Soviet and Russian false alarms and nuclear weapons incidents

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Introduction

At the peak of its development, the Soviet nuclear arsenal included tens of thousands of nuclear warheads. Thousands of them were deployed with delivery systems on alert and ready to be used on short notice. The Soviet nuclear enterprise included all three components of the nuclear triad, non-strategic weapons and delivery systems, as well as systems that supported all aspects of their operations—command and control, various communication systems, early warning radars and satellites, space-based capabilities. It is inevitable that a complex system like this is bound to lead to accidents or false alarms, some of which could have had catastrophic consequences. The record indeed shows that accidents have occurred, and while the worst outcomes have been avoided so far, this does not necessarily mean that a catastrophic event can be completely ruled out.

One problem with the analysis of past events is that in the Soviet Union's case the record is fragmentary and incomplete. The documentary evidence regarding accidents is virtually nonexistent. Most of the information about them comes from semi-official histories, memoirs, or interviews. While the record remains sparse, it holds enough information to provide a fairly high level of confidence that the most serious incidents are known. It also provides some information about key details of these events.

Nuclear incidents can be divided into several categories. The most dangerous ones are those that could have plausibly started a chain of events leading to nuclear use. Events in this category are usually false alarms generated by early-warning systems or violations of the command-and-control protocol. The danger posed by these incidents could increase significantly if they occur during a crisis, such as the Cuban Missile Crisis, or during a particularly tense time, as happened in the fall of 1983.

Another category is the nuclear accidents that could have resulted in an inadvertent nuclear detonation. This would have been a significant event but in most cases would probably not lead to nuclear escalation. Events of this type are important in their own right; they also provide additional insight into nuclear weapons handling and managing practices.

The understanding of the dangers associated with various kinds of accidents requires placing them in the broader context of nuclear doctrine, operations, and command and control. Accordingly, this chapter begins with an overview of the basics of nuclear operations in the Soviet Union. It then considers the two most prominent early-warning events, the September 1983 false alarm and the Black Brant event in January 1995. It concludes with a discussion of accidents that could have led to a nuclear detonation as well as other relevant events.

Soviet nuclear operations

Control over the use of nuclear weapons in the Soviet Union was centralized from the very beginning of their deployment. Initially, it was a function of the complexity of the first weapons, which were stored as components and required assembly by specialized crews. During the first decade, the storage, assembly, and delivery of weapons to the troops were the responsibility of the industry. All weapons and their components were stored in dedicated storage facilities and would be released to the military only when necessary. Apparently, in this situation an order to release the weapons would require a coordinated high-level decision of the political and military leadership.

With time, the military started acquiring a more prominent role in handling the weapons. In 1958, this responsibility was given to a new structure, the 12th Main Directorate of the Ministry of Defense (the 12th GUMO). Despite various reorganizations, the 12th GUMO has remained a distinct branch of the Soviet and now Russian armed forces responsible for handing nuclear weapons.[1] Initially, the basic organization of the operations remained the same: all nuclear weapons were stored in dedicated facilities in the custody of the 12th GUMO units. The Soviet Union did not practice deploying nuclear weapons in high degree of readiness, such as bomber airborne or ground alert. The early ballistic missiles also were on combat duty without nuclear warheads. If an order to use the weapons had been issued, the 12th GUMO personnel would have removed weapons from storage, moved them to a designated point, and armed the delivery system by mating warheads with missiles or by loading air-delivered weapons onto aircraft. The procedure was different for naval weapons, such as torpedoes and early cruise and ballistic missiles, which began entering service in the late 1950s. The custody over these weapons was transferred to the crews when the weapons were deployed on a ship.

To control the release and use of weapons, the military initially relied on the standard military chain of command and means of communication, such as cable or radio. The deployment of weapons required a clear order or authorization from the high military command. The order would include authorization codes to be compared with the one distributed to the units in advance by the General Staff.[2] The weapons, however, were not yet equipped with blocking devices, similar to permissive action links (PALs), which would be introduced much later.

In the late 1950s the Soviet Union developed delivery systems that gave it the capability to attack the territory of the United States – most importantly, the intercontinental ballistic missiles (ICBMs). The early missiles, however, were deployed in limited numbers and could not maintain a high degree of readiness. For these, the weapon release sequence likely remained unchanged, with warheads being in storage. Nor did the procedure change for the bombers. There are no indications that Soviet bombers have ever conducted patrol with nuclear weapons on board.

The introduction of ICBMs that were capable of maintaining a higher degree of readiness, and especially of silo-based ICBMs in the second half of the 1960s, led to a change in the deployment procedures. Once a missile was installed in a silo, the units

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[1] See: *Рожденные атомной эрой. История создания и развития 12 Главного Управления Министерства Обороны Российской Федерации. т. 1* (Наука, 2007), http://elib.biblioatom.ru/text/biryukov_rozhdennye-atomnoy-eroy_t1_2007/go,0/.

[2] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation* (Center for Defense Information, 2003), 140, http://www.scribd.com/doc/282622838/C3-Nuclear-Command-Control-Cooperation.

responsible for handling nuclear weapons would install the warhead and transfer custody of the armed system to the missile crew. A launch order would be transmitted from the General Staff to missile units via the general-purpose military communication system.

Throughout the 1960s, when the Soviet Union was deploying its first-generation strategic delivery systems, not much attention was given to the strategy of employment of strategic nuclear forces or to the questions of effective command and control procedures. It appears that the strategy relied on the ability to bring nuclear forces to a high degree of readiness during a crisis. Accordingly, it was assumed that the military command would have sufficient time to transmit the orders and, if necessary, delegate the authority to launch. It was further assumed that a significant number of launchers could either survive an attack or be launched preemptively.

The first serious examination of the nuclear strategy was undertaken in the second half of the 1960s. Formally, it was linked to decisions about the direction of the missile modernization program, as the competing design bureaus advocated different visions of the strategy of their employment. To resolve the dispute, known as the "small civil war," the government established a high-level commission that studied the issue and recommended that the Soviet Union should rely on a "deep second strike" strategy, also known as "retaliation after a ride-out." This strategy required the deployment of ICBMs in hardened silos and supported the development of missiles with multiple independently targeted re-entry vehicles (MIRVs).[3]

The implementation of this strategy also required the development of a robust command and control system that would be capable of delivering launch orders and authorization to the troops. It also involved the development of a command-and-control procedure that would support operations of strategic forces under the conditions of a nuclear attack. As part of this work, which was done in a very deliberative manner, the designers explored a range of issues affecting the reliability of the system, such as the number of people participating in the decision. In another example, they set, as a design criterion, that the probability of an unauthorized launch should be comparable to that of a catastrophic collision with a large asteroid.[4]

At that point, the idea of implementing the launch-on-warning posture was considered as well, but it was ultimately rejected in favor of a deep second strike. At about the same time, in the late 1960s the Soviet Union initiated a major program of building a series of early-warning radars that would be capable of detecting a ballistic missile attack.[5] The early warning system was ultimately integrated into the command-and-control procedure, but at that point it was not aimed at enabling a launch-on-warning capability.

There are several reasons why launch on warning was not the primary option in the Soviet command and control system. One is that during the 1970s, US ballistic missiles did not have the accuracy that would allow them to be used in a disarming counterforce strike. The Soviet Union had considerable confidence that a significant fraction of its

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[3] Pavel Podvig, "The Window of Vulnerability That Wasn't: Soviet Military Buildup in the 1970s—A Research Note," *International Security* 33, no. 1 (2008): 118–38; Pavel Podvig, "In Defense of Silo-Based MIRVed ICBMs," *Russian Strategic Nuclear Forces*, June 2, 2021, http://russianforces.org/blog/2021/06/in_defense_of_silo-based_icbms.shtml.
[4] Gennady Khromov, "History of Soviet strategic forces," interview by Pavel Podvig, October 31, 2002.
[5] Pavel Podvig, "History and the Current Status of the Russian Early-Warning System," *Science & Global Security* 10, no. 1 (2002): 21–60.

deployed ICBMs would survive an attack, provided that the command and control could transmit the launch orders. Another factor was the geographic reality of the Soviet Union that prevented its early-warning radars from detecting incoming missiles early enough for a true launch on warning. Unlike the United States, the Soviet Union did not have forward-deployed radars or early-warning satellites that would give the leadership at least several minutes for making the decision. The Soviet Union began the development of a space-based segment of the early-warning system in the early 1970s, but the addition of satellites would not significantly change its decision timelines.[6]

The procedures designed for dealing with these circumstances relied on a sequence of commands that would enable the transmission of a launch order in various conditions without having to deal with the uncertainties inherent in the reliance on the information from the early-warning system. Most importantly, during normal peacetime operations the combat systems are physically incapable of executing a launch order. To bring these systems to a working condition, the national command authority would have to issue what is usually known as a preliminary command. This command enables the physical transmission of a launch order via a number of communication channels. It is likely that in a crisis situation the General Staff can bring the forces and all command centers into a higher degree of readiness before the preliminary command is issued. However, the preliminary command positively requires an authorization of the national command authority.[7]

In the conditions of a suspected nuclear attack, the early-warning system would generate an alarm. The system would also indicate the nature of the alarm, distinguishing between various threat levels, for example, "a single target," "a group of targets," or "a massive launch."[8] It is possible that the alarm would have to be evaluated and confirmed by the command center of the early-warning army and/or the command center of the Air Defense Forces (currently Air and Space Forces) before it was transmitted to the command center of the General Staff. It is also possible that certain alarms, such as "a massive launch," are transmitted automatically to be followed by an evaluation by the lower-level command centers.[9]

Once the alarm is received at the command center of the General Staff and is properly validated, the duty officer at the command center contacts the national command authority via the dedicated secure communication network. This network, known as Kavkaz, is used to establish a conference call between all relevant officials in the political and military leadership. It is believed that this call would have to include the president (the General Secretary in the Soviet days), the minister of defense, and the chief of the General Staff.[10] If the participants in the call reach an agreement on the course of actions, they would use their terminals ("nuclear suitcases," known as Cheget) to transmit the preliminary command. It is important to note that this authorization is

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[6] Pavel Podvig, "Reducing the Risk of an Accidental Launch," *Science & Global Security* 14, nos. 2–3 (2006): 75–115.

[7] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation*, 152–53. The author used somewhat different terminology. What is described as a preliminary command in this paper is a combination of the permission and direct command described in the book.

[8] Pavel Podvig, "An Early-Warning Satellite Command Center Opens Up," *Russian Strategic Nuclear Forces*, May 31, 2012, https://russianforces.org/blog/2012/05/interesting_look_at_the_early-.shtml.

[9] Pavel Podvig, ed., *Russian Strategic Nuclear Forces* (MIT Press, 2001), 61.

[10] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation*, 150–51. There is no reliable information about who exactly is required to be on the call, but it is almost certain that in the Soviet Union the General Secretary did not have the sole authority to issue a nuclear launch order.

not a launch order, so the threshold for issuing a preliminary command is not prohibitively high.

After the preliminary command was transmitted, the command center of the General Staff would wait for positive confirmation of the attack. It was expected that this confirmation would typically come as a detection of nuclear detonations on the country's territory.[11] Once this confirmation is received, the national command authority could issue a launch order. It should be noted that the response was not automatic, and the leadership could choose not to respond. For example, Soviet leaders might not have retaliated against a single missile launch or even a single nuclear detonation, presumably considering it to be accidental.[12]

This mode of operation of strategic forces could be vulnerable to a decapitating strike or to an attack against the nuclear command and control structure. To deal with this problem, the system included several backup command centers and a variety of communication channels. For example, one of the communication systems that would be used to deliver the launch order in these conditions, known as Perimeter, used command missiles that could deliver the launch command directly to individual silos, bypassing all intermediate levels of the command-and-control chain. This would provide assurances that at least some surviving missiles can be launched.

The preliminary command would authorize at least one of the backup centers, a reserve command post, to issue a launch order, subject to a number of conditions. In addition to the confirmation of nuclear explosions, the center would have to establish the loss of the leadership and the central command post of the General Staff.[13] The degree to which operators of the reserve command post would have autonomy in initiating a retaliatory strike is unknown. In the arrangement often described as the Dead Hand, the reserve post would issue a launch order automatically once all the conditions are met, maybe even without a human in the loop. Soviet documents suggest that one idea discussed in the 1980s was that this mode could be activated during a "threatening period" with a notification to the adversary warning them of the fact of activation.[14] Presumably, this notification would have discouraged an attempt to launch a decapitating strike. However, the same documents show that the idea did not have sufficient support in the leadership and that the command-and-control system has never operated in this mode. This means that the decision to issue a launch order would not be automatic and would still require an overall assessment of the situation by someone in the chain of command, even if the communication with the national command authority was lost.

In the early 1980s the Soviet Union started implementing a range of measures to move its operations from retaliation after a ride-out to a launch from under attack. While the decision-making mechanism would still rely on the detection of nuclear detonations to issue a launch order, the retaliatory strike could be initiated while the attack was still underway. To achieve this capability, the Soviet Union undertook a massive program of hardening all elements of its strategic forces, which included such elements as ensuring

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[11] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation*, 157; Pavel Podvig, "Does Russia Have a Launch-on-Warning Posture? The Soviet Union Didn't," *Russian Strategic Nuclear Forces*, April 29, 2019, https://russianforces.org/blog/2019/04/does_russia_have_a_launch-on-w.shtml.

[12] Gennady Khromov, "History of Soviet strategic forces."

[13] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation*, 157; Podvig, *Russian Strategic Nuclear Forces*, 64.

[14] Pavel Podvig, "Dr. Strangelove Meets Reality," *Russian Strategic Nuclear Forces*, April 14, 2006, https://russianforces.org/blog/2006/04/dr_strangelove_meets_reality.shtml.

that ICBMs could be successfully launched even when adjacent silos had been hit by nuclear warheads.

Interestingly, the Soviet Union had not attempted to communicate the basic principles of its nuclear command-and-control procedures, with its emphasis on retaliation, delayed action and guards against a decapitating attack, to the United States. Even if it had, it is possible that this communication would not have been successful. When the Soviet Union declared a no-first-use policy in 1982, this declaration was met with considerable skepticism. While it is not clear if the no-first-use pledge covered the use of non-strategic nuclear weapons in case of a conflict in Europe, it reflected the fact that the Soviet Union had neither capability nor a plan to launch a first strike against the US strategic forces. The United States, on the other hand, interpreted the Soviet modernization program in the 1970s as aiming to obtain a first-strike capability.

Overall, the Soviet approach to nuclear command-and-control operations gave its leadership the option to defer retaliatory decisions until receiving positive confirmation of an attack. Technically, it allowed the implementation of true launch on warning when the launch order is based only on the information from the early warning system. However, as noted earlier, for the Soviet Union this option would have been extremely risky since the lack of forward-deployed radars meant that even though satellites could provide an independent confirmation of an attack, they could not increase the time available for decision-making.

Equally importantly, since the primary (indeed the only) mission of the strategic forces was retaliation, they were not under the "use them or lose them" pressure. Since the Soviet Union emphasized guaranteed retaliation against a relatively small set of targets, it assumed that even though a significant portion of the land-based force would be lost, the remaining launchers would still be able to deliver a retaliatory response. For example, one Soviet document suggests that the military considered that only about 15 percent of mobile missile launchers would survive an attack and that these launchers could destroy 80 targets in US territory in a retaliatory strike.[15]

Today's command and control procedure may be different in some respects from the one developed in the Soviet Union. Moreover, latest Russian doctrinal documents explicitly mention the option of launch on warning. The version of the doctrine approved in 2020 specified that Russia reserves the right to use nuclear weapons in the case of the "receipt of reliable data on the launch of ballistic missiles attacking the territories of the Russian Federation and (or) its allies."[16] In 2024, the doctrine was amended to include the "receipt of reliable data on the massive launch (take-off) of air and space attack means."[17] This clearly indicates the possibility of a launch on warning based solely on the data from the early warning system. At the same time, a declaratory statement like this may have been made to introduce additional uncertainty into the calculation of an attacker and does not necessarily mean that launch on warning is the preferred, let alone the only, option. The key factors that led the Soviet Union to consider

[15] Pavel Podvig, "A Note on Mobile Missiles in the Kataev Archive," *Russian Strategic Nuclear Forces*, May 9, 2021, https://russianforces.org/blog/2021/05/a_note_on_mobile_missiles_in_t.shtml.
[16] "Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence," June 2, 2020, https://archive.mid.ru/en/web/guest/foreign_policy/international_safety/disarmament/-/asset_publisher/rp0fiUBmANaH/content/id/4152094.
[17] "Fundamentals of State Policy of the Russian Federation on Nuclear Deterrence," November 19, 2024, https://www.mid.ru/ru/foreign_policy/international_safety/disarmament/1434131/?lang=en.

deep second strike (and later a launch from under attack) remain unchanged, suggesting that the basic operations of the command and control remained the same.

Incidents and false alarms

September 1983 false alarm

The September 1983 false alarm is arguably the best-known accident in the Soviet early-warning system. On the night of September 26, the space segment of the system generated an alarm that indicated a detection of several missiles launched from US territory. After checking for visual confirmation of the launch, the officer on duty, Lt.-Colonel Stanislav Petrov, recognized the alarm as false and reported his assessment to the higher-level command center.[18] In the standard account of the accident, this assessment averted a full-scale nuclear conflict. Technically, an alarm like that one would be the kind of event that could initiate a chain of decisions enabling a Soviet retaliatory strike. This, together with the fact that the fall of 1983 was an extremely tense period in the US-Soviet relations, drew additional attention to the incident. The fact that it received special attention of the Soviet military leadership also indicates that this event was more serious than others.[19] However, the analysis of the accident strongly suggests that a catastrophic outcome was extremely unlikely.

The alarm took place at the command center of the space-based segment of the early-warning system. At the time, all early-warning and missile defense assets were organized in several division-level units that comprised the Third Early-Warning Army, which was part of the Air Defense Forces, a separate service in the Soviet armed forces.[20] Some divisions operated early-warning radars of different types and one division, with the command center at Serpukhov-15 in Kaluga region, operated the early-warning satellites. The divisional command center transmitted information to the command post of the early-warning army, which then forwarded it, along with its assessment, to the Main Command Center of the Air Defense Forces. That center would communicate any warning to the Command Center of the General Staff, which would have the authority to act and initiate the command-and-control sequence described earlier.[21] It appears that certain alarms generated by the lower-level command posts would be transmitted up the reporting chain automatically.

The Soviet space segment of the early-warning system, known as US-K or Oko, had been in development since the early 1970s. The system was formally accepted for service in December 1982. As of September 1983, it included seven operational satellites deployed on highly elliptical orbits.[22] The data transmitted by the satellites were processed automatically to produce an assessment. In addition, operators had access to the visual picture transmitted by the sensors. On the day of the alarm, the alarm signal was generated by a computer algorithm that indicated the early-warning satellite had detected a missile launch. A few minutes later, it detected the launch of several missiles, corresponding to a "missile attack" warning.[23] The alarm was automatically transmitted to the command center of the early-warning army. Following the alarm, the crew on

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[18] David Hoffman, *The Dead Hand: The Untold Story of the Cold War Arms Race and Its Dangerous Legacy* (Knopf Doubleday Publishing Group, 2009), 8–10.
[19] Ю. В. Вотинцев, "Неизвестные войска исчезнувшей сверхдержавы," *Военно-исторический журнал*, nos. 8–11 (1993).
[20] Podvig, *Russian Strategic Nuclear Forces*, 422.
[21] Podvig, *Russian Strategic Nuclear Forces*, 432.
[22] Podvig, "History and the Current Status of the Russian Early-Warning System."
[23] Hoffman, *The Dead Hand*, 8–10; "Stanislav Petrov," interview by David Hoffman, January 22, 2006.

duty performed a checkup of the equipment and the software and did not find any malfunctions. The visual control, however, did not confirm the detection and the duty officer in charge, Stanislav Petrov, reported to the army command center that in his assessment the alarm was false.

The account of the incident given by Petrov suggests that there were several factors that contributed to this assessment.[24] One was the understanding that notwithstanding the tense period in the US-Soviet relations, a bolt out of the blue attack was unlikely. Another one was that a US missile attack, should it happen, would not consist of a small number of missiles. Finally, false alarms were known to happen and since the early-warning system was still in the early stages of operation, the reliability of the system was still in question.

It appears that the initial alarm was automatically transmitted through the entire command chain, reaching the Central Command Post (CCP) of the General Staff. The subsequent assessment was transmitted through the chain as well. Accounts of the operations of the early-warning system suggest that this was not a unique occurrence and that alarms reached the TsKP with some regularity.[25] However, the military gave the September 1983 event a special attention, creating a high-level investigative commission that reported to the minister of defense. The commission reportedly found that the system's software incorrectly processed the signal in difficult lighting conditions.[26]

There is no evidence that would indicate that the higher-level command centers of the command-and-control system were prepared to assess the alarm as a true missile attack. It is true that Petrov's report contributed to the correct assessment of the nature of the alarm, but it is likely that the alarm would have been recognized as false in any event. There is also no evidence that the General Staff Command Center was considering acting on the warning. But even if it had, the most consequential decision that it would have made in the circumstances was a transmission of the preliminary command. This suggests that the danger of the accident is somewhat exaggerated.[27]

January 1995 event

Another event related to the operations of the early-warning and command-and-control systems was the detection of a sounding rocket launched from Norway in January 1995. The launch of the rocket, of a type known as a Black Brant XII, was conducted as part of a scientific experiment designed to study the upper levels of the atmosphere.[28] The rocket was launched at about 06:24 UTC on January 25, 1995, from the Andøya rocket range in northern Norway. The rocket was launched in the direction of the North Pole on a trajectory with an apogee of about 1500 km. This trajectory placed the rocket in the field of view of the early-warning radar near Olenegorsk on the Kola peninsula in north-western Russia.

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24 Hoffman, *The Dead Hand*, 8–10.
25 Н. Г. Завалий, *Рубежи обороны - в космосе и на земле: Очерки истории ракетно-космической обороны* (Вече, 2003), 152–53.
26 Ю. В. Вотинцев, "Неизвестные войска исчезнувшей сверхдержавы."
27 Pavel Podvig, "Did Stanislav Petrov Save the World in 1983? It's Complicated," *Russian Strategic Nuclear Forces*, October 22, 2022, https://russianforces.org/blog/2022/10/did_stanislav_petrov_save_the_.shtml.
28 "SCIFER - Optical and Magnetometer Data," University Centre in Svalbard, January 16, 2005, https://web.archive.org/web/20050116064117/http://haldde.unis.no/scifer/.

What happened next is a matter of dispute. It is known that the rocket was detected by the radar and by all indications the early warning system generated an alarm. At some point during the day, the Russian news agency Interfax reported, referring to a source in the Ministry of Defense, that the early-warning radars detected the launch, and that the missile was intercepted by the missile defense system. Since Russia had no missile defense system deployed in the region, this detail about the intercept indicated a problem with the report and should have raised immediate concerns about its correctness. Indeed, the news agency withdrew the story about an hour after it was issued.[29] Nevertheless, it appears that the information about the launch did reach some command center in Moscow.[30]

The story continued with a new development the next day, when the Russian president revealed that he used the Cheget terminal of the command-and-control system during the incident to communicate with the military leadership.[31] However, the circumstances of the incident strongly suggest that this was not the case. None of the disinterested knowledgeable sources confirmed that the terminals were activated on January 25, 1995.[32] Moreover, there is some evidence that suggests that the work of the Cheget terminal was demonstrated to the president the day after the incident.[33]

Norway had provided a notice of the planned launches, and the impact areas mariners should watch out for. The most likely explanation of the event is that operators of the early-warning radar and maybe the early-warning command center did not receive Norway's notification.[34] The fact that the Black Brant XII missile was significantly larger than all missiles previously launched from the site may have contributed to the incident as well. It should be noted that Norway updated its notification procedures after the incident.[35]

Even if the Kavkaz communication network was activated on January 25, 1995, the most that the president and the military leadership could have done was to follow the standard procedure and issue the preliminary command. No account of the incident suggests that this was actually done.

Other early warning errors

While the September 1983 and January 1995 events have received the most attention, these were far from isolated cases. The literature describes a number of problems related to the functioning of the early-warning system.[36] Various components of the system experienced technical problems, malfunctions of the computers, support, and communication systems. Radars as well as satellites had to deal with complex natural phenomena. The overall reliability of the system was rather low and various accounts of the history of its development and operation strongly indicate that this fact was understood by the operators. It therefore seems unlikely that the command authorities would have relied on alarms generated by the early-warning system to take irreversible

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[29] Andrew Higgins, "How Boris Saved the Kremlin," *The Independent*, February 3, 1995.
[30] Benoit Pelopidas, *Overconfidence and Learning from Nuclear False Alarm: Lessons on the Blank Brant XII Event from an Oral History Workshop after Twenty Years*, 2015.
[31] "Ельцин в Липецке," *Коммерсантъ*, January 27, 1995, https://www.kommersant.ru/doc/100511.
[32] Pelopidas, *Overconfidence and Learning from Nuclear False Alarm*.
[33] Bruce Blair "Norway 1995," to Pavel Podvig, January 2, 2014.
[34] Pavel Podvig, "Norway Black Brant Letter," *Russian Strategic Nuclear Forces*, August 8, 2005, https://russianforces.org/blog/2005/08/norway_black_brant_letter.shtml.
[35] Pelopidas, *Overconfidence and Learning from Nuclear False Alarm*.
[36] Завалий, *Рубежи обороны - в космосе и на земле*, 148–55.

steps toward a nuclear launch. The reliance on retaliation after absorbing initial detonations and the command-and-control procedure that supported a deferred response further decreased the importance of early warning. Early warning was given a more prominent role in the late 1970s and early 1980s, when the Soviet Union started transition to the launch from under attack posture, but even in that case the procedure did not require an immediate response to an alarm generated by the early-warning system.[37]

In addition to managing these technical issues, the system had to deal with procedural violations that could lead to false alarms. One event of this kind took place on January 13, 1978, during a visit of a high-level party official to an early-warning radar site in the Far East. During the demonstration of the work of the system, the unit's commander ran the combat computer in a training mode without notifying the command of the division or the army. The training data showed a missile attack from China and the radar node generated an alarm that was delivered to all higher-level command centers, including the CCP at the General Staff. It was called off by the army command center about seven minutes before the projected "impact." A similar incident, in which a trajectory of a US missile used for calibration was processed as real, took place in March 1979.[38] Notably, neither of these events resulted in the activation of the retaliatory launch procedure.

A mistaken alert order

One of the events described in the literature provides an interesting insight into the operations of the command-and-control system even though it does not qualify as a true accident. It occurred in the mid-1970s, when, due to a technical malfunction, the command centers of the Strategic Rocket Forces received an automatically generated order to put them on combat alert. The order apparently went to the entire command chain that included the central command post of the Rocket Forces, those of missile armies, and those of divisions. Out of the total of about thirty command centers, only one division-level center followed the order and put its unit on alert. All others recognized that the order was issued in error and did not follow the standard procedure.[39]

Nuclear weapons accidents

Yet another category of accidents includes those that involved damage or a threat of damage to live nuclear weapons. Although there is no official, comprehensive account of accidents of this type, it appears that the most serious ones have been described in the literature.

The most important factor that affected the number and seriousness of accidents with nuclear weapons was the fact that, unlike the United States, the Soviet Union did not maintain the practice of keeping its bomber force on high alert. Soviet and Russian nuclear-capable aircraft have not conducted patrols with nuclear weapons on board. Indeed, by all indications, the only time when Soviet bombers took off with nuclear weapons was when the flight was part of a nuclear test. There is one known case when

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[37] Podvig, "In Defense of Silo-Based MIRVed ICBMs."
[38] Михаил Первов, *Системы ракетно-космической обороны России создавались так* (Авиарус-XXi, 2003), 416.
[39] Valery E. Yarynich, *C3: Nuclear Command, Control, Cooperation*, 208. The author uses the term "preliminary command" in the sense that is different from the one used in this paper. The command in this incident was an order to raise the alert level of all systems that would be issued in a case of a crisis. See footnote 7.

an aircraft landed with a nuclear weapon after a test was aborted. This may well be the only landing of this kind in the Soviet or Russian system.

Accidents involving nuclear weapons on submarines were rather frequent, owing to the practice of continuous submarine patrols and the dangerous nature of these operations. The Soviet Union lost three nuclear-armed submarines at sea, along with 25 nuclear weapons they carried.[40] In addition to that, there were numerous fires and other accidents at ports, but it is not always clear if nuclear weapons were on board at the time of the accident. The most recent event of this kind took place in December 2011, when the Ekaterinburg ballistic missile submarine caught fire during a maintenance stop in a dry dock. The submarine may have had the full complement of 16 missiles with 64 nuclear warheads on board, although this has never been officially confirmed.[41]

A known accident that involved a fire and an explosion of an armed SLBM took place in September 1977 in Vilyuchinsk, Kamchatka. A submarine of the Project 667B/Delta I class was in the process of loading a nuclear-armed missile, R-29. Because of a human error, the missile's fuel tanks were damaged, leading to a fire and eventually to an explosion. The nuclear warhead that was installed on the missile landed in water undamaged and was recovered.[42]

The third leg of the strategic triad, the Strategic Rocket Forces, also had accidents with missiles armed with nuclear warheads. Two explosions of silo-based UR-100/SS-11 missiles happened in 1967, during the early stages of missile deployment.[43] According to an official account, these were the only two events of this kind.[44] Further accidents were probably avoided by the introduction of procedures for deploying and maintaining the missiles that minimized the instances when an armed missile can be damaged. Silos provided a much better controlled environment than launch tubes on submarines, and warheads were installed only after a missile was placed in a silo and filled with fuel. Additional precautions were taken as well. For example, when UR-100/SS-11 missiles reached the end of their service life in the 1970s, some of them were kept in silos to study the possibility of extending the service life. Nuclear warheads, however, were removed.[45]

There are no known accounts of accidents that involved non-strategic nuclear weapons.[46] To a certain extent this can be explained by the Soviet (and now Russian) practice of strict separation of all operations with nuclear weapons from those of the general armed forces. At the same time, even though none of these weapons have been deployed, normal operations involve routine transportation of a very large number of weapons between various storage facilities. While transportation is an inherently risky

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40 *Global Fissile Material Report 2010: Balancing the Books: Production and Stocks* (International Panel on Fissile Materials, 2010), 54, http://ipfmlibrary.org/gfmr10.pdf.

41 Pavel Podvig, "Ekaterinburg Submarine Had Missiles on Board during the Fire," *Russian Strategic Nuclear Forces*, February 13, 2012, https://russianforces.org/blog/2012/02/ekaterinburg_submarine_had_mis.shtml.

42 В. В. Коротких, "На грани катастрофы," *Мой город*, July 23, 2008.

43 Pavel Podvig, "Early Accidents with ICBMs," *Russian Strategic Nuclear Forces*, July 8, 2008, https://russianforces.org/blog/2008/07/early_accidents_with_icbms.shtml.

44 Виталий Линник, "Безопасность гарантирована," *ВПК*, July 6, 2008, https://web.archive.org/web/20080706232123/http://www.vpk-news.ru/article.asp?pr_sign=archive.2008.242.articles.army_03.

45 Gennady Khromov, "History of Soviet strategic forces."

46 For example, the semi-official history of the 12 GUMO does not mention any accidents of this kind. See *Рожденные атомной эрой*.

activity, it is possible to imagine that it can be conducted without major accidents that would endanger the weapons. Most of the transfers were conducted by rail and overseen by a dedicated branch of the military that prioritized safety. The return of thousands of non-strategic weapons from outside of the Soviet Union toward the end of the Soviet period, and then from the non-Russian states that resulted from the Soviet collapse, in the midst of immense political, economic, and social turmoil and tightly constrained resources, apparently without incident, is especially remarkable; most of that work was accomplished before any Western assistance arrived. However, it is possible that some incidents were not reported.

Conclusions

This overview of known false alarms and nuclear accidents in the Soviet Union and Russia identifies a number of factors that helped avert an inadvertent use of nuclear weapons or a major nuclear accident. It also points at the practices that can increase the probability of an accident. It cannot, however, provide a definitive answer as to whether the institutions that manage nuclear weapons learn from the experiences of past events and correct their practices accordingly. The lack of a systematic accounting and analysis of these incidents in the nuclear enterprise limits the opportunities for institutional learning. While some of the learning may have occurred internally, it is not known whether it actually has.

Factors that Reduced Nuclear Dangers

Retaliatory strike posture. Perhaps the most important factor in managing the risk of nuclear false alarms and accidents was the overall nuclear posture, including the decision not to rely on launching on warning, before any attacking weapons detonated. This posture reflected the understanding of the role of these weapons and shaped nuclear operations accordingly. The decisions made by the Soviet Union to rely on a second-strike capability in its nuclear posture shaped its approach to command and control, helping to create procedures that provide a considerable degree of protection against the inadvertent use of nuclear weapons.

Expectation that a nuclear conflict would come after a prolonged crisis or conventional conflict. Another important factor was the understanding that a nuclear conflict would follow a period of heightened tensions and escalation from a sub-conventional or conventional level. This would allow time to bring the nuclear forces to a higher degree of readiness. This factor played out in two ways. First, it was reflected in the absence of such practices as continuous patrol of bombers and in the practice of keeping non-strategic nuclear weapons separated from their delivery systems. Second, the expectations about the circumstances for nuclear use allowed military personnel responsible for interpreting and reporting false alarms and malfunctions to dismiss them as such. Even though the 1983 incident occurred during a period of tensions between the United States and the Soviet Union, Colonel Petrov was still able to judge that the conditions did not make a massive US first strike credible. This set of understandings and expectations helped prevent further escalation of the incident.

History of false alarms and system malfunctions. Another factor that appeared to play a role is the rather low reliability of various technical systems that supported nuclear operations. Operators widely perceived the warning systems to be unreliable and tended to interpret malfunctions or ambiguous signals accordingly. The role of humans in the decision-making loop extended beyond processing information collected by various monitoring systems; it also included making judgments about the broader context of events and the trustworthiness of the information presented to the operators.

Factors that Elevated Nuclear Dangers

While this overview seems to suggest that the dangers of nuclear accidents can be managed, for example by adopting some practices and avoiding others, it also shows that it is impossible to fully eliminate that danger. As long as nuclear weapons remain in service, states will continue to develop scenarios in which they might be used and put in place specific procedures to do so. Even if these procedures incorporate various safety mechanisms, they are ultimately designed to enable the use of nuclear weapons, which means that such use cannot be completely ruled out.

Inherent systems complexity and "normal accidents." Since nuclear operations rely on a variety of complex technical systems, there is an inherent risk that these systems may malfunction or interact in unpredictable ways. While human operators can sometimes recognize a malfunction, there are limits to what they can do, especially since the nuclear command and control appears to have the attributes of a complex and tightly coupled system that is susceptible to "normal accidents."[47]

Secrecy and compartmentalization. The high levels of secrecy and compartmentalization within the nuclear complex limit the opportunities for organizational learning that could, in principle, lead to safer operational practices.[48] From this perspective, serious crises are particularly dangerous because it is impossible to prepare for a specific chain of events and to predict how these events will affect various elements of the nuclear complex, as well as the judgment of political leaders and operators.[49] Secrecy and compartmentalization between various parts of the nuclear deterrence complex might also impede analysis and learning from past incidents.

Political context. The technical and organizational complexity of the nuclear complex is compounded by the inherently political nature of most decisions regarding nuclear posture and operations. The situation is further complicated by the fact that these decisions are often made in response to the choices made by the opponent and that the information about these choices is frequently imperfect and can be easily misinterpreted, sometimes deliberately. In an atmosphere of secrecy and mistrust, the interpretation of the opponent's motives can be vulnerable to political manipulation.

What Has Changed

Finally, although it may be possible to identify some factors that could either increase or mitigate the risk of a catastrophic nuclear accident, these factors are not static. The systems that support nuclear operations evolve together with the technological and political environments in which they operate.

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[47] Charles Perrow, *Normal Accidents: Living with High-Risk Technologies*, Princeton Paperbacks (Princeton University Press, 1999).

[48] Scott Douglas Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons*, Princeton Studies in International History and Politics (Princeton University Press, 1993).

[49] Coincidences may be more frequent than is usually realized, and some are discovered only after the fact, if at all. See, for example, Pavel Podvig, "Russia and the Prompt Global Strike," *Russian Strategic Nuclear Forces*, October 7, 2006, https://russianforces.org/blog/2006/10/russia_and_the_prompt_global_strike.shtml; Pavel Podvig, "Unexpected Dangers," *Bulletin of the Atomic Scientists*, July 10, 2013, http://thebulletin.org/unexpected-dangers.

Launch on warning nuclear posture. As discussed earlier, the new version of the Russian nuclear doctrine specifies that among the "conditions enable the possibility of nuclear weapons employment" are the "receipt of reliable data" on the launch of ballistic missiles or on a massive attack by aircraft, cruise missiles, and other means.[50] Importantly, the doctrine does not explicitly say that these attacks must be nuclear to trigger a response. While it is not clear to what extent these declarations have been reflected in the nuclear command and control procedure, Russia does have the capability to detect ballistic missile launches against its territory and may have the capability to detect a massive air attack. Russia also has the technical capability to launch a retaliatory attack on warning, before receiving a positive confirmation of an attack. The doctrinal language seems to suggest that in order to trigger a nuclear response the attack should threaten Russia's sovereignty or territorial integrity, but the document leaves significant uncertainty on this point, most likely deliberately. A move to launch on warning would definitely increase the danger posed by false alarms and similar incidents.

Increased hostility and political complexity. The last years of the Soviet Union and the decades immediately following the Soviet collapse represented a period of much-reduced tensions which reduced the danger of any launch in response to a false alarm or accident. Today, U.S.-Russian hostility is more intense than it has been since the Cuban Missile Crisis. The overall environment is becoming increasingly complex as well, with China's growth to one of the world's great powers and its nuclear buildup, North Korea's burgeoning nuclear arsenal and new relationship with Russia, and growing doubts among U.S. allies about U.S. leadership. The war in Ukraine created a serious crisis that brought in almost every factor that makes accidents more likely. Additionally, it introduced high uncertainty in risk calculations, opening multiple pathways for escalation. It is possible that the heightened risk of escalation has made all parties more cautious in their assessment of the situation, and there is some evidence suggesting that this is indeed the case. At the same time, the potential for a catastrophic misunderstanding is definitely higher than it has been in decades, especially since Russia, and to a certain degree the West as well, seems willing to use the risk of escalation as a tool to manage the conflict.

These developments strongly suggest that there are limits to what technical or organizational measures aimed at reducing the probability of accidents can achieve. Ultimately, if nuclear weapons possess military or political utility, it is inherently linked to their ability to create a credible risk of use. A more reliable way to reduce the risk of an accident is to dramatically reduce both tensions between nuclear-armed states and the salience of nuclear weapons, while ensuring that possessor states do not rely on them to achieve their political or military goals.

[50] "Fundamentals of State Policy of the Russian Federation on Nuclear Deterrence" Section III.19.