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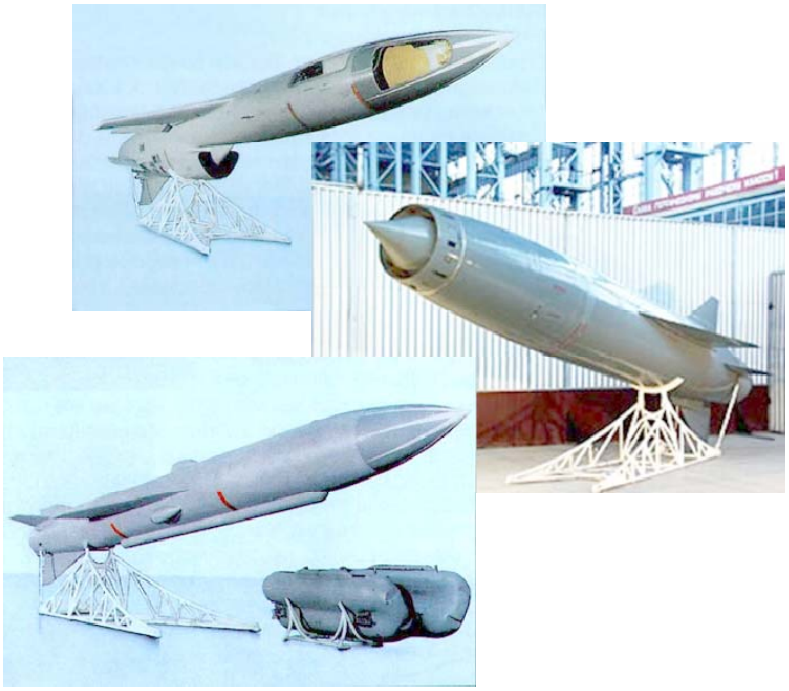
RUSSIAN/SOVIET SEA-BASED ANTI-SHIP MISSILES



Special Report

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RUSSIAN / SOVIET SEA-BASED ANTI-SHIP MISSILES

The Cold War required the Soviet Union to compete with the US on the high seas. Never being a naval power, the Soviets had to find a way to bypass US dominance in blue waters. The answer was the submarine and the guided missile. As the aircraft-carrier battlegroup is a symbol of US naval power, the missile-armed submarine became a symbol of Soviet naval power. Russia continues in this line, hoping to restore some of its former glory.

After WWII, it was obvious that reaching naval parity with the US Navy was too difficult a task for the Soviet Navy. But new weapons and technology would provide adequate capabilities. Therefore, three parallel anti-ship missile programs started in 1947: Kometa (NATO: AS-1 Kennel), air launched; Shchuka, sea launched; and Shtorm, shore launched. In February 1953, only the first of these missiles was accepted to service, while the other programs were terminated due to the lack of satisfactory results. Further analyses revealed that treating the missile as a pilotless airframe was the wrong approach to the problem. As a result, since early 1954, all missile programs in the Soviet Union and then Russia have been led by the guidance-system design facility, not by the missile-design facility.

In 1955 the Shchuka program was restored under the codename "KSShch" and led by the guidance-system designer. The missile was actually fielded in moderate numbers on Kildin- (56EM/M) and Krupny-class destroyers. It was a complete failure, though. Designed as a long-range attack system with a theoretical range of 185 km, the operational range was limited to only 30-35 km by its poor guidance system. The P-1 missile (NATO: SS-N-1 Scrubber) was radio-command guided to the target, which was observed by the destroyer's radar. The KSShch-B version with active-radar guidance and target designation by Ka-15RC helicopter was never fielded, since the radar and targeting equipment were too heavy to be carried by a light shipboard helicopter. The whole system was withdrawn in the mid-1960s. All the later anti-carrier missiles were developed by OKB-52 (NPO Mashinostroyenia since 1983) in Reutovo near Moscow. The organization was lead by the famous Valdimir N. Chelomey until his death in 1984 and then by Gerberd A. Efremov. The OKB-52/NPO Mashinostroyenia also developed some Soviet/Russian intercontinental ballistic missiles (ICBMs).

In 1955 the Soviet Union embarked on a program to arm smaller naval vessels with missiles to replace torpedoes as their primary anti-ship armament. It was assumed that, at a distance of about 35 km, a small ship would be able to detect a cruiser-sized target 15 minutes before it was itself detected, due to the difference in radar cross- sections (RCS). Additionally, analysts projected that the probability of a missile hit on a cruiser-sized target would be 10 times higher than with a torpedo. Also, the time of the attack from launch to hit was much shorter with a missile than with a torpedo, leaving the enemy much less time to react.

P-15 Termit (SS-N-2 Styx)

The development of an anti-ship missile suitable for small naval vessels was undertaken by OKB-155-1 (a division of OKB-155 Mikoyan-Gurevich) in Dubna, near Moscow. As perhaps befitting its MiG origins, the resulting P-15 Termit (SS-N-2 Styx) missile had the appearance of a small aircraft, with trapezoid (delta) wings to fit in a hangar-launcher and tail-control surfaces. It was powered by a liquid-fuel rocket engine with a solid-propellant booster. The Termit was capable of flying at a speed of 1,150 kmph (Mach 0.95) at an altitude of about 150-300 m, maintained by a barometric altimeter. It had a gyro- stabilized auto-pilot (AM-15) and an active radar seeker for terminal homing. The missile's range was about 40 km. The first ship to employ it was the "Project 183R" Komar-class patrol boat with two launchers. It was equipped with the Klen fire-control system with the Rangout fire-control radar and an auxiliary PMK-453 optical aiming device.

The first trial shot was conducted in October 1957 on the Black Sea. The missile tests were very successful, and in 1960 the P-15 Termit was accepted into service. Between 1958-1965, no less than 112 Komar-class vessels were built. Many were exported and used in combat. On October 21, 1967, Egyptian P-15 missiles hit and sank the Israeli destroyer Eliat This was the first success of an anti-ship missile, and it demonstrated that mid-sized naval vessels were now at risk.

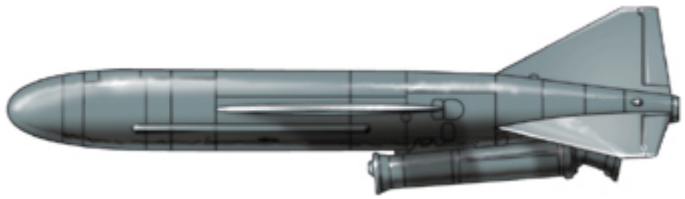
In the latter half of the 1960s, 427 "Project 205MR" Osa-II-class missile boats were built, each armed with four P-15 missiles in individual launchers. Although they have been withdrawn from service in the Russian Navy, many Osa-II vessels remain in service today in other navies (more than 150 were exported). In the late 1950s, the system was sold to the People's Republic of China,

which developed its own version: the Type 601 Silkworm, which saw use even in Operation Iraqi Freedom, launched from shore batteries on the Al Faw Peninsula.

In the summer of 1958, a new Kondor infrared-seeker terminal- homing system for the P-15 was tested. The seeker's range was 10 km in daytime and 5 km at night, and it had a 2.5-degree field of view. Eventually, the seeker was developed into the more advanced Snegir, which was employed in the new version of missile - the P-15U.

In the late 1960s, a new version appeared with folding wings and slightly improved onboard equipment. The folding wings enabled engineers to decrease the size of the missile's hangar-launcher, which was also hermetic. This increased the missile's reliability. The missile was produced in two versions: the P-15U and the P-15T, the latter of which used the Snegir infrared seeker instead of radar. The export designations were P-21 and P-22, respectively. They were used on "Project 205U" Osa-U boats and on more advanced "Project 1241" (NATO: Tarantul) vessels. They were also used for modernization of some Kynda- and Kashin-class destroyers. The last type was used even very recently by the Polish and Indian navies.

In the Soviet Navy, P-15U/T missiles were replaced by P-15M and P-15TM Termit missiles in 1970, the latter of which had the improved Snegir-M seeker. The radar seeker was also improved. The missile received an inertial-navigation system (INS) for mid-course guidance in place of its gyro-stabilization system. The range was increased to 50 km, and the cruise altitude was decreased to 15 m through the use of a radar altimeter. Export designations are P-26 and P-27.



P-15 Termit

The P-15 Termit is a medium-range antiship missile that has been in use since the late 1950s and was the first Russian anti-ship missile to enter service. It was, in fact, the first missile to sink a ship in combat: the Israeli destroyer Eilat, which was sunk by a P-15 fired from an Egyptian missile boat in 1967. Since that date, the missile has been in successful action on several occasions in the Middle East area and in the India-Pakistan conflict. It is fitted primarily to small vessels such as fast attack craft but may also be found in ships up to destroyer size.

Over the past 40 years, a number of modifications and upgrades have been introduced. The initial missile was upgraded to the P-15M (SS-N-2C), with increased range and an auxiliary IR seeker to counter its vulnerability to ECM. This was followed by a series of export versions and new variants with IR and radar seekers, culminating in the P-27 (Styx-D) with completely modernized electronics. A coastal-defense variant is known as the SS-C-3 Styx. These upgrades have increased the range from about 45 km for the P-14 to 100 km for the P-27. After launch the missile climbs to a preset altitude until the radar seeker locks on; it finally enters a shallow-dive terminal phase to impact. The fire-control system associated with the Styx missile is the MR-331 Rangout (Square Tie) system, operating in I band and providing target detection and tracking. Its maximum range is 130 km.

The Chinese HY-1/HY-2 "Silkworm" anti-ship missile was derived from a license-produced copy of the Termit that entered service with the Chinese forces in the mid-1960s. Due to the Termit's unsatisfactory performance, the Chinese undertook a comprehensive upgrade of the system, and the improved HY-1 version went into production in 1975. Many Silkworms remain in service today.

Russian Designation	P-15 Termit (4K40)	P-15U Termit-U/T (4K40U/T)	P-15M Rubezh (4K51)	P-15TM Rubezh (4K51M)
NATO / DoD Designation	SS-N-2A Styx	SS-N-2B Styx	SS-N-2C Styx	SS-N-2D Styx
Manufacturer				
Guidance	Mid-course autopilot with barometric altimeter; terminal I-band active radar homing, or passive IR seeker			
Warhead	453 kg HE hollow charge		513 kg semi-armor piercing	
Propulsion	Solid-rocket booster, liquid-fuel sustainer			
Range	45 km	75 km	85 km	100 km
Speed	Mach 0.9 / 300 m/sec			
Length	5.79 m		6.49 m	5.49 m
Body Diameter	780 mm			
Wingspan	2,500 mm		2,400 mm	
Launch Weight	2,125 kg	2,300 kg	2,500 kg	
Development Start	1955	n.k.	n.k.	n.k.
Date Operational	1958	late 1960s	1970	late 1970s
Launch Platforms	Project 183R (Komar), Project 205 (Osa), Project 206MR (Matka) –class fast missile boats, Project 1241 (Tarantul I) class corvettes, Project 56U (Kildin), Project 57B (Krupny), Project 61U (Kashin) –class destroyers			
Users	Russia, Algeria, Angola, Bulgaria, Croatia, Cuba, Egypt, Ethiopia, Finland, India, Iraq, North Korea, Libya, Poland, Romania, Syria, Vietnam, Yemen and Yugoslavia.			

P-6/P-35 Progress (SS-N-3 Shaddock / Sepal)

The first priority of the Soviet Navy was to defend coastal areas to provide security for land operations. The second task of the Red Fleet was to disrupt US/NATO shipping across the Atlantic and in European waters. In the early 1950s, it became clear that the aircraft-carrier battlegroup represented the most significant threat to the Soviet Navy. Carrier battlegroups could hamper any Soviet naval operations, defensive or offensive.

To fight the carrier battlegroup, it was decided in August 1956 that a long-range anti-ship cruise missile would be developed. The basis for it was to be the P-5 Progress (4K95; SS-N-3A Shaddock) supersonic land-attack cruise missile with a range of 500 km. The P-5 had inertial autonomous guidance, and the modernized P-5D version had Doppler radar mid-course correction. The missile, developed by OKB-52 (presently NPO Mashinostroyenia) in Moscow, had a solid-propellant booster and an air-breathing turbojet sustainer. The missile's wings unfolded after launch, which reduced the size of the launch container.

From the outset, two versions of the missile were developed: the surface-ship-based P-35 (SS-N-3B Sepal) and the submarine-based P-6 (SS-N-3C Shaddock). For both, a guidance system was developed with INS/Doppler for the mid-course phase and an active-radar seeker for the terminal phase. The first (land) tests began in October 1959 for the P-6 and the following December for the P-35. During the years 1963-68, eight surface ships were equipped with P-35 missiles: four Kynda-class cruisers with two four-tube SM-70 launchers and four Kresta I-class large frigates with two twin-tube KT-35 launchers. From 1963 to 1968, 16 Juliet-class diesel submarines were also fielded, with each submarine carrying four launch tubes and the same number of P-6 missiles. In 1966 it was also decided that the P-5 land-attack cruise missiles that armed five Echo I-class nuclear submarines would be withdrawn from service, with the subs being converted into torpedo-armed attack submarines. Between 1963 and 1966, 16 Echo II-class nuclear submarines were built for the Northern Fleet and 13 for the Pacific Fleet, all of which were armed with P-6 anti-ship missiles. Each Echo II sub carried six launch tubes and the same number of missiles.

The P-6 and P-35 missiles, which differ only in minor ways, were fitted with the same guidance system and warhead. The latter could be either a 800 kg high explosive (HE) or a 100 kT-yield (approximately) nuclear weapon. After launch, the missile climbed to a high altitude, accelerated to Mach 1.5, and started searching the front area with its radar seeker. The resulting picture was transmitted to the launching ship via a TV channel. When a target was acquired, the operator on the ship verified whether it was the desired target (e.g., the aircraft carrier in the group). If so, the operator designated it as such and turned the missile's seeker on automatic-track mode. Thereafter, the missile descended to low altitude, remaining at supersonic speed. The missile was intended to hit the water 10-20 m before the target and dive to detonate underwater to increase damage. The range of the missile was 300-350 km.

The P-6/P-35 Progress missiles gave the Soviet Navy long-range anti-ship capabilities for the first time. Prior to that, only Tu-16KS maritime bombers, armed with K-10 anti-ship cruise missiles, had such reach. Nevertheless, the whole system was cumbersome and full of shortcomings. A single salvo took 8-12 minutes to reach the target, depending on range. Then it took 4-6 minutes to prepare for the the next salvo, followed by another 8-12 minutes of flight. Thus, the whole missile-launch sequence for six missiles from a nuclear submarine, or eight from a cruiser, took 20-30 minutes. Meanwhile, the attack force, consisting of surface ships or submarines (which had to remain surfaced), was exposed to enemy counterattacks. Moreover, only three or four ships, launching no more than 12 missiles between them, could operate at the same time against a given carrier battlegroup due to the number of radar and datalink channels available. It was determined that two to four hits with nuclear-armed missiles would be enough to disable the entire carrier battlegroup. The situation was different in the case of conventional warheads, and Soviet commanders knew that, in this case, the task was unachievable.

However, even this thin threat led the US Navy to seek a fighter capable of engaging multiple aircraft and cruise missiles at long range. As there was no time to conduct traditional intercept (a F-4 Phantom armed with AIM-7 Sparrow missiles was inadequate for this task), the AN/AWG-9 fire-control system and AIM-54 Phoenix missile systems were developed, initially for the the F-111B and then for the F-14A Tomcat. Teams of E-2B Hawkeyes and F-14s working together could provide early warning of cruise-missile launches. A single F-14 could engage six targets simultaneously with AIM-54A missiles. The E-2 and F-14 tandem became a nightmare for Soviet long-range reconnaissance and missile-carrying aircraft for years to come, and the danger was also appreciated by submarine commanders, who understood that many of their cruise missiles had little chance of reaching the target.

In the early years, the biggest problem was targeting. To find and track an carrier group on the ocean was an extremely difficult task. The answer was found in the use of signals- intelligence (SIGINT) and radar- reconnaissance aircraft, typified by the Tu-16RM Badger-D and Tu-95RT Bear-D, respectively. The Badger D SIGINT aircraft would pick up radar and radio signals emitted by a carrier group and direct a Bear D, equipped with a long-range sea-search radar. Both aircraft cooperated but operated independently. There was no need for SIGINT aircraft to approach the deadly zone around the carrier, and when the radar track was established, the SIGINT aircraft would search other areas.

The MRSC-1 Uspekh system was developed specifically for target acquisition and designation for anti-ship missiles. It consisted of a Tu-95RC Bear D with its radar and a data-exchange system with aircraft and ship interfaces. Echo II submarines used the Argument fire-control system for presetting a missile's INS and for data exchange with the missile in flight. The whole system was fielded the in latter half of the 1960s. Two new systems were developed in the early 1970s. First was the more capable Uspekh-U, which was based on a modernized Tu-95RC aircraft. The other became the primary targeting means of the Soviet - and presently the Russian - Navy. This was the MKRC Legenda space-based system, operational in 1979, the main element of which is radar-equipped 17F16 satellites that use onboard miniature nuclear reactors for power. Again, the system consisted of both SIGINT- and radar-equipped components, but in this case they were satellites. The Legenda system did not replace the Uspekh-U, which also remains in service, but provides greater coverage and flexibility. The deployment of both systems solved the problem of targeting for cruise-missile-armed units, both surface warships and submarines. The latter, equipped with the Kasatka (and later-model) receiving equipment, are able to receive basic targeting information from the Legenda reconnaissance system, even when submerged. This feature greatly improved submarine survivability.

P-6 Progress

P-35 Progress

The P-35 Progress system is a long-range anti-ship missile that originated as a strategic cruise missile (P-5 Pityorka). It can carry out over-the-horizon attacks on hostile ships. A P-5S coastal-defense variant is known by the NATO designation of SS-C-1 Sepal. The missile's guidance is by command and an active-radar/passive-IR seeker. Because of the very long range of this missile (450 km), the P-6D Progress version was introduced with mid-course guidance provided by a Tu-95 Bear D reconnaissance aircraft using its Big Bulge I-band search radar to locate the target and pass information back to the main control. The Big Bulge has a range of 350-400 km at 4,000 m altitude and is used to transmit radar pictures of the target to the missile-launching vessel. After launch, the missile climbs to about 400 m to enable the radar seeker to lock on as early as possible and to relay information back to the fire-control system. Final attack is in the form of a shallow dive. The P-7D Progress version has a radar altimeter to enable a more controled flight profile.

Russian Designation	P-6, P-7, P-35 Progress (3M44)
NATO / DoD Designation	SS-N-3 Saddock
Manufacturer	NPO Mashinostroenia Chelomey
Guidance	Mid-course autopilot (some versions with command update by datalink), terminal active radar
Warhead	800 kg hollow charge or 100 kT nuclear
Propulsion	two solid-fuel booster, Turbojet
Range	460 km
Speed	Mach 1.4 / 480 m/sec
Length	10.00 m
Body Diameter	900 mm
Wingspan	2,600 mm
Launch Weight	4,500 kg
Development Start	1956
Date Operational	1960s
Launch Platforms	Project 651 (Juliett), Project 659 (Echo I) -class submarines and Project 1134 (Kresta I) and Project 58 (Kynda) -class cruisers
Users	Russia

P-70 Ametist (SS-N-7 Starbright)

The development of an anti-ship missile system for underwater launch was initiated in April 1959, and the OKB-52 Design Bureau, led by Vladimir Chelomey, was appointed to the task. At the same time, development of the first submarine to be armed with the new system, the Project 661 Anchar (NATO: Papa) class, also started in 1959. The submarine was nuclear powered and armed with 10 launchers for P-70 missiles.

The P-70 Ametist (SS-N-7, 4K66) had a small delta wing and was powered by a solid-propellant sustainer. It was also provided with four small boosters that worked underwater. It had a programmable INS guidance system and an analog radar seeker with some anti-jamming capabilities. The missile itself had a very small frontal radar cross-section. The missile could be launched from depths of up to 30 m. It flew to the target at an altitude of 40-60 m using a radar altimeter at a high subsonic speed. Maximum range of the missile was 70-80 km when the target was designated from a third source, or about 50 km when the target was detected by the launching sub's powerful MGK-300 Rubin digital sonar. The missile had a 1,000 kg conventional warhead or a 200 kT-yield nuclear one. The first underwater launch of a 4K66 Ametist missile from a special stand occurred in June 1961. From July to December of 1964, the missile was tested on a modified Whisky-class experimental submarine. The missile was accepted to service in June 1968.

The construction of K-162, the first Papa-class boat, began in 1962 and continued through 1969. The long construction period was a result of the use of many revolutionary systems at the same time: a titanium hull, a modern nuclear reactor, and a lot of digital and analog- digital electronic equipment. Due to the enormous costs, the navy called the ship "Golden Fish." During trials, the submarine's performance was excellent. For example, the underwater speed was 42 knots, and in 1971 the ship established a still-unbeaten underwater speed record of 44.7 knots. However, that speed came at the price of high costs during construction, and both excessive noise and significant damage to hull features when used. The tactics of attack required a quiet approach to the target as long as possible and missile launch from maximum range. Escape maneuvers were then to be performed at maximum speed.

K-162, however, was to be a one-of-a-kind ship, since it was too expensive and complicated. Instead, from 1967 to 1973, eleven Charlie I-class submarines were built with more conventional

equipment. The MGK-100 Kerch analog passive sonar had a range of 30-35 km. Each submarine was armed with eight launchers (small silos) for the P-70 system. The Brest analog fire-control system had interfaces to the Legenda and Uspekh systems. Most of the Charlie Is served with the 11th Division of the 1st Flotilla of the Northern Fleet, while some formed the 10th Division of the 2nd Flotilla of the Pacific Fleet. All of these submarines were withdrawn from service by 1993.

From very beginning, it was obvious that the P-70 Ametist system would have little chance of successfully engaging a target. The main limitation came from the relatively short range of the launching sub's sonar. Even when the target's position was known before approaching the group, sonar contact (in passive mode) was desired to update the location of moving targets. Therefore, in February 1963, the decision was made to develop a longer-range missile, while work on new, long range sonars was underway. In the mid-1970s, the Charlie I class was equipped with the digital, long-range (150-200 km) MGK-300 Rubin sonar and, in the late 1970s, with the even more capable MGK-400 Rubikon sonar with a range of over 200 km. The foundation for a longer-range, underwater-launched missile has been laid.

P-70 Ametist

The P-70 was the first Soviet ASM that could be launched by a submerged submarine. It is a medium-range missile with mid-course guidance by autopilot, with a J-band active-radar seeker for the terminal phase. Initial detection of the target is by either the submarine's ESM system or by the Snoop Head search radar operating in the ESM mode. Normally, the missile is launched from ranges up to 65 km, after which it climbs to about 100 m before the seeker locks on. Final approach for the attack is in the form of a shallow dive. Externally, the P-70 is cylindrical in shape, with a sharply pointed nose and a prominent reinforcing member or wiring duct along the underside of the body. There are short, folding, swept-back wings midway up the body in the rear half and three rear-facing cooling ducts around the wing leading edge.

Russian Designation	P-20, P-70 Ametist (4K66)
NATO / DoD Designation	SS-N-7 Starbright
Manufacturer	NPO Mashinostroenia Chelomey
Guidance	Mid-course autopilot; terminal active-radar seeker
Warhead	530 kg semi-armor piercing or 200 kT nuclear
Propulsion	four solid-fuel booster, solid-state rocket
Range	65 km
Speed	Mach 0.9 / 300 m/sec
Length	6.70 m
Body Diameter	550 mm
Wingspan	1,200 mm
Launch Weight	3,375 kg
Development Start	1959
Date Operational	1968
Launch Platforms	Project 670 (Charlie I) and Project 661 (Papa) -class submarines
Users	Russia

P-120 Malakhit (SS-N-9 Siren)

Soviet planners determined that approaching a US carrier group closer than 100 km was suicide for a submarine, so a minimum range requirement of 120 km was set. The new P-120 Malakhit (SS-N-9 Siren) missile was also developed by the Chelomey-led CKBM Design Bureau (presently NPO Mashinostroenia). It was based on the earlier P-70 Ametist missile, though larger to meet the range requirement. Contrary to its predecessor, which could be launched only from submarines, the P-120 had a universal booster that enabled launch from both surface ships and subs. It could be launched from a depth of 50 m. The P-120 was powered by a solid-fuel sustainer that gave the missile high subsonic speed as it flew at an altitude of 40 m. The range was dictated by the aforementioned requirement, though some sources say it could reach 150 km. A modernized terminal-phase guidance system had two sensors combined in one: a traditional but improved active-radar seeker supported by a passive infrared seeker mounted beneath. This measure

improved resistance to countermeasures launched by defending ships. The missile had either a 500 kg HE or 200 kT-yield nuclear warhead.

The P-120 Malakhit system was accepted to service in March 1972. Tests of the underwater system took longer, and the P-120 missile was accepted into service onboard submarines in November 1977. The new missiles armed small, fast corvettes of the Nanuchka I class. In all, from 1969 to 1976, 18 of these ships were built, followed by 21 Nanuchka III-class ships. Today, though, only the latter remain in service. Between 1973 and 1980, six Charlie II-class submarines were built. Each sub had eight missile tubes and usually carried six conventional and two nuclear missiles. All of the submarines had the MGK-400 Rubikon sonar system. In the early 1980s, the Rubikon sonar was replaced by the MGK-500 Skat system, which used a much more capable digital computer and advanced signal processing. Launch of P-120 missiles (all eight could be launched in a quick salvo) was directed by the Raduga fire-control system. Submarines were provided with a Molnia digital interface to the Uspekh and Legenda targeting systems, along with a Paravan towed array for very-low-frequency communications. All of the Charlie II submarines were very recently withdrawn from service, but P-120 missiles continue to be used on Nanuchka III corvettes.

P-120 Malakhit

The P-50 Malakhit was developed as a "universal" anti-ship missile for submarines and surface ships. It was intended to replace the high-altitude, relatively slow P-35 Progress (SS-N-3 Shaddock). Before the project was completed, it was replaced by a more advanced design - the P-120. The missile entered service in 1969. It was initially deployed on surface ships and subsequently on the Charlie II submarines. It also has longer range than the Ametiste (SS-N-7 Starbright) (70 km when submarine launched and 110 km surface-ship launched). The fire-control radar normally associated with the missile is either the Band Stand or the Plank Shave. The Band Stand operates over the D to F frequency bands and is used for target acquisition and tracking. The Plank Shave is a missile-control radar of which very few details are available. The missile's guidance is identical to that of the Ametiste with one important distinction: it can receive mid-course command updates from the launching platform or a third party.

Russian Designation	P-50, P-120 Malakhit (9K85)
NATO / DoD Designation	SS-N-9 Siren
Manufacturer	NPO Mashinostroenia Chelomey
Guidance	Mid-course autopilot; terminal active-radar and a passive infrared seeker
Warhead	500 kg semi-armor piercing or 200 kT nuclear
Propulsion	two solid-fuel booster, solid-state rocket
Range	110 km (surface launch) 70 km (submarine)
Speed	Mach 0.9 / 300 m/sec
Length	8.84 m
Body Diameter	762 mm
Wingspan	2,600 mm
Launch Weight	3,000 kg
Development Start	1963
Date Operational	1972
Launch Platforms	Project 670M (Charlie II) submarines, Project 1234 (Nanutchka), and Project 1240 (Sarancha) fast missile boats
Users	Russia

P-500 Bazalt (SS-N-12 Sandbox) and P-1000 Vulkan

Presently, the P-500 Bazalt (SS-N-12 Sandbox) remains only on surface ships, but it is still one of the most capable Russian naval weapons. For a long time it was underestimated in the West. Since the missile was similar in appearance to the P-6/P-35 series, it was not even recognized for a long time, especially as the main armament of Echo II submarines.

Development of the intended P-6/P-35 replacement was initiated on the very same day as the P-120 Malakhit program (February 28, 1963). It was to be a surface-launched missile for both submarines and surface ships. To avoid any counterattack from a carrier group, the missile's range

was to be 500 km, outside the usual operational radius of carrier-protection forces. At the same time, the guidance system and missile survivability were to be greatly improved and in line with evolving tactics. For the first time, it was assumed that any attack on a carrier group would be of a massive character. The tactics of such an attack is described later, but it is worth describing some P-500 Bazalt features beforehand.

The P-500 missile is similar in appearance to the P-6/35 and was powered by a liquid-fuel sustainer and solid-rocket booster. It has a speed of Mach 2 at high altitude and Mach 1.5-1.6 at low altitude. The flight profile of the missile varies from 30 to 7,000 m (low-low or low-high). Guidance is based on a digital INS on a gyro- stabilized platform and an active-radar seeker, which periodically switches to passive mode. For the first time, the missile was equipped with a digital computer (Tsifrova Vichislenna Mashina, "digital computing device"). The guidance system was also equipped with a datalink to communicate between missiles in a salvo, with a salvo consisting of eight missiles launched at short intervals. Usually, one of the missiles flies high (5,000-7,000 m) to pick up the target, while the rest remain at medium to low altitude with their radar seekers switched to passive mode. The leading missile then transmits targeting data to the others and allocates individual targets, with half of the salvo directed at the aircraft carrier and half at other ships in the area, one apiece. The onboard radar seekers are turned on at the last moment, just before reaching the target. If the lead missile is shot down, another one (in a programmed sequence) takes over and climbs to a higher altitude to continue directing the salvo. All the missiles have active radar jamming to disrupt any defensive action from fighters and shipboard air-defense systems. In addition, vital parts of the P-500 missile are armored to increase survivability.

Early trials of the first version of the P-500 system were conducted from 1969 to 1970, and from 1971-75, tests of the final version, with a 550 km range, were completed. The missile has a 1,000 kg HE warhead or a 350 kT-yield nuclear warhead. In 1975 the P-500 system was introduced to service on 10 out of the 29 Echo II-class submarines then in service. Nine of them received the Kasatka-B system for receiving data from the Uspekh and Legenda targeting systems (radar picture only), while one received the Uspekh interface only, without access to the Legenda space targeting system. Communications with targeting systems could be conducted from periscope depth with the antenna above the surface. Usually, Soviet submarines carried six conventional and two nuclear P-500 missiles on combat patrols. All of the submarines armed with P-500 missiles were withdrawn from service in the mid-1990s.

The P-500 Bazalt system, however, was not only used on submarines. In 1977 the system was accepted into service onboard Kiev-class aircraft carriers, four of which were built. The first three had a battery of eight launchers in the forward deck. The last ship of the class, commissioned the *Baku* in 1987, was built to a modified design and had no less than 12 launchers. All of these ships were withdrawn from service in the 1990s, but the last ship, renamed *Admiral Gorshkov* , is to be sold to India - after stripping off the P-500 missiles.

The only ships still armed with the P-500 Bazalt system are Slava-class cruisers. The first ship of the class, commissioned in 1983, underwent a major overhaul in the 1990s and was renamed the *Moskva* . It serves with the Russian Navy's Black Sea Fleet. The Northern Fleet operates the *Marshal Ustinov* , commissioned in 1986, while the Pacific Fleet operates the *Varyag* , commissioned in 1989. According to unconfirmed sources, however, the last was re-armed with the P-1000 system (see below). The first two ships (and possibly all three) have a tremendous battery of 16 P-500 Bazalt missiles, which can be directed at targets with the assistance of embarked Ka-27 Helix helicopters. A fourth cruiser, the Ukrainian *Ukraina* , was armed with the P-500 system. The ship was completed in late 2001, but after lengthy deliberations, it never entered service with the Ukrainian Navy. Declared spare, it now is to be sold abroad.

The P-1000 Vulkan was one of the most mysterious missiles in Soviet service. It was also the last Russian missile that required a submarine to surface for launch. Its existence was never discovered by NATO, despite the fact it was operational on five submarines. It was generally similar to P-500 but had titanium armor, and many of its steel parts were replaced by titanium ones. This enabled a significant decrease in launch weight. At the same time, a more powerful booster and a more powerful and more fuel-efficient sustainer turbojet engine was employed. This increased the range to about 700 km. Its development was initiated in May 1979, and it underwent tests in the mid-1980s. The P-1000 was introduced into service in about 1987. In the late 1980s, five Echo II-class submarines were modernized to accommodate the new P-1000 Vulkan system, but all five were withdrawn from service in the mid-1990s. Thus, it was in front-line service for only about seven or eight years (unless it has, in fact, been installed on the *Varyag*).

P-500 Bazalt

The P-500 is a long-range, supersonic cruise missile. The development of the missile started in 1963 as the P-350 (4K77) program, which was cancelled but subsequently evolved into the P-500 (4K80) project. It was accepted to service in 1973 and became operational two years later. It has a cylindrical body, the front of which is slim with a sharply pointed nose. Two-thirds of the way along, it bulges before tapering toward the rear. The missile is powered by a turbojet, and there is a small air intake about halfway along the body. The missile features command or inertial guidance with the option of mid-course updates. Aircraft such as the Tu-95RC Bear D, the Ka-25 Hormone B, and the Ka-27 Helix B may be used for over-the-horizon (OTH) targeting. Terminal-phase guidance is either by an active-radar seeker or by passive radar homing. The payload consisted of either a 1,000 kg high-explosive warhead or a 350 kT nuclear device, but the latter has now been removed.

The internal configuration is similar to that of the 4K44 missile with radar seeker in the nose (this having improved ECCM performance) and the Argon guidance system which was the first Soviet system to feature an on-board digital computer and which, in the terminal mode, allows the seeker to select specific targets. A larger, 1000 kg semi-armor piercing warhead is installed and it is believed there was an alternative 350 kT nuclear warhead but this has now been removed. In the rear is the KP-17-300 turbojet.

It can be launched from surface ships or submarines, although the latter must surface to launch. Associated radars are the H/I-band Front Door or the Front Door C system, which both provide mid-flight updates to the missile if required. The former is a missile-guidance radar that has a multiple antenna system and is primarily for submarine use. The Front Door C is used by surface vessels and features a "hidden" antenna that hinges out when needed.

Russian Designation	P-350 (4K77), P-500 Bazalt (4K80)	P-1000 Vulkan (3M70)
NATO / DoD Designation	SS-N-12 Sandbox	n.k.
Manufacturer	NPO Mashinostroenia Chelomey	
Guidance	Mid-course autopilot; terminal active-radar seeker	Mid-course autopilot; terminal active-radar seeker and passive anti-radiation
Warhead	1,000 kg HE semi-armor piercing or 350 kT nuclear	
Propulsion	two solid-fuel booster, liquid-fuel sustainer	
Range	550 km	700 km
Speed	Mach 2.5 / 835 m/sec	Mach 2.8 / 935 m/sec
Length	11.70 m	n.k.
Body Diameter	884 mm	884 mm
Wingspan	2,600 mm	n.k.
Launch Weight	4,800 kg	n.k.
Development Start	1963	1979
Date Operational	1975	1987
Launch Platforms	Project 1143 (Kiev) aircraft carriers, Project 1164 (Slava) cruisers, Project 675 (Echo II) submarines	Project 675 (Echo II) submarines
Users	Russia and Ukraine	Russia

P-700 Granit (SS-N-19 Shipwreck)

The development of the P-700 missile system started in 1969, but it was prolonged due to its complexity. It was assumed that the main source of information would be the satellite-based reconnaissance network, and from the very beginning, it was believed that the missile would be able to communicate with it directly after launch. The initial targeting information was to be received by a submarine cruising at a depth of about 30 m via a long-wave communications system from ground bases. The attack was to be coordinated with a group of long-range Tu-22M anti-ship aircraft. The underwater attack group consists of three to five Oscar and Oscar II subs, each armed with 24 P-700 missiles. The subs were to launch 70-120 such missiles against a single carrier group in a single mass attack. Roughly 30-50% of them are aimed at the carrier, while the others go after accompanying ships. Another salvo of 12-24 missiles was to be launched by aircraft,

mainly to saturate the carrier group's defenses. The 30-knot speed of the Oscar I/II submarines enables a rapid approach to the launch area, about 450-500 km from the carrier group, and equally quick evasion after the attack.

The missile employs all of the techniques from the Bazalt / Vulkan. One lead missile per every 24 in the salvo flies at high altitude to reconnoiter the target, using its radar in active and passive modes. The active mode is used in quick "looks," then turned off to increase the penetration probability. The lead missile assigns targets to all subordinate missiles and communicates with the other lead missiles in the massive salvo to coordinate the attack. To achieve this, the missile is equipped with a powerful digital computer with three processors. The missile has an onboard integrated electronic-countermeasures suit for avoiding enemy anti-missile attacks using a combination of maneuver and deception jamming. The computer could order the missile to one of various stored courses with multiple altitudes. At high altitude, the missile speed is Mach 2.5, while at low (sea-skimming) altitude, it is Mach 1.5. Vital parts of the missile are armored to increase penetration against fire from Phalanx-type close-in weapon systems and against fragments of closely exploding air-defense missiles. The missile has a nuclear warhead with a selectable yield of 200 or 350 kT, or a conventional 750 kg unitary shaped charge, or bomblets (primary for anti-ship attack, but also useable against land targets: 750 x 1 kg, a mix of incendiary, AP, HE, which can be varied to meet requirements).

The missile has a KR-93 turbojet which is used in the cruising phase after the missile has been launched with the aid of an intregal solid propellant booster in the tail. There are two sharply swept-back wings and two swept-back tail fins with a stabiliser on the top side of the missile. The seeker is reported to operate in ESM, J-band (10-12 GHz) and K-band (27-40 GHz) modes, using the last in the terminal phase to select specific targets.

The guidance system was developed by TsNII "Granit." The missile itself was developed in OKB-52 (later NPO Mashinostoyeniya) under the direction of Chelomey and, after his death in 1984, under Gerberd Efremov. First tests of the missile started in November 1975. Numerous difficulties prolonged the factory tests until 1979, and in autumn of that year, the missile began state trials. Technical difficulties further prolonged the trials through October 1983, and the missile was officially accepted into service in March 1983. At this time, the space-based Legenda reconnaissance system had been fully deployed. In addition to the satellite system, the submarine could also use its own MGK-540 Skat-3 sonar system for targeting.

Only two Oscar I ships have been built: the K-525 (*Arkhangelsk*) and K-206 (*Murmansk*), commissioned in 1981 and 1983, respectively. Both remain in service with the Northern Fleet, and each are armed with 24 missiles and have Kasatka-U receivers for communication with the Legenda system. The subs were followed by the "ultimate" Oscar II class, of which 11 have been commissioned since 1986. The Northern Fleet operates the K-119 (*Voronezh*), K-148 (*Krasnodar*), K-410 (*Smolensk*), K-266 (*Orel*), K-186 (*Omsk*), and K-150 (*Tomsk*). The K-141 (Kursk) exploded and sank on August 13, 2000. The Pacific Fleet operates the K-132 (*Irkutsk*), K-173 (*Krasnoyarsk*), K-442 (*Chelabinsk*), and K-456 (*Vyluchinsk*). The Russian Navy plans to commission a replacement for the Kursk, the K-329 (*Belgorod*).

The P-700 missile was also introduced to service as a weapon for surface ships. Four Kirov-class nuclear cruisers were commissioned between 1980 and 1998: the *Kirov* (renamed *Admiral Ushakov*), *Frunze* (renamed *Admiral Lazarev*), *Kalinin* (renamed *Admiral Nakhimov*) and *Yuriy Andropov* (renamed *Pyotr Velikiy*). They were armed with 20 semi-vertical (with some oblique, like in submarines) P-700 Granit launchers. The system was directly adapted from submarines - to the point where the launchers have to be filled with water before launch. Fire control is provided by the MR-212 Vaygach-U onboard radar and other ships' electronic systems (the Gurzuf or Kantata-M passive reconnaissance systems, for example). The first two cruisers were withdrawn from service in the late 1990s, but the *Admiral Nakhimov* and the *Pyotr Velikiy* continue to serve. The only other ship equipped with P-700 Granit system is the aircraft carrier *Admiral Kuznietsov* , commissioned in 1990 and operational with Russian Northern Fleet since 1995. The ship is armed with 12 P-700 launchers.

P-700 Granit

The improved US ASW defenses around carrier battlegroups during the 1970s increasingly restricted the effectiveness of Soviet submarines carrying the Ametist/Malakhit (SS-N-7/9 Starbright/Siren) missiles. At the same time, the Soviet Navy wished to strengthen the defenses of its SSBN bastions, and this led to a requirement for a new missile. The P-700 Granit was developed as a more successful turbojet alternative to the Bazalt (SS-N-12 Sandbox) from which it was derived and whose liquid rocket proved troublesome. The long-range, sea-skimming anti-ship missile is launched from both surface ships and Oscar-class submarines. In the mid-course, it has an autopilot and can receive course updates by X-band datalink. It has a Ku-band active radar for terminal guidance and has a radar-homing capability.

Russian Designation	P-700 Granit (3M45)
NATO / DoD Designation	SS-N-19 Shipwreck
Manufacturer	NPO Mashinostroenia Chelomey
Guidance	Mid-course autopilot; terminal active / passive radar seeker
Warhead	750 kg HE or 200/350 kT nuclear or submunitions
Propulsion	one solid-fuel boosters, turbojet sustainer
Range	550 km
Speed	Mach 2.5 / 835 m/sec
Length	10.00 m
Body Diameter	853 mm
Wingspan	2,600 mm
Launch Weight	7,000 kg
Development Start	1969
Date Operational	1983
Launch Platforms	Project 949 (Oscar I) and Project 949A (Oscar II) submarines, Project 1143.5 (Kuznetsov) aircraft carriers, Project 1144 (Kirov) battle cruisers
Users	Russia

P-270 Moskit (SS-N-22 Sunburn)

In the early 1970s, it became obvious that the P-15 family no longer met the requirements of the current naval battlespace, which called for better penetration capabilities and longer range. To meet the new requirements, a team from MKB Raduga (Dubna) started working on a new, supersonic, sea-skimming anti-ship missile that would be designated the 3M80 Moskit (SS-N-22 Sunburn), which is also referred as the P-270 system in numerous Russian sources. A new active/ passive radar-guidance system was developed by GosNPO Altair. The radar works in switchable modes, from active search to passive track of the target's radar and electronic-countermeasures (ECM) signals (home on jam).

The Moskit missile has the typical missile shape, with "X" scheme wings at mid-fuselage and "X" all- moving control surfaces in the rear. The missile is powered by a ramjet-type, liquid-fuel sustainer and a solid-rocket booster, which is used in the first four seconds of flight. The missile's range is 120 km (high-low profile) or 80 km (low profile), or 160 and 120 km, respectively, for the 3M82 Moskit-M version. These ranges include maneuvers, so theoretically a missile could reach longer distances if it flew directly. The missile's speed is Mach 2.6 (2,800 kmph) at high altitude and Mach 1.5 (1,800 kmph) at low altitude. At 10 km from its target, the time until impact is less than 20 seconds, leaving little opportunity for reaction. Also, the passive radar mode enables the missile to detect active jamming sources and use them for homing. This and other features of the missile's radar seeker make it very ECM resistant.

Work on the Moskit missile started in 1973, and it was accepted into service in 1981 in its initial 3M80 / P-80 version (93 km range) and in 1984 in the subsequent 3M80M / P-80M (3M80E in export) version (120 km range). The final version of the missile is the 3M82 Moskit-M / P-270 , with the range extended to 150-160 km. It is fired from the KT-190M launcher. Series production of the missile continues at the AKK Progress factory in Arsenyev.

The 3M80 and 3M80M missile systems were introduced to service with "Project 956" Sovremenny-class destroyers, while the 3M82 entered service on slightly modified later ships of the type. In total, 18 of both sub- variants were commissioned between 1980 and 1999 for the Russian Navy (one was reportedly stored, incomplete due to a lack of funding). Two more have been built and commissioned in from 2000 to 2001 by the Chinese Navy (with 3M80E systems). Each destroyer is armed with eight launchers, in two KT-190 boxes of four launchers each. The Mineral (NATO: Band Stand) ire-control system consists of a radar set integrated with a passive radio/ radar receiver.

In the 1980s and 1990s, the Soviet and later the Russian Navy also received 34 small ships of the "Project 1241.1RZ" Molnya-M class (NATO: Tarantul III), 28 of which remain in Russian service today. One was transferred to Ukraine in 1997, and five were decommissioned due to a lack of funds. The ships are a modified version of the "Project 1241.1" Molnya class (Tarantul II), which were armed with four launchers for P-15M Termit missiles. Under Project 1241.1RZ, these were replaced with four launchers for P-270 Moskit missiles: two KT-152 boxes with two launchers each. The ships also have the smaller Titanit (NATO: Band Stand) fire-control system, also of the active/passive type.

The last type of ship that employs the 3M80 Moskit system is the "Project 1239" Sivuch (Bora / Dergach -class) small missile air-cushioned vessel, of which two were commissioned (in 1989 and 1992). The Bora-class is armed with eight launchers, similar to Sovremenny-class destroyers. One of these ships serve with the Russian Baltic Fleet (41st Brigade), and one serves with the Russian Black Sea Fleet (36th Brigade).

The 3M80/82 Moskit system is one of the most successful Russian anti-ship missiles. It is designed to be employed against smaller NATO naval groups in the Baltic Sea (Danish and German) and the Black Sea (Turkish) and non-NATO vessels in the Pacific (Japanese, South Korean, etc.). The other main targets were to be NATO amphibious groups. Against the latter, small vessels were to conduct attacks in groups of two to four ships in hit-and-run-type attacks, firing eight to 16 missiles in a coordinated salvo. The Moskit's computerized mission-planning system enables a given salvo, fired over a period of time, to have routes preset so that the entire salvo arrives at the target area at the same moment. Similar tactics were to be used against transport ships in coastal waters, although fewer missiles were to be fired (two to four against a single target).

Destroyers armed with the Moskit were intended to operate in larger naval attack groups formed around cruisers. The purpose of such groups during the Cold War was to protect the Northern Area (the so-called "Bastion") against penetration by US submarines and carrier groups, to support Soviet amphibious operations, and - in favorable conditions - to engage trans-Atlantic shipment and disrupt sea lines of communication between the US and Europe. Presently, in the Russian Navy, the Moskit-armed destroyers are intended to fight ships such as cruisers, destroyers, and frigates that are part of a carrier group or, more frequently, operating separately in groups. Although the Cold War is over, the US Navy is still treated as an adversary by the Russian Navy. It is also commonly understood that if the Russian Navy is able to counter US fleet elements, it is able to defeat any other enemy.

P-270 Moskit

The P-270 (3M80) Moskit is a medium-range high-supersonic anti-ship missile with sea-skimming capability that came into service in the 1980s and was designed to attack ships with a sophisticated command-and-control system. Earlier versions were designated P-80 Zubr. Its guidance is by an inertial system with final-stage homing by an active radar seeker. The latter has a home-on-jam capability. Associated with the Moskit is the Band Stand radar, which operates over the frequency ranges from D to F and acts as an air and search radar, with a secondary tracking function for anti-ship missiles. As with several of the Russian long- and medium-range missiles, the fire-control system also receives data from the ship's helicopters using the I/J-band Big Bulge radar to provide radar pictures for mid-course guidance updates if necessary. The Moskit is a ramjet-powered missile with a slim forward body, ovoid nose, and a fatter rear half with four divided air intakes. There are four clipped delta-platform wings and four smaller tail surfaces of similar shape, organized in a cruciform configuration around the fuselage. It is a main armament of Sovremenny-class destroyers.

The missile is powered by a ramjet-type, liquid-fuel sustainer and a solid-rocket booster, which is used in the first four seconds of flight. The missile's range is 120 km (high-low profile) or 80 km (low profile), or 160 and 120 km, respectively, for the 3M82 Moskit-M version. These ranges include maneuvers, so theoretically a missile could reach longer distances if it flew directly. The missile's speed is Mach 3 at high altitude and Mach 2.2 at low altitude. The passive radar mode enables the missile to detect active jamming sources and use them for homing. This and other features of the missile's radar seeker make it very ECM resistant.

Russian Designation	P-80 Zubr (3M80)	P-80M Moskit (3M82)	P-270 Moskit-M (3M82M)
NATO / DoD Designation	SS-N-22 Sunburn		
Manufacturer	Raduga Design Bureau		
Guidance	Mid-course autopilot; terminal active / passive radar seeker		
Warhead	320 kg HE semi-armor piercing or 200 kT nuclear		
Propulsion	Solid-rocket accelerator, liquid-fuel ramjet sustainer		
Range	93 km	120 km	160 km
Speed	Mach 2.6 / 865 m/sec	Mach 3 / 1000 m/sec	
Length	9.385 m	9.72 m	9.73 m
Body Diameter	1,298 mm		
Wingspan	1,900 mm	2,100 mm	
Launch Weight	3,950 kg	n.k.	4,150 kg
Development Start	1973	n.k.	n.k.
Date Operational	1980	1984	Mid 1990s
Launch Platforms	Project 956 (Sovremenny), Project 1155B (Udaloy II) -class destroyers, Project 1241.1MR (Tarantul III), Project 1239 (Bora / Dergach) –class fast missile corvettes		
Users	Russia	Russia and China	

Kh-35 (3M24) Uran (SS-N-25 Switchblade)

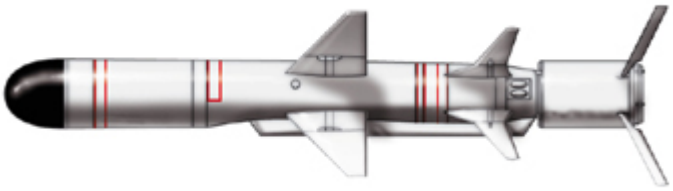
Following a decision made in April 1984, OKB Zvezda started work on a "universal" (sea-, air- and coastal-launched) anti-ship missile, designated the Kh-35 (air launched) or 3M24 (sea launched). It was almost an copy of the US AGM-84 Harpoon, with the same concept, layout, and similar characteristics. The air-launched missile could be fired from altitudes from 200 to 5,000 m and had a range of 150 km. The missile was designed to engage small and fast vessels, such as enemy missile and torpedo boats and small assault ships. It could also attack transport ships with displacements of up to 5,000 tons. It was then assumed that such types of targets did not require sophisticated missile systems like the Moskit or Oniks, which were designed to engage frigates, cruisers, destroyers, and larger transport ships, especially those in convoys protected by frigates or destroyers. That is why the Uran missile is small and less sophisticated, as well as having a seeker optimized for low-RCS targets and able to track fast-moving objects. It has also low-weight high-explosive, fragmentation/incendiary warhead (believed to weigh 145 kg, though some sources say 90 kg).

In the early 1990s, a sea-launched version of the missile, dubbed the 3M24, was tested. This version has a range of 130 km and has a solid-rocket booster with a turbojet engine for cruise. The cruise phase is conducted at 10-15 m in altitude at a speed of up to 300 m/sec. The terminal phase is conducted at an altitude of 3-5 m at the same speed. The missile employs the ARGS-35 active radar seeker The typical sea launcher, designated KT-184, has four angled tubes. Four such launchers (16 missiles) are mounted on modified Tarantul-class vessels. The ships have been exported to Vietnam, and a single ship is used by the Russian Navy for trials and training of foreign crews. Space for four launchers can also be found on a single new Russian "Project 1154" frigate. The ship, the *Neustrashimiy* , was commissioned in 1993 and serves with the Baltic Fleet, but the launchers have never actually been mounted on it. Also, two "Project 1135" Krivak I-class frigates - the *Legkiy* and the *Pilkyi* - were modernized to the "Project 1135.2" standard, receiving two four-tube launchers for the 3M24 Uran system. Through 2002 the ships have not carried any actual missiles, only empty stands for the launchers. The ships also received the MR-755 Fregat (NATO: Half Plate) radar for target designation and the Garpun-Bal (NATO: Plank Shave) radar for fire control. The Garpun-Bal combines quickly switchable active and passive modes. In the active target- designation mode, it operates in I/J band and can detect and track up to 150 targets. The radar's range is 35-45 km. The passive channel searches for pulse and continuous-wave signals. When a signal is located, the radar identifies the hostile emitter from a library of up to 1,000 signatures. The signal's bearing is also measured. The maximum range of the passive channel is over 100 km, depending on the frequency.

Aside from Vietnam, the other export customer of the Uran system is the Indian Navy. Four Delhi-class destroyers are armed with 16 Uran launchers apiece. The ships are also equipped with Russian-made MR-755 Fregat and Garpun-Bal radar sets. Other Indian ships on which 3M24 Uran system is used are four P-25A type corvettes. They also have four quadruple KT-184 launchers.

In addition to the anti-ship version of the Uran system, a Glonass-controlled, land-attack variant has also been developed: the 3M24M Uranium (3M24E1 in export). The 3M24E1 system will be introduced into service with the Indian Navy. It carries more fuel, extending its maximum range to 250 km. An imaging-infrared seeker, in place of the active radar seeker, has reportedly also been tested on a basic 3M24 missile.

3M24 (Kh-35) Uran



The Kh-35 (3M24 Uran) missile is similar to the US Harpoon. Like the Harpoon, it is deployable on a wide variety of platforms, with ship- and air-launched and coastal-defense versions available. It is an autonomous weapon using an inertial system for initial guidance, followed by an active radar seeker for the final stage. The latter is equipped with home-on-jam and ECCM capabilities. The air-launched version has TV-guided and IR variants, designated Kh-37 Uranium. An air-launched version entered limited service in 1994. The missile's power plant consists of a solid-fuel booster and a turbojet sustainer.

Russian Designation	3M24 (ship launched); Kh-35 Uran (air-launched)
NATO / DoD Designation	SS-N-25 Switchbalde
Manufacturer	Zvezda Design Bureau
Guidance	Mid-course autopilot; terminal active/ passive radar seeker (TV and possible IR seeker for some export models)
Warhead	145 kg semi-armor piercing incendiary
Propulsion	one solid-fuel boosters, turbojet sustainer
Range	130 km
Speed	Mach 0.95 / 315 m/sec
Length	3.75 m
Body Diameter	420 mm
Wingspan	930 mm
Launch Weight	630 kg
Development Start	1984
Date Operational	1993 (ship launched), 1994 (air launched)
Launch Platforms	Ships: Project 1135.4 (Krivak IV), Project 1454 (Neustrashimy), Project 1166.1 (Gepard) –class frigates, Project 1241.8 (Tarantul IV) -class corvettes. Project 151A (Sassnitz) -class fast missile boats Air: Tu-142 Bear, MiG-29K Fulcrum, Su-27K Flanker, Su-32 Fullback, Ka-27 Helix
Users	Russia, India, China, Vietnam and Algeria

P-100 / P-800 Oniks/Yakhont (SS-N-26)

Work on an even more advanced anti-ship missile for small vessels was started in the late 1970s by NPO Mashinostroenya. It was assumed that the new system would be used not only on surface vessels but also on submarines, by coastal-defense units, and in an air-launched version. Requirements considered in the development of the system included over-the-horizon range, full autonomy of operation (fire and forget), employment of various trajectories (low-low, high-low, etc.), maximum commonality between different versions (surface, submarine, air, and shore), and use of stealth technologies.

Trials of the new 3M55 missile for the P-800 Oniks system started in 1987. Earlier versions were designated P-100 Bolide. Final tests were undertaken in 1996 aboard two converted testbed ships: the *Nakat* , a modified Tarantul with two six-rail SM-403 launchers, and on the "Project 06704" submarine *K-452* with eight three-rail SM-315 launchers. There is no information as to whether the Oniks missile was ever accepted into Russian service. However, three types of ships received the system during their construction. Among them were 10 vessels of the "Project 12301" Scorpion-type missile corvettes in the Russian Navy (the replacement for the Nanutchka and Tarantul classes) and some of the 28 vessels of the same type built for export (armed with the Yakhont, the

export version of the Oniks. In December 1993, the first ship of a new multirole submarine type was laid down, the "Project 885" Yaseni (NATO: Granay). Construction was suspended in 1996 but has recently been restarted and bears the name *Severodvinsk* . It will be armed with 24 missiles arranged in eight triple SM-315 launchers.

The Oniks missile has a typical Russian appearance, with folded delta wings in the middle and tail surfaces right behind them. The missile presently carries only a conventional penetration warhead, weighing 300 kg. It is propelled by a ramjet engine running on liquid fuel, with launch assisted by a solid-rocket booster. The missile flies on various trajectories up to an altitude of 20,000 m. Typically, it flies at 14,000 m at the high point of a high-low trajectory and at about 10-15 m at the low point of a low-low trajectory. Just before terminal engagement, the missile usually descends to 5-10 m. The maximum range is 300 km (high-low) or 120 km (low-low). At a distance of 60-80 km to the target the missile's radar switches on and searches for the target. As soon as the target is located, at a distance of about 25-30 km, the radar stops transmitting and works in passive mode only while the missile is directed into a computed point of intercept. Usually one out of every three missiles turns on its radar with the others being directed by the "leading" missile. There are also some other features that enhance the missile's air-defense-penetration capabilities. First of all, the missile is coated with radar-absorbent materials (RAM). The missile also has an onboard radar-warning receiver and analyzer, enabling it to initiate sharp maneuvers when necessary. The high speed of the missile - Mach 2.6 at high altitude and Mach 1.5-1.7 at low altitude - on the one hand helps in penetration of the enemy ship's air defenses, but on the other hand, it causes the missile to become aerodynamically heated, giving it a relatively high infrared signature.

The original export version, the Yakhont, was available starting in 1998. Since then, another export version has been under development called the PJ-10 Brahmos. It is a joint venture between Russia and India's Defense Research and Development Organization. The Brahmos is more or less a modified Oniks, adjusted to Indian requirements. Russia invested $122 million in the program, while India allocated $128 million. The first launch of the Brahmos missile took place in June 2001. The most recent test was conducted on February 13, 2003. After the trials, Indian sources claimed that a salvo of nine Brahmos missiles could destroy a group of three frigates under any conditions. According to some unconfirmed sources, the Brahmos will be used onboard India's newly built Shivalik-class frigates (also known as the P-17 project). The Brahmos differs from the Russian missile mainly in that it is launched vertically, whereas the Russian Yakhont is launched from angled launchers. A land-attack version of the Brahmos is also said to be planned.

P-100 Oniks, P-800 Yakhont

The missile is powered by a ramjet-type, liquid-fuel sustainer and a solid-rocket booster, which is used in the first seconds of flight. The missile's range is 300 km (high-low profile) or 120 km (low profile. These ranges include maneuvers, so theoretically a missile could reach longer distances if it flew directly. The missile's speed is Mach 2.3 at high altitude and Mach 1.5 at low altitude. The passive radar mode enables the missile to detect active jamming sources and use them for homing. This and other features of the missile's radar seeker make it very ECM resistant.

The original export version, the Yakhont, was available starting in 1998. Iran is said to be considering purchasing the missiles, perhaps for its Kilo-class subs.

Russian Designation	P-100 Oniks, P-800 Yakhont (3M55)
NATO / DoD Designation	SS-N-26
Manufacturer	NPO Mashinostroenya
Guidance	Mid-course autopilot; terminal active/ passive radar seeker
Warhead	200 kg HE semi-armor piercing
Propulsion	Solid-rocket booster and liquid-fuel ramjet
Range	300 km, mixed trajectory; 120 km, low trajectory
Speed	Mach 2.3 / 750 m/sec
Length	8.90 m
Body Diameter	670 mm
Wingspan	1,400 mm
Launch Weight	3,000 kg
Development Start	1987
Date Operational	1998
Launch Platforms	Ships, submarines, aircrafts, truck-mounted launchers
Users	Russia, India and possibly Iran?

P-900, 3M54 Klub family (SS-N-27 Sizzler)

The Klub family of missiles was developed by NPO Novator in Yekaterynburg, a company best known for its surface-to-air missiles (SAMs), like the Krug, Buk, and S-300V (integrated into SAM systems by Antey). Development of the Klub started in the late 1980s and resulted in a technology demonstrator known as the 3M51 Alfa (also called the Beryuza). The current family, commonly referred to as the 3M54 Klub, includes the submarine-launched Klub-S and ship-launched Klub-N groups.

The Klub-S is launched from a torpedo tube while the Klub-N is fired from a 533mm vertical-launch tube. The sub- and ship-launched varieties differ in booster type. There are five types of Klub. Two come in three-stage "long" versions and are about 8 m long. They fit into Russian torpedo tubes but do not fit the standard Western 533 mm tubes, which are usually only 6.5 m long. This means that all five types can be used in Russian-built subs, whereas Western subs can only use the three "short" types.

The supersonic 91RE1 (long) and 91RE2 (short) types are anti-submarine missiles, armed with a 324mm self-homing torpedo. Both types go ballistic after launch, directed to the target area via INS. Their ranges are 50 and 40 km, respectively. The subsonic 3M14 (NATO: SS-N-30), is a land-attack cruise missile, with a range of 300 km. It has an integrated INS/GLONASS mid-course navigation system and a Scene Matching Area Correlator seeker (it is similar technology to the DSMAC in the U.S. BGM-109 Tomahawk)

The last two types are anti-ship missiles. The 3M54 (or 3M54E in the export version) long missile is a supersonic, three-stage missile. The first stage is a booster, while the second is a winged cruise stage. It can be launched vertically, from an angled launcher, or from a torpedo tube. At an altitude of up to 150 m the solid-propellant booster is jettisoned, and the under-fuselage air intake is extended. The turbojet sustainer engine is started, and at the same time, the wings and tail surfaces are extended. The missile transitions to cruise mode and descends to its cruising altitude of 10 to 15 m above sea level. At a distance of about 30 to 40 km from the target, the missile climbs to a higher altitude and activates its ARGS-54 active radar seeker. After the target is located and the INS updated, at about 20 km from the target, the terminal (third) stage separates. The missile accelerates to supersonic speed (Mach 2.9) and attacks using the ARGS-54 active/passive seeker to guide the diving missile. For the last 15-20 km, the missile descends to 3-5 m above the wave tops, with some loss of speed. The ARGS-54 was developed by Radar MMS, of St. Petersburg. It can detect targets from 60 km, at a 45-degree angle. The warhead of the supersonic 3M54E is a penetration type, weighing 200 kg. The missile has low radar signature and could be covered in RAMs. High speed and maneuvers increase its penetration capabilities. The missile's range is 220 km.

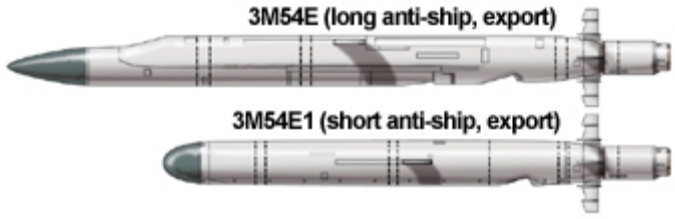
The 3M54E1 version is designed for export only. It is a short, subsonic version of the 3M54E. The ARGS-54 seeker is mounted directly in the second stage, along with the 400 kg warhead. It flies at Mach 0.6-0.8 at about 150 m in altitude initially, descending to 15 m. At about 40-50 km from the programmed target, the missile climbs again to locate the target itself. Having done so, it descends

again to a very low (3-5 m over smooth sea and 5-10 m over rrough sea) altitude. The seeker is activated again for terminal engagement during the last 20-30 km. The missile's range is 300 km.

The Klub family has not yet been accepted into Russian service but has already been exported. Eight vertical launchers are mounted on three Indian Talwar-class frigates, built in Russia. It will probably be accepted into service with Lada-class submarines built for the Russian Navy and possibly also for the Amur version for the Indian Navy. The submarine would carry up to 18 torpedoes and Klub-S missiles in various combinations and would have six torpedo launchers. The first sub of the class for the Russian Navy, the *St. Petersburg* , was laid down in December 1997. The first export version was also laid down in the same month and was named the *Amur* .

Interestingly, the Klub system is also to be used by Yaseni-class submarines (NATO: Granay), along with the 24 launchers for the Oniks system. The Klub-S is to be fired from 533 mm torpedo tubes (the ship also has 650 mm torpedo tubes).

According to some sources, the main version used by the Indian Navy will be the land-attack version. It has also been suggested that a technical possibility exists for the Indian Navy to mount nuclear warheads on these, though no evidence of such a fit has been detected.



3M54 Klub family

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The Klub family has not yet been accepted into Russian service but has already been exported to India and China.

Russian Designation	3M54E Klub-N (surface-launched), Klub-S (submarine-launched)	3M54E1 Klub-N (surface-launched), Klub-S (submarine-launched)
NATO / DoD Designation	SS-N-27 Sizzler	
Manufacturer	NPO Novator	
Guidance	Mid-course INS with ARGS-54 active / passive radar seeker	
Warhead	200 kg semi-armor piercing	400 kg semi-armor piercing
Propulsion	Solid-rocket booster and turbojet sustainer, rocket boostet penetrator	Solid-rocket booster and turbojet sustainer
Range	220 km	300 km
Speed	Cruise Mach 0.8, terminal up to Mach 2.9	Mach 0.6-0.8
Length	8.22 m	6.20 m
Body Diameter	533 mm	533 mm
Wingspan	3,080 mm	3,080 mm
Launch Weight	2,300 kg	1,780 kg
Development Start	n.k.	n.k.
Date Operational	Late 1990s	Late 1990s
Launch Platforms	Ships and submarines	
Users	Russia, China and India	

Russian-Source Naval Anti-Ship Missiles in Action

The first occasion came shortly after the Six Day War in 1967, during the so-called War of Attrition, when Israeli and Egyptian forces continually clashed around the Sinai Peninsula. On October 21, 1967, the Israeli destroyer Eliat rather unwisely closed in on Port Said, conducting a combat patrol. Two Egyptian Komar-class (Type 183R) missile vessels, armed with two P-15 missiles each, maneuvered within the harbor and fired four missiles. The first three hit the target, breaking the destroyer in two, and it quickly sank. The fourth missile also arrived at the scene, but too little debris was left on the surface for its radar to pick up a target. The action was a big shock for Israeli naval forces, but they soon started to develop countermeasures against anti-ship missiles.

The next action was rather mysterious. According to Russian sources - specifically, missile specialists A.E. Taras and A. Shirokorad - another success came almost exactly one year later. According to Taras and Shirokorad, on that day, Egyptian Osa-class (Type 205) missile vessels fired a few P-15 missiles and sank a 10,000-ton "merchant ship" that Israel had converted into a signals-intelligence (SIGINT) ship. It was reported to have taken place off the Egyptian coast, but the story has never been confirmed in the West.

During the Yom Kippur War in 1973, however, the P-15 was much less successful. From October 6-12, 54 missiles were fired to no effect, according to Western sources. The aforementioned Russian sources, however, claim that a total of seven ships were sunk - all small types, such as trawlers, patrol boats, and missile boats. But the Russian specialists agreed with their Western counterparts that the overall results were unsatisfying, especially considering that seven Egyptian and Syrian vessels were sunk after being hit by Israeli Gabriel Mk.1 anti-ship missiles. Interestingly, this last figure is commonly recognized by specialists in both the West and East.

The first such encounter took place during the night of October 6-7, 1973, near Latakia on the Syrian coast. Israeli forces used helicopters flying slowly at very low altitude, effectively simulating naval targets. No Israeli ship was hit by the large salvo of P-15s subsequently fired by Syrians, who themselves lost the T-43 class trawler Jarmuk and three torpedo boats to Israeli Gabriel missiles. The Syrian missile boats withdrew successfully, but all of their missiles missed the Israeli helicopters, which had climbed to break the missile radars' locks. On the same night, a similar trick with helicopters was repeated against Egyptian ships north of the Sinai Peninsula. Yet another encounter took place near Latakia on the night of October 10-11. This time, the missile exchange between Israeli and Syrian missile boats took place without the use of helicopters, and Israeli ships relied on chaff launchers. The Syrian vessels maneuvered outside their harbor, among the anchored merchant ships. Two of the warships were sunk by Gabriels, which also hit two neutral ships (the Greek Tsimentaros and the Japanese Yamashuro Maru). According to Israeli sources, the use of chaff saved all of its vessels, but it is possible that, on that occasion, at least one Sa'ar-class missile boat was hit and sunk (Russian sources claim three). The following night, the helicopter trick was again successfully used during an encounter near Tartus, off the Syrian coast. Again, no Israeli ship was hit by a salvo of P-15s fired by Syrian missile boats. On the Syrian side, two Komar-class vessels were sunk by Gabriels and also the Soviet merchant ship *Ilya Mechnikov* was hit. On the same night, a similar encounter took place off the coast of Port Said.

The Soviets realized the high vulnerability of the P-15 to active and passive countermeasures even before the Yom Kippur War, and adjustments were made. New versions of P-15 missiles, such as the P-15U, were less susceptible to jamming, and the use of an infrared-guided version, the P-15T, also increased the system's effectiveness. It was proven during the India-Pakistan conflict in December 1971, when Indian forces fired 11 missiles (seven P-15U and four P-15T) at targets with good effect. On the night of December 3-4, Indian Osa-class vessels, towed 950 km from Bombay to the mission area around Karachi by trawlers conducted very successful actions. During the attack, the Pakistani destroyer *Khaibar* (an ex-British Battle class destroyer) and the trawler *Muhafiz* were sunk, The *Khaibar* was hit by two P-15U missiles, while it took only a single one to sink the *Muhafiz* . The Osa-class vessel *Nirghat* has been credited with sinking the *Khaibar* , while her sister ship, the Veer, sank the Muhafiz. Of 289 crewmen, only 70 were saved.

Perhaps even more interestingly, three P-15T missiles were once fired against a ground target! On December 4, 1971, the oil refinery at Keamari was attacked. The large oil tanks were heated by the sun during the day, and at night they emitted heat (infrared energy). The P-15Ts, with their infrared seekers, picked up the target and caused a great deal of damage to the facility. A second missile attack was conducted four days later, on December 8, 1971, by the *Vinash* , an Osa-class vessel. The *Vinash* fired four missiles, first one P-15T and then three P-15Us. According to the Pakistan Military Consortium, an independent, non-governmental organization, the first missile flew over the ships at the anchorage, crossed Manora Island, and crashed into an oil tank at the

Keamari oil refinery. The remaining three missiles (radar-guided P-15Us) hit three different vessels anchored at Manora. Two of them were merchant ships: the British *Harmattan* and the Panamanian *Gulf Star* . The first sank, while the other was seriously damaged but survived. The third ship, the Pakistani replenishment ship *Dacca* also survived, despite having been hit in her oil tanks.