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To cite this article: Hans M. Kristensen & Robert S. Norris (2017) Russian nuclear forces, 2017, Bulletin of the Atomic Scientists, 73:2, 115-126

To link to this article: <http://dx.doi.org/10.1080/00963402.2017.1290375>



Published online: 28 Feb 2017.



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NUCLEAR NOTEBOOK

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Hans M. Kristensen and Robert S. Norris

ABSTRACT

Russia is in the middle of a broad modernization of its strategic and nonstrategic nuclear forces, including both new programs and some that have been underway for many years. As of early 2017, the authors estimate that Russia has a military stockpile of roughly 4,300 nuclear warheads assigned for use by long-range strategic launchers and shorter-range tactical nuclear forces. Of these, roughly 1,950 strategic warheads are deployed on ballistic missiles and at heavy bomber bases, while another 500 strategic warheads are in storage along with some 1,850 nonstrategic warheads. In addition to the military stockpile for operational forces, a large number of retired but still largely intact warheads await dismantlement, for a total inventory of around 7,000 warheads. The modernizations, combined with an increase in the number and size of military exercises and occasional explicit nuclear threats against other countries, contribute to growing concern abroad about Russian intentions. These concerns, in turn, drive increased defense spending, nuclear modernization programs, and political opposition to reductions in Western Europe and the United States.

KEYWORDS

ALCM; GLCM; ICBM; Intermediate-Range Nuclear Forces Treaty; MIRV; missile; New START; nuclear weapons; Russia; SLBM; SSBN; United States

Russia is in the middle of a broad modernization of its strategic and nonstrategic nuclear forces. While much of this process is simply a continuation of well-known programs that have been underway for many years, some developments are new. These modernizations, combined with an increase in the number and size of military exercises and occasional explicit nuclear threats against other countries, contribute to growing concern abroad about Russian intentions. These concerns, in turn, drive increased defense spending, nuclear modernization programs, and political opposition to reductions in Western Europe and the United States.

As of early 2017, we estimate that Russia has a stockpile of roughly 4,300 nuclear warheads assigned for use by long-range strategic launchers and shorter-range tactical nuclear forces. Of these, roughly 1,950 strategic warheads are deployed on ballistic missiles and at heavy bomber bases, while another 500 strategic warheads are in storage along with about 1,850 nonstrategic warheads. In addition to the military stockpile for operational forces, a large number – perhaps almost 2,700 – of retired but still largely intact warheads await dismantlement, for a total inventory of around 7,000 warheads¹ (see [Table 1](#)).

These numbers are different from those reported under the New Strategic Arms Reduction Treaty (New START) because the treaty has special counting

rules and only includes certain categories. As of September 2016, New START counted Russia as having 508 deployed strategic launchers, which is well below the limit of 700 set by the treaty for February 2018. Since the treaty entered into force on February 5, 2011, Russia has reduced the number of accountable deployed launchers it has by 13 (from 521 to 508), but increased the number of warheads attributed to those launchers by 259 (from 1,537 to 1,796) (State Department 2011, 2016). That increase is a temporary fluctuation primarily caused by deployment of new nuclear-powered ballistic missile submarines (SSBNs), however, and Russia is still expected to reach compliance with New START limits by February 2018.

Overall, Russia's nuclear modernization effort will present the international arms control community with new challenges. Unless a new arms reduction agreement is reached in the near future, the shrinking of Russia's strategic nuclear arsenal that has characterized the past two decades will likely come to an end, with the force leveling out at around 500 launchers with roughly 2,400 assigned warheads. To remain below the New START limit of 1,550 deployed strategic warheads after 2018, Russia will probably have to reduce the warhead loading on some of its missiles.

The broad modernization reflects the conviction of President Vladimir Putin's government that nuclear forces – in particular strategic nuclear forces – are

Table 1. Russian nuclear forces, 2017.

Type/name	Russian designation	Launchers	Year deployed	Warheads × yield (kilotons)	Total warheads
<i>Strategic offensive weapons</i>					
ICBMs					
SS-18 M6 Satan	RS-20V	46 ^a	1988	10 × 500/800 (MIRV)	460
SS-19 M3 Stiletto	RS-18 (UR-100NUTTH)	20	1980	6 × 400 (MIRV)	120
SS-25 Sickle	RS-12M (Topol)	90	1988	1 × 800	90 ^b
SS-27 Mod 1 (mobile)	RS-12M1 (Topol-M)	18	2006	1 × 800?	18
SS-27 Mod 1 (silo)	RS-12M2 (Topol-M)	60	1997	1 × 800	60
SS-27 Mod 2 (mobile)	RS-24 (Yars)	70	2010	4 × 100? (MIRV)	280
SS-27 Mod 2 (silo)	RS-24 (Yars)	12	2014	4 × 100? (MIRV)	48
SS-27 Mod ? (mobile)	RS-26 (Yars-M)	-	(2016)	4 × 100? (MIRV)	-
SS-27 Mod ? (rail)	Barguzin	-	?	4 × 100? (MIRV)	-
SS-30 "heavy" (silo)	RS-28 (Sarmat)	-	(2020)	10 × 500? (MIRV)	-
Subtotal		316			1076
SLBMs					
SS-N-18 M1 Stingray	RSM-50	2/32	1978	3 × 50 (MIRV)	96 ^c
SS-N-23 M1	RSM-54 (Sineva)	6/96	2007	4 × 100 (MIRV) ^d	384 ^e
SS-N-32	RSM-56 (Bulava)	3/48	2014	6 × 100 (MIRV)	288
Subtotal		11/176^f			768^g
Bombers/weapons					
Bear-H6	Tu-95 MS6	25	1984	6 × AS-15A ALCMs, bombs	84
Bear-H16	Tu-95 MS16	30	1984	16 × AS-15A ALCMs, bombs	400
Blackjack	Tu-160	13	1987	12 × AS-15B ALCMs or AS-16 SRAMs, bombs	132
Subtotal		68			616^h
Subtotal strategic offensive forces		560ⁱ			~2,460^j
<i>Nonstrategic and defensive weapons</i>					
ABM/air/coastal defense					
S-300 (SA-10/20) ^k		~800	1980/2007	1 × low	~300
53T6 Gazelle		68	1986	1 × 10	68 ^l
SSC-1B Sepal		33	1973	1 × 350	~15
Land-based air					
Bombers/fighters	(Tu-22M3/Su-24M/Su-34)	~390	1974/2006	ASM, bombs	~570
Ground-based^m					
Short-range ballistic missiles (SS-21/SS-26)		~140	1981/2005	1 × ?	~140
GLCM (SSC-8)		~8	2016	1 × low to ?	~8
Naval					
Submarines/surface ships/air				SLCM, ASW, SAM, DB, torpedoes	~760
Subtotal nonstrategic and defensive forces					~1,850ⁿ
Total					~4,300^o

ABM: antiballistic missile; ALCM: air-launched cruise missile; AS: air-to-surface; ASM: air-to-surface missile; ASW: antisubmarine weapon; DB: depth bomb; GLCM: ground-launched cruise missile; ICBM: intercontinental ballistic missile; MIRV: multiple independently targetable reentry vehicle; SAM: surface-to-air missile; SLBM: submarine-launched ballistic missile; SLCM: sea-launched cruise missile; SRAM: short-range attack missile.

^aThis includes three regiments at Dombarovsky. It is possible that a fourth regiment is still active.

^bIt is possible that more of these SS-25 regiments at bases undergoing upgrades to RS-24 have been inactivated.

^cThere are only warheads for two operational Delta IIIs in the Pacific Fleet. They will be replaced by the new Borei SSBNs in the near future.

^dThe Sineva is a modified SS-N-23 and probably carries four MIRVed warheads. In 2006, US intelligence estimated that the missile could carry up to 10 warheads, but it lowered the estimate to four warheads in 2009.

^eAt any given time, only 320 of these warheads are deployed on five operational Delta IV submarines, with the sixth boat in overhaul.

^fThe first figure is the number of operational SSBNs and the second is the total number of missiles (launchers) on the SSBNs. Note that some SSBNs may be in overhaul at any given time.

^gAt any given time, two thirds of the 11 SSBNs are in overhaul and do not carry nuclear weapons, so not all 768 warheads are deployed.

^hOf the 68 bombers, nuclear weapons are only assigned to the 50 deployed nuclear-capable bombers. Bomber weapons are not deployed on the aircraft under normal circumstances. We estimate that a couple hundred weapons are present at the two bomber bases, with the remainder in central storage.

ⁱThis is the total number of operational launchers (ICBMs, SLBMs, and bombers) in service. Russia also has more than 230 launchers that are in the process of being dismantled.

^jOnly about 1,950 of these warheads are deployed on missiles and at bomber bases. New START counts fewer deployed warheads because it does not count weapons in storage and because at any given time, some SSBNs are not fully loaded.

^kIt is unknown whether the SA-21 on the S-400 system has nuclear capability. If it does, the number of air-defense warheads could be higher.

^lWe estimate that the warheads for the remaining Gazelle interceptors are kept in central storage under normal circumstances. All previous 32 Gorgon missiles have been retired.

^mRussia is replacing the SS-21 with the SS-26.

ⁿNumbers may not add up due to rounding. All nonstrategic warheads are in central storage. The 1,850 listed make up the estimated nominal load for nuclear-capable delivery platforms.

^oNumbers may not add up due to rounding. In addition to these warheads, we estimate that an additional 2,700 retired warheads are awaiting dismantlement, for a total inventory of about 7,000 warheads.

indispensable for Russia's security and status as a great power. It is motivated in part by Moscow's strong desire to maintain parity with the United States, but the development of multiple versions of the same missiles also indicates that the military industrial complex has a strong influence on Russia's nuclear force planning.

Russia's ambitious nuclear modernization program is likely to be challenged by the country's financial crisis. Finance Minister Anton Siluanov warned in October 2014 that the country's wider plan to modernize the armed forces was unaffordable (Reuters 2014), and the budget crunch is already forcing tradeoffs between nuclear and conventional programs. Plans to build a rail-based intercontinental ballistic missile (ICBM) appear to have been delayed or canceled (Novichkov 2016), the Russian Defense Ministry's construction company has been forced to cut back on key projects (Novosti 2015a), and engine deliveries for some warships and submarines have been disrupted (Novosti 2015b).

What is Russia's nuclear strategy?

Russia's nuclear strategy has been the subject of extensive discussion in the North Atlantic Treaty Organization (NATO) over the past several years. Some claim that Russia has recently lowered the threshold for using nuclear weapons (Miller 2015), while others see the changes as a Russian attempt to emulate Western concepts of selective nuclear use (Arbatov 2016). Like other nuclear-armed states, Russia does not declare much information about its nuclear strategy or the circumstances under which it would consider using nuclear weapons. The government's military doctrine, published in December 2014, says that Russia

shall reserve for itself the right to employ nuclear weapons in response to the use against it and/or its allies of nuclear and other kinds of weapons of mass destruction, as well as in the case of aggression against the Russian Federation with use of conventional weapons when the state's very existence has been threatened. (Russian Federation 2014)

This formulation is almost identical to the previous version from 2010 (Russian Federation 2010).

Whatever its nuclear strategy is, Russia seems to be administering it more dynamically and offensively than it did a decade ago. Russian officials have made many statements about possible use of nuclear weapons that appear to go beyond the published doctrine, threatening to potentially use them in situations that do not

meet the conditions described. For example, officials have made threats to use nuclear weapons against ballistic missile-defense facilities, and in regional scenarios that do not threaten Russia's survival or involve attacks with weapons of mass destruction. Russia has also conducted offensive exercises that involve simulation of nuclear weapons use, including against Sweden, which does not have nuclear weapons, is not a member of NATO, and does not have the military capability to threaten Russia's existence.

Moreover, the fact that Russian military planners are pursuing a broad range of existing and new versions of nuclear weapons suggests that the real doctrine goes beyond basic deterrence toward regional war-fighting strategies – or even weapons aimed at bluntly causing terror. One widely cited example involves the disclosure in 2015 of plans for a nuclear-armed, submarine-launched, self-propelled underwater craft blatantly described as intended to create “areas of wide radioactive contamination that would be unsuitable for military, economic, or other activity for long periods of time” (Podvig 2015). Such indiscriminate damage would appear to violate the proportionality and distinction principles of the laws of war. A diagram and description of the proposed weapon, first revealed in a Russian television broadcast, can still be seen on YouTube (YouTube 2015).

Reports about the emergence of a Russian “escalate-to-de-escalate” strategy have fueled perceptions in the West of a government with a greater readiness – even willingness – to use nuclear weapons on a limited scale early in a conflict. Retired US Navy Adm. Cecil Haney, then commander of STRATCOM, said in March 2016 that Russia is “declaring and recklessly demonstrating its willingness to escalate to deescalate if required” (Haney 2016). Others have suggested that Russian leaders are signaling a willingness to use nuclear weapons even *before* an adversary retaliates against a Russian conventional attack by “employing the threat of selective and limited use of nuclear weapons to *forestall opposition to potential aggression*” (emphasis added) (Miller 2015). The implication is that Russia would potentially use nuclear weapons first to scare an adversary from even defending itself.

The public evidence for such a radical shift is scarce, however, and US and NATO officials have so far not presented public evidence of one. Clearly, more factual information is needed about how Russia views the role of its nuclear weapons.²

Intercontinental ballistic missiles

Based on what we observe via satellite images, Russia appears to deploy approximately 316 ICBMs, which we

estimate can carry approximately 1,076 warheads. The size of the force we see in the images, though, is difficult to square with statements made by Russian officials. In December 2016, the commander of the country's Strategic Rocket Forces, Col. Gen. Sergey Karakayev, told journalists that Russia had approximately 400 ICBMs on combat duty (TASS 2016). But since Russia declared 508 deployed strategic launchers under New START in September 2016 (State Department 2016), a force of 400 ICBMs would mean Russia only deployed 108 submarine-launched ballistic missiles (SLBMs) and bombers, or about half of what it appears to actually deploy (see Table 2).

Unless Karakayev misspoke or exaggerated, the discrepancy might be that the 400 ICBMs he spoke of included both deployed and non-deployed missiles. Even Russian news media reports differed on what he said, with some saying he spoke of 400 ICBMs "on combat duty" and others saying he referred to 400 ICBMs "in service." The term "on combat duty" seems to refer to operational missiles, while "in service" could refer to the Strategic Rocket Forces' total inventory, including those not yet fully operational. For example, some missiles may have been delivered to the Strategic Rocket Forces, a branch of Russia's armed services, but not yet deployed at the garrisons. New START counts 847 total Russian deployed and non-deployed launchers (ICBMs, SLBMs, and bombers), but we do not know the breakdown, because the Kremlin does not disclose it and US intelligence is silent on the matter. For the figures in Table 2, we have assumed Karakayev was referring to both deployed and non-deployed ICBMs.

The ICBMs are organized under the Strategic Rocket Forces in three missile armies with a total of 11 divisions consisting of approximately 39 missile regiments. (The 40th regiment in the 12th division at Yurya is not nuclear-armed). The ICBM force has been declining for three decades and Russia is about two-thirds of the way through a modernization program to replace all Soviet-era missiles with newer types by the early 2020s on a less-than-one-for-one basis. Currently, the remaining Soviet-era ICBMs include:

SS-18 (RS-20V). The SS-18 is a silo-based, 10-warhead heavy ICBM first deployed in 1988. It is being gradually retired, with approximately 46 SS-18s with 460 warheads remaining in the 13th Missile Division at Dombrovsky and the 62nd Missile Division at Uzbur. The SS-18 is scheduled to remain in service until the early 2020s, when it will be replaced by the SS-30 (Sarmat or RS-28) ICBM.

SS-19 (RS-18 or UR-100NUTTH). The silo-based, six-warhead SS-19 entered service in 1980 and is gradually

being retired and replaced by the silo-based SS-27 Mod 2 (RS-24). We estimate that up to 20 of these missiles remain in service, with 120 warheads, at the 60th Missile Division at Tatishchevo. The SS-19 is scheduled to be retired in 2019.

SS-25 (RS-12M or Topol). Russia appears to be retiring its SS-25 missiles at a rate of one to three regiments (nine to 27 missiles) each year, replacing them with the SS-27 Mod 2 (RS-24) and possibly the new RS-26. There remains some uncertainty about how fast the SS-25 is being retired and how many remain in service. Satellite photos show a total of 13 garrisons with 117 intact SS-25 launcher garages. It is possible that three of those garrisons, with 27 launchers, are in the very early phase of upgrading, leaving an estimated 90 SS-25s in the force. The number could potentially be as low as 72 if divisions converting to the SS-27 Mod 2 retire all SS-25s in one step instead of gradually, regiment by regiment. Karakayev said in December 2016 that the last remaining SS-25s would be retired in 2021-2022. (TV Zvezda 2016a)

The new ICBMs include the SS-27 Mods 1 and 2 (Topol-M and RS-24). The SS-27 Mod 1 is a single-warhead missile, known in Russia as Topol-M, that comes in either mobile (RS-12M1) or silo-based (RS-12M2) variants. Deployment of the SS-27 Mod 1 was completed in 2012 with a total of 78 missiles: 60 silo-based missiles with the 60th Missile Division in Tatishchevo, and 18 road-mobile missiles with the 54th Guards Missile Division at Teykovo.

The focus of the current phase of Russia's modernization is the SS-27 Mod 2, known in Russia as the RS-24 or Yars, which is a modified SS-27 Mod 1 (Topol-M) that carries up to four multiple independently targetable reentry vehicles (MIRVs). Following initial deployment in 2010-2012 of the first 18 missiles in two regiments with the 54th Guards Missile Division at Teykovo, deployment of the mobile SS-27 Mod 2 version is now well underway at the Novosibirsk and Tagil divisions, where the first regiments went on experimental combat duty in 2013-2014. Tagil now seems to have two operational SS-27 Mod 2 regiments and Novosibirsk one with a second under construction, while an upgrade to the first garrison has recently started at Irkutsk. An upgrade at Yoshkar-Ola is expected to begin in 2017. Finally, installation of the silo-based version of the SS-27 Mod 2 is well underway at the Kozelsk division, where the first regiment is operational and an upgrade to a second has begun.

Statements by Russian officials about the operational status of the SS-27 Mod 2 at the various divisions appear to be optimistic, and do not entirely correspond to what we observe in satellite photos. For example, after the first regiment was placed on experimental combat duty at Novosibirsk in late 2013, the Russian

Table 2. Estimated status of Russian ICBM forces 2017.

Locations	Divisions	Regiments (coordinates)	Missiles ^a	Status
Barnaul	35th MD	307th MR (53.3128, 84.5080)	9 SS-25 TEL	Active
		479th GMR (53.7709, 83.9580)	9 SS-25 TEL	Active
		480th MR (53.3054, 84.1459)	9 SS-25 TEL	Active
		867th GMR (53.2255, 84.6706)	9 SS-25 TEL	Active
Dombrovsky Irkutsk ^c	13th MD	3 regiments (51.1766, 60.2224) ^b	18 SS-18 Silos	Active
	29th GMD	92nd GMR (52.5085, 104.3933)	(9 SS-27 Mod 2 TEL)	Upgrading
		344th GMR (52.6694, 104.5199)	9 SS-25 TEL	Active
		586th GMR (52.5505, 104.1584)	9 SS-25 TEL	Active
Kozelsk	28th GMD	74th MR (53.7982, 35.8039)	10 SS-27 Mod 2 silos	Active
		168th MR (54.0278, 35.4589)	(10 SS-27 Mod 2 silos)	Upgrading
		357th GMR (55.3270, 82.9417)	9 SS-25 TEL	Active
Novosibirsk ^d	39th GMD	382nd GMR (55.3181, 83.1676)	(9 SS-27 Mod 2 TEL)	Upgrading
		428th GMR (55.3134, 83.0291)	9 SS-27 Mod 2 TEL	Active
		308th MR (58.2298, 60.6773)	9 SS-27 Mod 2 TEL	Active
Tagil	42nd MD	433rd MR (58.1015, 60.3592)	9 SS-25 TEL	Active
		804th MR (58.1372, 60.5366)	9 SS-27 Mod 2 TEL	Active
		6 regiments (51.8062, 45.6550)	60 SS-27 Mod 1 silos	Active
Tatishchevo	60th MD	1–2 regiment ^e	10–20 SS-19 silos	Active
		235th GMR (56.9324, 40.5440)	9 SS-27 Mod 1 TEL	Active
		285th GMR (56.8091, 40.1710)	9 SS-27 Mod 2 TEL	Active
Teykovo	54th GMD	321st MR (56.7041, 40.4403)	9 SS-27 Mod 1 TEL	Active
		773rd MR (56.9167, 40.3087)	9 SS-27 Mod 2 TEL	Active
		4 regiments (55.2453, 89.9194)	28 SS-18 silos	Active
Uzhur Vypolovo	62nd MD	41st MR (57.8620, 33.6500)	9 SS-25 TEL	Active
	7th GMD	510th GMR (57.7889, 33.8660)	9 SS-25 TEL	Active
		697th MR (56.8328, 48.2370)	9 SS-25 TEL	Active
Yoshkar-Ola ^f	14th MD	702nd MR (56.5601, 48.2144)	9 SS-25 TEL	Active
		779th MR (56.5821, 48.1550)	9 SS-25 TEL	Active
		11 Divisions ^g	39 regiments	316 ICBMs ^h

GMD: Guards Missile Division; GMR: Guards Missile Regiment; MD: Missile Division; MR: Missile Regiment; TEL: transporter erector launcher.

^aUses US/NATO missile designations: SS-18 (RS-20V), SS-19 (RS-18), SS-25 (Topol), SS-27 Mod 1 (Topol-M), SS-27 Mod 2 (RS-24).

^bIt is possible that the 621st Missile Regiment has begun upgrading silos for deployment of the new “heavy” Sarmat ICBM in a couple of years.

^cOne of Irkutsk’s three garrisons appears to have stood down to begin upgrading to SS-27 Mod 2 (RS-24) in 2017.

^dConstruction of the second SS-27 Mod 2 (RS-24) garrison at Novosibirsk started in mid-2016.

^eIt is possible that one or two SS-19 regiments remain in service at Tatishchevo. The SS-19 is scheduled to retire in 2019.

^fUpgrade to SS-27 Mod 2 (RS-24) at Yoshkar-Ola is said to have begun, but garrison reconstruction was not yet visible at the end of 2016. It is expected to begin in 2017.

^gA 12th division at Yurya has one SS-25 regiment that does not carry warheads but serves as a back-up ICBM launch code transmitter.

^hUpgrading regiments sometimes go on experimental combat alert with only a few launchers ready.

plan was for a second regiment to follow by the end of 2014 (TASS 2014). But as of January 2017, there was still only one upgraded regiment at Novosibirsk, with the second being in the very early stages of construction. A third regiment still appears to be armed with the old SS-25. Likewise, the Russian Ministry of Defense reported in December 2016 that the SS-27 Mod 2 had entered service at Yoshkar-Ola (Russian Federation Defense Ministry 2016a), but none of the known garrisons showed signs of having been upgraded yet.

In our 2016 Nuclear Notebook on Russian nuclear forces, we estimated that Russia deployed 63 mobile and 10 silo-based SS-27 Mod 2s for a total of 73 (Kristensen and Norris 2016). Russian officials said the Strategic Rocket Forces received another 23 missiles during 2016 (TV Zvezda 2016b), which would bring the total to 96 SS-27 Mod 2s. But satellite photos at the end of 2016 only showed fully upgraded garrisons for 45 mobile launchers (two at Teykovo, two at Targil, and one at Novosibirsk), and perhaps 12 Kozelsk silos,

for a total of 57 deployed missiles. The discrepancy might hinge on the number of launchers for the second Novosibirsk regiment, the first Irkutsk regiment, the first Yoshkar-Ola regiment, and the remaining missiles for the second regiment at Kozelsk, which may have been delivered to the Strategic Rocket Forces for integration but not yet fully deployed in the garrisons.

Russian officials have also described development of a compact version of the SS-27 Mod 2, known as Yars-M or RS-26.³ The 29th Guards Missile Division at Irkutsk was supposed to be the first to be equipped with the RS-26, but deployment has been delayed. A scheduled flight test in 2016 was also delayed. The 7th Guards Missile Division at Vypolzovo was also rumored as a potential location for the RS-26, but officials now talk about the upgrades at Irkutsk and Vypolzovo involving Yars, which presumably refers to the original, non-compact SS-27 Mod 2.

Russian defense officials have stated that a rail-based version of the SS-27 Mod 2, known in Russia as *Barguzin*, is in early design development. A writer for

Jane's Defence Weekly speculated in early 2016 that the program might have been delayed or even canceled due to Russia's financial crisis (Novichkov 2016), but *Interfax* reported an ejection test in November 2016 and the first flight is said to be planned for 2017 (Interfax 2016).

Russia is also developing the SS-30, or Sarmat (RS-28), which is intended to replace the SS-18 (RS-20V) by the end of the decade. A Russian newspaper reported a static first-stage engine test in mid-2016 (Rossiyskaya Gazeta 2016), but a missile pop-up test (ejection without engine ignition) originally scheduled for 2015 has not yet occurred. Deployment may not occur until the early 2020s.

There are many rumors about the SS-30, which some media have dubbed the "Son of Satan" because it is a follow-on to the SS-18, which the United States and NATO designated "Satan." While some say the SS-30 will carry "at least 15 MIRV" warheads (Litovkin 2016), that is probably exaggerated. (For comparison, the US Trident II SLBM was test-launched with 14 warheads, but is only equipped to carry 8 and is normally loaded with an average of 4-5). We estimate that the SS-30 will carry up to 10 warheads, the same number carried on the SS-18, but may also be capable of delivering a bulkier maneuverable warhead. Karakayev has said the SS-30 will carry "new types of warheads" (VPK-News 2015), and Russian Deputy Defense Minister Yuriy Borisov says the missile "will be able to carry equipment for surmounting missile defense" and "have a sufficient power reserve to fly over the North or South Pole." Borisov has also said the RS-28 "will be equipped with maneuverable warheads" (Rossiyskaya Gazeta 2014).

The SS-30 is expected to be deployed at Dombrovsky and Uzhur, where it will replace the SS-18. One of the former SS-18 launch groups (the 621st Missile Regiment) at Dombrovsky appears to be undergoing an upgrade. Five of the regiment's 10 silos have been upgraded, with new and different security perimeters and new buildings for crew and guards. A sixth silo might have been used for test launching new payloads intended for the missile.

Despite the widespread modernization and claims by some that Russia is building up its ICBM force, the number of ICBMs is not increasing and it seems likely that the size of the Strategic Rocket Forces will level out at around 300 missiles or perhaps even drop below that number. Either way, Russia is well below the New START level of 700 deployed launchers. Because the Russian ICBM force is significantly smaller than the 400-strong ICBM force the United States plans to retain, Russian planners are compensating by

increasing the number of ICBMs equipped with multiple warheads. Prior to 2010, no mobile ICBMs carried MIRVs; by the early 2020s, all will do so.

Russian road-mobile ICBM forces normally conduct two large-scale exercises each year: a winter exercise in January or February and a summer exercise in July or August. Last year's bi-annual exercises involved SS-25 and SS-27 launchers from nearly all the operational missile divisions, and saw mobile ICBM battalions deploying further from their bases for longer periods than in previous years. In addition to these periodic exercises, Russian ICBMs also participate in broader exercises along with SSBNs and bombers, which normally include test launches of ICBMs, SLBMs, and cruise missiles. One exercise held in October 2016 was said to be one of the largest of its kind since the Soviet era. Writing in the *Washington Times*, national security columnist Bill Gertz reported that an unnamed US official familiar with intelligence reports about the maneuvers said they "resembled the days of the Soviet Union in both numbers and breadth of exercises" (Gertz 2016).

Submarines and SLBMs

The Russian Navy operates a fleet of 11 operational SSBNs of three classes: six Delta IV (Project 667BRDM), two Delta III (Project 667BRD), and three Borei (Project 955).⁴ Each submarine can carry 16 SLBMs for a combined total of nearly 800 warheads.

Until the mid-2020s, the mainstay of Russia's nuclear submarine force will continue to be the six third-generation Delta IVs built between 1985 and 1992, each equipped with 16 SLBMs. All Delta IVs are part of the Northern Fleet and based at Yagelnaya Bay (Gadzhiiyev) on the Kola Peninsula. Russia has upgraded the Delta IVs to carry a modified SS-N-23 SLBM known as the Sineva, each of which carries up to four warheads. Normally four to five of the six Delta IVs are operational at any given time.

There are media rumors that the Delta IV SSBNs will be upgraded to carry a modified version of the Sineva SLBM known as the Layner (or Liner). Some have speculated that the Layner is a new missile with 10 warheads, but it appears to be a modified Sineva with only four warheads. "It is in fact a Sineva. Only the warhead is new," said a Russian navy spokesperson (Interfax 2012). The Layner may carry an enhanced payload, which in addition to the new warhead, likely includes penetration aids.

Two Delta III nuclear submarines remain operational with Russia's Pacific Fleet on the Kamchatka

Peninsula. A third boat is in overhaul at any given time. Each boat is equipped with 16 SS-N-18 M1 Stingray (RSM-50) SLBMs with three warheads each. One of the Delta IIIs – *Podolsk (K-223)* – launched an SS-N-18 on November 3, 2015. The other boat – *Saint George (K-433)* – test-launched a missile in 2016 and conducted patrols in 2015 and 2016. Launched in the late 1970s, the Delta IIIs are outdated and will be replaced by Borei-class SSBNs in the near future.

The Delta IIIs and Delta IVs will be replaced by the new class of Borei (Project 955/A) SSBNs. Each boat is armed with 16 SS-N-32 (Bulava) SLBMs that can carry up to six warheads apiece. Three boats are in service, with another five in various stages of construction. The first boat, *Yuri Dolgoruki (K-535)*, is based at Yagelnaya in the Northern Fleet, from where it conducted its first 2-month patrol under Arctic ice from August to October of 2015 (Interfax 2015). The second boat, *Alexander Nevsky (K-550)*, arrived at its home base at Rybachiy near Petropavlovsk in September 2015, where it was joined by the third Borei, *Vladimir Monomakh (K-551)*, in September 2016. The *Alexander Nevsky* reportedly returned from its first operational deployment in November 2016 (Russian Federation Defense Ministry 2016b), although it is unclear if the deployment was a formal deterrent patrol.

Five more improved Borei-A (Project 955A) SSBNs are in various stages of construction. The first of these and the fourth Borei submarine in total, *Knyaz (Prince) Vladimir*, was scheduled to be delivered to the navy in 2016 but will be delayed until 2018. The fifth boat under construction – *Knyaz Oleg* – underwent hull pressure tests in November 2016 and was scheduled for delivery in 2018, but will probably also be delayed. The keel of the sixth boat – *Generalissimus Suworov* – was laid down in December 2014 for possible completion in 2018. The keel for the seventh boat, the *Emperor Alexander III*, was laid down in December 2015 for delivery in 2019. And the keel for the eighth and so far final Borei SSBN – *Prince Pozharsky* – was laid in December 2016 for potential delivery in 2020. Whether these delivery schedules will hold remains to be seen.

Expectations are emerging that Russia will order another four Borei SSBNs for a total fleet of 12 boats, the same number of SSBNs planned by the US Navy. Russia is already beginning to design the next class of SSBNs, which its Ministry of Defense describes as a fifth-generation SSBN that will be more effective than the Borei class (Russian Federation Defense Ministry 2016c).

The Borei-class modernization will increase the capability of the Russian SSBN fleet because the SS-N-32 SLBM carries six warheads, compared with three and four on the SS-N-18 and SS-N-23, respectively. As a result, the future

SSBN fleet will be able to carry more warheads than the current one. The implication is that the strategic importance of the SSBN fleet will increase, which will make it more significant to Russia's adversaries. Russian SSBN operations are reported to have picked up in recent years. "From January 2014 to March 2015 the intensity of patrols by submarines has risen by almost 50 percent as compared to 2013," Russian Navy Commander Adm. Viktor Chirkov said in March 2015 (Sputnik News 2015a). One year later, in March 2016, another Russian navy official said that Northern Fleet nuclear-powered submarines (including three SSBNs) collectively spent a total of 1,500 days underway during 2015, 50% more than in 2014 (Soper 2016).

The commander of NATO's Maritime Command, Vice Adm. Clive Johnstone, told *Jane's Defence Weekly* in February 2016 that Russian submarine activity in the North Atlantic was "equaling or even surpassing" cold war levels, and that the commanders of his submarine cells were reporting "more activity from Russian submarines than we've seen since the days of the Cold War" (Larrinaga 2016). We know that the entire Russian submarine force conducted nine to 16 patrols in 2012, because the US Office of Naval Intelligence once declassified those numbers and supplied them to us (Kristensen 2013). Now that Russian submarine activity has apparently increased, the Office of Naval Intelligence has declined to release the patrol data.

Nevertheless, the claim that Russian submarine activity was "equaling or even surpassing Cold War levels" seems exaggerated given that the Russian submarine fleet today is much smaller than during the cold war, and that the submarines in those days normally conducted well over 100 patrols each year (Kristensen 2013).

Moreover, intelligence analysts told the *New York Times* in 2016 that the increase in Russian submarine activity mainly involves attack submarines, not SSBNs, and that SSBNs do not pose the same degree of concern to US Navy officials (Schmitt 2016). The SSBN patrols appear to be limited, probably to around 10 per year, a fraction of the cold war level. For example, a satellite photo of the Northern Fleet SSBN base at Yagelnaya Bay (Gadzhievvo), taken on September 10, 2016, shows only two of the seven SSBNs in port, all Delta IVs. Two other Delta IVs were in overhaul, leaving only two potentially on patrol. The single Borei in the Northern Fleet – the two others have been transferred to the Pacific Fleet – was in Severodvinsk at the time, preparing for an SLBM salvo test-launch.

Strategic bombers

Russia operates two types of nuclear-capable heavy bombers: the Tu-160 Blackjack and the Tu-95MS Bear H. We

estimate that there are 60–70 bombers in the inventory, of which perhaps only 50 are counted as deployed under New START. Both bomber types can carry the nuclear AS-15 Kent (Kh-55) air-launched cruise missile (ALCM)⁵ and possibly gravity bombs.⁶ The Tu-160 was also equipped to carry the nuclear AS-16 Kickback (Kh-15) short-range attack missile, but the status of this weapon is uncertain.⁷ A new long-range nuclear cruise missile, designated the Kh-102, is being fielded and will probably replace the older nuclear missiles.

Estimating the size and operational status of the Russian heavy bomber force is difficult because neither Russia nor Western intelligence provides enough information. Moreover, as the Tu-160 and Tu-95MS bombers are being modernized, they change operational status. New START counts all nuclear-capable bombers, not just those currently assigned a nuclear mission. Russia will have to eliminate 47 launchers to meet the New START limit of 800 deployed and non-deployed launchers by February 2018, so some of the Tu-95MS bombers might be denuclearized or retired.

Our current estimate of roughly 50 deployed nuclear bombers is based largely on commercial satellite images, which show an average of 46–56 bombers typically present at the two strategic bomber bases, Engels and Ukrainka. Another half a dozen or so aircraft from these bases might be on training flights or temporarily at other bases. (On October 8, 2015, for example, two Tu-160s from Engels were present at the Tu-22M3 base at Belaya.) The images show another 12–14 bombers typically present at the Ryazan training base, the Kazan production plant, and the Zhukovsky design plant, for a total inventory of 60–70 bombers, of which we estimate about 50 are counted as deployed under New START.

We don't know how many nuclear weapons are assigned to the heavy bombers. Each Tu-160 can carry up to 12 nuclear AS-15A ALCMs. The Tu-95MS can carry 6–16 cruise missiles, depending on configuration. Combined, the 50 deployed nuclear bombers could potentially carry more than 600 cruise missiles. The Tu-160 may also have a secondary mission with nuclear gravity bombs, but it seems unlikely that the old and slow Tu-95 would stand much of a chance against modern air-defense systems. Most of the nuclear weapons assigned to the bombers are thought to be in central storage, with only a couple of hundred deployed at the two bomber bases.⁸

Nearly all of the ageing Tu-160s and most of the Tu-95MSs are undergoing various upgrades. The first seven upgraded Tu-160s and Tu-95MSs returned to service in 2014, and another nine followed in 2016. Only a few dozen of the Tu-95MSs – perhaps around 44 – will be modernized, while at least 10 Tu-160s will be modernized

by 2019, although there has been some production delay. The upgrade will likely fully integrate the Kh-102 nuclear cruise missile and improve the bombers' ability to deliver conventional cruise missiles such as the Kh-101. The future bomber force will likely include 50–60 aircraft.

In addition to modernizing some of the existing bombers, in 2015 the Russian Ministry of Defense announced plans to restart production of the Tu-160. Production of the new version, known as Tu-160M2, is scheduled to begin sometime after 2023 (Sputnik News 2015b). Russian Air Force Commander Col. Gen. Viktor Bondarev said that the plan is to buy at least 50 of the new version, according to Russian news media (TASS 2015). That figure might be exaggerated, but if it is accurate, it would probably result in the retirement of all remaining Tu-95MSs.

The Tu-160M2, meanwhile, is only a temporary bridge to the next-generation bomber known as PAK-DA, the development of which has been underway for several years. The Russian government signed a contract with manufacturer Tupolev in 2013 to construct the PAK-DA at the Kazan factory. The first flight is scheduled for around 2021, with delivery starting in the mid-2020s. But there have already been delays, and it seems unlikely that the Russian aviation industry has enough capacity to develop and produce two strategic bombers at the same time.

Nonstrategic (tactical) weapons

In addition to modernizing its strategic nuclear forces, Russia is also updating some of its shorter-range, so-called nonstrategic nuclear forces. This effort is less clear and comprehensive than the strategic forces modernization plan, but also involves phasing out Soviet-era weapons and replacing them with newer but fewer arms. The emergence of more advanced conventional weapons will likely have a stronger impact on the numbers and composition of nonstrategic nuclear forces than on strategic forces, and result in retirement of many nonstrategic weapons over the next decade.

Nonetheless, the Russian military continues to attribute importance to nonstrategic nuclear weapons for use by naval, tactical air, and air- and missile-defense forces, as well as on short-range ballistic missiles. Part of the rationale is that nonstrategic nuclear weapons are needed to offset the superior conventional forces of NATO and particularly the United States. Russia also appears to be motivated by a desire to counter China's large and increasingly capable conventional forces in the Far East, and by the fact that having a sizeable inventory of nonstrategic nuclear weapons helps

Moscow keep overall nuclear parity with the combined nuclear forces of the United States, Britain, and France.

We estimate that Russia has nearly 2,000 nonstrategic nuclear warheads assigned for delivery by air, naval, and various defensive forces.⁹ The Russian government does not provide any information on how many or what kinds of nonstrategic nuclear weapons it possesses. We estimate that the Russian inventory is declining and will continue to do so over the next decade with or without an arms control agreement. The Russian government has repeatedly said that all of its nonstrategic nuclear weapons are in central storage.

Among Russia's armed forces, the biggest user of nonstrategic nuclear weapons is the navy, which we estimate has an inventory of approximately 760 warheads for use by cruise missiles, antisubmarine rockets, anti-aircraft missiles, torpedoes, and depth charges on submarines, aircraft carriers, cruisers, destroyers, frigates, corvettes, and naval aircraft.

Naval modernization programs include work on the next class of nuclear attack submarines, the Severodvinsk (known in Russia as Project 885M or Yasen). The first of these boats entered service in 2015 and is thought to be equipped with a nuclear version of the Kalibr sea-launched cruise missile (SLCM) (the SS-N-30A) (Gertz 2015). The subsequent seven planned boats will have an improved design. The Severodvinsk-class submarines will also be able to deliver SS-N-16 (Veter) nuclear antisubmarine rockets, as well as nuclear torpedoes. Other upgrades of naval nonstrategic nuclear platforms include those planned for the Sierra class (Project 945), the Oscar II class (Project 949A), and the Akula class (Project 971). While the conventional version of the Kalibr is being fielded on a wide range of submarines and ships, the nuclear version will likely replace the current SS-N-21 nuclear land-attack cruise missile on select attack submarines.

Upgrades to nuclear-capable warships may replace some nuclear weapons with conventional arms. An upgrade of the Oskar II-class (Type 949A) nuclear-powered attack submarine is expected to replace the 24 launchers for the SS-N-19 nuclear-capable cruise missile with 74 launchers for Kalibr and Tsirkon cruise missiles (Lenta 2016a). Likewise, the nuclear-powered cruiser *Admiral Nakhimov* reportedly will be the first of several Kirov-class cruisers to have its SS-N-19 SLCM replaced by vertical launchers with the Kalibr, Oniks, or Tsirkon cruise missiles (Lenta 2016b). The Oniks and Tsirkon are conventional missiles, and the Tsirkon is hypersonic. The Kalibr is primarily a conventional land-attack cruise missile, but also exists in a

nuclear version. It remains to be seen if the Oscars and Kirovs will carry the nuclear version.

Tactical air forces are Russia's second-largest user of nonstrategic nuclear weapons, with an estimated 570 such weapons assigned for delivery by Tu-22M3 (Backfire) intermediate-range bombers, Su-24M (Fencer-D) fighter-bombers, and the new Su-34 (Fullback) fighter bomber. All types can deliver nuclear gravity bombs, and the Tu-22M3 can also deliver AS-4 (Kitchen) ALCMs. NATO reported in early 2016 that Tu-22M3s carried out a simulated nuclear strike exercise against Sweden in March 2013 (NATO 2016). The Tu-22M3 and Su-24M are being upgraded, but will eventually be replaced by the Su-34, which has already started deploying to air bases in Russia's southern and eastern military districts. A total of 120 Su-34s are planned through 2020.

Russia's air- and missile-defense forces are also upgrading nuclear-capable systems. The S-300 air-defense system with nuclear-capable SA-10/20 interceptors is deployed across Russia, and is slowly being upgraded to the S-400 system with SA-21 interceptors. An upgrade of the nuclear-tipped A-135 antiballistic missile-defense system around Moscow is said to be underway (Red Star 2017).

It is highly uncertain how many air-defense nuclear warheads Russia has, or which of its interceptor types are nuclear-capable. Russian officials said in 2007 that about 40% of the country's 1991 stockpile of air-defense nuclear warheads remained. Alexei Arbatov, then a member of the Russian Federation State Duma defense committee, wrote in 1999 that the 1991 inventory included 3,000 air-defense warheads (Arbatov 1999). Many of those were probably from systems that had been retired, and US intelligence officials estimated that the number had declined to around 2,500 by the late 1980s (Cochran et al. 1989), in which case the 1991 inventory might have been closer to 2,000 air-defense warheads. In 1992, Russia promised to destroy half of its nuclear air-defense warheads, and Russian officials said in 2007 that 60% had been destroyed (Pravda 2007).

If those officials were correct, the number of nuclear warheads for Russian air-defense forces might have been 800–1,000 a decade ago, significantly more than the 68–166 warheads assumed by one 2012 study (Sutyagin 2012). Assuming the inventory has shrunk since 2007 (due to the improving capabilities of conventional air-defense interceptors), we estimate that roughly 300 nuclear warheads remain for air-defense forces today, plus an additional 80 for the Moscow A-135 missile-defense system and coastal defense units, for a total inventory of about 380 warheads.

The Russian Army is in the middle of a modernization of its short-range ballistic missile force that involves replacing the SS-21 (Tochka) with the SS-26 (Iskander-M). Whereas the SS-21 launcher carries a single missile with a range of 120 km, the SS-26 launcher carries two missiles with a range of about 300 km. We estimate there are roughly 140 warheads for short-range ballistic missiles.

Finally, Russia appears to have deployed a new ground-launched cruise missile (GLCM) in violation of the 1987 Intermediate-Range Nuclear Forces Treaty (INF). US government sources told *New York Times* that two battalions have been fielded, one of which is operational with an estimated four launchers. The sources said the launcher closely resembles the launcher used for the Iskander (SS-26), which will make identification difficult (Gordon 2017). The US government has not publicly identified the new GLCM but previously explained what it is not (Kristensen 2015).

Notes

1. We estimate that Russia stores its nuclear weapons at approximately 40 permanent storage sites across the country, including about 10 national-level central storage sites (Kristensen and Norris 2014, 2–9). Essential references for following Russian strategic nuclear forces include the general New START aggregate data that the US and Russian governments release biannually, BBC Monitoring, Pavel Podvig’s website on Russian strategic nuclear forces (Podvig n.d.), and the Russia profile maintained by the James Martin Center for Nonproliferation Studies for the Nuclear Threat Initiative (2012).
2. For an interesting review of the role of nuclear weapons in Russia’s broader deterrence strategy, see Bruusgaard (2016).
3. For details of the RS-26, see the Nuclear Notebook “Russian nuclear forces, 2015” (Kristensen and Norris 2015).
4. Three Typhoon-class (Project 941) submarines also remain afloat, of which one has been converted to a missile test platform. None of these submarines carry nuclear weapons.
5. The Tu-95MS is equipped with the AS-15A and the Tu-160 with the AS-15B, which has a longer range. Each bomber can carry 6–16 weapons, depending on type. Hence it would be possible for 50 deployed bombers to be loaded with approximately 600 warheads, but still only be counted as 50 warheads under New START.
6. One normally well-informed source says there are no nuclear gravity bombs for the Tu-95MS and Tu-160 aircraft (Podvig, Pavel 2005).
7. There are rumors that the AS-16 may have been retired or placed in storage.
8. Russia is also adding conventional cruise missiles to its bomber fleet, a capability that was showcased in September 2015 when Tu-160 and Tu-95MS bombers launched several long-range conventional kh-555 and kh-101 cruise missiles against targets in Syria. New storage facilities have been added to Russia’s bomber bases over the past few years that might be related to the introduction of conventional cruise missiles.
9. A US government telegram stated in September 2009 that Russia had “3,000–5,000 plus” nonstrategic nuclear weapons (Hedgehogs.net 2010), a number that comes close to our estimate at the time (Kristensen 2009). The US principle deputy undersecretary of defense for policy, James Miller, stated in 2011 that nongovernmental sources estimated Russia might have 2,000–4,000 nonstrategic nuclear weapons (Miller 2011). For a more in-depth overview of Russian and US nonstrategic nuclear weapons, see Kristensen (2012). Some analysts estimate that Russia has significantly fewer warheads assigned to nonstrategic forces (Sutyagin 2012).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research was carried out with grants from the New Land Foundation and the Ploughshares Fund.

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