

Bad Posture

UK nuclear warhead numbers and the Integrated Review

Nukewatch



Nukewatch monitors movement of weapons of mass destruction in Britain. More information can be found at nukewatch.org.uk

Aim of the paper

This paper is published in the aftermath of the UK government's 2021 Integrated Review of Security, Defence, Development and Foreign Policy to help readers interpret statements in the Review relating to UK nuclear warhead stockpile numbers and the announced increase in the warhead stockpile ceiling.

It reviews the recent history of UK government announcements on warhead numbers and compares these with trends observed by Nukewatch UK based on our monitoring of warhead convoy movements over the last decade. We provide an assessment of current UK warhead stockpile numbers based on our observations and conclude that the increase in warhead numbers inferred by the Integrated Review has, in fact, already been largely achieved as a result of a continued build-up in warhead numbers over the last five years.

UK government statements on warhead numbers

Over recent years the UK government has published indicative figures on the numbers of warheads in its nuclear stockpile. In 1998, the Strategic Defence Review undertaken by the then Labour government stated that the UK needed "a stockpile of less than 200 operationally available warheads".¹ The Labour government's subsequent White Paper on the future of the Trident nuclear weapons programme, published in 2006, stated that "We are reducing the number of operationally available warheads from fewer than 200 to fewer than 160, and making a

corresponding reduction in the size of our overall stockpile”.²

In 2010 the Conservative-Liberal Democrat coalition government provided greater transparency and committed to further measures to reduce warhead numbers in its Strategic Defence and Security Review, stating: “The Government has concluded that we can meet the minimum requirement of an effective and credible level of deterrence with a smaller nuclear weapons capability. We will therefore cut the maximum number of nuclear warheads onboard each deployed submarine from 48 to 40. Together with improved stockpile management, that will reduce our requirement for operationally available warheads from fewer than 160 to no more than 120. We will also reduce the number of operational missiles on the Vanguard class submarines to no more than eight. These changes will start to take effect over the next few years. This will enable us to reduce our overall nuclear warhead stockpile ceiling from not more than 225 to not more than 180 by the mid 2020s”.³

The Strategic Defence and Security Review published in 2015 by the Conservative government gave a slightly more limited declaration, stating that: “Submarines on patrol will continue to carry 40 nuclear warheads and no more than eight operational missiles. We will retain no more than 120 operationally available warheads and, by the mid 2020s, we will reduce the overall nuclear weapon stockpile to no more than 180 warheads, meeting the commitments set out in the 2010 SDSR”.⁴ No mention was made in the Review of a warhead stockpile ceiling. The Review also contained the caveat that “We will continue to keep our nuclear posture under constant review in the light of the international security environment and the actions of potential adversaries”.⁵

The Integrated Review of Security, Defence, Development and Foreign Policy published in March 2021 by Boris Johnson’s Conservative government took a different position, declaring: “In 2010 the Government stated an intent to reduce our overall nuclear warhead stockpile ceiling from not more than 225 to not more than 180 by the mid-2020s. However, in recognition of the evolving security environment, including the developing range of technological and doctrinal threats, this is no longer possible, and the UK will move to an overall nuclear weapon stockpile of no more than 260 warheads”.⁶ The Prime Minister has since said that that figure of 260 warheads “is a ceiling; it is not a target”.⁷ In an explicit step back from the limited steps towards increased transparency made in previous announcements, the government also stated that it would “no longer give public figures for our operational stockpile, deployed warhead or deployed missile numbers”.⁸

The Integrated Review also states that the UK will replace its existing nuclear warhead,⁹ as originally announced in February 2020 by the Secretary of State for Defence.¹⁰ According to the 2013 Trident Alternatives Review, “Experts judge that it is likely to take 17 years to design, develop, certify and produce a ballistic missile-based thermonuclear warhead, should one be required”.¹¹ The proposed new warhead would therefore not enter service until the mid 2030s at the earliest. At this early stage in development it is not possible to draw any conclusions about numbers, roles, or production of a new warhead, and so the proposed new warhead will not be discussed any further in this analysis.

UK statements on warhead numbers distinguish between “operationally available warheads” and a “stockpile ceiling”. We interpret “operationally available” warheads as those being available to the Royal Navy for deployment on board submarines. The margin above this has been defined by the government as the additional warheads “required to allow for routine processing, maintenance and logistic management so as to maintain the number of operationally available warheads at the required level”.¹² We interpret this as including:

- i) Warheads required as a contingency to replace those within the operationally available pool which may have become unserviceable or faulty.
- ii) Warheads within the servicing and supply cycle which are not available to the Royal Navy.¹³
- iii) Over past years, redundant warheads which had become surplus to requirements as a result of policy to reduce the number of operationally available warheads.

The number of warheads in this margin has not been revealed by the government.

Nukewatch UK observations and warhead numbers

The UK’s Trident nuclear warheads are manufactured and serviced at the Atomic Weapons Establishment (AWE), which is located at two main sites, Aldermaston and Burghfield, in Berkshire in the South of England. They are delivered by road convoy to the Royal Naval Armaments Depot (RNAD) at Coulport on the Clyde estuary in Scotland, where they are stored and loaded onto submarines for deployment at sea. Nukewatch UK has been monitoring warhead convoy movements since the 1980s.

The account below is based principally on observations of nuclear warhead convoy movements by Nukewatch UK, complemented by

deduction as to the purpose of each convoy journey and whether or not warheads were carried.¹⁴ It is important to note that our observations may be incomplete, and may not represent all warhead convoy movements, and that our deductions are based on assumptions that may not always be correct. The figures presented below can only be considered as indicative estimates, but they are sufficient to give a general picture of changes in the UK's warhead programme over the last decade.

Nukewatch UK's observations of warhead convoys movements during the 1990s, together with our estimates on the numbers of warheads carried in each convoy, suggested that between 200 and 260 Trident warheads had been delivered from the warhead manufacturing facilities at the Atomic Weapons Establishment to the RNAD Coulport store when bulk production ceased at the end of the 1990s. It is possible that 'trickle production' of warheads continued at a rate of one or two warheads per year after bulk production ceased in order to retain warhead production skills at AWE. Our figure is broadly consistent with the warhead stockpile ceiling of not more than 225 which was disclosed in the 2010 Strategic

Year	Warheads delivered to RNAD Coulport	Warheads returned to AWE Burghfield	Difference
2010	1	1	0
2011	0	4	- 4
2012	2	5	- 3
2013	2	4	- 2
2014	6	9	- 3
2015	6	5	+ 1
2016	34	28	+ 6
2017	14	9	+ 5
2018	12	9	+ 3
2019	15	6	+ 9
2020	22	9	+ 13
Total	114	89	+ 25

Table 1. Comparison of warhead numbers delivered to RNAD Coulport with numbers returned to AWE Burghfield over the period 2010 – 2020. Numbers shown are Nukewatch's best estimates of warheads transported during each year as presented in annual logs of convoy movements.

Defence and Security Review.

Taking a figure of 225 warheads as a baseline, it is possible to estimate the number of warheads currently in the UK stockpile by examining the net numbers of warheads subsequently moved from AWE to Coulport annually as monitored and reported by Nukewatch.¹⁵ Table 1 shows the numbers of warheads transported to and from each site for each of the calendar years 2010 to 2020.

There is a distinct difference in the pattern of warhead movements during the first half of the period from 2010 – 2020 and during the second half. These patterns are explored further in Table 2.

Years	Number of warheads out of / into stock		
	Minimum estimate	Nukewatch best estimate	Maximum estimate
2010 - 2015	8 out of stock	12 out of stock	16 out of stock
2016 - 2020	24 into stock	37 into stock	64 into stock
Aggregate: 2010 - 2020	16 into stock	25 into stock	80 into stock

Table 2. Comparison of warhead numbers taken out of and introduced into the Coulport stockpile for the first and second half of the period 2010 – 2020.

Numbers shown are calculated from Nukewatch’s minimum, maximum, and best estimates of warheads transported during each year as presented in annual logs of convoy movements.

Table 2 shows that during the early 2010s there was a small but ongoing reduction in numbers of warheads in the UK warhead stockpile held at Coulport. Extrapolating into the future, if continued this would have been of the order necessary to reduce the warhead stockpile by 45 warheads by the mid 2020s, as pledged in the 2010 Strategic Defence and Security Review.

From 2015-6 onwards this trend is reversed, and there has been a net transfer of warheads from AWE to Coulport, resulting in an increase in the stockpile held by the Royal Navy. There has been a marked upturn in the rate of delivery of warheads from AWE to Coulport over the past two years, 2019 and 2020.

In 2007 it was revealed that the UK government intended to upgrade its Trident warhead and purchase a new Mk4A arming, fusing, and firing system for the warhead from the US.¹⁶ The Mk4A system increases the effectiveness of the warhead by ensuring it detonates at the optimum point

above ground during its downwards trajectory, allowing it to destroy hardened targets.¹⁷ The corresponding US programme, the W76-1 / Mk4A life extension programme, has been described as “a tip-to-tail complete redo of a system” by Keith Smithson of the National Nuclear Security Administration, and is intended to extend the life of the warhead from twenty to sixty years.¹⁸

Nukewatch believes that in 2015-16 AWE commenced delivery of the Mk4A upgrade of the UK Trident warhead to the Royal Navy, and that increases in the stockpile observed since 2015-16 represent deliveries of newly manufactured Mk4A warheads. Details of the Mk4A programme, including its costs and delivery dates, remain secret, but the programme was approved in 2006¹⁹ and was first acknowledged by the government in 2009,²⁰ with production of the Mk4A warheads apparently commencing some time after July 2014²¹ and before December 2017.²² An upturn in the number of warheads delivered in 2016 corresponds to the re-entry into service of HMS Vengeance, following the submarine’s Long Overhaul Period (Refuelling) refit at Devonport naval base and presumably represents delivery of the submarine’s complement of Mk4A warheads. Nukewatch speculates that the Mk4A bulk production programme will end some time in 2021 - 2022 following delivery of Mk4A warheads for HMS Vanguard, currently in refit in Devonport.

During transition to the Mk4A warhead, the UK’s warhead stockpile has increased as new warheads have been delivered. Assuming a 2010 baseline of 225 warheads in the stockpile, on the basis of the assessment above Nukewatch estimates that the UK warhead stockpile as of December 2020 was between 241 and 305 warheads, with our best estimate as 250 warheads.

The inferences to be drawn from this are that the government has not provided a fully accurate picture of warhead numbers since the 2015 Strategic Defence and Security Review and that the increase in the stockpile ceiling announced in the Integrated Review has apparently been long planned and is already well on the way to being reached as a result of a secret increase in warhead numbers under way since 2015.

Commentary

There has been considerable speculation over the reasons for the increased warhead ceiling announced following the March 2021 Integrated Review. Although the UK government has given no rationale to explain the increase, the likelihood is that it is the result of a combination of factors, rather than for one single reason. Relevant factors are examined below.

Temporary stockpile increase

The increase in the UK warhead stockpile over the period from 2016 – 2020 has, Nukewatch believes, been the result of adding newly manufactured Mk4A warheads to the warhead stockpile at a faster rate than older Mk4 warheads have been withdrawn. Once the Mk4A programme is complete it is conceivable that the warhead stockpile could be drawn back down to a lower level. The government has given no indication of its intentions in this regard.

Technological threats

The Integrated Review states that warhead numbers are to increase in recognition of the “evolving security environment, including the developing range of technological and doctrinal threats”. Technological threats to the effectiveness of UK Trident could possibly include improvements in ballistic missile defence systems deployed by Russia, the principal rival against which Trident is intended to act as a deterrent. In an interview on the BBC television Andrew Marr Show on 21 March 2021 Defence Secretary Ben Wallace said that it was his role “to reflect and review what the Russians and others have been up to in the last few years. We have seen Russia invest strongly in ballistic missile defence they have planned and deployed new capabilities and that means if it’s [Trident] going to remain credible, it has to do its job. Fundamentally, we deploy enough [warheads] to make sure it is credible and if that takes an increase of warheads to do that...” He continued: “Quite a clear study of effectively how warheads work and how they re-enter the atmosphere means you have to make sure they are not vulnerable to ballistic missile defence otherwise they no longer become credible”.²³

Open source information suggests that airspace defence is a Russian military priority and that Russia is expanding its missile defence infrastructure both geographically and in terms of new radar and interceptor capabilities, although there are questions about Russia’s capacity to produce such systems and their combat effectiveness.²⁴ An increase in the UK warhead stockpile, combined with improvements in targeting capability allowed by the Mk4A warhead, could be intended to increase the range of targets held hostage by UK nuclear weapons. The Mk4A warhead, with its new arming, fusing, and firing system, provides increased targeting capabilities, making the warhead more accurate and more effective against hardened targets.²⁵ This would broaden the range of targets that can be held at risk and perhaps allow the same number of targets to be destroyed with fewer warheads, since multiple warheads would no longer need to be assigned to critical hard target locations.

Doctrinal threats

There has been speculation²⁶ that the ‘doctrinal threats’ referred to in the Integrated Review refer to Russia’s alleged ‘escalate to de-escalate’ doctrine, under which Russia could use tactical nuclear weapons first during a conflict with NATO forces.²⁷ It is difficult to see how an increase in warheads, in itself, might counter this threat. The United States has developed and fielded the W76-2 low-yield Trident warhead to “address the conclusion that potential adversaries, like Russia, believe that employment of low-yield nuclear weapons will give them an advantage”.²⁸ Following the retirement of the UK’s Cold War WE177 tactical nuclear weapon, the UK for a time deployed Trident in a ‘sub-strategic’ role,²⁹ generally considered to be played by a UK Trident warhead without the tritium boost to give a lower nuclear yield. However, in January 2007 then-Defence Secretary Des Browne announced that “we have deliberately chosen to stop using the term ‘sub-strategic Trident’, applied previously to a possible limited use of our weapons”,³⁰ and the term has subsequently disappeared from UK nuclear doctrine. More recently, in response to a question about low-yield nuclear weapons capable of tactical use, the government has stated that “none of the United Kingdom’s nuclear weapons are designed for tactical use during conflict”.³¹

The US W76-2 warheads were manufactured by modifying a “small number” of existing W76-1 warheads to the new low yield specification.³² As a result, an equivalent number of W76-1 warheads are no longer available to the US Navy. It is possible that the increase in UK warhead numbers is intended to fill this gap and compensate for the small reduction in the US’s submarine-launched strategic nuclear capability, as part of the UK’s contribution to NATO nuclear targeting. As yet no evidence is available to either confirm or refute this hypothesis, although the numbers of warheads converted by the US to the W76-2 specification and the increase in the UK warhead ceiling appear to be of a similar order.

In terms of the UK’s own nuclear doctrine, ambiguity in the new position outlined in the Integrated Review could be intended by UK military planners to reinforce the UK’s deterrence posture.³³ Rival nations will be forced to consider what the new position means for them. Does the rise in warhead numbers mean a change in targeting policy? Does it indicate a return to an interest in tactical weapons? Is it intended as a response to changes in Russian nuclear doctrine and tactics, or is it something else?

Multiple simultaneous adversaries

Unexpected events in a region of strategic importance, such as the Persian Gulf could result in increased tension and military action which has the potential to draw both local actors, such as Iran, and external actors with interests in the region, such as the USA, Russia, China, and the UK, into a complex and rapidly developing crisis.³⁴ It is possible that the increase in warhead numbers may be the result of military planning intended to deter more than one adversary at the same time in such a situation.

Domestic politics

An increase in warhead numbers might be expected to be a popular move with the Johnson government's core supporters on the political right, particularly among Conservative Members of Parliament and much of the UK's print media. The focus on warhead numbers in media coverage of the Integrated Review has in part been at the expense of detailed scrutiny and critique of other controversial elements of the Review, in particular cuts in army personnel numbers, tanks, warships, and combat aircraft. It also provided a means to allow the government to highlight differences on nuclear weapons within the main Labour opposition party during Parliamentary debate over the Integrated Review.

Feasibility of increasing warhead numbers

Although the UK has said it will move to an overall nuclear weapon stockpile of no more than 260 warheads, does it actually have the capability to do this? As stated above, Nukewatch's best estimate is that the UK stockpile already comprises 250 warheads. Historically, AWE's predecessor establishments were able to produce WE177 nuclear weapons at a rate of between 2 and 4 warheads per month over the period September 1966 to April 1977.³⁵ During the period of Trident warhead bulk production Nukewatch considers that warheads were produced at roughly an equivalent rate to this, on the basis of warhead convoy movement records from the 1990s, and similar production rates appear to have been achieved for the Mk4A warhead over the past two years. Assuming production continues at the same rate, AWE should have no problems in bringing warhead numbers up to the 260 warhead ceiling if requested to do so by the government.

Over recent years AWE has experienced well-publicised difficulties in the construction of new buildings to replace ageing manufacturing facilities. Project Mensa, the new warhead assembly/disassembly intended to replace existing facilities at AWE Burghfield, was originally intended to

enter into service in 2017 but will not now open until 2023 at the earliest.³⁶ Another important facility, Project Pegasus, intended to deliver an enriched uranium storage and manufacturing capability, has also been rescheduled and the target for delivery of the first unit produced in Pegasus has been put back from 2019 to 2030 – considered “deliverable, although challenging”.³⁷ Until these new facilities open warhead manufacturing work can continue in existing facilities, albeit with a certain level of associated risk.

The supply of fissile material has historically been a limiting factor in the production of the UK’s nuclear weapons.³⁸ However, following the end of the Cold War the UK decommissioned its former WE177 and Chevaline nuclear warheads and now holds relatively large quantities of weapons grade plutonium and highly enriched uranium recycled from these legacy systems. The International Panel on Fissile Materials estimates that the UK’s stock of fissile materials is 3.2 tonnes of military plutonium and 21.9 tonnes of military highly enriched uranium.³⁹ The manufacture of new warheads should be possible without seriously reducing the UK’s strategic reserves of these materials.

Tritium gas is used to boost the yield of the fission primary for the UK Trident warhead. Tritium has a half life of 12.3 years and so the tritium content of the warhead needs to be regularly replenished. For the WE177 nuclear weapon the tritium reservoir was replaced at intervals of just less than four years.⁴⁰ The UK no longer has an indigenous capability to produce tritium and is likely to purchase tritium from the United States. However, the US has faced technical challenges in producing tritium, and production is now insufficient to meet the US’s own forthcoming needs. Programmes to ease the production shortfalls are not yet fully funded.⁴¹ This in turn raises uncertainties over the UK’s tritium supply over the longer term.

Conclusions

- UK government statements on warhead numbers are broadly consistent with Nukewatch UK’s observations of warhead movements over the period 2010-20.
- During the first part of the decade (2010 to 2015-16), the UK’s warhead stockpile was drawn down to a limited extent. This is assumed to be a move towards meeting the commitment in the 2010 Strategic Defence and Security Review to reduce the warhead stockpile ceiling from not more than 225 to not more than 180 by the mid 2020s.
- A build up of warhead numbers towards a new ceiling has been

underway since 2015-6. This is assumed to be the result of production of new Mk4A warheads. This trend has accelerated over the last two years.

- Assuming a 2010 baseline of 225 warheads, Nukewatch considers that the UK warhead stockpile as of December 2020 stood at between 241 and 305 warheads, with our best estimate as 250 warheads.
- The Atomic Weapons Establishment is in a position to deliver and maintain a stockpile of 260 warheads, although there are long term risks in maintaining an operational stockpile relating to the supply of tritium. The Prime Minister's statement that the figure of 260 warheads is a ceiling, not a target, provides the UK with some cover in the event of any future difficulties in maintaining a stockpile at this level.

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