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The funding of nuclear weapons in the Russian Federation

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The Russian federal budget is characterised by a high degree of non-transparency in relation to spending on defence and security. This particularly applies to the procurement of armaments and spending on the individual services of the armed forces. The funding of nuclear weapons is no exception. The available evidence is fragmentary and a considerable degree of estimation is required to obtain an overall total for spending on Russia's nuclear triad. For Russian specialists, this is a highly sensitive topic and the author is not aware of any published attempt to undertake this exercise within the country. Given the lack of transparency, the author has had no choice but to resort to the 'Sovietological' methods often necessary in the past to estimate economic data relating to the USSR – though this is a methodological issue, rather than a suggestion or foundation that Russia is "returning" to the USSR.

Before looking at the available data, it is necessary to examine the institutional structures for nuclear munitions and their delivery systems and then analyse the treatment of expenditure on these structures and how it is handled in the chapters and subchapters of the federal budget.

The institutions associated with nuclear weapons in Russia

The state corporation Rosatom is responsible for all development and production of nuclear munitions. This is the Russian successor to the Soviet Ministry of Medium Machine Building, the powerful structure, almost a 'state within the state', that was developed in the post-World War Two years for all military and civilian nuclear activities. From the outset, most work relating to nuclear weapons was undertaken within a network of closed cities subject to an extraordinary regime of security and secrecy.[2]

This remains true today, although the security regime is not as draconian as in the past. These were closed communities built around the research and production facilities engaged with nuclear munitions, usually in remote locations, surrounded by forests, and bounded by elaborate, secure perimeter fences with very strictly controlled entry and exit. Those living and working within the closed towns were subject to severe limitations

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[2] On the Russian nuclear industry and its Soviet origins see the authors, 'Minatom: the Last Soviet Industrial Ministry' in Stefanie Harter and Gerald Easter (eds.), *Shaping the Economic Space In Russia. Decision Making Processes, Institutions and Adjustment to Change in the El'tsin Era*, Aldershot: Ashgate, 2000. pp.147-162.

on their freedom of movement and contacts with the outside world but as compensation had pay, housing and social provision superior to the national average.

Within Rosatom the development and production of nuclear munitions is overseen by a directorate for the nuclear weapons complex headed by a first deputy general director of the state corporation, Ivan Kamenskikh. The directorate oversees the activities of 17 research and development (R&D) organisations and enterprises, which in 2016 were employing 95,230 people of a total Rosatom employment of 250,000.[3] Most of the organisations are located within ten closed cities, in Russia known as a 'closed administrative territorial formations' (ZATO – *zakrytoe administrativno-territorial'noe obrazovanie*), with an aggregate population of almost 750,000. The cities, their role and scale are shown in Table 1. Those working within the nuclear weapons complex are well paid by Russian standards and many of the personnel have higher education. The rate of pay in the complex is not known but for Rosatom as a whole the average monthly pay in 2016 was 69,700 roubles, compared with a Russian average of 37,709 roubles, but this was still only US$1,100 per month. While those working on nuclear munitions are likely to receive more, the figure provides an indication of the relatively low-cost nature of the Russian defence effort.[4]

Within the Russian Ministry of Defence (MOD) nuclear munitions are handled by the ministry's 12th main directorate, known for short as the 12th GUMO (*Glavnoe upravlenie Ministerstvo oborony*), responsible for their storage, transport and security. New munitions on leaving the structures of Rosatom are transferred directly to the arsenals and other storage facilities of the directorate. From here they are transported to relevant military units by 12th GUMO personnel, who are also responsible for their servicing and eventual dismantling. The directorate is also responsible for the Novaya Zemlya test site, formerly used for testing nuclear munitions and still maintained for research into non-nuclear explosions, and the Ministry of Defence's 12th Central Scientific Research Institute, concerned with the military uses of nuclear technology.[5] The current scale of the 12th GUMO is not known but in late 1998 it had some 30,000 personnel, of whom 45 percent were officers.[6]

[3] Number of organisations, Rosatom, *Publichnyi godovoi otchet za 2012 god*, p. 107; employment, Rosatom, *Godovoi otchet za 2016 god*, pp. 240-41. http://www.rosatom.ru/about/publichnaya-otchetnost/

[4] Rosatom, *Godovoi otchet za 2016 god*, pp. 211-3; Rosstat, *Srednemesyachnaya nominal'naya nachislennaya zarabotanya plata rabotnikov po polnomu krugu organizatsii v tselov poekonomike Rossiiskoi Federatsii v 1991-2017gg*. http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/wages/

[5] Dmitrii Andreev, 'Garanty yadernogo shchita', *Krasnaya zvezda*, 3 September 2012 (interview with Colonel Yurii Sych, then chief of 12th GUMO).

[6] 'Russian National-Level Nuclear Weapons Storage', http://www.globalsecurity.org/wmd/world/russia/storage.htm, accessed 14 October 2017. No more recent total has been traced.

Table 1 The closed cities of the Russian nuclear weapons complex

Closed city Present/Soviet designation	Region of Russia	Population 2012/2016	N-w enterprise employment 2012	Basic functions and main organisation
Sarov/Arzamas-16	Nizhegorodsk oblast	88,300/ 94,417	18,400	Development & production of nuclear munitions; Research Institute of Experimental Physics (VNIIEF)
Snezhinsk/ Chelyabinsk-70	Chelyabinsk oblast	50,500/ 50,104	9,400	Development of nuclear munitions; Research Institute of Technical Physics (VNIITF)
Lesnoi/ Sverdlovsk-45	Sverdlovsk oblast	55,100/ 51,339	9,200	Production of nuclear munitions; 'Elekrokhimpribor' combine
Trekhgornyi/ Zlatoust-36	Chelyabinsk oblast	34,500/ 32,540	9,400	Production of nuclear munitions; instrument making factory
Zarechnyi/ Penza-17	Penza oblast	62,000/ 64,497	7,200	Production of nuclear munitions; 'Start' factory
Ozersk/ Chelyabinsk-65	Chelyabinsk oblast	98,400/ 90,567	12,200	Nuclear materials, inc plutonium; 'Mayak' combine
Seversk/Tomsk-7	Chleyabinsk oblast	113,800/ 119,942	5,800	Nuclear materials, inc plutonium; Siberian chemical complex
Zhelenogorsk/ Krasnoyarsk-26	Krasnoyarsk krai	102,100/ 93,927	6,000	Nuclear materials, inc plutonium; Mining-chemical combine
Novoural'sk/ Sverdlovsk-44	Sverdlovsk oblast	95,600/ 85,292	3,700	Nuclear materials; Urals electrochemical complex
Zelenogorsk/ Krasnoyarsk-45	Krasnoyarsk krai	68,600/ 63,388	3,000	Nuclear materials; Elektrokhimicheskoi factory
Total		768,900/ 746,013	80,400	

Source

Soviet designations, activities, organisations: Podvig, P. L. (Ed.), *Strategicheskoe yadernoe vooruzhenie Rossii*, Moscow: IzdAT, 1998, pp. 79-91.

Population, 2016: Ministerstvo finansov Rossiikoi Federatsii, *Metodicheskim ukazaniyami po raspredeleniyu byudzhetnykh assignovanii federal'nogo byudzheta po kodam klassifikatsii raskhodov byudzhetov na 2016 goda i na planovyi period 2017 i 2018 godov, Prilozhenie* no.29.
http://asozd2.duma.gov.ru/arhiv/a_dz_6.nsf/ByID/17C0CAD87266F31E43257EE7006A755E/$File/%D0%90%D0%BB%D0%B3%D0%BE%D1%80%D0%B8%D1%82%D0%BC%20%D0%97%D0%90%D0%A2%D0%9E.pdf?OpenElement [documents for Duma consideration of federal budget for 2016].

Population and employment, 2012: Rosatom, *Publichnyi godovoi otchet za 2012 god*, 2012, p.78.

The Strategic Missile Forces (in Russian *Raketnye voiska strategicheskogo naznacheniya* – RVSN) are responsible for the country's land-based ICBMs, both silo-located and mobile. The current scale of the RSVN in terms of personnel is not known precisely but in 2009 there were more than 70,000 servicemen, with plans to reduce the number to 60,000, apparently by 2016.[7] According to the latest report of the RSVN's missile holdings in January 2018 there were 318 ICBMs with 1,138 warheads, of which some 800 were actually deployed.[8]

In recent years they have undergone considerable modernisation, older Soviet-era systems being replaced by the RS-12 M1 and M2 (SS-27 'Topol-M') and then the RS-24 (SS-27 Mod 2) 'Yars' missile, procured since 2011, with a total of 102 of the latter in service by early 2018. The next planned upgrade is the acquisition of the 'Sarmat' heavy liquid-fuelled ICBM with up to 10 warheads, developed by the Makeev State Rocket Centre in the Urals town of Miass, in the past the country's main development centre for SLBMs. This new missile has been a priority programme of the state armament programme, 2011-20 (about which more below), but is behind schedule. It will replace the Soviet RS-20V (SS-18) ('Voevoda') ICBMs scheduled for withdrawal in the early 2020s.

The naval component of the nuclear triad is carried by a fleet of nuclear strategic submarines, now being modernised with the procurement of the project 955/955A 'Borei' class vessels armed with 'Bulava' missiles, which as with the 'Yars' ICBM was developed by Moscow Thermal Institute and built by the Votkinsk factory in the Udmurt Republic. At the same time, older project 667 BDRM 'Delfin' submarines have been upgraded by the acquisition of 'Sineva'/'Lainer' SLBMs developed by Makeev centre and built by the Krasnoyarsk machine building works, which in future will also build the 'Sarmat'.

The airborne components of the triad are carried by Russia's fleet of long-range strategic bombers, the Tu-160 'Blackjack' (13 in 2017) and the elderly, but now largely modernised Tu-95 (55 in 2017). [However, of this total only 50 nuclear capable aircraft are kept on active service]. The nuclear systems are now predominantly cruise missiles, the Kh-55/55SM and X-102 and plus bombs. In addition, there are approximately 1,850 non-strategic warheads, all kept in the storage facilities of 12th GUMO.[9]

It has been estimated that the total number of personnel directly involved with the nuclear triad in the strategic missile forces, navy and air force is approximately 80,000.[10] In the author's view this is too low as it is based on an estimate of 50,000 for RVSN alone. A more plausible figure is 90,000, in addition to the 30,000 personnel of GUMO. In determining the total number of servicemen in the armed forces, distinction has to be made between the officially decreed upper limit, the *shtat*, and the actual number serving at any given time. A presidential edict in November 2017 set the limit as 1,013,628 servicemen plus 889,130 civilian personnel.[11] The available evidence, however, suggests that the actual number in 2017 was approximately 850,000.[12] This means that nuclear triad troops account for just over 10 per cent of the total.

Nuclear weapons in the Russian federal budget

Only two components of Russia's spending on nuclear weapons are openly identified in the chapters and subchapters of the federal budget. All other relevant expenditure is classified but as indicated below it is possible to generate an approximate total. The open items of spending are, first, funding of the 'nuclear weapons complex', a subchapter of the chapter on 'national defence' for which only a single aggregate figure is revealed, and, second, subsidies provided each year for the maintenance of the closed cities of Rosatom engaged in work

[7] 'Lichnyi sostav raketnykh voisk RF budet sokrashchen do 60 tys. chelovek', *RBC*, 5 September 2017, https://www.rbc.ru/society/05/09/2009/5703d6269a7947733180ad8c. Note, The International Institute for Strategic Studies, *The Military Balance 2017*, Routledge, Abingdon, 2017, p.211, gives a total of 50,000, clearly too low.

[8] Hans M. Kristensen and Robert S. Norris, 'Russian Nuclear Forces, 2018', *Bulletin of the Atomic Scientists*, Vol.74, Issue 3, 2018.

[9] *Op.cit.*, p.423.

[10] IISS, *loc.cit.*

[11] Ukaz prezidenta Rossiiskoi Federatsii ot 17.11.2017 No.555, 'Ob ustanovlenii shtatnoi chislennosti Vooruzhennykh Sil Rossiiskoi Federatsii', *Russian Government Website*, 17 November 2017, http://publication.pravo.gov.ru/

[12] 'Aleksandr Gol'ts, 'Skol'ko soldat v Rossii?', *Ezhedevnyi Zhurnal*, 26 October 2017, http://www.ej.ru/?a=note&id=31734. Note, IISS, *loc. cit.* gives 813,000, in the author's view also too low.

on the development and production of nuclear munitions, included in the budget chapter 'inter-budgetary transfers'.

The precise scope of the subchapter 2.06 'nuclear weapons complex' is not entirely clear. According to the official budget classification it includes three components.[13] First is the delivery of armaments. Second is their repair, both within the framework of the state armament programme. The third component is budget investment in objects of capital construction. The budget holder for this subchapter is Rosatom, so it can be assumed that the investment is for production or other facilities relating to nuclear munitions. Under the Russian budget classification basic classes of weapons are given a code number. Thus, aircraft are 401, ships 402, and tanks and armoured vehicles 403. Nuclear weapons are treated as part of 408, 'other armaments, military and special equipment'.

For one year, 2012, more information is available. In his report on the implementation of the 2012 federal budget in relation to defence, the Accounts Chamber auditor, Valerii Bogomolov, revealed that Rosatom's actual spending under the chapter 'national defence' totalled 80,943 million roubles, of which 33.9 per cent (c.27,440 million roubles) went on the acquisition of armaments and other military equipment, 40.1 per cent on R&D (c. 32,460 million roubles), and the remaining '26.9' per cent (giving a total of 100.9 percent) under the budget chapter 2.09 'other questions in the field of national defence'.[14] The first figure corresponds almost exactly to the sum specified in the budget for the sub-chapter 'nuclear weapons complex' (27,470 million roubles, see Table 2 below), confirming that it covers the procurement of nuclear munitions. It can reasonably be assumed that the second figure represents the Rosatom share of sub-chapter 2.08 of 'national defence', 'applied research in the field of national defence', and the third is probably funding under the federal targeted programme 'Development of the nuclear weapons complex of the Russian Federation during 2007-2020'.

Unfortunately, equivalent data for other years are not available, earlier reports of this status being classified and from 2013 the conclusions of the Accounts Chamber were presented in a different way. The proportions given are unlikely, however, to have changed very much over the years 2010 to 2016, so from the known allocation to the 'nuclear weapons complex' it is possible to estimate the other two components of spending, using shares of the total Rosatom 'national defence' allocation 34 (acquisition), 40 (R&D) and 26 per cent (investment). The R&D component is thought likely to have remained significant as Rosatom must have been involved in development work on new warheads for ICBMs under development, in particular the multiple-warhead 'Sarmat'.[15]

Apart from spending under the subchapter 'nuclear weapons complex', almost all other budget expenditure on nuclear weapons is subject of a very high degree of classification and located in three other subchapters of 'national defence' chapter: 2.01 'armed forces of the Russian Federation', 2.08 'applied research in the field of national defence' and 2.09 'other questions of national defence'. Funding of 12th GUMO will be mainly found in 2.01 including personnel, operation and maintenance. There may be some R&D under 2.08 and the construction of arsenals and other infrastructure will be under 2.09.

The Russian federal budget does not show spending by service arm. Spending on nuclear weapons held by the strategic missile forces, navy and aerospace forces is presented in the budget simply as spending on the armed forces under subchapters 2.01, 2.08 and 2.09. The only exception is the annual report submitted by Russia to the United Nations Office of Disarmament Affairs. This does have a limited breakdown by service of the armed forces, although the strategic missile forces are not shown separately, being included with the air defence forces as 'other combat forces'. As discussed by the author elsewhere, these reports have deteriorated in quality over

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[13] Ministerstvo finansov Rossiiskoi Federatsii, *Tablitsa sootvetstviya razdelov(podrazdelov)i vidov raskhodov klassifikatsii raskhodov byudzhetov, primenyayushchikhsya pri sostavleniya ispolnenii federal'nogo byudzheta na 2017 god i na planovyi period 2018 i 2019 godov, Russian Ministry of Finance website,* 26 July 2017

[14] Schetnaya palata Rossiiskoi Federatsii, *Zaklyuchenie Schetnoi palaty Rossiiskoi Federatsii na otchet ob ispolnenii federal'nogo byudzheta na 2012 god po napravleniyu deyatel'nosti Schetnoi palaty Rossiiskoi Federatsii po kontrolyu raskhodov federal'nogo byudzheta na obespechenie natsional'noi oboronony (auditor Schetnoi palaty Rossiiskoi Federatsii V.N.Bogomolov),* Moscow: 2013. p. 3, http://asozd2.duma.gov.ru/main/nsf/(Spravka)?OpenAgent&RN=312571-6.

[15] 'Kompleks RS-26 Rubezh/Avangard - KY-26/SS-X-31', http://militaryrussia.ru/blog/topic-553.html.

time and it is not possible to reconcile the data presented with data of the federal budget.[16] The last reasonably comprehensive report was that for 2010. Now, Russia completes only the very basic simplified reporting form and for 2016 almost all arms procurement was omitted, rendering the report meaningless.

Having set the scene and established the limits of the handling of expenditure on nuclear weapons in the Russian federal budget, it is necessary to assemble any additional data from other sources that might assist in an estimation of the volume of funding. While nuclear weapons are distributed by service arm, occasionally, senior defence officials make reference to the nuclear triad as a single entity. This was the case in 2011 when the then first deputy defence minister for armaments, Vladimir Popovkin, revealed that in the state armament programme to 2020 approximately 10 percent of the 19,000 billion roubles allocated to the MOD forces for the procurement of new weapons, the repair and modernisation of existing military hardware and research and R&D, would go to the modernisation of the nuclear triad. This would include the building of eight new strategic nuclear submarines with 'Bulava' missiles, modernisation of the 'Topol" ICBM of the strategic missiles forces (i.e. the 'Yars') plus the development of a new liquid-fuelled heavy ICBM, and the modernisation of Tu-160 and Tu-95 strategic bombers.[17]

This provides a basis for estimating the annual procurement and R&D costs of the nuclear triad but it is necessary to consider the actual implementation of the armament programme to judge whether the 10 per cent is appropriate. Analysis of implementation from 2011 to 2017 suggests that in reality the proportion of funding going to the nuclear triad has probably been larger than envisaged at the outset, at least in more recent years. The procurement of ICBMs has had a very high priority as also the building of nuclear strategic submarines and their equipment with 'Bulava' and 'Sineva' SLBMs. The modernisation of long-range strategic bombers has also been undertaken steadily, plus the development of a new, modernised, version of the Tu-160. At the same time, the re-equipment of the ground forces and navy has been proceeding in ways that have probably reduced costs, in the former case by modernising more existing equipment than originally planned, instead of acquiring more expensive newly-produced systems, and in the latter by building fewer large surface vessels than planned and focusing more on smaller, cheaper, quickly built combat ships.

This suggests that while the 10 per cent of total spending on procurement and R&D going to the nuclear triad may have been appropriate at the time the state armament programme was adopted at the end of 2010 in subsequent years it may well have increased to 15 per cent or even more. An additional factor reinforcing this trend may well have been the breakdown of supply relations with Ukraine in 2014, which both ended the servicing of SS-18 'Voevoda' heavy ICBMs by their Ukrainian producer, making the development of a domestically-built replacement missile more urgent, and stopped the delivery of power units for larger naval vessels, one of the factors that changed the priorities of the shipbuilding programme.[18]

Estimating expenditure on nuclear weapons, 2010-2016

Two items of spending are readily identified, namely the budget subchapter 'nuclear weapons complex' and subsidies for the closed cities of 'Rosatom' involved in the development and production of nuclear munitions. Actual expenditure on the 'nuclear weapons complex' is shown in Table 2.

Table 2 Actual expenditure on 'nuclear weapons complex' in federal budget, 2010-2017 (million roubles)

2010	2011	2012	2013	2014	2015	2016	2017
18 746	26 964	27 470	29 289	36 717	44 385	45 623	44 437

Source

[16] Julian Cooper, *Russian Military Expenditure: Data, Analysis and Issues*, FOI Report, FOI-R-3688-SE, Stockholm: FOI, September 2013, pp. 38-40, https://www.foi.se/reportsummary?reportNo=FOI-R--3688--SE

[17] Yurii Gavrilov, '"Bulava" k kontsu goda', *Rossiiskaya gazeta*, 25 February 2011, http://rg.ru/2011/02/24/pole-site.html

[18] Julian Cooper, *Russia's State Armament Programme to 2020: a Quantitative Assessment of Implementation 2011-2015*, FOI Report, FOI-R-4239-SE, Stockholm: FOI, March 2016. p. 36.

Annual reports of budget implementation, Russian Federal Treasury: http://www.roskazna.ru/ispolnenie-byudzhetov/federalnyj-byudzhet/

In the case of subsidies to closed cities, the allocation is as set out in the annual law on the federal budget, which is always implemented in full and not subject to change if the budget law is amended, the allocation being determined by a standard formula taking account of the size of the population of each city, the special regime of security, and the extent to which it imposes limits on economic activity and entrepreneurship. Over time support has been consolidated into a single subsidy relating to the regime of security but in earlier years was allocated under three headings: a) subsidies to the budgets of the closed cities; b) subsidies for the development and support of science and technology; c) budget support for the resettlement of residents. The annual allocations to all of the ten closed cities are shown in Table 3. It will be seen that support for Sarov, the principal centre for the development and production of nuclear munitions is not as substantial as that for some of the other cities and is now diminishing. This is probably explained by the fact that Sarov has been successful in developing new, profitable, civilian activities aided by the existence there of a relatively open technology park.[19] This line of development is now being followed at other closed cities, several of which have industrial or technology parks.

Table 3 Budget subsidies to support the closed cities of the nuclear weapons industry (million roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
Sarov	278	518	526	658	619	435	416	367
Snezhinsk	518	516	463	480	547	613	610	573
Lesnoi	212	146	144	144	134	156	120	65
Trekhgornyi	156	139	139	136	274	301	254	254
Zarechnyi	890	998	1 159	1 194	1 262	1 075	1 108	1 081
Ozersk	666	606	523	565	585	555	479	477
Seversk	1 034	929	919	927	971	1 011	867	881
Zheleznogorsk	1 041	1 020	935	1 105	1 076	1 049	994	998
Novoural'sk	263	277	259	387	520	591	427	320
Zelenogorsk	536	526	524	722	579	656	564	547
All	5 594	5 675	5 591	6 318	6 293	6 442	5 839	5 553

Source
Laws on federal budgets, 2010-2017:
https://www.minfin.ru/ru/perfomance/budget/federal_budget/budgeti/17/

The other two components of Rosatom's budget spending on nuclear munitions have to be estimated. As noted above, these are R&D and investment, which can be estimated on the basis of their shares of the total Rosatom budget allocation under the budget chapter 'national defence' in 2012, namely 40 and 26 per cent respectively, calculating the total from the 34 per cent share devoted to acquisition as shown in Table 2. This estimated additional spending is shown in Table 4.

Table 4 Estimated spending on R&D and investment related to nuclear munitions, 2010-2017 (million roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
R&D	22 054	31 722	32 318	34 458	43 196	52 218	53 674	52 279
Investment	14 335	20 620	21 006	22 397	28 077	33 941	34 888	33 981

Source
Calculated from data of Table 2, on the basis of R&D being 40 per cent and investment 26 per cent of total Rosatom spending under the 'national defence' budget chapter.

[19] Its website is http://itechnopark.ru/. Zheleznogorsk also has an industrial park for the development of nuclear and space technologies, Rosatom, *Godovoi otchet za 2016 god*, p. 264. In 2016, total sales of civilian goods produced by the nuclear weapons complex (supercomputers, machine tools, medical equipment, etc) amounted to 76.2 billion roubles, a 12 per cent increase compared with 2015 (*Ibid*., p. 135).

This permits the estimation of total spending linked directly to Rosatom's work on nuclear munitions, as shown in Table 5.

Table 5 Total spending directly associated with Rosatom's development and production of nuclear munitions (million roubles)

2010	2011	2012	2013	2014	2015	2016	2017
60 729	84 981	86 385	92 462	114 283	136 986	140 024	136 250

Source
Calculated from data of Tables 2, 3 and 4.

The next element of spending can only be established as an estimate: budget expenditure on the nuclear triad for the acquisition of new weapons, their modernisation and repair, plus R&D for their creation. As discussed above, the volume of funding can be estimated as a 10 per cent share of total spending on the annual state defence order (SDO) in 2010, rising to 15 per cent by 2015 and 16 per cent in 2017, on the assumption that the extensive procurement of new nuclear system during this period has placed an increasing burden on the budget. In recent years, budget spending on the SDO has been supplemented by state guaranteed credits. However, analysis of the recipients of these credits suggests that this method of funding is not used for items of procurement relating to Russia's nuclear capability. For this reason, the analysis focuses on actual federal budget funding of the SDO. The growth of funding on equipping the nuclear triad is shown in Table 6.

Table 6 Approximate funding of the state defence order of the nuclear triad, 2010-17 (billion roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
Total SDO[1]	476	554	644	930	1 190	1 882	1 685	1 600[2]
Per cent share n.t.	10	11	12	13	14	15	15	16
Nuclear triad	47.6	58.7	81.5	126.0	175.0	282.3	252.8	256.0

1. Excluding nuclear munitions, a separate budget item as shown in Table 2.
2. Based on amended budget for 2017 as actual total (over 1,400) deflated by a decision to delay some payments until early 2018.

Source
2010-14: Cooper, *Russia's state armament programme to 2020*, p.21.
2015-16: Julian Cooper, 'Prospects for military spending in Russia in 2017 and beyond', *CREES Working Paper,* March 2017, pp.10 and 24, https://www.birmingham.ac.uk/schools/government-society/centres/crees/research/working-papers/index.aspx
2017: Federal Treasury of Russia, 'Otchet ob ispolenii federal'nogo byudzheta, 2017', http://www.roskazna.ru/ispolnenie-byudzhetov/federalnyj-byudzhet/; actual implementation: draft law, 'Ob isplonenii federal'nogo byudzhetaz za 2017 god', http://sozd.duma.gov.ru/bill/514334-7

Two more components of spending remain to be estimated. First, there is spending on 12th GUMO, its personnel plus operations and maintenance. Second, there is the equivalent spending on the three service arms holding strategic nuclear weapons. Given the absence of any other direct evidence, here the only option is to base estimates on the number of personnel. As indicated above, in the case of 12th GUMO the personnel are generally highly skilled and probably relatively well paid. The current number of personnel is not known but, as noted above, in 1998 there was a total of 30,000. The number of strategic nuclear warheads has fallen substantially from 5,972 in January 1999 to 2,460 in January 2017 suggesting a contraction of the number of personnel.[20]

But since 1998 there have been organisational changes which may have increased the number. In particular, since the mid-1990s 12th GUMO has taken over some responsibilities for nuclear munitions previously handled by units of the relevant armed services. This process was completed in 2009, increasing the level of centralised control of nuclear devices.[21] Numbers may also have increased as the armed forces in recent years have acquired

[20] *SIPRI Yearbook 1999*, p. 550; *SIPRI Yearbook 2017*, p. 422.
[21] Andreev, 'Garanty yadernogo shchita'.

new strategic systems for the first time since the end of the USSR. While the total number of personnel in 12th GUMO may now be less than 30,000 it is likely that the costs associated with them will be relatively high, not least because of their relatively advanced skills and the considerable responsibility they have for safety. For this reason, the 30,000 is considered to provide an appropriate basis for estimating funding. For the forces associated with the nuclear triad, estimated funding is based on the 90,000 personnel noted above. Assuming a total number of military personnel in the MOD armed forces of 850,000, then 12th GUMO accounts for 3.5 per cent and the nuclear triad forces 10.5 per cent. This item of spending is shown in Table 7.

Table 7 Spending on personnel and operations and maintenance, 12th GUMO and the nuclear triad forces (billion roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
Total exp, P, O&M[1]	606	685	800	854	906	843	911	877
12th GUMO (3.5%)	21.2	24.0	28.0	30.0	31.7	29.5	31.9	30.7
Nuclear triad (10.5%)	63.6	71.9	84.0	89.7	95.1	88.5	95.7	92.1

1. Budget subchapter 2.01, 'armed forces of the Russian Federation'.

Source

Budget chapter 2.01: Annual reports of budget implementation, Russian Federal Treasury: http://www.roskazna.ru/ispolnenie-byudzhetov/federalnyj-byudzhet/.

There is a missing element in this estimation of expenditure on nuclear weapons, namely the funding of capital investment for facilities and infrastructure directly associated with them. Unfortunately, the data available are such that it is not possible to provide a meaningful estimate. Most capital investment in the budget of the MOD is funded from the subchapter 2.09, 'other questions in the field of national defence'. But there is a lack of specification of its function and the volume shown is subject to considerable variation on a year-to-year basis. For this reason, it has been omitted but the limited analysis possible suggests that taking a notional 15 percent of the total, the sum involved would not be large, for example approximately 20 billion roubles in 2016, and its inclusion would have only a marginal impact on the total spending set out below.

With this qualification, spending on nuclear weapons can now be aggregated, as shown in Table 8. This shows estimated total budget spending on nuclear munitions, plus estimated spending on R&D and the acquisition of the weapons of the nuclear triad, on the pay and maintenance of the 12th GUMO and the forces of the nuclear triad. It also shows total spending on nuclear weapons as a share of total spending under the Russian budget chapter 'national defence'.

Table 8 Total spending on nuclear weapons (million roubles)

	Total, nuclear munitions	Nuclear triad SDO	12-GUMO pay, O&M	Nuclear triad, pay, O&M	Total expenditure on n.w.	% ND[1]
2010	60 700	47 600	21 200	63 600	193 100	15.3
2011	85 000	58 700	24 000	71 900	239 600	15.8
2012	86 400	81 500	28 000	84 000	279 900	15.4
2013	92 500	126 000	30 000	89 700	338 200	16.1
2014	114 300	175 000	31 700	95 100	416 100	16.8
2015	137 000	282 300	29 500	88 500	537 300	16.9
2016	140 000	252 800	31 900	95 700	520 400	17.2[2]
2017	136 300	256 000	30 700	92 100	515 100	17.9[2]

1. Per cent of total spending under budget chapter 'national defence'.
2. In 2016 total spending on 'national defence' was inflated by a one-off 793 billion rouble settlement of past defence industry debt, in 2017 187 billion roubles, excluded here in both cases.

Source

Assembled from data of Tables 2 to 7. Total 'national defence' as 'Ezhegodnaya informatsiya ob ispolenenii federal'nogo byudzheta', https://www.minfin.ru/statistics/fedbud. Note, for 2017 total 'national defence' as amended budget for

the year, as actual total artificially deflated by a decision to delay some payments under the state defence order until the early months of 2018.

Unsurprisingly, with an increased volume of procurement of new delivery systems for nuclear munitions the share of total defence spending devoted to the nuclear triad has steadily increased. The issue of the conversion of total spending into $US or another internationally comparable unit of measurement is addressed below.

The analysis so far has used as its reference point the Russian budget chapter 'national defence' which includes spending on the military activities of the MOD forces but not on the ministry's spending on housing, education, health, pensions or other non-military outlays. To estimate the share of nuclear weapons in total military expenditure these additional items for spending must be taken into account and again this can be done only on the basis of the number of personnel. Here the staff of 12th GUMO and the forces of the nuclear triad can be taken together, representing 14.0 per cent of the total number of MOD servicemen. The resulting figure is shown in Table 9.

Table 9 Nuclear weapons related other MOD spending (billion roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
Total MOD other exp.	320	335	468	434	486	596	611	674
Nuclear-related (14.0%)	44.8	46.9	65.5	60.8	68.0	83.4	85.5	94.3

Source
Total MOD other spending: Annual reports of budget implementation, Russian Federal Treasury: http://www.roskazna.ru/ispolnenie-byudzhetov/federalnyj-byudzhet/

This allows the estimation of all expenditure on nuclear weapons and its share in Russia's total military expenditure according to the SIPRI definition, as show in Table 10.

Table 10 Aggregate budget spending on nuclear weapons (billion roubles)

	2010	2011	2012	2013	2014	2015	2016	2017
Military exp. on n.w.	193.1	239.0	279.9	338.2	416.1	537.3	520.4	515.1
Other nuclear-related	44.8	46.9	65.5	60.8	68.0	83.4	85.5	94.3
Total spending on n.w.	237.9	285.9	345.4	399.0	484.1	620.7	605.9	609.4
Total military expend.	1 760	2 090	2 505	2 787	3 222	4 026	3 830[1]	3 855[1]
Nuclear weapons, %	13.5	13.7	13.8	14.3	15.0	15.4	15.8[1]	15.8[1]

1. Excluding from total military spending in 2016 793 billion roubles one-off settlement of past debts to the defence industry; in 2017 187 billion roubles. Note, 2017 total as amended budget, as Table 8.

Source
Expenditure on nuclear weapons: aggregate of totals of Tables 8 and 9
Total military expenditure: 2010-17: author's calculations based on annual laws on budget implementation.

For purposes of international comparison expenditure in current rouble terms must be converted into US dollars or another internationally accepted unit of currency. Following SIPRI practice, the former option is chosen although with recent sharp fluctuations of the rouble/dollar exchange rate it gives a somewhat misleading impression of a decline in spending on nuclear weapons since 2014, as shown in Table 11.

Table 11 Spending on nuclear weapons in current billion US$

	2010	2011	2012	2013	2014	2015	2016	2017
Exp. on n.w. (bn. r.)	238.2	285.9	345.4	399.0	484.1	620.7	605.9	609.4
Exchange rate, r/US$	30.36	29.35	31.07	31.82	37.97	60.66	66.90	58.33
Exp. on n.w. bn. $US	7.8	8.0	11.1	12.5	12.7	10.2	9.1	10.4

Source
Expenditure on nuclear weapons: from Table 10.
Exchange rate, annual average: Central Bank of Russia, statistics: http://www.cbr.ru/statistics/?PrtId=svs

Compared with the United States, or even France and the United Kingdom, the volume of funding is probably relatively modest reflecting the lower labour costs in Russia and perhaps economies of scale. This issue needs further investigation.

Looking to the future

The state armament programme to 2020 was intended as an intensive once-and-for-all catch up process, making good almost two decades when the country was unable to afford to acquire new weapons for its armed forces. Top priority for nuclear weapons was seen as vital to Russia's defence at a time when conventional forces were unusually weak. Now the situation has changed to a considerable degree. The armed forces have been extensively modernised and soon transition to a more normal rate of renewal of the stock of equipment will be possible. Strategic nuclear forces will continue to have top priority in the new state programme, 2018-27, and the modernisation started in the previous programme will continue. More 'Yars' ICBMs will be acquired, the new multi-warhead 'Sarmat' will enter service, probably from 2020 at the earliest. It is likely that warheads for the 'Sarmat' have already been developed to an advanced stage and the upgrading of warheads for the 'Yars' and the 'Bulava' SLBM has become routine, giving the possibility of scaling back R&D on nuclear munitions. Another development in the coming years will be the new 'Avangard' glide vehicle revealed by President Putin in his speech to the Federal Assembly on 1st March 2018. This is to be used with some of the Soviet-era RS-18 'UR-100N UTTKh' (SS-19 Stiletto) ICBMs, approximately 20 of which are still deployed by the RVSN. It is also possible that an upgraded version of the 'Bulava' SLBM will be developed before 2027.[22]

Modernisation of the delivery systems of the other two components of the nuclear triad will also continue under the state armament programme to 2027. The upgraded TU-160M2 strategic bomber, now under development, is scheduled to enter serial production after 2023, the modernisation of Tu-95MS to Tu-95MSM status, begun in 2015, will be completed, and work will continue into GPV-2027 on the development of the future advanced strategic bomber, expected to be a very long-range, sub-sonic aircraft.[23] By the mid-2020s, eight 'Borei' class strategic nuclear submarines will have been built, including five of the upgraded project 955A. Under GPV-2027 it is likely that development work on its successor, project 955B, will be undertaken.[24]

For a number of years, under the state armament programme to 2020, development work has been underway on two other new systems that could in the future add to Russia's nuclear capability. These were revealed by President Putin in his Federal Assembly speech in 2018. The first, clearly more advanced in its development, is the 'Poseidon' underwater nuclear-powered, long-range drone capable of carrying nuclear munitions. The second, the 'Peresvet' nuclear-powered, very long-range, cruise missile, although it is not at all clear that this will ever reach the point when it can be deployed. Work on these systems will continue under the new armaments programme to 2027.[25]

At the same time, there is another development that could have an impact on the resource commitment to nuclear weapons. There are indications that Russia may be beginning to downgrade somewhat the central role of nuclear forces in its military strategy, in particular non-strategic nuclear weapons. As Chief of the General Staff, Valerii Gerasimov, argued in November 2017, considerable priority under GPV-2027 will be given to non-nuclear, precision-guided, weaponry of long-range, including, when development has been completed,

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[22] Leonid Nersiyan, 'Kak budut vooruzhat'sya Vooruzhennye sily Rossii v sleduyushchie desyat' let?', Regnum, 17 November 2017, http://regnum.ru/news/polit/2346188.html. For more detail on intentions under the new state armament programme see Julian Cooper, 'The Russian State Armament Programme, 2018-2027', *Russian Studies*, 01/18, May 2018, NATO Defence College, Rome, http://www.ndc.nato.int/research/research.php?icode=0

[23] Tu-160M2: 'Rabochaya strecha s Zamestitelem Predsedatelya Pravitel'stva Dmitriem Rogozinym', Russian Presidential Administration Website, 16 November 2017, http://www.kremlin.ru/events/president/news/56115; Pavel Ivanov, 'I chernokrylyi serafim. Dal'nei aviatsii predstoit pod"em na kachestvenno inuyu stupen' razvitiya', Voenno-promyshenny Kurier, 20 November 2017, https://www.vpk-news.ru/articles/40008

[24] Three project 955 'Borei' are in service, one 955A has been launched and four more are under construction. 'Sroki stroitel'stva "Boreev-B" opredelyat po itogam ikh eskiznogo proektirovaniya', https://vpk.name/news/198621_sroki_stroitel'stva_boreevb_opredelyat_po_itogam_ih_eskiznogo_proektirovaniya.html (original TASS).

[25] On the news systems presented by Putin, see Julian Cooper, *Russia's Invincible Weapons: Today, Tomorrow, Sometime, Never?*, CCW Research Paper, April 2018, http://www.ccw.ox.ac.uk/blog/2018/4/30/russias-invincible-weapons-today-tomorrow-sometime-never

hypersonic weapons. The intention is evidently to raise the nuclear threshold by enhancing long-range conventional deterrence, although as increasingly recognised by security specialists, new dangers may be created, not least so-called 'entanglement'.[26] All these developments are such that the rate of growth of the volume of funding of nuclear weapons could possibly moderate after 2020 and perhaps decline as a share of total defence spending.

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