**

JASON's HEU life 60 years plus; US – refurb work at Y 12;  
New replace

## **Interstage**

Separating Volume, Radiation Channel  
Channels energy from Primary to Secondary – direction & time ?  
Fogbank story – in UK ?  
Be used  
New – substitute Fogbank and Be

## **Radiation case**

*LEP* - “enhanced collaboration” programme between AWE and LANL on radiation cases.  
*New – simpler design*

## **AF&F Job Vacancy**

PQs – initially refused to say  
Feb 2007 Job description released [detail – 2 versions]  
- Guardian front page on day of Trident replacement vote 14 March.

## **Mk4A AF&F**

*Key part of US W76-1 upgrade*  
*Advanced fusing options* – similar to W88/Mk5 path length fuse ?  
*Increased targeting flexibility and effectiveness* [source]  
Hans Kristensen - *Increase the warfighting effectiveness of D5 missile*  
Increased accuracy – means can attack more targets – bunker/silo – 2 or more NW, if more accurate can use 1 – and so destroy more targets with same number of weapons – counteracts effects of reducing numbers of NW.  
Des Browne admission & letter to Nick Harvey in 2007 – introduced over next decade – ie *before 2017*; “replacing obsolete component”, refuse to acknowledge improvement in capability.

*New – new AF&F*

## **Neutron Generator**

US – replaced with MC4380 in earlier upgrade  
UK – also replaced, supplied from Sandia in US in 2003  
new – new NG

## **Gas Transfer System**

US – Acorn introduce 2000 plus  
UK – New GTS only entered service around 2005, probably original Acorn W76-1 Acorn 2.  
New – new design

The *timelines* for the British and US warhead progs are not identical ...  
US – Extending life to 60 years, with LEP work at ½ way, 30 years.  
UK – Warheads built 10 years later than in US. Warheads won't be 30 years old until 2024. But some refurbishment will be done sooner, probably one refurb shortly and a second later, if no RRW.



### **Modernisation of AWE**

The clearest practical sign of the intention to keep Br NW for another 50 yrs is at AWE

23 new build projects; substantial refurbishment; 2005 – 2015 + Orion some operational capability 2010

*Hydrus* 3 axis hydrodynamic facility; first axis 2015

*High Explosives Fabrication Facility*; Planning permission approved

*Uranium Production Facility* Secondary/Fusion component: US equivalent 2018 \$3 billion ?

A90 main pu pit production plant *refurbishment*

A45 current HEU plant *refurbishment*

*Supercomputers* Aim Petaflop computing [dates]

*Burghfield* Safety issues with old Gravel Gerties *new facility proposed*

### **AWE budget**

Has risen from £493 m in 2005/06 to £800m this year and is due to rise further to £950m in 2010/11. Increase due to modernisation of the site, although split 2008/11 not published. Most of these modernisation costs from main MoD budget, at expense of conventional forces, not new money.

### **Tritium supply**

*half-life 12 years*; reduce stockpile to 6% by 2054;

*previous sources* – Chapelcross Production Plant – closed;

old warheads – Chevaline & WE 177 all dismantled;

*New source* – *new facility* – *next to new power station* ?

MoD silent about plans

### **(Lower Yield Warhead)**

White Paper *continued availability of a lower yield warhead ...*

PQ – *yield fixed determined at time of manufacture*

With lower numbers of warheads US expected to look at variable yield on missile warheads (currently only on bombs); possibly exploring for W78 minuteman ICBM warhead;

### **Targeting**

Image from War Game film – computer system at STRATCOM which can automatically start nuclear war – list of games from chess and poker to “Global Thermonuclear War” – in the film a child is able to use the computer to save the world.

### **Transfer of US Targeting data**

*Oplan 8044* replaced SIOP *sanitised UKLO*; *SACEUR* (also Cdr USEUCOM); *NOTC*; *SWS IPT*

### **Corsham**

**Corsham** miles of underground quarries / bunkers

**Site 3** Cold War bunker for PM and Queen; no longer active

**Defence Communications Service Agency HQ** controls comms from Northwood; hub of UK comms; controls transmitters to sub

**Corsham Computer Centre** Trident targeting computer systems

**Targeting System** target planning (Corsham) & fire control (submarine)  
Data produced on *tapes* and radio message *target change message*  
Target planning system and fire control very complex; 2 systems have to work together; missile system is American, including fire control computers; Corsham houses some hardware from US

### **Targeting System upgrades**

*SLBM retargeting system started 1989, completed 2003 quickly, accurately & reliably retarget missiles to targets process increased number of targets*

*supports adaptive planning – not just pre-arranged targets, but emerging targets*

*SLBM Planning & Operational Flexibility (SPOF)*

*follow on to SRS; current US budget funding 2010 –12:*

*budget says – improve flexibility & responsiveness:*

*enhance accuracy & effectiveness – Prob linked to Mk4A AF&F*

*- suggests UK will copy*

SRS was a substantial upgrade in capability; SPOF will take further – ability to rapidly retarget Trident

So far no direct evidence beyond SPOF – but can be expected that the US & UK will continue further down this road – and that ULMS would have more flexibility, accuracy & effectiveness than Trident.

US & Br NW are being enhanced – not by having more bombs or bigger bombs – but by improving the software – this is having a substantial effect on the capability of the weapon systems, especially Trident.

### **Fire Control hardware upgrades**

Mk 98 FCS, upgraded, US contractor General Dynamics produced 2 versions: Mod 4 for US subs, Mod 5 for British subs, both entered service in September 2003. This was crucial part of SRS, replaced old computers with PC-based system.

General Dynamics now developing a new computer system, Mod 6 for US subs, Mod 7 for British subs; UK version to be in service in 2010.

*- further upgrade in capability*

Regular software upgrades approx every two years;

current focus is on developing software for the new hardware;

US and UK versions produced each time.

### **Targeting software for UK Trident**

*Software for US Trident Items highly classified US-eyes only removed*

*Combined with software components created in Britain;*

*US could cripple software to restrict use*

Recent problems with computer software at Terminal 5 Heathrow – had to resort to manual alternative – there is no manual option for Trident.

## **Scenarios for use of British nuclear weapons**

### *NATO*

Blair to Bush Dec 06 – “a future UK deterrent submarine force .. will be assigned to the NATO, and will be used for the purposes of international defence of the Atlantic Alliance”.

1980 report by Quinlan on why Trident was needed – “The decisive consideration in favour of an independent British capability is the contribution that it makes to NATO’s strategy of deterrence”. – the same cannot be said today.

2007 Kevin Tebbit, ex PUS MoD – “preservation of NATO’s nuclear posture remains formally one of our reasons for possessing the deterrent. We say that we are still helping to defend countries who have foresworn any nuclear weapons themselves, notably Germany. It is unclear how far we shall be able to emphasise this dimension as we go through the public debate over the next few years”

### *independent attack;*

Blair to Bush Dec 06 – assigned to NATO “except where the United Kingdom Government may decide that supreme national interests are at stake”.

Michael Quinlan 1980s NATO nuclear exercise – SACEUR wanted deep nuclear strike – asked US – denied – asked very senior British officer – his response was that if US had refused to release NW then Britain would have to refuse as well. Quinlan was shocked – this undermined the whole concept of independent nuclear deterrent.

### *bilateral*

capability is for bilateral

## **Closing Points**

*Dependence on American support*

*Now at the early stage of a long-term plan*

*Need for greater transparency costs Aldermaston*

*Endangered Species* (Admiral Matthews re nuclear submarines- because of cost) Archives show there have been times when future of Br NW has been at risk – eg in early 1970s Conservative chancellor Tony Barber had doubts about its affordability.