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2021

Information and Blind Spots: Satellite-imaging technology and contending arguments for nuclear disarmament, arms control, and modernization in U.S. policymaking

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Princeton, NJ : Princeton University

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INFORMATION AND BLIND SPOTS:

SATELLITE-IMAGING TECHNOLOGY AND CONTENDING ARGUMENTS FOR NUCLEAR DISARMAMENT, ARMS CONTROL, AND MODERNIZATION IN U.S. POLICYMAKING

Tamara Lilinoe Patton

A DISSERTATION PRESENTED TO THE FACULTY

OF PRINCETON UNIVERSITY

IN CANDIDACY FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

RECOMMENDED FOR ACCEPTANCE BY THE SCHOOL OF PUBLIC AND INTERNATIONAL AFFAIRS

Adviser: Alexander Glaser

November 2021

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Information and Blind Spots:
Satellite-imaging technology and contending arguments for nuclear disarmament, arms control, and modernization in U.S. policymaking

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Abstract: In the United States in the late 1950s and early 1960s, arms control gained traction as the preferred option for dealing with Soviet nuclear advances. The development of the first imaging satellites is often credited with enabling nuclear arms control under the conventional wisdom that more information enabled verification and thus facilitated restraint and cooperation. This research shows that while satellites indeed provided information to verify arms control and contributed to its rise, the information and blind spots stemming from the high-resolution satellites fielded by the United States related to Soviet nuclear weapon developments were often leveraged to pursue more diverse and expansive U.S. modernization efforts, including to retain nascent weapon programs when their banning or cancellation was a possibility under debate. New information and remaining blind spots from satellites were thus co-constitutive in arms control limits (rather than bans), but also in qualitative arms build ups. The result was that arms control, while initially framed by U.S. political leaders as a step toward disarmament, became increasingly interwoven with modernization, and this combination was often positioned as the policy alternative to a potential ban. The advancement and use of high-resolution satellites thus contributed to the shaping of U.S. nuclear policy by encouraging arms control while creating new opportunities for pursuing nuclear superiority and further diminishing disarmament as a policy choice.

Contents

Introduction 1

Chapter 1: The Resolution Initiative 45

CORONA and GAMBIT 46
HEXAGON 71
KENNEN 93

Chapter 2: Intelligence Foundations of Information and Uncertainty: The Practices and "Stories" of Imagery Analysts 117

CORONA and GAMBIT 117
HEXAGON 131
KENNEN 142

Chapter 3: SALT I under CORONA and GAMBIT, 1960-1972 156

Nuclear strategy overview 157
Established weapon systems: ICBMs, SLBMs 165
Pending weapon systems: MIRVs, ABMs, Mobile ICBMs 204
Conclusion 237

Chapter 4: SALT II under HEXAGON, 1972-1976 244

Nuclear strategy overview 245
Established weapon systems: ICBMs, MIRVs 254
Pending weapon systems: Cruise missiles, Mobile ICBMs 279
Conclusion 312

Chapter 5: START and INF under KENNAN, 1976-1987 318

Nuclear strategy overview 319
Established weapon systems: ICBMs, MIRVs 323
Pending weapon systems: Mobile ICBMs, Mobile IRBMs 333
Conclusion 368

Conclusion 373

Introduction

Information, whether framed as knowledge, transparency, or verification, has been seen by scholars as a way for individuals or states to have confidence in the pursuit of international cooperation without sacrificing their interests or sovereignty.[1] This relationship between information and cooperation has been credited with arms control gaining traction within the United States in the late 1950s and early 1960s as the preferred option for dealing with Soviet nuclear weapon advances. In particular, the development of the first imaging satellites is often credited with enabling nuclear arms control.[2] These machines, it is said, provided information and resolved the uncertainty that initially contributed to uncontrolled arms racing. Such

[1] The following works make general claims about cooperation to this effect; page numbers point to various formulations and extensions of this argument. Young, Oran R. *Compliance and Public Authority: A Theory with International Applications.* Baltimore: Johns Hopkins University Press, 1979, p. 45; Ernst Haas, "Why Collaborate? Issue-Linkage and International Regimes," *World Politics* 32, no. 3 (April 1980), pp. 367-368; Keohane, Robert O. "The Demand for International Regimes." *International Organization* 36, no. 2 (1982): 325-55; Axelrod, Robert M. *The Evolution of Cooperation.* New York: Basic Books, 1984, pp. 140-141; Jervis, Robert O. "From Balance to Concert: A Study of International Security Cooperation." *World Politics* 38, no. 1 (1985): 58-79, pp. 73-74; Oye, Kenneth A., *Cooperation Under Anarchy.* Princeton: Princeton University Press, 1986, pp. 16-17; Grieco, Joseph M. *Cooperation among Nations: Europe, America, and Non-tariff Barriers to Trade*. Ithaca; London: Cornell University Press, 1990, p. 153.

[2] Historical accounts of verification technology and of U.S. satellite-imaging programs have frequently credited the emergence of satellites with the realization of arms control. See, for example, Burrows, William E., *Deep Black: Space Espionage and National Security.* New York: Random House, 1986, pp. viii-ix. Day, Dwayne A., John M. Logsdon, and Brian Latell. *Eye In the Sky: The Story of the Corona Spy Satellites.* Washington, D.C.: Smithsonian Institution Press, 1998. Scholars of arms control have also framed the issue in terms of treaty verification technology as an asset that increases the quality and quantity of information, and in doing so better enables cooperation. See for example, Patrick Morgan's argument about verification in the context of his chapter on "Elements of a General Theory of Arms Control," in Arms Control: History, Theory, and Policy, Volume 1, etd. Robert E. Williams Jr. and Paul R. Viotti, Santa Barbara: Praeger Security International, 2012, p. 29.

information and transparency gains are expected to ameliorate the problems of uncertainty and risk that might otherwise prevent a mutually beneficial arms control agreement.[3]

This research shows that while satellites indeed provided information to verify arms control and contributed to its rise, the information and blind spots stemming from the high-resolution satellites fielded by the United States related to Soviet nuclear weapon developments were often used to pursue more diverse and expansive U.S. modernization efforts, including retaining nascent weapon programs when their banning or cancellation was a possibility under debate. The result was that arms control, while initially framed by U.S. political leaders as a step toward disarmament, became increasingly interwoven with modernization, and this combination was often positioned as the policy alternative to a potential ban. The advancement and use of high-resolution satellites thus contributed to the shaping of U.S. nuclear policy by encouraging arms control while creating new opportunities for pursuing nuclear superiority and further diminishing disarmament as a policy choice.

Nuclear arms control was originally devised to balance weapon capabilities in ways that reduced the chances of nuclear war.[4] Despite this vision, arms control ultimately evolved to possess a central focus on numbers of weapons while qualitative competition endured and intensified. A small number of qualitative controls have been built into treaties between the United States and

[3] Keohane, "The Demand for International Regimes," 1984. See for example, arguments on p. 345 and pp. 337-338. This range of information quality has been presented as a spectrum: while partial or imperfect information can present problems, under perfect information, it is argued, reaching cooperative outcomes is more likely. See for example, Downs, George, David Rocke, and Randolph Siverson. “Arms Races and Cooperation.” *World Politics* 38, no. 1 (October 1985): 118–46, p. 144.

[4] A founding text elaborating this principle is: Schelling, Thomas and Morton Halperin. *Strategy and Arms Control*. Washington: Pergamon-Brassey’s, 1985.

the Soviet Union/Russia concerning factors like range and missile throw-weight. But for the most part, treaties have left each side free to improve qualitative features like accuracy and targeting, hardness and survivability, warhead destructiveness, speed of delivery, mobility, and stealth capabilities. Modernization is defined here as the qualitative advancement of nuclear weapons either by expanding into new types or adding novel capabilities to existing weapons in ways that lead to significant changes in the realm of strategy, in the organization of military forces, or in the distribution of resources among services.[5] This direction has led some strategists of nuclear weapons and arms control to lament the many things that went 'wrong' with arms control, arguing that an outsized focus on numbers of weapons rather than their distinctive capabilities does little to actually mitigate the tensions and incentives that could lead to conflict.[6]

The impact of decisions about satellite-use stems from both information and uncertainty. As satellite technology improved, the increased capabilities contributed to helping achieve arms control through limits on weapon systems. But, as more details of the Soviet arsenal came into focus, this also increased the demand for information about the quantity and qualities of that arsenal. No matter how good satellites became, there were always blind spots. Satellites could only ever supply pictures, not resolve disputes about their interpretation. These blind spots worked to the advantage of conservative and pro-nuclear forces who were able to leverage them into stories about what "might be" going on in those blind spots. Those narratives assumed the worst case and were used to obtain support to retain and advance U.S. nuclear weapon systems.

[5] This definition draws upon Matthew Evangelista's definition of technological innovation in weaponry. See Evangelista (1988), p. 51.

[6] See, for example, Schelling, Thomas C. "What Went Wrong with Arms Control?" Foreign Affairs 64, no. 2 (1985): 219-33.

Additionally, as new information and details about the Soviet arsenal were revealed, this augmented arguments for parity and thus for modernization. Because arms control focused on limits rather than bans, this allowed for a qualitative arms race, or at least for modernization of the U.S. nuclear arsenal. The dissertation provides evidence that the use of satellite technology contributed to the shaping of arms control in ways that abetted rather than negated the impetus for modernization. As detailed in the literature review in this chapter, the conventional wisdom is that more information enabled verification and thus helped arms control. In contrast, this dissertation shows that more information and remaining blind spots were co-constitutive in arms control limits (rather than bans), but also in qualitative arms build ups.

This research also shows that the direction of satellite technology development mattered. During this period, some pushed for what is termed in this study as the "resolution initiative." This entailed an emphasis on achieving an increasingly high resolution of satellite imagery in an effort to overcome the blind spot of blurred or indecipherable imagery (referred to in this study as the resolution blind spot). Juxtaposed to this was what is termed here as the "temporal initiative," under which the priority was to deploy satellites more quickly and affordably, even if they were less capable, with the result of fielding greater numbers of satellites in a way that would work to minimize the amount of time between images of a given target. This gap between images is referred to here as the temporal blind spot.

Importantly, these two initiatives were opposed in terms of technological requirements. The resolution initiative required a large, robust camera system and a spacecraft with advanced stabilization capabilities. This translated to a very large, complex satellite design that was

prohibitively expensive to duplicate in large numbers, leaving an enduring temporal blind spot. The temporal initiative would have entailed building simpler satellite designs with lower-resolution imagery that would have allowed the deployment of large numbers of satellites. The pursuit of the resolution initiative in the United States therefore created an information environment characterized by increasing amounts of detail about Soviet nuclear forces together with uncertainty about Soviet construction and maneuvers that could take place in the remaining temporal blind spot. Rather than the particular nature of this blind spot, what mattered was the combination of high-resolution information and detail – a unique product of the resolution initiative – together with enduring uncertainty.

The particular information environment generated through the resolution initiative shaped the types of arguments and their salience in U.S. domestic debates about nuclear forces and arms control. Specifically, the argument that the new, detailed information about Soviet forces altered or expanded what was necessary for deterrence and warfighting was used to justify the development or retention of weapon programs that had originally been devised out of undirected technocratic initiatives. In parallel, the remaining temporal blind spot was used to justify the retention of weapon systems when their cancellation or banning was being considered under the assertion that it was impossible to verify with certainty the absence of a corresponding weapon system in the Soviet Union without on-site inspections, a measure deemed impossible at this time due to Soviet opposition. On top of this, the temporal blind spot was used to justify modernization of the retained weapon system under the argument that because satellites could not provide certainty of the quantity or qualities of a given Soviet weapon system, the U.S. must hedge its security by modernizing its nuclear forces.

Arguments about uncertainty could admittedly have still been made had the United States adopted the temporal initiative in satellite development; uncertainty in this case would have likely just been reframed in terms of the resolution blind spot and the inability to decipher details from images. Therefore, the ultimate significance of the resolution initiative was the combination of uncertainty left by the remaining temporal blind spot together with the presence and proliferation of high-resolution imagery information. Had there not been high-resolution information, the majority of data and details that comprised arguments for modernization would not have existed. Under the temporal initiative, attempts to argue for modernization within the framework of warfighting and deterrence would have instead had to rely on information consisting of fixed launcher numbers alone, given that this is all that could have been deciphered from low-resolution imagery. But in the debates over arms control, such arguments for more investment in nuclear weapons based on purely quantitative grounds and "missile matching" were often rejected by the White House, Congress, and in public opinion, all of which were uncomfortable with such outright arms racing.

Importantly, blind spots were interpreted not as neutral uncertainties, but as spaces where the Soviets "might be" doing something that would harm U.S. national security. The interpretation of satellite images as what "might be" is a legacy not of the military's interest in nuclear superiority, nor its advocacy for additional funding. Instead, this research shows that the practice arose from the analysts who interpreted satellite photos. Without the benefit of computer memories, the analysts held a tradition of telling "stories" within an organizational culture of meritocracy that rewarded the richest and most detailed accounts. As imagery resolution

improved and the volume of imagery expanded, this tradition of storytelling would persist and intensify; stories would become increasingly focused on and intertwined with the bigger strategic picture and issues of superiority in ways that contributed to strengthening arguments for modernization.

This focus on satellite technology adds to our understanding of both arms control and the evolution of U.S. nuclear strategy. The conventional wisdom about arms control argues that the improvement in information quality provided by satellites should increase the perceived value of cooperation with an adversary and of arms control characterized by mutual restraint as a policy choice. Beyond these ideas generated in the scholarly community, policy makers have acknowledged the complexity of the relationship between information and cooperation, arguing that information and knowledge can be a double-edged sword: some important national security information may be extracted by an adversary through treaty verification processes, but that sacrifice of sovereignty can be outweighed by what is gained. Many have also recognized the issue of nuclear arms control verification as inherently political and subjective.[7] Building on both the scholarly and policy understandings, this research shows that satellites provided more than technical improvements. Those improvements fed into contending narratives about the U.S.-Soviet competition, enabling differing interpretations of that competition rather than resolving

[7] Schors, Arvid. "Trust and Mistrust and the American Struggle for Verification of the Strategic Arms Limitation Talks, 1969–1979." In *Trust, but Verify: The Politics of Uncertainty and the Transformation of the Cold War Order*, 1969-1991, edited by Klimke Martin, Kreis Reinhild, and Ostermann Christian F. Stanford, California: Stanford University Press, 2016.; Meyer, Stephen, "Verification and Risk in Arms Control," *International Security* 8, no. 4 (Spring 1984): 111-126; Krepon, Michael, "The Politics of Treaty Verification and Compliance," In *Arms Control Verification: The Technologies that Make it Possible*, etd. Kosta Tsipis, David W. Hafemeister and Penny Janeway, Pergamon-Brassey's International Defense Publishers, 1986; Gallagher, Nancy W. "The politics of verification: Why 'how much?' Is not enough," *Contemporary Security Policy* 18, no. 2 (1997): 138-170.

them through increases in information and transparency. This study shows how the information and uncertainty produced through high-resolution satellites was used to build multiple evidence-based arguments in this space in ways that were used to win support for arms control limits over bans.

Focus and level of analysis

This study focuses on the United States due to its contributions to early and enduring technologies and ideas related to arms control, verification, and modernization that continue to affect international relations and security. The study focuses on interactions among U.S. leadership, including decision-makers at the executive and Congressional level, together with the individuals and organizations in the U.S. bureaucracy and arms control epistemic community that were active on nuclear weapon issues.

A focus at the domestic level presents clear limits for the analysis of international cooperation and competition. The intention is not to discount factors at other levels, particularly at the international level, where Soviet actions certainly played an influential role in the shape that arms control ultimately took. This includes, for example, diplomatic negotiations in which Soviets supported or rejected U.S. proposals or put forth their own ideas, as well as the intelligence and information feedback process wherein U.S. actors responded to, interpreted, and leveraged observations of Soviet activity in satellite imagery. Rather, this study assumes based on relevant scholarship that Soviet actions were ultimately secondary influences that may have

propelled and intensified trends in the development of arms control, but that the emergence and embedding of these processes were primarily driven by factors within the United States.

This understanding draws from research indicating that domestic factors within the United States were often primary drivers for modernization and arms control. For example, in his study of nuclear weapon innovation, Matthew Evangelista notes that in the United States, nuclear weapon design concepts often sprung from a "technocratic initiative" motivated by general scientific discovery and that only later were external threats invoked to build support for motivating and funding the idea throughout the U.S. government. He contrasts this "bottom-up" process of the United States with the Soviet "top-down" process, where choices about its nuclear forces and weapon designs and investment priorities were often primarily responsive to U.S. initiatives.[8] In the context of arms control, Emanuel Adler has argued that nuclear arms control was an "American invention" that grew out of an epistemic community within the United States.[9] He argues that the Soviets were initially skeptical of the U.S. technical approach to arms control, believing that the ideas and even deterrence more broadly would merely lead to arms racing. Adler makes a case that the American epistemic community was instrumental in diffusing ideas about arms control and crisis stability to the Soviet Union and that only much later in the process did the Soviets become more influential in shaping the course of events.

[8] Evangelista, 1988. For an overview of his argument, see p. 52. For a more in-depth analysis of the Soviet nuclear weapons' innovation and decision process, see pp. 68-82.
[9] Adler, Emanuel. "The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control." *International Organization* 46, no. 1 (1992): 101-45.

In terms of satellites and verification technology, the United States was also the first to work in this area out of a determined necessity. During the Cold War, U.S. intelligence efforts were hindered by the Soviet Union's existence as a closed society. While the Soviet Union could review public records of U.S. Congressional appropriations and debates to assess U.S. nuclear weapon development activities, the United States had no similar portals. The United States therefore earnestly pushed for overhead reconnaissance technologies like the U-2 aircraft and satellites.[10]

This did not mean that the Soviet Union saw no value in monitoring and verification through technology. Indeed, the Soviets began launching their own photo-reconnaissance satellite series soon after the U.S. program was underway.[11] The espionage activities of the CIA symbolized for Nikita Khrushchev long years of technological inferiority and humiliation, largely exemplified by the U-2 program: a high-altitude photo-reconnaissance aircraft operating from 1956 that carried out numerous missions which, while far from offering a comprehensive picture, pried open a number of closely-held Soviet military secrets.[12] While Soviet leaders gradually accepted the role of verification in nuclear affairs and maintained its own reconnaissance systems, its endeavors in this area were driven more by the desire to exist as a technological equal to the United States rather than a genuine hunger for the information produced by satellites.

[10] Miller, Steven. "Politics over Promise: Domestic Impediments to Arms Control." International Security 8, no. 4 (Spring 1984): 67–90, p. 72.
[11] Gorin, Peter A. "Zenit - The first Soviet photo-reconnaissance satellite," *Journal of the British Interplanetary Society* 50, no. 11 (1997): 441 - 448.
[12] Zubok, V. M., and Konstantin Pleshakov. *Inside the Kremlin's Cold War: From Stalin to Khrushchev.* Cambridge, Mass.: Harvard University Press, 1996, p. 203.

Because the Soviets did not place the same value on verification and also prized secrecy as a form of security, the United States was more often the one to make verification proposals (often to have them rejected by the Soviet side) and then to engage in attempts to engineer unilateral monitoring solutions or verification compromises. The United States also advocated the importance of verification at the international level, resulting in the extension of ideas about verified security to other states. This includes the eventual embodiment of these ideas in international organizations dealing with nuclear weapons such as the International Atomic Energy Agency and the Comprehensive Nuclear Test Ban Treaty Organization.

Therefore, without discounting the importance of Soviet perspectives and actions, this research offers an in-depth investigation of the process within the United States of creating and embedding arms control, including the domestic-level bargaining and decision-making processes toward issues of cooperation and competition with the Soviet Union regarding nuclear weapons. Particularly in light of the evangelistic nature of U.S. practices and theorizing with respect to nuclear strategy, arms control and verification, this scope arguably still offers useful insights for understanding the multidimensional process of generating cooperation, competition, or an interplay of both in the area of armaments at the international level. Still, the study of other international perspectives through this lens would clearly enrich understanding of cooperative and competitive outcomes and should be considered in the scope of future research.

Research design and methods

This research conducts comparative case studies of five arms control debates within the United States during the Cold War. These cases include the Strategic Arms Limitation Talks I (SALT I), including the Interim Agreement and the Anti-Ballistic Missile (ABM) Treaty, the Strategic Arms Limitation Talks II (SALT II), the Strategic Arms Reduction Treaty (START I), and the Intermediate-Range Nuclear Forces (INF) Treaty. The analysis shows that that satellite imagery information was an essential element of arguments over pending weapon systems to win support for limits, not bans, in ways that were increasingly supportive of modernization. The one exception is the debate over the INF treaty, where a ban on intermediate-range forces was achieved amid strong support for the measure by the military establishment. Given that the military was usually the party opposed to bans and that actively pushed for modernization, this case does not contradict the overall findings. Each chapter of the dissertation examines arms control debates in light of the current state of satellite technology as well as anticipated improvements.

The research draws on a process-tracing approach to illuminate the ways that satellite imagery shaped arms control and modernization.[13] As evidence, it examines changes in discourse, institutions, and arguments within U.S. domestic debates over nuclear forces. This focus derives from expectations about the observable implications that should be present if indeed imagery

[13] Alexander L. George and Andrew Bennett, Case Studies and Theory Development in the Social Sciences (Cambridge, MA: MIT Press, 2005), pp. 205–32.

information and blind spots are strong contributors to decision-making outcomes.[14] The study finds that satellite imagery information and blind spots were crucial factors toward establishing arms control limits instead of bans or for retaining and sometimes modernizing a weapon program over canceling it.

Case study chapter 1: 1960-1972 *Satellites*: CORONA and GAMBIT *Debates*: SALT I and ABM Treaty *Established weapon systems*: ICBMs, SLBMs *Pending weapon systems*: MIRVs, Mobile ICBMs, ABMs	Case study chapter 2: 1972-1976 *Satellites*: HEXAGON *Debates*: SALT II *Established weapon systems*: ICBMs, SLBMs, MIRVs *Pending weapon systems*: Mobile ICBMs, Cruise missiles	Case study chapter 3: 1976-1987 *Satellites*: KENNEN *Debates*: START and INF *Established weapon systems*: ICBMs, SLBMs, MIRVs *Pending weapons systems*: Mobile ICBMs, INF

Table 1. Case study content and structure overview

To assess the influence of the use of high-resolution satellites on outcomes more precisely, each of the case studies treats weapon systems with two categories: *established* or *pending*. Established weapon systems are those systems which were institutionally rooted in the U.S. nuclear force structure and the existence of which was never in contention within the period of this analysis. These systems include ICBMs, SLBMs, bombers, and in later cases MIRVs. Pending weapon systems, on the other hand, were weapon systems for which banning or cancellation was an actively considered policy option and subject to domestic debate. These systems included MIRVs (early on), ABMs, cruise missiles, mobile ICBMs and mobile IRBMs. This structure allows for clarity in showing how the use of high-resolution satellites contributed to limits and modernization for established systems over the alternative of seeking superiority and arms racing, and for pending systems, how it contributed to the establishment of limits and modernization over bans.

[14] Gary King, Robert Keohane, and Sidney Verba, Designing Social Inquiry: Scientific Inference in Qualitative Research (Princeton, NJ: Princeton University Press, 1994), pp. 28–31.

This research assumes, in the traditions of science and technology studies (STS), that technological and social outcomes co-produce one another. The STS framework of sociotechnical imaginaries usefully addresses these issues through its anchoring in the idiom of co-production, or the proposition that science and technology both embed and are embedded in social practices, identities, norms, discourses, and institutions.[15] Co-productionist accounts thus avoid the charges of both technological and social determinism, and further, can be seen as a critique of the realist ideology that persistently separates the domains of nature, facts, objectivity, reason and policy from those of culture, values, subjectivity, emotion and politics.[16] To political scientists, with the idiom's emphasis on dimensions of meaning, discourse and textuality, co-production offers new ways of thinking about power, highlighting the often invisible role of "knowledges, expertise, technical practices and material objects" in "shaping, sustaining, subverting or transforming relations of authority."[17] Together, these principles guide this study's analysis of technical and policy documents, memoirs, meeting transcripts, and historical accounts in order to distill the emergence and operation of language, concepts, and assumptions that were co-produced with satellite-imaging technology to shape nuclear weapon politics.

[15] Jasanoff, Sheila, and Kim, Sang-Hyun, eds. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago, IL: University of Chicago Press, 2015, p. 19.; Jasanoff, Sheila, and Sang-Hyun Kim. "Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea." *Minerva* 47, no. 2 (2009): 119-46.
[16] Jasanoff, Sheila, ed. States of Knowledge: The Co-Production of Science and the Social Order. Abingdon, Oxon: Taylor & Francis Group, 2004, pp. 3-4.
[17] Jasanoff 2004, p. 4.

Literature review

Some have acknowledged the relationship between arms control and modernization without addressing the role of information and transparency.[18] But for the most part, explanations for arms control have been treated separately from explanations about modernization and competition. Explanations for modernization and competition have focused on external factors (balance of power), internal factors (bureaucratic politics), and a combination of the two centered on processes of innovation in weapons technology.[19] Explanations for arms control have focused on "the shadow of the future" and repeated games, changed notions of the causes of war, and the emergence of an American epistemic community.[20] All of these explanations rely to some extent on the role of information as an input that helps shape domestic decisions to cooperate or compete at the international level, yet the nature of this information is often taken for granted. This study shows how imagery information is constructed through technology and practices and is woven into political arguments and narratives in the exercise of power.

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[18] Allison, Graham and Frederic Morris, "Exploring the Determinants of Military Weapons," Daedalus 104 (Summer 1975):99-129.; Aron, Raymond, "Science, the arms race, and arms control," in Bogdanor, Vernon, *Science and Politics.* Oxford: Clarendon Press, 1984; Downs, George, David Rocke, and Randolph Siverson. "Arms Races and Cooperation." *World Politics* 38, no. 1 (October 1985): 118–46.

[19] Kenneth N. Waltz, *Theory of International Politics*, Reading, Mass.: Addison-Wesley Pub. Co., 1979, p. 127.; Posen, Barry, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (Ithaca, 1984), p. 62.; Evangelista, Matthew, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies*. Ithaca: Cornell University Press, 1988.; Allison, Graham T., and Philip Zelikow. *Essence of Decision: Explaining the Cuban Missile Crisis.* 2nd ed. New York: Longman, 1999.

[20] Jervis, Robert, "Arms Control, Stability, and Causes of War," *Political Science Quarterly 108*, no. 2 (Summer 1993): 239-253.; Adler, Emanuel. "The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control." *International Organization* 46, no. 1 (1992): 101-45.

With its close look at satellite technology, this study is also necessarily situated in the timeworn, yet resilient debate over technological determinism.[21] For decades, STS scholars have worked to unravel notions of technology as an autonomous agent of change, divorced from human control or responsibility, and most consider the debate definitively won and over.[22] And yet, ideas of technological determinism endure. Sally Wyatt argues that it persists in the responses of government leaders and policy makers toward the need for or appropriateness of new technologies, as a heuristic for organizing accounts of technological change, and as part of a broader public discourse that often renders technology opaque and beyond political intervention and control. Understanding the persistence of technological determinism, she says, is a matter of recognizing how the simplicity of the narrative allows it to endure. This includes what STS scholars consider one of the most misleading and dangerous aspects of technological determinism: its equation of technological change with progress, despite the complex and sometimes harmful or injurious path technological development can actually take.[23] This warning holds particular relevance to the domain of intelligence and verification technology, which has for the most part been treated uncritically as a "technology of progress" by both scientists and scholars of arms control.[24]

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[21] Sally Wyatt, "Technological Determinism is Dead; Long Live Technological Determinism," in *The Handbook of Science and Technology Studies*. 3rd ed., edited by Edward J. Hackett, Olga Amsterdamka, Michael Lynch, and Judy Wajcman, 165-80. Cambridge MA: MIT Press, 2008.

[22] Smith, Merritt Roe, and Leo Marx. *Does Technology Drive History?: The Dilemma of Technological Determinism.* Cambridge, Mass.: MIT Press, 1994.; Pinch, Trevor J. and Wiebe E. Bijker, "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," In *the Social Construction of Technological Systems: New Directions in the History of Technology* edited by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, Cambridge: MIT Press, 1987.

[23] Wyatt, pp. 167, 175-176.

[24] Tsipis, K., D.W. Hafemeister, P. Janeway, Massachusetts Institute of Technology Program in Science, and Technology for International Security. *Arms Control Verification: The Technologies That Make It Possible*. Pergamon-Brassey's International Defense Publishers, 1986; Jasani, B., and T. Sakata. *Satellites*

Existing explanations for nuclear arms control

One prominent explanation for arms control based in realism and game theory concerns "the shadow of the future."[25] It centers on the idea that if a game among the choices of cooperation and defection is to be played only once, incentives are typically set up such that the only rational choice is to defect and compete. If, however, the game is repeated indefinitely, the latter characteristic no longer holds and mutual incentives for cooperation, and thus arms control, emerge.[26] Robert Jervis later expanded this discussion by framing this as a changed understanding of war, stating that "a shift in the way war was viewed opened a space for arms control."[27] He points to Bernard Brodie's assertation that "Thus far the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them. It can have almost no other useful purpose."[28] Arms control strategists thus proceeded to emphasize the importance of crisis stability and on the need to reduce "the reciprocal fear of surprise attack" as described Thomas Schelling.[29]

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for Arms Control and Crisis Monitoring. Stockholm International Peace Research Institute. Oxford University Press, 1987; Graham, T., K.A. Hansen, and R. Huffstutler. *Spy Satellites and Other Intelligence Technologies That Changed History*. Donald R. Ellegood International Publications. University of Washington Press, 2012.

[25] Jervis, Robert. "Cooperation Under the Security Dilemma." *World Politics* 30, no. 2 (1978): 167-214.; Axelrod, Robert M. *The Evolution of Cooperation.* New York: Basic Books, 1984.; Downs, George, David Rocke, and Randolph Siverson. "Arms Races and Cooperation." *World Politics* 38, no. 1 (October 1985): 118–46.

[26] See, for example, Jervis, Robert. "Cooperation Under the Security Dilemma." *World Politics* 30, no. 2 (1978): 171.

[27] Jervis 1993, 241.

[28] Brodie, Bernard, *The Absolute Weapon*, New York: Harcourt Brace (1946), 76.

[29] Jervis 1993, 242.; Thomas Schelling, The Strategy of Conflict, Cambridge, MA: Harvard University Press, 1960, chap. 9; Schelling, Arms and Influence (New Haven: Yale University Press, 1966), chap. 6.

This account, however, provides a minimal account of the linkage between the "shift in the way war was viewed" and the emergence of arms control. Much of the explanation centers on the unique nature of nuclear deterrence and the nuclear revolution, or the idea that nuclear weapons are so destructive that they transformed war itself into an insane policy choice, forcing alternatives such as nuclear arms control to emerge.[30] And yet, in terms of force planning, in the early years of the Cold War and throughout the 1950s, the United States and the Soviet Union were behaving much as they had for the past century: building steadily greater numbers of weapons, both conventional and nuclear, in attempts to achieve superiority over the other.[31] Adherents to explanations for arms control centering on causes of war do not specify why, in particular in the early 1960s, arms control ideas gained traction in U.S. politics over the competing ideas of nuclear superiority and nuclear disarmament.

As for domestic or internal explanations of arms control, most accounts thus far have largely taken the existence of arms control as an approach for granted, focusing instead on the dynamics of its successes and failures at the level of bureaucratic politics.[32] These studies leave unexamined why arms control emerged and why it may have become so deeply embedded in U.S. politics. The most thorough explanation centered on internal factors, put forth by Emanuel

[30] Mandelbaum, Michael. *The Nuclear Revolution: International Politics before and After Hiroshima.* Cambridge: Cambridge University Press, 1981.; Jervis, Robert, The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon, Ithaca: Cornell University Press, 1989.
[31] Arkin, William M., Milton M Hoenig, and Thomas B Cochran. *Nuclear Weapons Databook.* Cambridge, Mass.: Ballinger Pub. Co., 1984.
[32] See for example Krepon, Michael and Dan Caldwell, *The Politics of Arms Control Treaty Ratification*, New York: St. Martin's Press, 1991.; Caldwell, Dan. *The Dynamics of Domestic Politics and Arms Control*, Columbia: University of South Carolina Press, 1991.; Clarke, Duncan L. *Politics of Arms Control*, New York: The Free Press, 1979.

Adler, takes the emergence of an epistemic community on arms control as its central thesis. Alder has argued that this epistemic community originated within the United States and played a key role in creating the international shared understanding and practice of nuclear arms control.[33]

Adler's arguments harmonize with this study in many ways, including through his attention to the potential of individual ideas to rise to the status of collective visions of the progress. However, Adler does less to explain why arms control, and the path of qualitative build-up with which it was intertwined, rose above the competing visions of nuclear superiority and nuclear disarmament. These alternative visions each also had their own epistemic communities, yet found their arguments gradually eclipsed by arms control ideas in bureaucratic practice. This study addresses how satellite-imagery, and in particular the innovation trajectory focused on increasing resolution, worked to privilege the arguments of the arms control epistemic community over those with alternative views by shaping the information landscape in ways that were coherent with arms control prescriptions for stability.

This research adds to this literature on the origins of arms control by showing how the development and use of high-resolution satellites in the early 1960s were instrumental in helping already existing arms control ideas developed by the arms control epistemic community gain traction in the U.S. domestic political environment. In particular, resolution advances allowing for the identification and balancing of qualitative aspects of nuclear weapons gave credence to arms control prescriptions for achieving balance and stability. In practice, the study will show how these resolution advances, together with the uncertainty of blind spots, also contributed to

[33] Adler, 101.

the directing of arms control away from its original vision: rather than banning destabilizing systems such as MIRVs or ABMs, satellite information and uncertainty were used to argue for the retention and modernization of these weapon systems. Such developments helped set the course of nuclear force planning, strategy, and the direction of arms control toward competition rather than restraint and cooperation.

This research adds to the literature new understandings of the relationship between information, uncertainty, and arms control. The conventional wisdom about arms control argues that the improvement in information quality provided by satellites should increase the perceived value of cooperation with an adversary and of arms control characterized by mutual restraint as a policy choice. This argument has been made broadly within the context of international cooperation.[34] It has also been made specifically in the context of arms control. Kenneth Abbot has argued that among the types of information relevant to cooperation in an arms control context, "information on compliance is particularly important, both for itself and for the light it can shed on other issues." He asserts that states will be reluctant to enter into agreements without "clearly defined mechanisms for the ongoing production of reasonably timely and reliable information on these matters."[35] Others have framed this assumption about the relationship between information and cooperation in terms of the quality of intelligence information, arguing that the more open a government is about the character of its weaponry, the less likely it is that the worst-case

[34] See Keohane, "The Demand for International Regimes," (1984) p. 345 and pp. 337-338 for discussions about how information sharing supports cooperative outcomes more generally.
[35] Kenneth W. Abbott, "Trust but Verify: The Production of Information in Arms Control Treaties and Other International Agreements," Cornell International Law Journal 26, no. 1 (Winter 1993): 4.

scenario will dominate the other state's response.[36] This general understanding is also reflected in historical accounts of satellite technology and arms control. Such accounts of verification technology and of U.S. satellite-imaging programs have frequently credited the emergence of satellites with the realization of arms control.[37]

This study agrees that the development, use, and innovation of satellites contributed to the realization of arms control. The research adds to the literature by showing that the advancement and use of high-resolution satellites contributed to the shaping of arms control to focus on limits over bans and to the strengthening the case for modernization and qualitative build-ups. It shows how both new information and uncertainty were instrumental to this process. High-resolution imagery information was used to add depth and nuance to arguments for modernization under the heading of seeking strategic stability rather than crude missile matching and overt arms-racing. At the same time, as the United States acquired more information about Soviet nuclear forces through these satellites, the information it did not have became more powerful. Remaining blind spots were used to make the case for securing the United States against stories of worst-case scenarios and covert Soviet nuclear endeavors. The result was a transformed realization of arms

[36] Downs, George, David Rocke, and Randolph Siverson. "Arms Races and Cooperation." *World Politics* 38, no. 1 (October 1985): 138-139.

[37] See, for example, arms control histories such as Stuart Croft, *Strategies of Arms Control: A History and Typology*. Manchester: Manchester University Press, 1996, p. 59, and Patrick Morgan's argument about verification in the context of his chapter on "Elements of a General Theory of Arms Control," in Arms Control: History, Theory, and Policy, Volume 1, etd. Robert E. Williams Jr. and Paul R. Viotti, Santa Barbara: Praeger Security International, 2012, p. 29. Other examples include technological histories such as Burrows, William E., *Deep Black: Space Espionage and National Security.* New York: Random House, 1986, pp. viii-ix. Day, Dwayne A., John M. Logsdon, and Brian Latell. *Eye In the Sky: The Story of the Corona Spy Satellites.* Washington, D.C.: Smithsonian Institution Press, 1998.

control from the vision of its originators: one that was characterized by qualitative build-up rather than restraint.

Existing explanations for modernization

Another central concern of this study is understanding the persistence of decisions by U.S. leaders to choose modernization initiatives that later result in qualitative competition with the Soviet Union over the alternatives of bans and mutual restraint. Some scholars have placed this development in World War II together with the beginning of the nuclear weapons age. Raymond Aron, for example, argues that before 1914, the arms race was essentially quantitative – a question of the number of divisions and warships. Between 1914 and 1918, and then again on a larger scale between 1939 and 1945, the mobilization of science and technology in the service of armaments, together with the qualitative arms race, became a permanent and indeed normal situation.[38] Those studying the nuclear weapon era have similarly characterized it as dominated by qualitative competition. As Allison and Morris stated in 1975, "arms-control agreements have only constrained and channeled national weapons-development processes; they have not slowed them down."[39]

The security studies literature has offered a number of explanations for the persistence of nuclear weapon modernization and competition between the United States and the Soviet Union, with some of the literature focused on the early arms races that were primarily characterized by

[38] Aron, Raymond, "Science, the arms race, and arms control," in Bogdanor, Vernon, *Science and Politics.* Oxford: Clarendon Press, 1984, p. 13.
[39] Allison and Morris, p. 100.

quantitative competition, and some focused on the qualitative competition that endures to present day. Such explanations can be broadly grouped into three categories: those emphasizing external factors in the international system, those emphasizing internal state factors, and those that capture a mixture of both.

Explanations focused on external factors, anchored in the realist school of international relations, have focused on ideas concerning the balance-of-power. In *Theory of International Politics*, Kenneth Waltz explains arms races in part by arguing that contending states "imitate the military innovations contrived by the country of greatest capability and ingenuity. And so the weapons of major contenders, and even their strategies, begin to look much the same all over the world."[40] As others like Matthew Evangelista have pointed out, such explanations centered on balance-of-power theory don't capture the origins of this phenomenon, that is, what drives domestic decisions for weapons innovation, modernization, and qualitative competition within the state exhibiting the greatest "ingenuity."[41]

Barry Posen augmented this explanation in part by elaborating a central premise of balance-of-power theory, namely that states engage in balancing behavior through either coalition forming (alliances) or internal mobilization (building weapons). Posen argues that in bipolar systems, there is likely to be greater attention to internal mechanisms both for mustering real power and increasing perceived power.[42] He frames this in terms of the importance of perceptions of power,

[40] Kenneth N. Waltz, *Theory of International Politics*, Reading, Mass.: Addison-Wesley Pub. Co., 1979, p. 69.
[41] Evangelista 1988, p. 7-8.
[42] Posen 1984, p. 62.

explaining that, “Thirty-five years into the Soviet-American arms competition, and fifteen years after the Soviets obtained an inescapable second-strike capability, many analysts and high officials still regularly become disturbed over minor inequalities in numerical indices of particular components of military capability. Such indices evidently influence political perceptions of relative strength.”[43]

Posen’s words point to a trend in the literature where IR scholars have placed a dominant focus on the role of perceptions of the adversary. Robert Jervis’ work on *Perception and Misperception in International Politics* examined perception from a psychological perspective, looking at how decision-makers draw inferences about adversaries and process information in ways affected by factors like cognitive biases and belief systems.[44] This work laid a foundation that would be built upon by many others. As Robert Axelrod and Robert Keohane wrote in 1986, “The contributors to *Cooperation Under Anarchy* did not specifically set out to explore the role of perception in decision-making, but the importance of perception kept asserting itself.”[45]

This study approaches the issue of decision-making with a view that individual perceptions of an adversary, while an important and valuable site of analysis, is only part of a larger information and decision-making landscape affecting outcomes. Jervis gets to this issue in part by noting the importance of belief systems that translate to rigidity of perceptions (or misperceptions) in

[43] Posen 1984, p. 62.
[44] Jervis, Robert, *Perception and Misperception in International Politics: New Edition*. Princeton, NJ: Princeton University Press, 2017.
[45] Axelrod, Robert, and Robert O. Keohane. "Achieving Cooperation under Anarchy: Strategies and Institutions." *World Politics* 38, no. 1 (1985): 226-54, p. 247.

response to incoming information.[46] A stronger explanation can arguably be found through an understanding of how information, technology, and social processes intertwine and co-produce one another to shape the space of political and strategic variables within which decision-makers are operating as held by theoretical traditions in science and technology studies (STS) such as sociotechnical imaginaries, a body of work from which this research draws inspiration.[47]

Explanations for modernization and qualitative competition focused on internal factors have emphasized the role of bureaucratic politics and organizations. Graham Allison, for example, has criticized balance-of-power explanations as an exercise in oversimplification, reducing complex dynamics to an action-reaction phenomenon.[48] In work together with Frederic Morris, the authors described nuclear force posture as a political resultant characterized by analytic uncertainty. As they put it, "problems of force posture are so complex that reasonable men can disagree about which weapons system the United States should have (and even about which strategic doctrine, or which objective)."[49] These differences of opinion among individuals and groups are argued to be organizationally based and that resolution must be achieved through bargaining or politics.[50] Allison expanded upon these ideas in his work Philip Zelikow, *Essence of Decision*, explaining that the players in these domestic bargaining games are formed by the interaction of not just organizational preferences, but many other competing preferences as well. They note that these games are comprised of "players who act according to various conceptions

[46] Jervis, Robert. "Cognitive Dissonance and International Relations." In *Perception and Misperception in International Politics: New Edition*, 382-406. Princeton; Oxford: Princeton University Press, 1976.
[47] Jasanoff, p. 4 and 322.
[48] Allison and Morris, p. 103.
[49] Allison and Morris, p. 106.
[50] Ibid.

of national, organizational, and personal goals; players who make government decisions not by a single, rational choice but by the pulling and hauling that is politics.[51]

Such explanations focused on bureaucratic politics have a greater sensitivity to the constructed nature of information used to make decisions. In the words of Allison and Zelikow, "Information does not pass from the tentacle to the top of the organization instantaneously… Information must be winnowed at every step up the organizational hierarchy…those who decide which information the boss shall see rarely see their bosses' problem."[52] While accounting for how information can be filtered as it rises from the analyst level to executive-level decision makers is vital, such explanations have focused less attention on the malleability of such information, including how it can be constructed and framed in ways to direct policy focus to certain problems over others and to shape political narratives about responsibility, notions of security, and the salience of various policy approaches. In addition, as with balance-of-power explanations, these explanations have so far not accounted for the capabilities and blind spots of the technology used to produce information and its interaction with the political and social processes that surround information capture, analysis, and dissemination into policy circles.

Some explanations for nuclear modernization have sought to combine external and internal approaches. One explanation was put forth by Matthew Evangelista in *Innovation and the Arms Race*. He argues that a focus on the external versus internal causes of the arms race has become unproductive. His thesis posits that the relationship between technological innovation and the

[51] Allison and Zelikow, p. 255.
[52] Allison and Zelikow, p 223.

accumulation of new weapons lies at the core of the Soviet American arms race.[53] Namely, that U.S. domestic leaders tended to see external threats more as rationalizations for weapons already desired than as genuine stimuli for new systems.[54]

Evangelista depicts various stages to the process of weapons innovation driven by domestic forces. The process begins with a *technocratic initiative* where there is the discovery of new technical possibilities and scientists then advocate military applications. This is followed by a stage of *consensus building* wherein scientists and military associates generate interest in new technology within the military-technical community, followed by the stage of *promotion* where scientific, military, and industrial entrepreneurs promote new weapon proposals within the military services, Congress, and Executive. From here, *open windows* may emerge wherein external threats serve as windows of opportunity for military to push a new weapon into production. This is closely followed by a stage of *high-level endorsement* where Pentagon officials gain congressional support for mass production of a new weapon, justified with more specific reference to an external threat.[55] Evangelista's argument comes closest to the argument of this study by highlighting the ways that information about external threats is leveraged as part of a broader process of adopting new weapons that begins with independent scientific innovation.

This study adds to the literature on nuclear modernization by showing how satellite imagery information and uncertainty were leveraged together as an important mechanism for depicting

[53] Evangelista 1988, ix.
[54] Evangelista 1988, 13.
[55] Evangelista 1988, 52.

external threats to justify weapon investments, including in contexts where cancellation or banning the weapon system was a seriously considered alternative. This research challenges the notion of the criticality of *open windows*, or the idea that particular moments in time, such as the aftermath of the Sputnik launch, were particularly important for enabling support for a new weapon system. This study argues instead that more important are the persistent political narratives built up over time, formed and exercised in spaces like the National Security Council, Congressional appropriations debates, and in the arms control epistemic community, which utilized high-resolution satellite imagery information and uncertainty to disseminate the broad understanding that persistent modernization was necessary on the basis of threats to deterrence, the pursuit of parity, and the importance of strategic stability.

High-resolution satellites and the origins of arms control

Emanuel Alder has argued that an American epistemic community played a key role in creating the international shared understanding and practice of nuclear arms control.[56] This study adds to Adler's explanation by showing that new information from high-resolution imaging satellites helped make practical the ideas and envisioning of limits and controls that were taking shape within the arms control epistemic community. The epistemic community would in turn be better positioned to diffuse these ideas into the U.S. government and into the public through the adoption of language, concepts, and assumptions in discourse.

[56] Adler, Emanuel. "The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control." *International Organization* 46, no. 1 (1992): 101.

The individuals that comprised the early arms control epistemic community in the late 1950s and early 1960s shared an expectation that war in the nuclear age would break out as a result of crisis instability and misperception. They valued forces and tactics designed to prevent a first strike and cooperation with the adversary.[57] Members of this community, including scientists and academics with Harvard and MIT serving as a gravitational center, learned from one another and together generated the standards by which they assessed the validity of their ideas. They came to share expectations that set them apart from the experts and policymakers who had a strong faith in technological fixes, military superiority, and "victory" in nuclear war.[58] The arms control epistemic community stressed the futility of disarmament, and they expected that for the foreseeable future the world would have to depend for stability on the possession of nuclear weapons.[59]

These ideas had grown out of individual visions before being articulated and solidified via public forums. About a decade before arms control ideas had gained prominence, Leo Szilard anticipated the nuclear stalemate, called for intermediate steps of force reduction with different totals for different systems, considered that an overwhelming counterforce capability would cause instability, and envisioned an international corps of scientists and engineers to report and investigate nuclear violations.[60] Some scholars point to specific events as the point where

[57] Adler, p. 109-110.
[58] Adler, p. 112.
[59] Levine, Robert A. *The Arms Debate*, Cambridge: Harvard University Press, pp. 61 and 89-90.
[60] Adler, p. 119-120, citing Barton J. Berenstein, "Introduction," in Szilard, Leo., Helen S Hawkins, G. Allen Greb, and Gertrud Weiss Szilard. *Toward a Livable World: Leo Szilard and the Crusade for Nuclear Arms Control*. Cambridge, Mass.: MIT Press, 1987, pp. xvii-xxiv; and Leo Szilard, "Shall We Face the Facts? An Appeal for a Truce Not a Peace," Bulletin of the Atomic Scientists 5 (May 1949), pp. 269-73.

individual ideas converged to form the arms control epistemic community, such as the Surprise Attack Conference in Geneva, which brought together scientists and RAND strategists to discuss stable deterrence and arms control to consolidate the ranks of the emerging epistemic community.[61] The talks served as a "catalyst for much of the serious rethinking of arms control and stabilized deterrence which took place in the U.S. between 1959 and 1961."[62]

This new work on arms control intertwined itself deeply with nuclear strategy and doctrine. Indeed, Thomas Schelling and Morton Halperin, two individuals often credited with shaping ideas about arms control that endure today, stated in their 1961 book, "What is striking is not how novel the methods and purposes of arms control are, and how different from the methods and purposes of national military policy; what is striking is how much overlap there is."[63] In another phrasing, they noted that "we believe that arms control is a promising, but still only dimly perceived, enlargement of the scope of our military strategy."[64]

With arms control's core ideas centered on crisis stability, adherents to these ideas concerned themselves greatly with the types and qualitative characteristics of weapons. They argued that setting numerical limits for their own sake was less effective than directing the qualitative nature of both states' nuclear forces. One idea was that principles of stability were not absolute, but

[61] Adler, p. 117-118, citing Jennifer Sims, "The Development of American Arms Control Thought, 1945-1960," Ph.D. diss., Johns Hopkins University, Baltimore, Md., 1985, p. 302.
[62] Adler, p. 118, citing Bernard G. Bechhoefer, Postwar Negotiations for Arms Control (Washington, D.C.: Brookings Institution, 1961), p. 475, and Holst, "Strategic Arms Control and Stability," pp. 261 and 282.
[63] Schelling, Thomas and Morton Halperin. Strategy and Arms Control. Washington: Pergamon-Brassey's, 1985, p. 4. Note that the original version was published in 1961 and was reprinted without changes in 1985.
[64] Schelling and Halperin, p. 1.

rather relative to an adversary's own forces. Schelling and Halperin described that "a missile-carrying submarine may be a useful first-strike weapon if the enemy has fixed land-based missiles near his shores, but not if he, too, has his missiles under water." They took this principle further by arguing that each side should be allowed to compose its own mixture of forces to achieve this stabilizing second-strike capability.[65]

In the late 1950s, this heavy focus on qualitative capabilities presented clear information problems. This included challenges to the task of accurately assessing the detailed capabilities of an adversary's forces. Schelling and Halperin acknowledged as much, noting that such principles "make arms control more difficult," but that such force asymmetries are inevitable, and that any agreement may need to recognize and accommodate such dissimilarities.[66] Challenges also presented in the area of monitoring and verification. Schelling and Halperin argued that measures to slow down or to stabilize the technological race might be approached cooperatively at a number of different points. These would include the research stage, the development stage, the testing stage, and the stage of updating and improving weapons. There was little depth to these early proposals. As the authors' put it, "it is for example, probably feasible, but by no means easy, to devise control mechanisms and agreements that would retard the development of military missiles while permitting some development and use of outer-space vehicles."[67]

Within this context, advances in satellite resolution and coverage strengthened arms control ideas against alternatives by directly enabling the detailed analysis of Soviet weapon capabilities. With

[65] Schelling and Halperin, p. 54.
[66] Schelling and Halperin, p. 54.
[67] Schelling and Halperin, pp. 37-38.

the early low resolution imagery of the CORONA program, an analyst could only count probable or possible missiles in blurry images. Satellite technology at this point was useful mainly to those advocating for *superiority* who saw value in numerical superiority and believed in matching "missile-for-missile" in ways that even blurry imagery would have enabled. The agenda of arms control "to minimize, to offset, to compensate or to deflate" destabilizing factors between opposing states and their nuclear forces required a detailed understanding of the technical capabilities of nuclear weapons of each side together with how they were employed in orders-of-battle. It was only with this information that U.S. thinkers might devise an appropriate way to "compensate" or to "offset" the particular Soviet development, whether that meant setting limits or investing in a new weapon program that might seemingly reinforce deterrence in the face of new variables. As detailed in Chapter 2, it was only with high-resolution satellite images that U.S. analysts began to learn to assess and to seek information at this level of granularity. High-resolution imagery, in this sense, transformed arms control ideas from being idealistic to appearing increasingly practical for managing cooperation and competition with the Soviet Union.

The new asset of high-resolution imagery was important given the highly theoretical nature of arms control ideas. As Adler explains, arms control theory "cannot be a priori valid or true." Its validity and power as a conceptual basis for international cooperation will depend on shared expectations developed in large part by communication throughout and from the epistemic community.[68] The fate of arms control ideas, in this sense, was tied to related thought processes such as notions of deterrence. In the late 1950s, when the idea of nuclear arms control was

[68] Adler, pp. 107-108.

introduced, nuclear deterrence was only a concept that could neither be taken for granted nor ruled out.[69] When there is no prior experience, as in the case of nuclear war, strategic thinking depends on theories that seek to explain human behavior on the basis of some generalizable propositions, such as rationality, and on the basis of abstract models, simulations, and games. Just as arms control ideas were not falsifiable, they also couldn't be taken seriously unless there was a path to implement them.[70]

While satellite imagery wasn't explicitly mentioned, early arms control thinkers paved the way for acceptance of so called "unilateral" verification measures that satellites would eventually enable. For example, in response to the years of debates without progress on the issue of on-site inspections, Schelling and Halperin began a chapter in their book *Strategy and Arms Control* with the sentence, "Inspection has been overemphasized in most discussions of arms control."[71] They identified it as but one of a series of problems in making arms control work and laid out a number of misperceptions they perceived in policy debates on the issue. They also laid out ideas such as the "Positive-Evidence Principle" wherein unilateral verification efforts could be aided by voluntary displays of treaty-accountable weapon systems. Such suggestions primed the arms control community for treaty measures that would follow such as displays of dismantled silos, submarines, and aircraft to the other side's reconnaissance satellites.[72]

[69] Adler, p. 101.
[70] Adler, p. 107
[71] Schelling and Halperin, p. 91.
[72] Schelling and Halperin, p. 97.

The ideas of early arms controllers also captured the notion of a broader role for satellite-imagery information than just verification of the terms of an arms control agreement. Schelling and Halperin argued that the idea that the focus of verification was to determine the other side's compliance with terms of the agreement was misguided. They purported that attention might actually be needed in other areas of the weapon complex. As they put it, "An agreement limiting missiles, for example, will enhance each side's concern about the other's air force. Limitations on particular weapons may enhance each side's interest in the other's research and development of new weapons."[73] They thus argued that verification played a "much broader and more dynamic role" than detecting violations. This envisioned role encompassed "continually help[ing] to safeguard against the threat of attack and the fear of attack," and included the idea that "the agreement itself must be continuously evaluated in the light of the strategic picture that emerges from inspection and intelligence activities."[74] High-resolution satellite imagery, if employed in this sense, was not just about verifying a treaty, it was about micromanaging nuclear forces in the context of balancing both cooperation and competition.

The arms control epistemic community was successful in bringing its ideas into government. Arms controllers used their scientific prestige to gain legitimacy and authority within the political system. They were one community, yet they were everywhere: dispersed among government bureaus, research organizations and laboratories, profit and nonprofit organizations, university research centers, and think tanks.[75] According to Adler, the scientists were the first to participate in active discussions with policymakers on arms control. As members of the

[73] Schelling and Halperin, 92.
[74] Schelling and Halperin. 93.
[75] Adler, p. 112.

Presidential Science Advisory Committee (PSAC), they had access to President Eisenhower, who gave support to "his" scientists. Among the most prominent of these scientists were George Kistiakowsky and James Killian, both of whom were also closely connected to the government's satellite-reconnaissance efforts. That many of the scientists and a majority of the strategists were from either Harvard or MIT was significant, making it easier for them to interact on a daily basis, formally or informally exchanging ideas.

As the PSAC scientists started to offer Eisenhower reliable technical information with which he could counter those opposing potential arms control measures, they began to transmit to him and other government officials a set of arms control assumptions, expectations, and values. "Educating" and persuading McNamara were likewise deemed vital steps in the movement of arms control ideas from innovation to political action. McNamara came to see in arms control the rational alternative to nuclear war. He trusted the RAND strategists, whose techniques and analytic style he shared, and was instrumental in protecting the community's members from the wrath of the Joint Chiefs of Staff.[76]

Scientists, keen to develop verification technology that required financial and institutional resources, were instrumental in pushing for the creation of the Arms Control and Disarmament Agency (ACDA). Many members of the arms control epistemic community had access to government secrets through RAND, PSAC, or Pentagon research agencies, making them well-positioned to suggest potential technological solutions to arms control challenges. Such proposals were initially met with reluctance, scientists such as Jerome Wiesner believed it was in part because no bureaucracy or organization existed to create a political stake in them. He spoke

[76] Adler, p. 129.

of a need "to create a vested interest in arms control, to develop a cadre of people whose full-time occupation is research and development on means of arms control and on the analysis of the political and military problems of arms control."[77] These scientists also proposed the creation of a "peace agency" to embody and empower them.[78] A study initiated in late 1959 at the Eisenhower's request. Kistiakowsky recommended creation of an office responsible for designing cooperation on nuclear weapon issues, located within the Office of the President, which would work closely with the Department of State.[79]

ACDA was established as an independent agency, which gave it the power and presence to play an active role in shaping nuclear policy. The Senate version of the bill had called for a semi-autonomous agency within the Department of State, but the House of Representatives preferred an independent agency – the idea that won out. As an independent agency, the director reported to the president, attended all principal committee meetings related to disarmament, and was a statutory advisor to the National Security Council. The lower-level committees all had an ACDA representative. This meant that at all levels of government, an independent official was present to place the arms control and disarmament options, many of which stood as an alternative in competition with military, economic and other proposed solutions to perceived national security issues.[80]

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[77] Adler, p. 114-115; Jerome B. Wiesner, Where Science and Politics Meet (New York: McGraw-Hill, 1965), p. 176.
[78] Adler, p. 117.
[79] "Editorial Note 261," Foreign Relations of The United States, 1958–1960, National Security Policy; Arms Control And Disarmament, Volume III, https://history.state.gov/historicaldocuments/frus1958-60v03/d261.
[80] Graham Jr., Thomas. *Disarmament Sketches: Three Decades of Arms Control and International Law.* Seattle: University of Washington Press, 2002, p. xvii.

To limit or to race: The erasure of disarmament from the U.S. agenda

ACDA's early years would reflect the gradual erasure of the already weak vision of nuclear disarmament from the U.S. agenda. On September 9, 1960, in Eisenhower's last few months, the State Department announced the establishment of ACDA's short-lived predecessor: the U.S. Disarmament Administration. As John F. Kennedy took over the Presidency, his vision for the group, at least initially, was also grounded within disarmament ideas. In a letter to Congress in June 1961, he called for the establishment of "a strengthened and enlarged disarmament agency to make intensified effort to develop acceptable political and technical alternatives to the present arms race." Kennedy argued that a disarmament program "should drive toward the creation of a peaceful world society in which disarmament, except for the forces needed to apply international sanctions, is the accepted condition of international life." He proposed to call this new, strengthened version of the group the "United States Disarmament Agency for World Peace and Security."[81] This initiative would lead to the formation of ACDA through the Arms Control and Disarmament Act of 1961. By adding "arms control" to the name of the agency, the choice reflects the subordination of disarmament and the primacy of arms control that would grow in the minds of U.S. decision-makers.

ACDA's early work centering on disarmament was met with a mix of skepticism and hostility. The agency made a number of plans and proposals for ways that the United States might achieve

[81] John F. Kennedy, Letter to the President of the Senate and to the Speaker of the House Proposing the Establishment of a United States Disarmament Agency Online by Gerhard Peters and John T. Woolley, The American Presidency Project https://www.presidency.ucsb.edu/node/234986

general and complete disarmament.[82] In 1961, there was, for example, the "Foster Plan" developed in the name of ACDA Director William C. Foster, which included six stages toward achieving worldwide disarmament, including through systematic inspections followed by random inspections, and the strengthening of a United Nations Peace Force to maintain order.[83] Given the nascent state of satellite-imaging technology at the time, most of these proposals relied on in-person inspection. For these and other reasons, ACDA's plans were not taken very seriously, both in the State Department where officials believed the Soviets would instantly reject calls for intrusive in-person inspection, as well as by the military services, which balked at the idea of subordinating themselves to a U.N. Peace Force.

The growing unpopularity of disarmament among U.S. leaders was endangering ACDA's agenda and, at times, its very existence. ACDA had worked under President Kennedy's orders to generate and submit proposals on general and complete disarmament (GCD) on behalf of the United States in the Eighteen National Disarmament Committee sponsored by the United Nations in Geneva. These proposals aroused alarm in the U.S. military and resulted in derision from Congress.[84] In the words of ACDA director William Foster, "We…had a good deal of mud

[82] See, for example, "Memorandum from the President's Deputy Special Assistant for National Security Affairs (Kaysen) to President Kennedy," FRUS via Kennedy Library, National Security Files, Departments and Agencies Series, ACDA, Eighteen Nation 1/62-2/62. https://history.state.gov/historicaldocuments/frus1961-63v07/d139.

[83] "The Foster Panel Plan for General And Complete Disarmament," Foreign Relations of The United States, 1961–1963, Volumes VII, VIII, IX, Arms Control; National Security Policy; Foreign Economic Policy, Microfiche Supplement, https://history.state.gov/historicaldocuments/frus1961-63v07-09mSupp/d65.

[84] Clarke describes ACDA's transition in priorities and image. See: Duncan L. Clarke. *Politics of Arms Control: The Role and Effectiveness of the U.S. Arms Control and Disarmament Agency.* New York: The Free Press, 1979, pp. 31-33.

slung at us over that one."[85] Threats and insults to the agency went deeper than mud, however. During the early sixties, ACDA became the boogeyman upon which all fears of a disarmament agenda were pinned. In 1963, ACDA employees were labeled "nutball people" by Congressman Craig Hosmer, a Republican of California. Others accused ACDA of wanting to regulate hunting rifles. One young ACDA attorney, upon briefing a Republican senator in 1963 on a proposed disarmament-related measure, was accused of treason.[86] By 1963, ACDA had largely given up on putting forth proposals related to GCD.

As satellite-imaging technology and analytic capabilities matured over the next few years, ACDA took notice and began the work toward leveraging the technology to support a re-balanced agenda that took a greater focus on arms control. A January 1964 study by ACDA was titled, "*The Contribution of Satellite Photography to the Verification of Current Arms Control and Disarmament Proposals*."[87] Near the outset of President Johnson's tenure in 1964, ACDA presented a case for arms control verification by satellites to Secretary of State Dean Rusk, Secretary of Defense Robert McNamara, Director of Central Intelligence John McCone and staff from the White House. The report asserted that, "this unilateral capability effectively provides the 'Open Skies' coverage of the USSR which was requested by President Eisenhower."[88]

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[85] William C. Foster, "Ban All Nuclear Testing," The Atlantic Community Quarterly 9 (Summer 1971): 175, as cited in Clarke 1979, p. 31.
[86] Clarke, p. 32.
[87] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Johnson) to Secretary of State Rusk and Secretary of Defense McNamara; Subject - Possible Disclosure of Satellite Reconnaissance." Foreign Relations of the United States, January 21, 1964. Johnson Library, National Security File, Intelligence File, TKH Jan. 1964–Feb. 1965, Box 1. https://history.state.gov/historicaldocuments/frus1964-68v10/d6.
[88] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Johnson) to Secretary of State Rusk and Secretary of Defense McNamara; Subject - Possible Disclosure of Satellite Reconnaissance." Foreign Relations of the United States, January 21, 1964. Johnson Library, National

ACDA leadership found that the focus on remotely-based, technology-centric verification approaches could give its agenda more traction than earlier proposals that used inspector-based strategies. Satellite imagery was beginning to be widely perceived as a non-intrusive method that gave higher volumes and higher quality of information than ever before possible. From here, the use of imagery would influence the development of new language and practices around monitoring and verification that would further elaborate and shape arms control. This process stemmed both from ACDA's greater systematic use of imagery for its proposals, together with groups like the National Photographic Interpretation Center (NPIC) and the CIA elaborating their methods of estimating nuclear forces through such imagery.

This process would eventually lead the United States to assert that it could verify a nuclear arms control agreement through so-called "national technical means," the term of art that came to capture the array of intelligence technologies, of which imaging satellites were a central component. As Adler describes, "The transition from disarmament to arms control meant that the bureaucracy had to go through a process of adjustment and conceptual evolution…. By the end of the Kennedy years, arms control had become an irreversible factor in the domestic political game and a key consideration as agreements were negotiated and even as new weapons systems were contemplated."[89]

Security File, Intelligence File, TKH Jan. 1964–Feb. 1965, Box 1. https://history.state.gov/historicaldocuments/frus1964-68v10/d6.

[89] Adler, p. 128.

This study begins in the early 1960s with the CORONA satellite program, a time by which nuclear disarmament – as a seriously considered policy option – was already largely being erased from the U.S. agenda. With arms control gaining traction, the only measures that remained in the vestige of disarmament in the decades to come were the prospects of bans on specific types of weapons viewed as destabilizing, hard-to-verify, or both. Therefore, in addition to focusing on how arms control came to center on limits for nuclear weapons, this study features and analyzes the numerous opportunities where bans were elevated as a serious contending policy option, an occurrence that took place for MIRVs, ABMs, cruise missiles, mobile ICBMs, and mobile IRBMs.

Chapter overviews

Chapter 1 presents a historical account of how the resolution initiative arose in the United States over the temporal initiative as the dominant trajectory of technology development. The history shows how the pursuit of high-resolution systems was a result of repeated choices by technology developers, military leaders, and policymakers that often had to resist against the alternative of the temporal initiative. The chapter details the satellite programs that resulted from such choices, explaining how the pursuit of the resolution initiative created an information environment characterized by increasing amounts of detail about Soviet nuclear forces together with uncertainty about Soviet construction and maneuvers that could take place in the temporal blind spot.

Chapter 2 is dedicated to explaining the role and influence of the community of imagery analysts within the CIA's National Photographic Interpretation Center (NPIC), whose work created the foundation of information and uncertainty upon which decisions about nuclear weapons would be based. The chapter shows how the introduction and proliferation of high-resolution imagery within this group would intensify certain practices, such as "storytelling" about qualitative weapon factors, in ways that allowed their reporting output to contribute to strengthening arguments for nuclear weapon modernization.

Chapters 3, 4, and 5 are the central case study chapters of this work. Each of the chapters begins with an overview of prevailing thought on nuclear strategy during the time period under examination. Each discussion works to show how high-resolution satellite information and uncertainty were interacting in the space of strategic planning and discourse as an overarching frame for how these variables affected outcomes of the debates over individual weapon systems and arms control.

Chapter 3 focuses on a case study of the first round of the Strategic Arms Limitation Talks (SALT I), which took place under the CORONA and GAMBIT satellite programs and resulted in two arms control agreements: the 1972 Interim Agreement and the Anti-Ballistic Missile (ABM) Treaty. The case study reveals a pattern of using information from high-resolution satellites to establish arms control limits for ICBMs and SLBMs and advance arguments for their modernization. This occurs together with the use of uncertainty stemming from satellite blind spots to build arguments about what "might be" happening in between image captures to extinguish prospects for banning and eliminating MIRVs, ABMs and mobile missiles.

Chapter 4 looks at the second round of the Strategic Arms Limitation Talks (SALT II) which took place under HEXAGON – a satellite program designed to blend the wide-area search potential of CORONA with the high-resolution of GAMBIT. HEXAGON dramatically increased the volume and frequency of imagery intelligence and information about the Soviet modernization program. This case study thus shows how these changes were capitalized upon by those seeking U.S. superiority to claim that the SALT process and arms control were failing the United States in the face of rampant Soviet modernization efforts. Historical analysis shows how advocates for further investment in U.S. nuclear weapon programs had an ample basis with which to claim the need for the United States to fund new weapon programs rather than reduce weapons. HEXAGON's advancements also increased the ability to verify hard-to-track systems like cruise missiles and mobile missiles, which effectively empowered advocates of these systems that sought to destroy the prospects for banning these categories of weapons by helping them make the case that such weapons could be responsibly developed, limited, and verified.

Chapter 5 looks at the KENNEN satellite program, which was the United States' first real-time satellite and its first digital satellite. The debate over START shows KENNEN information and the digitization process being leveraged in ways that drove a continued focus on limits intertwined with modernization, primarily through its use to depict Soviet external threats to help leave open room for U.S. qualitative investment and modernization within the START framework. The second section on pending systems looks at mobile ICBMs and IRBMs, where both faced the prospect of a ban. For mobile ICBMs, the issue of Soviet "hardening" of its missile and control sites observed in KENNEN imagery would become a severe concern of U.S.

officials in addition to old worries about superior Soviet throw-weight and warhead numbers. This information contributed to the durability of the domestic arguments for the United States own mobile missile initiatives, the MX and Midgetman programs. Despite the growing domestic resistance toward these systems, they would persist until after the end of the Cold War. The case of intermediate-range ballistic missiles (IRBMs) is examined as an exception in this study as the only case where satellite information and blind spots were successfully leveraged as part of an effort to codify a ban on a category of weapon within a treaty. This analysis will detail how this outcome relates primarily to defense and military leadership support for a ban, something that did not exist for any other case, and therefore how the outcome does not contradict the findings of this study.

Together, these case studies challenge the conventional wisdom about arms control, which has so far held that the improvements in information quality provided by satellites should increase the perceived value of cooperation with an adversary, including elevating restraint as a policy choice. In contrast, this research shows that satellites provided more than technical improvements. Those improvements fed into contending narratives about the U.S.-Soviet competition, enabling differing interpretations of that competition in ways that ultimately favored pro-nuclear arguments rather than resolving them in the direction of mutual restraint and cooperation.

Chapter 1: The Resolution Initiative

This study is based upon the assertion that the direction of satellite technology development, particularly the early acquisition of high-resolution imagery, mattered to the course of U.S. nuclear policy and arms control. This chapter therefore makes the case that at least two distinct directions were seriously considered: some pushed for what is termed in this study as the "resolution initiative." This entailed an emphasis on achieving an increasingly high resolution in satellite imagery to overcome the blind spot of blurred or indecipherable imagery. Juxtaposed to this was what is termed here as the "temporal initiative," under which the priority was to deploy satellites more quickly and affordably, even if they were less capable, with the result of fielding greater numbers of satellites in a way that would work to minimize the amount of time between images of a given target.

Importantly, these two initiatives were opposed in terms of technological requirements. The resolution initiative required a large, robust camera system and a spacecraft with advanced stabilization capabilities. This translated to a very large, complex satellite design that was prohibitively expensive to duplicate in large numbers, leaving an enduring temporal blind spot. The temporal initiative would have entailed building simpler satellite designs with lower-resolution imagery that would have allowed the deployment of large numbers of satellites. The pursuit of the resolution initiative in the United States therefore created an information environment characterized by increasing amounts of detail about Soviet nuclear forces together with uncertainty about Soviet construction and maneuvers that could take place in the remaining temporal blind spot. Rather than the particular nature of this blind spot, what mattered was the

combination of high-resolution information and detail – a unique product of the resolution initiative – together with remaining uncertainty.

The section tracing the history of the CORONA and GAMBIT satellite program focuses on how the pursuit of imagery with usable imagery resolution came to be seen as the central challenge of satellite technology development. Once the early CORONA designs had been established, the United States would have had the option to pursue the temporal initiative by producing that satellite in increasing numbers. Instead, policymakers and engineers continued to choose to emphasize the task of achieving ever-higher resolutions through GAMBIT, HEXAGON, and KENNEN.

CORONA and GAMBIT

From blinded to blind spots: First glimpses into the Soviet Union with the U-2 aircraft

Under both the Truman and Eisenhower administrations, U.S. leaders were fueled by fear and uncertainty of Soviet nuclear activities to invest in a brewing nuclear arms race and forestall any initiatives to control, reduce, or eliminate nuclear weapons. Historians continue to debate the intentions of these presidents and to question the sincerity of their espousals of the value and importance of nuclear disarmament.[90] In his monograph, *The American Nuclear Disarmament Dilemma*, David Tal makes the case that Eisenhower did indeed believe from the start that it was in the interest of the United States to dismantle both Soviet and American nuclear weapons.

[90] Tal, David. *The American Nuclear Disarmament Dilemma*. Syracuse University Press, 2008, p. 53.

Eisenhower's view was that the nuclear arms race was expensive, dangerous, and that the very existence of nuclear weapons exposed the United States, for the first time in its history, to the danger of devastating surprise attack. Tal evidences these claims not by Eisenhower's public speeches, but by his private communications. For example, Eisenhower told Lewis Strauss, upon his assumption of the role of director of the U.S. Atomic Energy Commission, "my chief concern and your first assignment is finding some new approach to the disarming of atomic energy."[91]

The big problem, as Eisenhower argued, was that an effective nuclear disarmament agreement with the present Soviet regime was "impossible." Any such agreement would require a thorough and rigid inspection system, and he was "perfectly certain" that the Soviets would never agree to one. His views were seen in many ways as a continuation of those held by President Truman, who held the same premise about effective verification being a requirement for disarmament, and the same reluctance that the Soviets would ever agree.[92] Lewis Strauss spouted the same views on verification, but with a greater focus on U.S. security: "In the absence of complete reliance on Soviet good faith, I do not believe that any arrangements can be devised concerning disclosure and verification of information about atomic weapons that might not be prejudicial, to some extent, to the security of the United States."[93]

With his military background, President Eisenhower valued intelligence and strongly believed in the value of photo reconnaissance as a potential solution to his "disarmament dilemma." So firm

[91] Tal 2008, 53.
[92] Tal 2008, 53.
[93] Kaplan, Lawrence S. "Special Assistant for Disarmament, 1955–1958." In *Harold Stassen: Eisenhower, the Cold War, and the Pursuit of Nuclear Disarmament*, 109-30. Lexington, Kentucky: University Press of Kentucky, 2018, p. 118.

was his conviction that he fostered a two-pronged strategy to get what he wanted: overhead images of the Soviet Union. The ideal option was a cooperative path with the Soviet Union. In 1955, at a Geneva Summit Meeting with Soviet Premier Nikolai Bulganin, Eisenhower made his proposal for "Open Skies." He proposed a number of steps that began with the United States and Soviet Union exchanging complete blueprints of their military establishments and then erecting facilities in both countries for aerial photography: "We to provide you…ample facilities for aerial reconnaissance, where you can take all the pictures you choose and take them to your own country to study, you to provide exactly the same facilities for us."[94] The proposal was almost immediately rejected by Nikita Khrushchev, leader of the Soviet Communist Party. Khrushchev saw the proposal as a ruse to spy on Russian facilities. He later stated, "whom was he trying to fool? In our eyes, this is a very transparent espionage device… You could hardly expect us to take this seriously."[95]

With the cooperative option definitively crushed by Khrushchev, the wheels began turning for Eisenhower's backup option: a covert photo-reconnaissance aircraft. The urgency of the effort was underlined in the CIA's first National Intelligence Estimate in 1954; the lack of hard intelligence then available was neatly summarized at the beginning of the estimate: "We had no firm current intelligence on what particular guided missiles the USSR is presently developing or may now have in operational use." The panel focused on an aircraft proposal that had previously been rejected by the Air Force for its lack of fighting power: the CL-282, which would fly at 70,000 feet with a pilot as the lone crew member. Eisenhower placed his weight behind the

[94] Kaplan 2018, p. 120.
[95] Kaplan 2018, p. 121.

proposal. To hide the aircraft's mission, the plane was put on the Air Force's books as a Utility aircraft. With U-1 and U-3 designations already taken, the aircraft became the U-2.[96] Eisenhower recognized the dangers of a covert approach, but saw the intelligence need as too important. Just prior to making his Open Skies pitch to the Soviets, Eisenhower had privately stated, "I'll give it one shot. Then if they don't accept it, we'll fly the U-2."[97]

While seeing some success, the U-2 program would prove to be a frustrating and nerve-wracking affair for Eisenhower. Although the first U-2 flight over the Soviet Union on July 4, 1956 passing over Leningrad to target a Soviet submarine construction program underway went undetected, the Soviets detected the second flight the very next day as it attempted to overfly Moscow to capture the Bison bomber program.[98] They issued a protest note, which deeply disturbed Eisenhower, who had authorized flights under the assumption that most were unlikely to be detected. He went on to question "how far this should now be pushed, knowing that detection is not likely to be avoided."[99] U-2 overflights would continue, but sporadically due to Eisenhower's concern over a possible Soviet reaction.

A major contribution of the U-2 program would be disproving the existence of a "bomber gap," or the idea touted by the U.S. Air Force that the Soviet Union had likely developed about 100 Bison bomber units capable of reaching the United States to deliver nuclear weapons. Over just a

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[96] Richelson, Jeffrey. *The Wizards of Langley: Inside the Cia's Directorate of Science and Technology.* Boulder, Colo.: Westview Press, 2001, p. 14.
[97] Beschloss, Michael R. *Mayday: Eisenhower, Khrushchev, and the U-2 Affair*. New York: Harper & Row, 1986, p. 105.
[98] Richelson 2001, pp. 15-16.
[99] Andrew J. Goodpaster, Memorandum for the Record, 19 July 1956, WHOSS, Alpha DDEL (TS), as cited in Pedlow and Welzenbach, 1998, p. 110.

three-week period from June to July in 1956, the U-2 had made eight overflights. The photography from these flights, which overflew all the Soviets nine long-range bomber bases, revealed that there were no Bison bombers at any of the bases. Based on this evidence, the White house denied Air Force requests for additional B-52 bombers to "catch up" to the Soviets.[100]

By 1960, while the U-2 program had proved effective for monitoring bomber bases, it was fruitless for addressing what the United States considered to be its most important national security issue: the status of the Soviet intercontinental ballistic missile (ICBM) program.[101] Soviet public statements about the success of its missile testing program fueled U.S. public and Congressional concern that the Soviets were overtaking the United States in missile strength, an unproven problem that became known as the "missile gap," and which played a visible role in the Kennedy-Nixon presidential election.[102] Bomber base locations were well known from intelligence built up over the course of World War II, enabling careful planning for U-2 flight paths. ICBM bases, on the other hand, were a new weapon system for which there was no infrastructural map to draw upon. Analysts predicted that deployment areas would be located near rail-road tracks, given the large size of the missile. Despite Eisenhower's reluctance to send U-2s over the Soviet Bloc, he once again authorized overflights in the summer of 1959, after a pause of more than a year. A U-2 mission revealed no missile sites, but the Air Force continued to insist that the Soviets had deployed up to 100 missiles, especially given that there was no way to prove that the U-2 had simply missed existing ICBM sites.[103] While Eisenhower authorized a

[100] Pedlow, Gregory W. and Donald E. Welzenbach, "The CIA and the U-2 Program, 1954-1974," History Staff, Center for the Study of Intelligence, Central Intelligence Agency, 1998, p. 111.
[101] Richelson 2001, p. 17.
[102] Pedlow and Welzenbach 1998, pp. 160-161.
[103] Richelson 2001, p. 17.

few U-2 overflights in response to a resumption of Soviet ICBM testing, on May 1, 1960, the risks and obstacles would prove insurmountable. Four and a half hours into Francis Gary Power's mission, a Soviet SA-2 surface-to-air missile detonated just behind his aircraft and disabled it.[104] After four years of playing with fire, Eisenhower had finally been burned. He ordered a final halt to the U-2 program's foray into the Soviet Union.

The shift from disarmament to arms control

By the late 1950s, President Eisenhower had come to favor an "incremental" approach to nuclear disarmament – an approach that would later be codified as arms control. Eisenhower's early policies toward nuclear weapons had largely been an extension of Truman's resistance to nuclear disarmament.[105] Facing pressure from reinvigorated U.N. disarmament initiatives together with Soviet public expressions of their desire for disarmament in the face of U.S. obstinance, he appointed the first cabinet-level advisor on nuclear disarmament, Harold Stassen. Stassen would often clash with leaders in the Defense Department, including the Joint Chiefs of Staff and Defense Secretary John Foster Dulles who firmly believed that nuclear weapons were there to stay. Stassen led the attack on the U.S. "all-or-nothing" approach to disarmament and introduced ideas about a more incremental approach.

[104] Pedlow and Welzenbach, 1998, p. 176.

[105] While Eisenhower was more expressive publicly of a general desire of world-wide nuclear disarmament, his actions were largely an extension of Truman's thinking and policies. He endorsed the same all-or-nothing approach, refused to consider compromises that the Soviets might be willing to accept, and insisted on an invasive inspection program as a precondition of any agreement. See Tal 2008, p. 52.

In 1955, Stassen introduced a report advocating an approach called "the Gray World," which was intended to offer the United States and the world the security that nuclear disarmament might provide, without insisting on disarmament as an "unattainable target." Gray World was proposed as an incremental approach: the first step centered on establishing a system of inspection and verification, and the second would take gradual, step-by-step reductions toward nuclear and conventional disarmament.[106] Stassen's first version of the report was dismissed as fantastic: it seemed to ignore the Soviets' long-held resistance to inspection and called for the presence of twenty to thirty thousand inspectors in the Eastern bloc. A revised version of the report, which Eisenhower supported, based the inspection system loosely on the proposal of Open Skies.[107] While the proposal would fail to receive Soviet support during the U.N. Disarmament Subcommittee meetings in London from 1956 to 1957, the ideas from the proposal permeated the Eisenhower administration's way of thinking. Both Eisenhower and Dulles became convinced that Stassen's incremental approach made sense, not necessarily because it was directed toward disarmament, but because such a position enabled them to tout the values of disarmament while retaining nuclear weapons.

Despite having achieved a clearer vision of the path forward, one that was coalescing around arms control ideas, Eisenhower lacked the technological and informational basis from which to justify arguments for his agenda. The Soviets had rejected Eisenhower's Open Skies proposal under suspicions of espionage, leaving him unable to advance Stassen's proposals for an "incremental" approach to disarmament. At the same time, with the U-2 program only providing

[106] Tal 2008, pp. 84-85.
[107] Tal 2008, p. 88.

sporadic snapshots of Soviet weapon development activities, by 1958, John F. Kennedy would frame the uncertainty stemming from intelligence issues as a "missile gap" in his bid to take power from Eisenhower. With meager amounts of reliable intelligence of Soviet nuclear weapon developments, Eisenhower had no basis from which to deflect calls from *superiority* adherents for more weapons spending or to advance steps toward disarmament without acceptable verification measures.[108]

The turn to satellites

Reliable information through intelligence, from Eisenhower's perspective, was a means to strengthen his political power; with the failure of the U-2 mission and Soviet rejection of Open Skies, he saw satellites as his best option based on existing levels of research and development. The two satellite programs that succeeded to reach active deployments during the 1960s and early 1970s were CORONA, a medium-resolution satellite that captured wide areas and was managed by the CIA, and GAMBIT, an ultra-high-resolution satellite for small areas and was managed by the Air Force. The two satellites would be used in tandem, diffusing new information and blind spots in ways that would permanently alter the information landscape and the nature of uncertainty. The origins of the CORONA and GAMBIT systems and choices about their design were shaped by a combination of individual visions, organizational rivalry, and a uniquely high level of classification and secrecy surrounding the projects.

[108] Dienesch, p. 60.

From early organizational battles over control of the satellite program, the Air Force would emerge as victorious.[109] As director of research and development on the Aeronautics Board, Major General Curtis LeMay of the Air Force had an outsized influence on the process of guiding the establishment of authority over the technology. He believed that detailed studies on satellite deployment would give the Air Force an edge. He therefore turned to Douglas Aircraft Company – an aerospace manufacturer that would soon establish Project RAND to produce research in support of the Air Force – for a scientific report on the feasibility of an orbiting satellite.[110] The group examined the elements necessary for launch, such as stabilization and power supplies and possible political and psychological repercussions. By 1950, on the basis of studies that examined the requirements and constraints of satellite reconnaissance going back to 1946, RAND had helped the Air Force through its early jurisdictional battles with the Army and Navy to emerge as the dominant agency for satellite development.[111]

Imagery resolution as the primary barrier to satellite-based reconnaissance

One reason that the advancement of optical capabilities became a driving priority can be attributed to the way resolution arose as a central challenge from the outset of the research process. In April 1951, RAND produced a new study examining all of the "limiting" factors of a satellite in a reconnaissance role such as power supplies, the reliability of the robotics and

[109] Both the Army wanted control of the satellite program as part of a larger effort to control strategic rocketry efforts, and the Navy was keenly interested in the possibility of satellite technology to support naval communications.
[110] Dienesch, p. 88.
[111] Dienesch, Robert M. *Eyeing the Red Storm: Eisenhower and the First Attempt to Build a Spy Satellite*. Lincoln Nebraska: University of Nebraska Press, 2016, p. 85.

control mechanisms, and the relationship between altitude, image resolution, and the longevity of the satellite body. The report found that the optimum orbital altitude for a reconnaissance satellite was about 350 miles, with an inclination of roughly 53 degrees from the equator. Basing their predictions on current technology, RAND scientists predicted a resolution of roughly two hundred feet.[112] Though suitable for weather data, such low resolution was not good enough for surface surveillance. It would detect major airfields, highways, railways, and large factories but not much more. At the time "productive" intelligence was deemed to begin with fifty-foot resolution. Increasing resolution by increasing lens magnification meant either decreasing the area covered per photo, thus increasing the temporal blind spot for some targets, or technically improving the camera system. In terms of data recovery, the study actually rejected the idea of a reentry vehicle containing exposed film that eventually became practice, believing that the extreme heat would destroy the capsule. Researchers instead advocated for photostatic facsimile transmission – a method of electronically scanning images recorded on standard camera film and converting them into electrical impulses – as well as an adaptation of standard television technology. The scientists were confident that resolution of forty feet would eventually be feasible, but that it would take time to get there.[113]

While temporal challenges existed, they were not seen as insurmountable. RAND's estimated orbital parameters meant that the satellite would orbit the earth fifteen times per day. Due to the earth's rotation, the satellite's orbital path over the main areas of interest would shift by about

[112] Dienesch 2016, p. 102.

[113] J. E. Lipp, R. M. Salter Jr., R. S. Wehner, R. R. Carhart, C. R. Culp, S. L. Gendler, W. J. Howard, and J. S. Thompson, "Utility of a Satellite Vehicle for Reconnaissance," Project rand Report r-217, April 1951, spi, gwu, file Project Rand Report "Utility of a Satellite Vehicle," ix, cited in Dienesch 2016, p. 102, footnote 53.

eight hundred miles with each orbit. Every eighty-seven or so days the satellite would return to its original flight path, having covered the entire area of interest. Because of the earth's rotation and daylight coverage constraints, the study determined it would take two satellites to give adequate coverage.[114] In terms of reliability, a satellite in space would have to operate independently and perform perfectly for a year or more in a vacuum and at extreme temperatures. In addition, it had to survive the excessive vibration of the launch, motion changes, and gravitational forces. None of these expectations seemed unrealizable. The scientists believed that technology "on the shelf" could sustain at least thirty-five days of operations. Through research and development, this might be extended to a year.[115] These issues, while important, received less attention than the problems of poor resolution, which were viewed as a potential dealbreaker for the entire satellite-imaging technology endeavor.

Given RAND's predictions of poor resolution, many Air Force leaders were skeptical of the project and had to be convinced to devote resources to the endeavor. When RAND's work was disseminated at various levels of the military, Air Force photo interpreters believed the resolution inadequate for their purposes, and skeptics of the concept of satellite reconnaissance such as Amron Katz, chief physicist of the Air Force Reconnaissance Lab, used the resolution problem to discount the whole proposal.[116] Together with other Air Force leaders, Katz put together a test intended to refute RAND's proposals, which was conducted at Wright Field in November 1951. It used an 8-mm camera and coarse film to take reconnaissance photos from an altitude of thirty

[114] Lipp et al., "Utility of a Satellite Vehicle," 7–11, cited in Dienesch 2016, p. 100, footnote 46.
[115] Lipp et al., "Utility of a Satellite Vehicle," 63–69, cited in Dienesch 2016, p. 102, footnote 54.
[116] Davies and Harris, RAND's Role, 55, RAND Corporation, Beschloss, May Day, 25-29, cited in Dienesch 2016, p. 103, footnote 56.

thousand feet to mimic the satellite's performance. Katz and his colleagues were stunned by the results. Expecting to see nothing of value, they were able to clearly identify roads and bridges in the Dayton area, the airfield itself, and several landmarks. Katz became an instant convert, joining RAND in 1954 and pushing for satellite development.[117]

With the Air Force on board, satellite development would move forward, becoming increasingly intertwined with military objectives. One reason for this was the overlap in rocket technology. RAND's study' had been based on theoretical concepts. The first real breakthrough had come in 1953 when the USAF Scientific Advisory Board reported to the Air Staff that it was feasible to produce relatively small and light-weight thermonuclear warheads that might be launched via rocket propulsion. As a result of that report, the ATLAS ICBM program was accorded the highest priority in the Air Force.[118] Since the propulsion required to place a satellite in orbit was of the same general order of magnitude as that required to launch an ICBM, the achievement of an ICBM-level of propulsion made it possible to begin thinking seriously of launching orbital satellites. Accordingly, General Operational Requirement No. 80 was levied in 1955 with the stated objective of providing continuous surveillance of pre-selected areas of the world to determine "the status of a potential enemy's war-making capacity." The Air Research and Development Command, which had inherited the RAND study program in 1953, assigned the satellite project to its Ballistic Missile Division.[119] By 1954, the Air Force consolidated its efforts

[117] Ibid.
[118] Kenneth E. Greer, "Corona," Studies in Intelligence, Supplement, 17 (Spring 1973): 1-37, p. 3.
[119] Greer, p. 4.

on satellite research into a program called WS-117L; this program is credited with laying the foundation for every military satellite that followed.[120]

New rivalries over the pursuit of a useable resolution between the CIA and Air Force

As these technical challenges were being navigated, a second major organizational shift would occur, which would have a lasting impact on design philosophy: Eisenhower's transfer of design authority to the CIA. On October 4, 1957, the Soviet's launch of Sputnik, the world's first artificial satellite, shocked U.S. leadership into a critical examination of the WS-117L program.[121] Eisenhower immediately ordered a board review of the program, which concluded that the WS-117L program was far from accomplishing its goals. The board believed Air Force mismanagement had resulted in a lack of focus, and shortage of funds only made the situation worse. Finally, the program was at the edge of current technology. The board found its camera/radio-relay system to be far below the necessary level for practical intelligence gathering. In order to speed acquisition of vital intelligence about Soviet missile development, the board called for an interim intelligence system that could be developed more quickly than WS-117L's ongoing endeavors. Borrowing RAND's concept of a film-return satellite, this second satellite system seemed less complicated and therefore more practical for rapid development than WS-117L. The board argued that the CIA should develop the system with support from the Air Force, in much the same way as the two bodies had developed the U-2.[122]

[120] Dienesch, p. 115.
[121] Dienesch, p. 137
[122] Dienesch, p. 147.

The board's findings resonated with Eisenhower's own distress over satellite management and his belief that satellite-imaging activities should be conducted with a frame of objectivity. All three military services had advocated their own brand of space program in the wake of Sputnik. From Eisenhower's view, the military, particularly the Air Force, appeared to concentrate more on lobbying for funds than on producing the reconnaissance satellite it was already developing. He believed that if the Air Force were to retain control over the program, it would mean retaining control over strategic intelligence. This made him wary given Air Force tendencies to leak information and exaggerate Soviet capabilities. For these reasons, Eisenhower would come to insist on CIA control of satellite reconnaissance. The decision reflected his view that the CIA should control national intelligence, as the National Security Act indented it to. By giving the CIA control, as with the U-2 program, he expressed confidence in its ability to produce results quickly, quietly, and objectively. He believed that he was initiating an interim program, but it outlasted WS-117L by many years. [123]

Eisenhower acted decisively in transferring satellite development authority to the CIA. In February 1958 he ordered the separation out of WS-117L's Program II-A, which focused on the film-return satellite design, for covert development by the CIA. The transfer took place under the cover of a cancellation of Program II-A, with notifications throughout Air Force ranks that would normally accompany the cancellation of a military program, including formal contract cancellations with prospective suppliers. Contractors were furious over the suddenness of the action and Air Force personnel were thunderstruck at the abandonment of the WS-117L program

[123] Richelson, Jeffrey. *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program*. New York: Harper & Row, 1990, 24–27; Burrows, William E., *Deep Black: Space Espionage and National Security.* New York: Random House, 1986, 55–56.; Dienesch pp. 155-156.

that seemed to have the best chance of early success. After the cancellation, very limited numbers of individuals in the Air Force and in the participating companies were cleared for Project CORONA and were informed of the procedures to be followed in the covert reactivation of the cancelled program. Eisenhower stressed two priorities: rapid development for operation by spring 1959 and covert work to avoid antagonizing the Soviet Union, conceal the satellite's capabilities to preserve its intelligence value, and prevent U.S. military hindrance with the effort.[124]

Eisenhower placed Richard Bissel, former head of the U-2 program, in charge of the CORONA program, thus ensuring that many of his ideas about the direction and priorities for design would transfer and endure. CORONA thus inherited the U-2 program's twin, competing technical objectives of high-resolution and wide geographic coverage. Bissel was inclined toward innovation to meet these objectives. Before his interventions, the leading camera design favored by the Air Force and RAND was a design by the company Fairchild, which would remain fixed and scan the earth below as the satellite spun in orbit. Bissel decided to go for an untested design by Itek, in which the panoramic camera would scan while the satellite itself remained stable, and importantly, would offer three times the resolution.[125] Bissel was empowered to pursue his vision for the satellite in part because of the heavy secrecy surrounding CORONA that limited the number of individuals who could weigh in. Bissel describes that the program began in a "marvelously informal" manner, and that because so few people were involved, decisions could

[124] Dienesch, p. 156; Greer, p. 6.
[125] Richelson 2001, p. 24; Richard Bissel interview video: https://www.shutterstock.com/video/clip-19933318-richard-bissel-osmond-ritland-helped-influence-corona, Accessed April 2, 2021.

be made quickly and cleanly.[126] Bissel would see the CORONA program through twelve launch failures, with success eventually being reached with the launch on August 18, 1960. The KH-1 camera produced images with a resolution of about 40 feet – sufficient to permit identification of the missile sites, airfields, and facilities, but of little use in producing detailed technical intelligence.[127]

While CORONA burgeoned under covert CIA leadership, the Air Force and RAND had begun to orient its work around achieving higher resolution as a matter of power in intelligence negotiations. In the wake of Sputnik, in November 1957, RAND produced a more comprehensive report that attacked problems in intelligence gathering and proposed a course for satellite development that was fundamentally oriented around improving resolution over time. Level A was a system for searching a large area and covering vast expanses quickly, but at low resolutions. Level B would allow identification of many major installations, aircraft on runways, and minor lines of communication (smaller roads and shorter railway and canal lines). Level C would facilitate photography of specific objects on airfields and in industrial zones, and Level D was to provide high resolutions that could satisfy technical intelligence needs.[128] This program and development trajectory would govern Air Force satellite development efforts for years to come.

[126] Greer, pp. 8-9.
[127] Richelson 2001, p. 26.
[128] M. E. Davies et al., "A Family of Recoverable Reconnaissance Satellites," RAND Corporation Research Memorandum, RM-2012, November 12, 1957, SPI, GWU, file "A Family of Recoverable Reconnaissance Satellites," 27-32, cited in Dienesch, p. 150, footnote 36.

The Air Force and GAMBIT

The Air Force's focus on resolution appears to have been influential when Eastman-Kodak proposed a new ultra-high-resolution satellite: that which would eventually become the GAMBIT KH-7. The design went to CIA first, but Bissel did not pick it up given his focus on bringing CORONA into being. The Air Force did. This development was primed by Eisenhower's concern over CORONA's early launch failures and his desire to hedge the chances of success by empowering an Air Force development channel in addition to the CIA's work. In the summer of 1960—one month before the first successful CORONA launch—the U.S. government identified the need for higher resolution and broader area coverage as necessary follow-on national reconnaissance satellite programs: in July, the Satellite Intelligence Requirements Committee (SIRC) issued a report to the U.S. Intelligence Board calling for additional satellite systems with greater capabilities than planned for CORONA. Focusing on the impending Soviet strategic threat, the SIRC delineated three urgent intelligence gaps. The primary intelligence need was greater capability of *searching* for and *surveilling* ICBM launch sites in Soviet Union. The secondary mission was to obtain more *detailed* intelligence on ICBM installations, i.e., imagery with greater resolution than CORONA. Finally, imagery from the follow-on systems should provide *greater technical specificity* on the highest priority targets.[129]

Based on these performance requirements that centered on high-resolution, the Air Force's work on GAMBIT envisioned pushing the state of the art in three specific areas: lightweight optics,

[129] Susan D. Schultz, "Why Gambit and Hexagon? *U.S. National Security and the Geopolitical Setting, 1957–1960," National Reconnaissance, Journal of The Discipline and Practice,* Spring 2012 Issue 2012-U1.

vehicle stability, and the complexity of orbital operations. Because the limits of optical resolution were largely decided by the surface quality of the primary mirror and the scanning mirror, GAMBIT mirrors were larger, made to closer tolerances, and lighter than in any previous system. The photographic quality of the GAMBIT camera also depended a great deal on vehicle stability. Pointing had to be extremely precise, requiring extreme accuracy in the horizon sensors and a stable platform gyro system that would allow the sensors to stay locked on the horizon while the vehicle rolled to point toward targets on either side of the orbital track. Because the ground swath width of GAMBIT cameras was only 10 miles, more photographs would be taken from a canted than a vertical position.[130] The endeavor was plagued with early issues, and the GAMBIT program's validity and future was called into question at several points based on schedule slippages and the increasing cost of the program.[131]

Competition between the CIA and Air Force, together with heavy secrecy, meant that there was little coordination or cooperation in the design of CORONA and GAMBIT. Few individuals were authorized for knowledge about both programs and little communication existed between them. When the GAMBIT program encountered technical challenges, there was often a delay before solutions could be drawn from findings already gleaned through CORONA development. For instance, the GAMBIT program focused for years on land-based recovery mechanisms, a process fraught with difficulties to prevent the payload from being destroyed or harming civilians. There was a significant delay in GAMBIT program leaders coming to realize that the

[130] Perry, Robert L. "A History of Satellite Reconnaissance: The Perry GAMBIT History," National Reconnaissance Office, November 1973, p. 20.
https://www.nro.gov/Portals/65/documents/history/csnr/programs/docs/prog-hist-05.pdf
[131] Perry 1973, p. 24.

CORONA's reentry vehicle design and over-ocean recovery could be adapted for their use. Similarly, when GAMBIT struggled with stabilization issues to improve its resolution, no one in the GAMBIT program knew about a CIA-devised solution of using a roll-joint between the Agena booster and the satellite payload to reduce reliance on the orbital control vehicle. Because of the classification and compartmentalization that existed between satellite programs, it seemed unwise to disclose CIA-origin of ideas to large numbers of GAMBIT workers. The kernel of the cover story was that Lockheed would be empowered to "develop" the earlier "idea," delivering finished roll joints to GAMBIT as though they were new items with no relationship to any other reconnaissance program.[132]

The CIA made its own attempt at a high-resolution satellite similar to GAMBIT given the program's delays and, in particular, the inability of KH-4 CORONA imagery to accurately determine whether the Soviets were embarking on an ABM program. In 1961, KH-4 CORONA photos showed in poor resolution roads ending in circular clearing, like "lollipops in the snow," according to one interpreter. NPIC's interpreters concluded that the photos likely showed construction for the deployment of the SA-5 GAMMON interceptor missile. The exact purpose of the configuration, called the Tallinn Line, was to be heavily debated within the intelligence community for years to come.[133] U.S. Secretary of Defense Robert McNamara requested high-resolution imagery of the suspected site, which ultimately prompted the CIA to produce the KH-

[132] Perry 1973, p. 28.
[133] Richelson 2001, p. 57, citing an interview with a former CIA official.

6 LANYARD satellite. The hope was for it to produce images with a resolution of two feet, but the program was plagued with high failure rates and was ultimately canceled.[134]

CORONA and GAMBIT provide new information with a temporal blind spot

Despite difficulties resulting from rivalry and poor communication, the CORONA and GAMBIT satellite programs would begin operating in tandem from 1963. While CORONA aimed to provide wide area coverage at a lower resolution ranging from 40 meters (KH-1 model) to 1.8 meters (KH-4B model), GAMBIT was used for high-precision monitoring of target areas at resolutions of about six to ten centimeters (see **Figures 1.1 and 1.2**). The technical specifications in **Table 1.1** are for the most advanced iterations of these two satellite programs. By the mid to late 1960s, the pair of satellites were operating at around one meter resolution and below. Under the NIIRs scale, the satellite pair was able to accomplish tasks like detection and general identification of missile silos with CORONA, and with GAMBIT, analysts could perform precise identification, description, and analysis.[135] A CORONA mission would produce a broad view of portions of Soviet territory with a mission length of 20-30 days, returning its film at two intervals (one in the middle and one at the end). Based in part on the examination of that photography, targets would be selected for the follow-up GAMBIT mission.[136] Throughout the 1960s, CORONA satellites were launched about every six weeks, with at least one GAMBIT launched

[134] Richelson 1990, p. 66.; Robert A. McDonald and Patrick Widlake, "Looking Closer and Looking Broader: Gambit and Hexagon – The Peak of Film-Return Space Reconnaissance After Corona," National Reconnaissance Office, Journal of Discipline and Practice, p. 5. https://www.nro.gov/Portals/65/documents/history/csnr/articles/docs/journal-03.pdf

[135] Perry, Robert. "A History of Satellite Reconnaissance Volume IIIA - GAMBIT." HQ Air Force Special Projects Production Facility for the U.S. National Reconnaissance Office, January 1974, p. iv.

[136] Richelson 1990, p. 78.

between CORONA missions. Both satellites were in high-inclination elliptical orbits, meaning that they operated in near-polar orbits that allowed them to scan the Soviet Union over the course of their mission lives.

CORONA KH-4B Technical Specifications	GAMBIT KH-8 Technical Specifications
Resolution: 1.09 meters Mission length: 25 days Film load: 80lbs	Resolution: 0.1 meters Mission length: 30 days Film load: 52 lbs

Table 1.1. Technical specifications for latest generation of CORONA and GAMBIT satellites.[137]

While optical capabilities advanced, temporal blind spots, including technical challenges in coverage and frequency, would endure. On a given mission, CORONA covered only about 20 to 30 percent of Soviet territory about every 30 days, and sometimes less due to frequent mission failures in early years.[138] **Figure 1.3** shows the geographic coverage for a CORONA KH-4A mission, indicating the temporal blind spots that remained. Further, often half of the imagery collected was unusable due to cloud cover, and coverage of different areas could only be achieved every few days, weeks, or even months depending on its the priority level. GAMBIT's specifications, including its shorter mission life, indicate that it covered far less. While the cameras on CORONA systems had a focal length of 60 centimeters useful for achieving a coverage of about 5000 square kilometers per image, the first GAMBIT system (KH-7), was equipped with a 196-centimeter focal length camera, and the camera for the second system,

[137] Mission lengths in these and subsequent tables are approximations tending toward the average mission length of the specified program.
[138] Interview, Richard Garwin, April 2019.

GAMBIT-3 (KH-8) had a 444-centimeter focal length.[139] The telescopic nature of the GAMBIT cameras thus covered a much smaller area than CORONA at a higher resolution. The temporal blind spot was further worsened by GAMBIT's short mission life. GAMBIT had a much lower perigee, meaning it was closer to the Earth when it captured images, which is in part what enabled it to get such high-resolution images.[140] At the same time, because of the atmospheric drag that comes with orbiting this low, the satellites had very short life spans and in the beginning lasted for only about three to five days.

The temporal blind spot contributed to increased inter-organizational competition for high-resolution imagery. The nature of the targeting negotiation process meant that the Air Force, interested in air defense sites, competed against those who came to work on arms control treaties, who wanted to look at missile bases more frequently in the same areas as the air defense sites. Conflicts over targeting priorities also arose out of differences between tactical intelligence of interest to military commanders versus strategic and long-term interests of interest to the CIA and NPIC, as well as competition between the military services themselves. The smaller swath widths of both CORONA and GAMBIT often meant that a choice had to be made.[141]

[139] "GAMBIT 1: America's Eyes in Space." 2011. National Reconnaissance Office, Center for the Study of National Reconnaissance. https://www.nro.gov/Portals/65/documents/history/csnr/gambhex/Docs/GAM_1_Fact_sheet.pdf.
[140] Perry, "A History of Satellite Reconnaissance Volume IIIA - GAMBIT," p. 129.
[141] O'Connor, Jack. *NPIC: Seeing the Secrets and Growing the Leaders, A Cultural History of the National Photographic Interpretation Center*. Alexandria, VA: Acumensa Solutions, 2015, p. 103.

[Image removed due to copyright concerns]

Figure 1.1. Top: CORONA KH-4A image of an SS-9 ICBM silo in Kazakhstan. Bottom: A Soviet SA-2 surface-to-air missile site which had to be monitored against conversion to an ABM site. *Credit: Archives of the National Air and Space Museum, 1967.*

[Image removed due to copyright concerns]

Figure 1.2. GAMBIT KH-7 Image of Launch Site 3, Plesetsk ICBM Complex in Former Soviet Union, 9 June 1967. *Credit: National Reconnaissance Office.*

[Image removed due to copyright concerns]

Figure 1.3. Drawing portrays typical coverage of the Eurasian landmass acquired by KH-4A and KH-4B missions. It shows the total coverage but does not indicate which were cloud covered. On most missions, about 50 percent of the imagery was obscured by clouds.[142]

[142] "KH-4 (Corona) Reconnaissance Satellite Program, History. [Photograph]." Smithsonian National Air and Space Museum, 1995. National Air and Space Museum, Archives Division, MRC 322, Washington, DC, 20560. https://airandspace.si.edu/collection-objects/kh-4-corona-reconnaissance-satellite-program-history-photograph.

HEXAGON

In deciding the path forward for satellite reconnaissance research and development, much of the U.S. bureaucracy advocated for the path of making modest improvements to the existing CORONA satellite system rather than attempting to design and deploy an entirely new system. Individual scientists were instrumental in redirecting this thinking toward the pursuit of HEXAGON and the goal of higher resolutions over wider areas.

One particularly influential force was the ongoing rivalry between the CIA and the National Reconnaissance Office (NRO) together with the Air Force. This organizational power struggle deepened during this decade. In the words of historian Jeffrey Richelson, "the conflict between the CIA and NRO over space reconnaissance had escalated from border skirmishes to war."[143] Already by the early 1960s, both had requested of higher authorities that the other be stripped of its responsibilities in space reconnaissance development, or as Director of Central Intelligence John McCone argued, that the NRO be dissolved completely.[144]

Dueling personalities in the battle between the resolution and temporal initiatives

At the center of this feud was a personal rivalry between Albert Wheelon, deputy director of the CIA's Directorate of Science and Technology, and Brockway McMillan, head of the NRO, which had been created to manage satellite deployments and operations. These two individuals

[143] Richelson 2001, p. 102.
[144] Richelson 2001, pp. 116-117.

were opposed to one another even before taking their respective posts.[145] McMillan held the view that the correct path forward was to continue to improve the existing CORONA system. He was attuned to the design failures on the path to CORONA and feared the challenges of developing a new system. His reading of the NRO charter convinced him he had been given full authority to manage U.S. space reconnaissance efforts subject only to the supervision of the Secretary of Defense.[146]

On the other side of table, Wheelon had a reputation as a "whiz kid" with a penchant for tinkering and big ideas and who held a Ph.D. in physics from MIT. His early work focused on missile guidance and flight systems, so when the Soviets launched Sputnik, he was called upon to help with the CIA's work of looking at Soviet rocket and missile photos from the U-2 system. In working closely with individuals like Albert Lundahl, director of the CIA's National Photo Interpretation Center, Wheelon was reportedly struck by the absence of satellite data during pivotal moments such as the Cuban missile crisis. He remarked that "CORONA was totally useless" during the crisis given the long delays for getting film back.[147] Such perceptions were at the root of his philosophy that radical new solutions in satellite reconnaissance were needed.

When McCone recruited Wheelon to lead the CIA's Directorate of Science and Technology, Wheelon had informed him that he didn't want the job unless he and the Kennedy administration were prepared to roll back the erosion of CIA recourses and guarantee the Agency a major role

[145] Several years before, McMillan served as a referee for a paper Wheelon had submitted to a prestigious technical journal, and at the end of the interactions, each questioned the other's intellectual honesty. Discussed in Richelson 2001, p. 103, citing Wheelon interview.
[146] Richelson 2001, p. 103.
[147] Taubman, p. 328.

in the development of new satellites. “I said this is even more important than nuclear weapons, where two laboratories are competing successfully. We’ve got to get his right and get the very best systems,” Wheelon recalled.[148] He would lead a process of coordinated resistance against the NRO and McMillan’s agenda. As a result, historians and policymakers alike have attributed HEXAGON’s origins in great part to Wheelon.[149] In 1994, William Perry then secretary of defense, said, “The national reconnaissance system which the United States now has, which are truly jewels in our crown, all stem, in my judgement, from the creative work that Bud Wheelon did in the sixties.”[150]

As the satellite development community looked forward, much of the community had settled on the idea of continuing with modest improvements to the CORONA system, a decision which would have been more in line with the temporal initiative. In the spring of 1963, Director of Central Intelligence John McCone established a special reconnaissance study group to examine options for the “next generation” of satellite systems.[151] He was responding in part to a series of studies conducted by CIA systems analysts, one of which suggested the need for a system that could perform wide-area coverage at very high resolutions. Called the ‘Panel for Future Satellite Reconnaissance Operations,’ or Purcell Panel, members included Edward Purcell as chairman, as well as Richard Garwin, Edwin Land, and NPIC director Arthur Lundahl.[152] The panel had been

[148] Taubman, p. 333.
[149] Richelson 2001, p. 130; Taubman, Phillip. *Secret Empire: Eisenhower, the CIA, and the Hidden Story of America’s Space Espionage*. New York: Simon and Schuster, pp. 331-347.
[150] Taubman, p. 331.
[151] Robert Perry, “A History of Satellite Reconnaissance, The Perry GAMBIT & HEXAGON Histories,” Center for the Study of National Reconnaissance, January 2012, p. 99.
[152] Also known as the Purcell Panel. See Perry, A History of Satellite Reconnaissance, Volume 5, p. 106; Actions Under Way Responsive to Purcell Panel Report Recommendations, attachment to Brockway McMillan, Memorandum for the Director CIA, Subject: implementation of the Purcell Panel

briefed by various contractors and the military and governmental personnel as to what systems were in design development or under consideration. James Reber, chairman of COMOR, which selected targets for the satellites, discussed the latest COMOR requirements. Arthur Lundahl, as director of NPIC, asserted that there was no difference in the intelligence that could be derived from the photographs with resolution of ten feet than of five feet. The Purcell group concluded that development of a new search system with resolution between four and six feet was not justified.[153] The panel stated that "the natural incompatibility of wide coverage and high resolution within a given payload is becoming more acute ... as the art advances." An effort to combine the two functions in a single system "with only a modest improvement in resolution... would not be a wise investment of resources," the committee decided.[154]

Robert Perry, in his history of the period, notes that the panel's conservatism was likely a response to the series of satellite failures occurring during this time. By early 1963, a number of Air Force satellite projects had been canceled due to insurmountable problems, the CIA's KH-6 Lanyard high-resolution satellite was in some early difficulty, and GAMBIT, still untested at this time, was recovering from technical and financial troubles that in October 1962 had led to a major program restructuring. With such losses vivid in recent memory, the technical community was understandably risk averse, leading them to focus on the fact that CORONA, despite having

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Recommendations, September 11, 1963; Brockway McMillian, Memorandum for the Director, CIA, Subject: Implementation of the Purcell Panel Recommendations, September 11, 1963, as cited in Richelson 2001, p. 122.

[153] John N. McMahon, Memorandum for [Deleted], Subject: References to the Purcell Panel, December 14, 1964; "Actions Under Way Responsive to Purcell Panel Report Recommendations," attachment to Brockway McMillan, Memorandum for the Director, CIA, Subject: Implementation of the Purcell Panel Recommendations, September 11, 1963, as cited in Richelson 2011, p. 123; Perry, A History of Satellite Reconnaissance, Volume 5, p. 106.

[154] Perry 2012, p. 99.

some technical hurdles, was largely working and should remain the focus.[155] The panel found that the CORONA KH-4 system operated at its ultimate photographic capability only about 10 percent of the time, partially as a result of recognized factors. The panel observed that "it seems entirely feasible to bring most of these factors under control so that one could count on peak resolution from the…system on 90% of the exposed film." The consequence would be "an enormous gain in information acquisition."[156]

John McMahon of the CIA's Directorate of Science and Technology later contended that the argument to stick with improving CORONA over designing a new system based on the Purcell Panel's report was misleading. He noted that the panel was told that the new search system (the eventual HEXAGON) proposed as a follow-on to CORONA was a "10,000 lb. monster" that would require a Titan 3C booster. Thus, "the panel felt that rather than bankrupt the U.S. Treasury… we turn to CORONA and make it work all the time" at nine-foot resolution. McMahon suggested that if the Panel was briefed on the current systems underway and the resolutions required, they would reach different conclusions than they did in July 1963.[157]

Wheelon also firmly disagreed with the outcomes of the Purcell Panel and acted to be able to reinforce his intuitions with scientific studies. He sympathized with an outlier voice on the Purcell Panel, Edwin Land, who concluded that a system was needed that covered as much

[155] Perry 2012, p. 100.
[156] Purcell Panel Report, p. 3, cited in Richelson 2001, p. 123.
[157] John N. McMahon, memorandum for: [Deleted], Subject: References to the Purcell Panel, December 14, 1964, cited in Richelson 2001, p. 126.

territory as CORONA but with the resolution of GAMBIT.[158] Wheelon was reportedly concerned that photo interpreters were currently finding it extraordinarily difficult to detect new items of interest with CORONA photography. He was also concerned about how the Air Force was using GAMBIT primarily to refine targeting plans in the event of a war.[159] A high-resolution search system, in his view, was a solution.[160] In October 1963, Wheelon reached out to Sidney Drell, a former colleague of his, and asked him to chair the Satellite Photography Working Group "to explore the whole range of engineering and physical limitations for satellite photography." The group's mandate was to determine whether CORONA could be improved enough to serve as a spotting system as well as a search system or whether a new satellite was required. According to Wheelon, the effort marked the "resurgence of CIA activity in the satellite business."[161]

Wheelon asked Drell's group, which included Rod Scott of Perkin-Elmer and two representatives from Itek, to determine how much CORONA's resolution could be improved and how much intelligence could be extracted from wide-area photos of higher and higher resolution. In an attempt to determine the intelligence value of increasingly sharp images, the group degraded aerial reconnaissance photographs to five different levels of resolution and gave them to photo interpreters at NPIC to see how much intelligence could be extracted at each level.[162]

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[158] Interview with a former CIA official, cited in Richelson 2001, p. 123.; Office of Special Projects, 1965-1970, Volume One Chapters I-II, p. 2.
[159] Taubman, p. 344.
[160] Wheelon interviews, April 9, 1997, and November 11-12, 1998, cited in Richelson 2001, p. 123.
[161] Taubman, p. 344; Garwin, Richard L. "Sid Drell's Contributions to Arms Control and Strategic Stability," Presented in the APS session "The Future of U.S. Nuclear Forces: What Do We Need?" https://fas.org/rlg/sid-drell.pdf; Albert D. Wheelon, Deputy Director (Science and Technology, to Dr. Brockway McMillan, Director, national Reconnaissance Office, November 5, 1963; telephone conversation with Albert Wheelon, December 26, 1999, cited in Richelson 2001, p. 123.
[162] Richelson 2001, p. 124, citing Wheelon interviews, November 11-12, 1998, and April 9, 1997.

Drell and his colleagues concluded that CORONA had been pushed about as far as it could be, and that to achieve significantly better resolution demonstrated that a wide-area system with resolution of two feet would dramatically improve their ability to spot new facilities and extract intelligence about them. According to Wheelon, "something a lot better was needed."[163]

The effort toward a high-resolution search system began to gain momentum despite resistance from McMillan and the NRO. Although the research work by Drell was funded by NRO, McMillan was not willing to go further based on the studies. Wheelon recalled that "from the outset McMillan did everything in his power" to stop that program, including refusing to provide funds.[164] Director of Central Intelligence McCone, making good on his promise to Wheelon upon recruiting him, stepped in an authorized the use of CIA funds for the project.[165] It was not until June 1964 that McMillan discovered the CIA effort, code-named FULCRUM (later HEXAGON), which the agency had concealed not only from the Soviet Union but from the NRO as well.[166]

Resistance to FULCRUM was not just institutional; it was also present in the private industry. Itek was originally contracted for the design of FULCRUM. But, as Walter Levison, a camera designer and senior Itek official at the time, recalled, Itek thought the decline in resolution that would result would be too great to justify attempting to produce a system that could scan 120

[163] Richelson 2001, p. 124, citing Wheelon interviews, November 11-12, 1998, and April 9, 1997.
[164] Richelson 2001, p. 124, citing Wheelon letter.
[165] Richelson 2001, p. 124, citing Wheelon letter; Office of Special Projects, 1965-1970, Volume I, Chapter I-II, pp. 2-3; and Interview with John McMahon, Los Altos, California, November 17, 1998.
[166] Richelson 2001, p. 125.

degrees.[167] After facing what they viewed as "dominating" pressure from the CIA, Itek withdrew from the FULCRUM project.[168]

Once Itek had withdrawn as the contractor, Rod Scott from Perkin-Elmer stepped in with a new design concept called the "twister." It would allow images to be recorded on film that was see-sawed back and forth – a radical departure from the practice of advancing the film frame by frame past the focal plane. The twister would permit placement of the cameras in the satellite so that they would be parallel to the satellite's motion rather than perpendicular – which in turn meant the satellite could carry cameras of sufficient size to achieve the CIA's resolution and scan objectives.[169] Wheelon again consulted the sympathetic ear of Edwin Land, who preferred Perkin-Elmer's design to Itek's. Land was reportedly supportive because he was not a systems engineer but a scientist who "liked nothing more than an innovative, cleverer device," and the twister "just knocked him off his chair." DCI McCone then put up more CIA funding to keep the project going.[170]

McMillan and the NRO were determined that FULCRUM would not be the only candidate to succeed CORONA. A contract to begin studies for a system designated the S-2 was issued to Eastman-Kodak, whose approach McMillan recalled as "fairly conventional," and would have been more in line with the temporal rather than resolution initiative. McMillan would continue to push this system and advocate it to Defense Department leadership as the most promising option.

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[167] Richelson 2001, pp. 126-127, citing Levinson interview.
[168] Richelson 2001, p. 127.
[169] Telephone conversation with Albert Wheelon, April 13, 2000, cited in Richelson 2001, p. 128.
[170] Wheelon interviews, 11-12 November 11-12, 1988, 8 February 2000; 13 April 2000; McMillan interview, all cited in Richelson 2001, p. 128.

Some attention was also devoted to a proposal for a smaller system, designated MATCHBOX that was advertised as being capable of producing equally detailed imagery.[171] McMillan later recalled that MATCHBOX was proposed by someone from IBM. The promise of attaining high resolution with a smaller optical system permitted smaller and less expensive boosters, which greatly appealed to the Pentagon's Office of Systems Analysis. However, according to McMillan, the physics was "crazy."[172] Indeed, such developments are now only being seen on a wider scale in the 2020s.

The CIA establishes its design authority and the resolution initiative

In the background, the CIA was advocating for more power over satellite reconnaissance design decisions. By 1965, DCI John McCone had made his point with Secretary of Defense McNamara that the CIA did indeed have a role to play in satellite reconnaissance. He gained the Secretary's consent to negotiate a new agreement to govern the U.S. national reconnaissance program – one which eventually gave fuller recognition to CIA's role. Principles to guide negotiation of a new agreement were formulated by McCone and Albert Wheelon, Deputy Director for Science and Technology: "*The acquisition of intelligence by overhead reconnaissance is a responsibility of the Director of Central Intelligence. Satellite photography makes a most important input into the intelligence inventory. The DCI in discharging his statutory responsibilities for producing estimates concerning the security of the United States must direct this intelligence-acquiring facility to meet his needs. To do this, the DCI, directly or through subordinates responsible to*

[171] Telephone interview with Walter Levison, September 17, 1999; McMillan interview, cited in Richelson 2001, p. 126; Perry, A History of Satellite Reconnaissance, Volume 5, p. 177.
[172] Interview with McMillan, cited in Richelson 2001, p. 326.

him, and with the continuing advice of the United States Intelligence Board, should determine the frequency of satellite missions, the target and the priority in which they must be treated, and the control of the satellite when in orbit to ensure coverage of the targets and therefore the acquisition of information considered essential by the DCI." The new NRO Agreement propounded by McCone early in 1965 and by his successor Admiral William F. Raborn, and Deputy Secretary of Defense Cyrus Vance, gave CIA the charter for continuing and improving the satellite reconnaissance system. The Office of Special Projects of the Directorate for Science and Technology of the CIA, established 15 September 1965, was given responsibility for carrying out these programs.[173]

As a result of the August 1965 agreement, the CIA was given responsibility for managing the development of the new search system and the agency awarded Perkin Elmer the contract to develop the satellite. The system was intended to yield resolution of three feet at the nadir (when the target was directly underneath) but produced no better than six feet at the extremes.[174] On April 22, 1966, the USIB gave its blessing to development of a new search system along the lines of FULCRUM over its main competitor, the S-2. The program became known as HEXAGON.[175]

[173] "Office of Special Projects, 1965-1970, Volume One, Chapter I-II," Central Intelligence Agency, pp. 5-7. https://www.nro.gov/Portals/65/documents/foia/CAL-Records/Cabinet2/DrawerA/2%20A%200075.pdf
[174] Burks interview, cited in Richelson 2001, p. 129.
[175] Perry, A History of Satellite Reconnaissance, Volume I: CORONA (Washington, DC: NRO, 1969), p. 162; Richelson 2001, p. 129.

Wheelon would leave his post before HEXAGON was fully developed, but his work during his tenure as Deputy Director for Science and Technology is credited with allowing the CIA to retain control of the satellite reconnaissance design effort. This study adds to this history that Wheelon can be credited for a large role in the United States maintaining its course on the path of the resolution initiative rather than shifting at this point toward the temporal initiative and developing the now well-oiled CORONA system en masse. Historian Jeffrey Richelson writes that without Wheelon, there would likely have been neither the HEXAGON nor the KENNEN programs.[176]

HEXAGON and the challenge of high-resolution over wide areas

Early proposals for the HEXAGON system continued to be met with skepticism about both its feasibility and its value. The Budget Bureau and the staff of the Secretary of Defense proposed that the HEXAGON project be canceled based on high costs for achieving what they viewed as already possible with the CORONA and GAMBIT programs.[177] The CIA made the case that extending the life of CORONA would roughly equal the costs of developing and deploying

[176] Richelson 2001, p. 130.

[177] "On the Bureau of Budgets Recommendation to Cancel HEXAGON." National Reconnaissance Office, March 11, 1969. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/85.pdf; "Response, re: On the Bureau of Budgets Recommendation to Cancel HEXAGON." National Reconnaissance Office, March 22, 1972. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/86.pdf; "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/88.pdf.

HEXAGON, but opponents continued to argue that HEXAGON added little new intelligence value.[178]

Advocates of the HEXAGON program, now led by Director of Central Intelligence Richard Helms after McCone departed, argued that the system's value was that it afforded greater flexibility by combining the capabilities of CORONA and GAMBIT. With both a longer mission life and a load of four film recovery buckets, HEXAGON could provide more frequent input depending on what the first batch of imagery revealed and still remain on orbit collecting photography. A 1968 NPIC study found that with respect to ground resolution, a third of U.S. intelligence needs could be met by CORONA alone, but that 70 to 80 percent could be met by the HEXAGON alone. It further noted that HEXAGON would be unaffected by the problems of target conflict in areas of high target density. This was a drawback of the existing GAMBIT system, given that its narrow field-of-view forced intelligence leaders to choose certain targets over others.[179]

[178] "Response, re: On the Bureau of Budgets Recommendation to Cancel HEXAGON." National Reconnaissance Office, March 22, 1972. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/86.pdf; "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/88.pdf.

[179] "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office.

CORONA KH-4B	GAMBIT KH-8	HEXAGON
Resolution: 1.09 meters Mission length: 25 days Film load: 80	Resolution: 0.1 meters Mission length: 30 days Film load: 52	Resolution: 0.6-0.9 meters Mission length: 124 days Film load: 1,350 lbs

Table 1.2. Resolution and mission life specifications for HEXAGON compared to the latest generation of CORONA and GAMBIT satellites[180]

According to Helms, one major benefit of HEXAGON was a substantial improvement of U.S. capacity to monitor Soviet adherence to or violation of arms control agreements.[181] Whereas the Bureau of Budget had argued that the higher resolution of GAMBIT-3 would be more able to detect subtle violations than the poorer resolution of HEXAGON, the intelligence community responded that this argument missed the crux of search challenges. They argued that unless the violation was occurring at a facility previously identified as having a weapon function, GAMBIT-3 would never be targeted at the location of the violation. They asserted that a country trying to violate a force-level freeze might try to deploy a camouflaged system in areas that had no history of weapons deployment. Such a system would escape targeting by GAMBIT-3, and it probably could not be detected on CORONA photography, since the resolution of that system was "hardly good enough to identify the function intended to be conveyed, let alone the one to be

[180] "HEXAGON, America's Eyes in Space." Center for the Study of National Reconnaissance, September 2011. https://web.archive.org/web/20120916090954/http://www.nro.gov/history/csnr/gambhex/Docs/Hex_fact_sheet.pdf.

[181] "On the Bureau of Budgets Recommendation to Cancel HEXAGON." National Reconnaissance Office, March 11, 1969. Declassified HEXAGON Records, National Reconnaissance Office.

disguised. Detection by HEXAGON," they contended, "while not assured, carries a much higher probability."[182]

Next to the strategic arguments facing HEXAGON, skepticism persisted that a single system could possess the capabilities of both the CORONA and GAMBIT satellites. Technologists believed that there was a "*natural incompatibility*" between wide coverage and high resolution.[183] The CIA eventually determined that even an improved CORONA could never provide search resolutions much better than 1.3 meters, which was above the effective range determined by the NPIC experiment.[184] There was growing agreement that search resolutions better than one meter were essential to verification of arms limitations agreements.[185]

[182] "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office.
[183] Perry, Robert. "A History of Satellite Reconnaissance Volume IIIB - HEXAGON." HQ Air Force Special Projects Production Facility for the US National Reconnaissance Office, November 1973, pp. 7-8.
[184] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 40.
[185] Perry, "A History of Satellite Reconnaissance Volume IIIB – HEXAGON," 1973, p. 72.

[Image removed due to copyright concerns]

Figure 1.4. KH-9 HEXAGON satellite vehicle and film recovery units [186]

To meet the technical challenge, Perkin-Elmer proposed a system that included a 60-inch focal length lens with an aperture of f/3.0 and four film recovery buckets (**Figure 1.4**). Following NPIC studies, the desired ground resolution had been set at 2.7 feet, which necessitated an altitude of 92 nautical miles. Perkin-Elmer's camera design was also lighter than other proposals, which allowed for a longer mission life.[187] During photography, the optical bars would rotate continuously through 360 degrees to provide cross-track scanning, with photography capture

[186] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011.

[187] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, Revised version, 2011, p. 111. https://www.nro.gov/Portals/65/documents/history/csnr/gambhex/Docs/Perry_Gambit_Hexagon_History_single_pages.pdf

occurring only between 30 degrees and 120 degrees of each rotation.[188] Together, these mechanisms would allow HEXAGON to capture wide geographic areas at high resolutions.

The process of bringing the system into being was far from seamless; As HEXAGON's budget and timeline increased beyond initial estimates, it was threatened with replacement by an advanced CORONA system, the KH-4B. The decision was ultimately determined by coverage requirements. By 1969, there was no reasonable possibility of developing an improved CORONA in time to substitute it for HEXAGON, with the risk being that the United States would go for a period without a single reconnaissance satellite. Despite HEXAGON's delays, it would be faster to pay for overtime work on HEXAGON than to develop a new CORONA. In the end, the HEXAGON program, from approval to first launch, had taken five years rather than two and had cost more than twice as much as initially estimated, mostly for camera development, which cost three times as much as the CIA had anticipated.[189] Beginning with Albert Wheelon's vision, the CIA's relentless push for HEXAGON had finally prevailed.

HEXAGON's first flights

The first HEXAGON mission was an undisputed success. The first return capsule contained coverage of more than two thirds of Soviet missile sites. During its 52-day mission (31 days in

[188] "HEXAGON," National Reconnaissance Office, video posted on September 19, 2011, https://www.youtube.com/watch?v=LQq9KcEw7nk

[189] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." Revised version, NRO, 2011, p. 118 and 120. https://www.nro.gov/Portals/65/documents/history/csnr/gambhex/Docs/Perry_Gambit_Hexagon_History_single_pages.pdf

active capture mode) this first HEXAGON system conducted 430 photo operations and produced an average ground resolution of 1.06 meters and a best resolution of 0.7 meters. The volume of film carried by HEXAGON also set new records: it used 1,350 pounds of film, and of this, 930 pounds was recovered. In comparison, the first successful CORONA recovery carried 20 pounds of film. Later, CORONA flights carried 40 pounds, and the two-capsule version, 80 lbs.[190] The NRO maintained a consistently successful record in deploying HEXAGON, launching 20 systems from June 1971 to April 1986, 19 of which were successful.[191] These missions reached durations of up to 180 days.[192]

HEXAGON also set new records in consistent image quality. In the first mission, approximately 75 percent of the photography in the three recovered film buckets was free of clouds, a considerable improvement over earlier satellite photography. This was due to a revolutionary new system named the Hexagon Targeting Program (HTP). The HTP effort was a computer-based method for determining, prior to launch, the accessibility on the intended targets for each mission as well as the likelihood of their being cloud-free. The major features of the HTP included the use of World Aeronautical Chart divisions known as World Aeronautical Grid cells, which made it more feasible to forecast cloud cover and maintain a climatological history for each cell. Eventually, HTP became part of a much larger NRO effort known as TUNITY (the

[190] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 32.
[191] "HEXAGON, America's Eyes in Space." Center for the Study of National Reconnaissance, September 2011. https://web.archive.org/web/20120916090954/http://www.nro.gov/history/csnr/gambhex/Docs/Hex_fact_sheet.pdf.
[192] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 96.

TRW Unified Information Transfer Software System). This system was made up of many computer programs and routines, and it performed on-orbit mission targeting, command and control, and mission reporting. TUNITY was used in coordination with the Air Force's Defense Meteorological Satellite Program and increased the efficiency of HEXAGON cameras to 90 percent.[193]

Other major advancements contributing to HEXAGON's search and surveillance capabilities were the development of additional statistical prediction and simulation software programs. HEXAGON's layered set of programs included the Sensor Subsystem Performance Prediction Program, known as CRYSPER. Based on predicted ground resolved distances (GRD) for selected targets, the CRYSPER program would consider the operating characteristics of the sensor subsystem to be flown, the type of film selected for the mission, the selected orbit and time of launch, haze characteristics, and the contrast and reflectance of the individual targets. Another program was the HEXAGON Analytic Mission Planning Estimation Routine (HAMPER) which was used to statistically predict mission performance with respect to satisfying intelligence collection requirements, and to generate recommended weighting and control parameters for use in the targeting software. This allowed HAMPER to predict the performance level of the satellite against the complex surveillance, area search and special areas of interest unique to the mission being planned, as well as to determine the amount of film required to satisfy particular mission objectives. Lastly, there was the HEXAGON Simulation Program (HSIM) which would simulate the satellite's camera operations by taking into

[193] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 32.

consideration the orbit to be flown, mission collection requirements, hardware constraints, film management, actual cloud-cover conditions from historical data on file, targeting software camera operation selection logic, and weighting and control parameters provided from HAMPER.[194]

While the majority of film used on HEXAGON systems was panchromatic (black and white), HEXAGON achieved a number of milestones in other film types. The program achieved color imagery, which improved search and surveillance functions by allowing the easier detection of military, industrial and transportation items with distinctive color-coding signatures.[195] HEXAGON also achieved infrared color film, which afforded the capability of separating man-made, hidden objects from natural vegetation. However, resolution for these early attempts at color and infrared were low compared to the black-and-white films, which remained the primary payload.[196] During its lifetime, HEXAGON's most far-reaching task would be monitoring Soviet research and development, production, and deployment of strategic weapon systems (**see Figures 1.5, 1.6, and 1.7**). On a typical mission, the mature HEXAGON system would image about 80 percent of the Soviet Union (over 24 million square kilometers), cloud-free (**Figures 1.8 and 1.9**).[197]

[194] "HEXAGON Concept of Operations." National Photographic Interpretation Center, September 1970. National Reconnaissance Office, pp. 11-12.
[195] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 158 of 405.
[196] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 160 of 405.
[197] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011, p. 33.

[Image removed due to copyright concerns]

Figure 1.5. Submarine construction, Severodvinsk Shipyard, 19 September 1976 [198]

[Image removed due to copyright concerns]

Figure 1.6. Perm ICBM complex, Destroyed SS-7 Silos, Mission 1215 [199]

[198] "HEXAGON (KH-9) Imagery." Center for the Study of National Reconnaissance, April 2012. https://web.archive.org/web/20120915093825/http://www.nro.gov/history/csnr/gambhex/Docs/Hexagon_KH-9_Imagery_web.pdf.

[199] "HEXAGON (KH-9) Imagery." Center for the Study of National Reconnaissance, April 2012. https://web.archive.org/web/20120915093825/http://www.nro.gov/history/csnr/gambhex/Docs/Hexagon_KH-9_Imagery_web.pdf.

[Image removed due to copyright concerns]

Figure 1.7. Moscow ABM Complex – Mission 1218-1 [200]

[200] "HEXAGON (KH-9) Imagery." Center for the Study of National Reconnaissance, April 2012. https://web.archive.org/web/20120915093825/http://www.nro.gov/history/csnr/gambhex/Docs/Hexagon_KH-9_Imagery_web.pdf.

[Image removed due to copyright concerns]

Figure 1.8. Clear stereo imagery coverage by HEXAGON mission 1209 from October 1974 to March 1975[201]

[Image removed due to copyright concerns]

Figure 1.9. Example of HEXAGON area coverage objectives. Dark spots indicate areas imaged approximately every three months [202]

[201] "Critical to US Security: The GAMBIT and HEXAGON Satellite Reconnaissance Systems." NRO, 2011.
[202] Ibid.

KENNEN

KENNEN was the United States' first digital and first real-time satellite. Historian Robert Perry points to an encapsulation of the debates leading up to the KENNEN satellite program as "mythography." He describes that the characters and differences of viewpoint were reminiscent of those expressed five years earlier in the context of HEXAGON, and "intervening experience and learning were interpreted in ways that reinforced existing institutional preferences."[203]

Obtaining satellite imagery faster was not a high priority for U.S. government officials during the first decade of satellite reconnaissance. The need for near-real-time reconnaissance capability was stated sometimes after key events like the Cuban Missile Crisis, the Six-Day War, or the invasion of Czechoslovakia—but was never clearly prioritized. Many people were in fact opposed to KENNEN's development.[204] Yet, as in the case of HEXAGON, determined individuals were largely responsible for organizing a process against this opposition. Once again, Albert Wheelon and Edwin Land were instrumental in pushing the project through bureaucratic and ideological barriers.[205]

The efforts of these individuals ultimately contributed to choosing large advances over incremental growth; for higher rather than lower risk in schedule, cost, and performance; and for higher cost, multi-function systems rather than lower-cost specialized systems. As Perry

[203] Robert Perry, "NRO History: NRO history Series Chapter 17, Vol. IV, Draft Only," [version approved for release 3-19-2018], National Reconnaissance Office, p. 14.
[204] Day, Dwayne A. "Intersections in real time: the decision to build the KH-11 KENNEN reconnaissance satellite (part 1)," *The Space Review*, 9 September 2019, https://www.thespacereview.com/article/3791/1.
[205] Day, "Intersections in real time (part 1)," *The Space Review*, 2019.

describes, that consistent expression of preference implicitly defined an acquisition strategy for new national reconnaissance systems and imposed important constraints. These constraints were dependence on a relatively few high-cost systems which, because of cost, had to embody long on-orbit operating lives; acceptance of relatively long-term system development programs (less than two for CORONA, compared to three and a half for GAMBIT, four for HEXAGON, and eight for KENNAN) with comparably larger development costs; and "reliance on a few multi-function systems rather than many limited-function systems that cost less and could be built in larger quantities." Perry is describing, in essence, the choice to focus on fast, high-resolution imaging capabilities and to leave the temporal blind spot largely unchanged in accordance with the resolution initiative.[206]

Satellite expert and historian Dwayne Day summarizes the story of KENNEN as "a story of competing advocates for different technologies and spacecraft. It is a story of in-fighting and disagreement as well as perseverance by a few key intelligence officials and government advisors. The story is not a clear case of intelligence requirements driving technology development, or of technology advances leading to development approval, but a mix of both, with advocates for multiple technical approaches to improving satellite imagery response time competing to gain approval to develop their preferred system."[207]

One of these advocates was again, Albert Wheelon, who as Deputy Director of the CIA's Directorate of Science and Technology (DS&T) had orchestrated the development of

[206] Perry, pp. 14-15.
[207] Day, "Intersections in real time (part 1)," *The Space Review*, 2019.

HEXAGON. Wheelon's experience in the Cuban Missile Crisis, as well as Soviet maneuvers in Eastern Europe, had showed him "how irrelevant satellite systems were to current intelligence and crisis management." In 1963, Wheelon recalled sitting at home near Washington, DC watching a football game on television when he had a revelation: if he could watch a show being broadcast over a communications satellite, he believed it should be possible to transmit images for intelligence purposes. His revelation led him to push for a directive together with the CIA's Deputy Director of Science and Technology, Leslie Dirks, for DS&T to develop a near-real-time system.

Others sought the KENNEN design not necessarily for the real-time capabilities it would offer, but rather for the possible stealth capabilities it would afford. In 1962, Dirks and others in the CIA considered whether the United States could operate a reconnaissance satellite without the knowledge of the Soviet Union. Analysts speculated that under existing capabilities, the Soviets could take steps to hide weapon activities as U.S. satellites passed overhead.[208]

A quest for a secret satellite was fraught with physical limitations. Dirks and his colleagues concluded that a secret satellite in low-earth orbit was not feasible. The Soviet space detection and tracking network would easily pick up the launch and then the orbit of the satellite. An alternative was to place the satellite in a much higher orbit, bringing it down only when needed. Possibly the Soviets would miss or be confused by this unusual maneuver. The problem with this

[208] Richelson, Jeffrey, *America's Secret Eyes in Space*, New York: Harper & Row, 1990. pp. 124-125.

strategy was that as the film sat in space, unused, it would quickly begin to degrade, rendering much of the film supply useless.[209]

The design for KENNEN was thus partially borne out of a failed quest for secrecy. Realizing that film would not be an option for a high-altitude orbit, Dirks and his colleagues dredged up a concept initially developed by RAND for a digital imagery return system. Whether or not such a satellite could be kept secret from the Soviets, it could send back timely data. While the technology was not available in 1962, Dirks suspected it would be at hand in 1972. He thus kept the project alive over the next 10 years, looking for advances in technology that would permit such a system.[210]

In 1963, Wheelon and Dirks visited AT&T's Bell Labs. The visit was a special favor from Bell Labs president William O. Baker, who was also a member of the President's Foreign Intelligence Advisory Board (PFIAB) and familiar with the requirements for reconnaissance satellites. Although AT&T rarely allowed outsiders to see their research and development work, Baker understood its possible value in overhead reconnaissance. Wheelon and Dirks saw work being done on charge-coupled devices (CCDs), which AT&T hoped would serve as a key technology in video phones. Such technology was not mature in 1963, but Dirks realized that it could be developed and perhaps deployed in a satellite in a decade.[211]

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[209] Interview as cited in Richelson, 1990, p. 125.
[210] Richelson, 1990, p. 125.
[211] Day, Dwayne A., "Ike's gambit: The KH-8 reconnaissance satellite," *The Space Review*, 12 January 2019, https://www.thespacereview.com/article/1283/2 . Day cites the following sources for this information: Merton Davies and William R. Harris, RAND's Role in the Evolution of Balloon and Satellite Observation Systems and Related U.S. Space Technology (Santa Monica, Ca.: RAND, 1988), p.

The program was given the code name "ZOSTER." Despite this 1963 directive, the work was slow moving due to the technical community's primary focus on CORONA, GAMBIT and HEXAGON during these early years. It would take another eight years before formal approval for satellite development was granted by presidential order, and 13 years before it finally orbited the earth.[212]

A big leap over a small step

The delay in developing KENNEN centered on a debate over whether to take an incremental step in technology or a big leap forward using yet untested approaches. The "incremental step" concept was known as Film Read-Out GAMBIT (FROG) under a study initiated by the National Reconnaissance Office (NRO) in 1966. The FROG system was to use the KH-8 GAMBIT camera and a modification of the read-out technique developed for the early Samos E-1 and E-2 programs, which had been an early (and losing) competitor to the film-based CORONA design. Samos, a concept dating back to 1946, was based on an approach that used film that was exposed on board the satellite and scanned with a "flying spot scanner," with the images converted to an analog signal that was transmitted to Earth while the satellite was in view of a ground station. The design ultimately didn't meet the requirements for orbital life and payload weight and had

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75; Jon Gertner, The Idea Factory: Bell Labs and the Great Age of American Innovation, Penguin Books, 2013, p. 261; Oder, Fitzpatrick, and Worthman, The GAMBIT Story, pp. 87, 194.

[212] Day, "Intersections in real time (part I)," 2019, citing: Frederick C.E. Oder, James Fitzpatrick, and Paul Worthman, The GAMBIT Story, p. 87; [Deleted], "Charting a Technical Revolution: An Interview with Former DDS&T Albert Wheelon," Studies in Intelligence 45, 2 (Summer, 2001): 31-44, at 39; Albert D. Wheelon, "And the Truth Shall Keep You Free: Recollections by the First Deputy Director for Science and Technology," Studies in Intelligence, 39, 1 (Spring 1995), pp. 73-78 at p. 77.

been declared dead.[213] In FROG, the film would also be developed in flight and scanned but instead of a flying spot scanner, it would use a laser.[214] It would produce ground resolution of three to five feet (0.9 to 1.5 meters). The satellite would have a lifetime of 30–90 days in orbit. Depending on the target, the satellite could return photographs as quickly as 20 minutes after it had taken them, or as long as five days later.[215]

FROG arose out of a report in January 1966 by the Committee on Overhead Requirements (COMOR), which indicated there was need for quick response satellite imagery and concluded that readout capability for GAMBIT would be a worthwhile investment.[216] In August 1966 the plan was to start formal development in fall 1966, with an initial operational capability in November 1968. Secretary of Defense Melvin Laird approved FROG despite its limited capabilities.[217]

The competing "great leap" concept was an idea that stemmed from the Zoster program initiated by Wheelon focused on digital transmission. By 1968, ZOSTER had been renamed to ZAMAN (which would later become KENNEN). The program was frequently referred to as the "electro-optical imaging" or "EOI" system. The CIA had firmly decided upon this technology and was opposed to the FROG program and any form of film-based readout that the NRO was pursuing. This marked a shift in the traditional fault lines between the CIA and NRO. Whereas most

[213] Day, "Intersections in real time (part I)," 2019, citing: Brockway McMillan, Director, National Reconnaissance Office, Memorandum for the Secretary of Defense, "Quick Reaction Surveillance System," January 11, 1965. QUILL Records, #15.
[214] Day, "Intersections in real time (part I)," 2019.
[215] Day, "Ike's gambit: The KH-8 reconnaissance satellite," 2019; Perry, p. 51.
[216] Perry, p. 38.
[217] Day, "Ike's gambit: The KH-8 reconnaissance satellite," 2019; Perry, p. 51.

discussion of a near-real-time reconnaissance system up to this time had been initiated and propagated by the Air Force and the NRO (beginning with the Samos design as a competitor to CORONA), starting in 1968 the CIA and its advisors became increasingly involved in advancing ZOSTER and EOI technology.[218] This is explained largely by the success of GAMBIT, and the NRO's tradition of sticking with what works.

Once Wheelon had left the agency, the CIA's shift to supporting read-out is largely explained by the vigorous support of Edwin Land. As recounted by Lt. General Lew Allen, an Air Force official who led work in satellites and space systems, "The CIA was not quite so leery [about the idea of a real-time satellite], but their original system thoughts were modest. I believe to a very major degree that it was Land personally who made the big leap."[219] He further specified that "a remarkable aspect of KENNEN history is the awesome effectiveness with which CIA and the Land Panel dedicated themselves to supporting KENNEN once Land made his basic commitment.[220]

Land, a scientist with a background in physics and optics, held a philosophy of "if anything is worth doing, it's worth doing to excess." He told a press interviewer, "My whole life has been spent trying to teach people that intense concentration for hour after hour can bring out in people resources they didn't know they had." He is best known as the inventor and re-inventor of instant

[218] Day, "Intersections in real time (part I)," 2019, citing: Brockway McMillan, Director, National Reconnaissance Office, Memorandum for the Secretary of Defense, "Quick Reaction Surveillance System," January 11, 1965. QUILL Records, #15.
[219] Perry, p. 3. Note: This section of Perry's draft was authored by Lt. General Lew Allen and is titled "Comments on National Reconnaissance History"
[220] Perry, p. 6.

photography from the mid-1940s to the early 1980s. Land had invented the Polaroid camera and acquired an esteemed reputation.[221] Land brought his personality and his philosophy with him into his work on overhead reconnaissance. He was appointed to lead a special long-standing advisory panel to the President's Science Advisor, the Director of Central Intelligence, and the Secretary of Defense—known as the "Land Panel," or the Panel on Overhead Reconnaissance.[222]

In October 1968, the Land Panel had completed its review of technology for real-time readout, delivering a formal report in March 1969. Land reported to President Johnson's Science Adviser Donald F. Hornig that "the necessary technology for a 'see it now' system has become available." Land believed that system development could start in 1969. Land stated that three existing capabilities made it possible to pursue such a system: satellites capable of operating a year or more in orbit, high data rates via satellite-to-satellite relay, and the emerging maturity of electro-optical-imaging technology.[223]

Land had a dim view of the FROG laser-scan system and believed that it was too complex and had limited growth potential.[224] The Land Panel also suggested that the ZAMAN system could take over the GAMBIT film-return mission if it operated lower, in 370- and 185-kilometer orbits, although this would have required the satellite to be equipped with orbit adjust capability.[225] Land asked the well-reputed physicist Richard L. Garwin, a member of the Land Panel, to

[221] "Edwin Herbert Land," in Biographical Memoirs: Volume 77, National Academies Press, 1999, p. 200.
[222] https://thebulletin.org/2007/01/u-s-national-security-and-u-s-governance-2/
[223] Perry, p. 43.
[224] Perry, p. 69.
[225] Perry, pp. 70-71.

oversee a review of the current status of solid-state sensor development. Garwin confirmed that "the solid-state technology is a viable approach and… there is a high probability that a system commitment and choice of detailed approach could be made by December 1969 or by March 1970 at the latest."[226] Overall, at the time, Land believed that a 1974–1975 operational date for ZAMAN was feasible.

Making the case for a "see-it-now" system to Nixon

The Nixon administration's interest in budget cutting extended to casualties among reconnaissance satellite programs. In the early months of the administration, with the exception of Land, there had been little optimism about or enthusiasm for the prospects of any currently conceivable satellite system.[227] In March 1969, Nixon canceled the HEXAGON satellite program in favor of an idea known as the Manned Orbiting Laboratory (MOL) and its DORIAN camera system, which relied on the concept of crewed space stations as reconnaissance satellites. By May 1969, Land wrote Nixon recommending that he cancel MOL and continue development of a very high-resolution camera that exploited DORIAN advances. Land also urged that most reconnaissance R&D be concentrated on near-real-time reconnaissance. He urged the President to start "highest priority" development of a "simple, long-life imaging satellite, using an array of photosensitive elements to convert the image to electrical signals for immediate transmission."[228]

[226] Perry, pp. 53-54.; Day, Dwayne A. "Intersections in real time: the decision to build the KH-11 KENNEN reconnaissance satellite (part 2)," *The Space Review*, 16 September 2019, https://www.thespacereview.com/article/3795/1.
[227] Perry, p. 51.
[228] Perry pp. 52-53.

A few months later Nixon canceled MOL/DORIAN. CIA director Richard Helms also appealed to Nixon on behalf of HEXAGON, and Nixon reinstated the program.

The next three years centered on the debate over the development of a near-real-time reconnaissance satellite at high resolutions, with the technology slowly advancing while U.S. officials disagreed about the best approach. Nixon's newly created Office of Management and Budget was also involved in the deliberations and its leadership was skeptical of the near-term feasibility of ZAMAN. James Schlesinger was then at OMB and represented the office at meetings of the NRO's Executive Committee, also known as ExCom, which was created to establish policy for the NRO and negotiate disputes and was chaired by the Deputy Secretary of Defense. Schlesinger was averse to high-risk technology and early cost estimates for complex systems, and presumably passed on his advice, and his skepticism, to OMB Director Charles Schultze, who expressed his own skepticism to Secretary of Defense David Packard.[229] Both the Director of Defense Research and Engineering, John S. Foster Jr., and Lieutenant General Joseph Carroll, head of the Defense Intelligence Agency agreed that it would be difficult to justify the cost of such a system "if a crisis management situation at some unknown time in the future was its only justification." HEXAGON was still expected to provide the majority of imagery for intelligence purposes.[230]

Land received a chance to make his case for ZAMAN during a June 4, 1971, meeting of the President's Foreign Intelligence Advisory Board (PFIAB), whose members included Land,

[229] Perry, p. 72.
[230] Day, "Intersections in real time (part I)," 2019.

William Baker of Bell Labs, former national security advisor Gordon Gray, and former chairman of the Joint Chiefs General Maxwell Taylor. Usually Henry Kissinger and his deputy attended, representing the President. But this meeting also drew Nixon himself, along with Schlesinger. At the meeting, Land told Nixon that FROG would be "the cautious choice," whereas the "adventurous choice, and one which would be a quantum technical advance, is to push the development of an electronic imaging system which can be read out through a relay satellite while the sensor is over the target." Nixon promised to take a hard look at the issue.[231]

Another relevant factor was Senator Allen J. Ellender, Chairman of the Senate Committee on Appropriations, informally advised Secretary Packard that he saw no need to develop both ZAMAN and FROG.[232] The CIA was reportedly instrumental in bringing Ellender to this view, as well as eliciting his support, however tepid, for ZAMAN over FROG.[233]

Under Perry's assessment, together, Ellender and Land made the ultimate difference in swaying the President to choose ZAMAN over FROG. He writes, "That reversal of position resulted from the CIA's skillful shepherding of Ellender's interests and Land's complete understanding of President Nixon's desire to be remembered as a more forceful, incisive, and astute decision maker than his immediate predecessors. Land's appeal to executive insight and his slighting of bureaucrats was a masterstroke."[234]

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[231] Day, "Intersections in real time (part II)," 2019, citing: Oder, Fitzpatrick, Worthman, The GAMBIT Story, p. 92; Memorandum for the President's File, Subject: President's Foreign Intelligence Advisory Board, Meeting with the President, June 4, 1971.
[232] Perry, p. 102.
[233] Perry, p. 104.
[234] Perry, p. 104.

Because the need for FROG was premised on an urgent need for timely, high-resolution imagery, one factor that made a big difference was the successful deployment of HEXAGON in 1972. Secretary of Defense Laird ultimately backed away from the earlier FROG decision and informed Nixon that the ExCom had decided to develop ZAMAN for a 1976 operational date, but at a different spending rate. He stated that now that HEXAGON was available—the first successful HEXAGON mission had taken place in June 1971—it negated any need for early readout capability, and the best course was to proceed toward ZAMAN operation in 1976.[235]

Finally, in a September 23 Top Secret classified memo from Kissinger to Laird, Helms, OMB director George Shultz, Eugene David, and PFIAB chairman Admiral George Anderson, Kissinger informed them that Nixon had "decided that the development of the Electro-Optical Imaging (EOI) system should be undertaken under a realistic funding program with a view towards achieving an operational capability in 1976." At the same time, he directed that all work on FROG should cease.[236]

The program name KENNEN was chosen, a Middle English term meaning "*to perceive*." The KENNEN satellite would operate alongside HEXAGON and GAMBIT for several years.[237] On

[235] Perry, p. 121.
[236] Day, "Intersections in real time (part II)," 2019, citing: Oder, Fitzpatrick, Worthman, The GAMBIT Story, pp. 92, 185; Henry A. Kissinger, Memorandum, Subject: Near-Real-Time Satellite Reconnaissance System, September 23, 1971.
[237] Richelson, 1990, p. 134.

October 18, 1984, when the last KH-9 mission concluded, KENNEN would become America's lone model of photographic reconnaissance satellite until December 2, 1988.[238]

Combining search and surveillance with close-look in near-real-time

The KENNEN satellite is believed to resemble the Hubble Space Telescope in size and shape, as the satellites were shipped in similar containers. Their length is believed to be about 19.5 meters, with a diameter of up to 3 meters.[239] Its weight is estimated to be around 13.6 metric tons.[240] These basic specifications are believed to have persisted throughout the time period of this case study, with only minor modifications being made to sensors and other equipment.[241]

KENNEN's imaging system consisted of four essential parts: (1) a powerful mirror telescope, (2) an infrared scanner, (3) a sperate sensor electronics package (which contains a photomultiplier tube, thematic mapper, multispectral scanner and appropriate mirrors and prisms), and (4) an array of charge-coupled devices or CCDs linked to each other to form a mosaic. The telescope brings in radiated energy at great magnification. That energy can then be directed to any of the sensors, depending upon tasking requirements, so that it is broken down according to whichever part of the electromagnetic spectral band is wanted for analysis.[242] Another key to KENNEN's ability to produce high-quality images was its computer. About the size of a VCR, the computer

[238] Richelson, Jeffrey. *The US Intelligence Community*. Boulder: Westview Press, 2008, pp. 177-178.
[239] Burrow, William, E. *Deep Black: Space Espionage and National Security*, New York: Random House, 1986, p. 247.
[240] Richelson, 1990, p. 129, citing Wilford, John Noble, "Spy Satellite Reportedly Aided in Shuttle Flight," New York Times, October 20, 1981, p. C4.
[241] Ibid.
[242] Burrows, pp. 245-246.

maintained the satellite in a stable position, pointed the mirror, and obtained images of desired targets.[243]

The CCDs allowed KENNEN to collect and transmit imagery in real-time. They acted as an extremely small, extremely precise light meter, capturing radiated energy emissions across the visible and invisible bands of the electromagnetic spectrum that can then be amplified and converted into photographs.[244] The technology originated at Bell Telephone Laboratories in the late 1960s when researchers sought to invent a new type of memory circuit. It became apparent that the tiny chip of semiconducting silicon that they first demonstrated in 1970 had other applications, including signal processing and imaging, given that silicon responds to visible light.[245]

The KH-11's optical system scanned its target in long, narrow strips and focuses the light onto an array of CCDs with several thousand elements. The light falling on each CCD during a short, fixed period of time is then transformed into a proportional amount of electric charge. In turn, the electrical charge is read off and fed into an amplifier., which converts the current into whole number between 0 and 256. The number represents a shade of color ranging from pure black to pure white. Each picture is therefore transmitted as a string of numbers.[246]

[243] Richelson, 1990, p. 131.
[244] Richelson, 1990, p. 130.
[245] Richelson, 1990, p. 129.
[246] Richelson, 1990, p. 129.

An image capture was a product of intricate coordination among these components. Night preparations for a missile launch at Plesetsk, for example, might call for the use of the infrared scanner. The telescope would draw in all the radiated energy coming from the scene but routing the image to the infrared scanner would automatically filter out energy on all wavelengths but infrared. The infrared imagery would pass through the scanner and register on the CCD array to form a moving infrared picture, which would then be amplified, digitized, encrypted, and transmitted up to one of the SDS spacecraft or another type for downloading to Fort Belvoir.[247]

KENNEN's design also required a quality mirror associated with the telescope. Without a good mirror system in front of them, even high-quality CCDs would produce images with poor resolution. Observers have inferred that the KH-11's primary mirror is most likely on the order of two meters wide. Based on this, its secondary mirror is calculated to be about 30 centimeters. The telescope itself is believed to be plugged into a two-position zoom lens, giving it both area-surveillance and close-look capability.[248]

KENNAN also came with the novel ability to capture images in low-light in a new way. It would combine the capabilities of the infrared scanner with a photomultiplier to capture clear images in the dark of night. Photomultipliers used in combination with CCDs are employed in astronomy to count photons, even at levels so low that they come in at a rate of only about one a minute (by comparison, an automobile's headlight generate many trillions of photons a second). But a photomultiplier alone would not be able to complete the task on KENNAN. Given that the

[247] Burrows, pp. 245-246.
[248] Burrows, p. 247; Richelson, 1990, p. 131.

satellite passed over or near its targets in about one-minute, pervasive darkness would make it difficult to pick up imagery with a photomultiplier. Using the photomultiplier together with the infrared scanner, KENNEN could provide imagery of objects such as darkened buildings. This was made possible by the fact that on Earth, there is always a certain level of light from the moon or galaxy that can be harnessed.[249]

Together, KENNEN's technology advancements would translate to ultra-high resolutions that would eventually make the United States' highest resolution satellite at the time, GAMBIT, obsolete. Dr. Jerry Nelson, a professor of astronomy at the Lawrence Berkeley Laboratory in San Francisco calculated that the theoretical limit of the resolution of the system is two inches in the visible light part of the spectrum, including night imaging with the photomultiplier, and somewhat more than that for the invisible bands. [250] These capabilities would be slightly reduced by atmospheric effects. Analysts have also inferred the resolution of KENNEN based on provisions developed under SALT II. The text stipulated that ICBMs could not be altered in length, diameter, launch weight, or throw weight (the size of their payloads) by more than 5 percent. This would have to apply to the smallest of the Kremlin's long-range missiles as well as the largest. The smallest Soviet ICBM at the time SALT II was concluded was the SS-11, a three-stage MIRV-ed missile that was sixty-four feet long and six feet in diameter. Five percent of six feet is 3.6 inches. Analysts thus believe that KENNEN's resolution must have at least been good enough in the visible light spectrum to enable the United States to spot a widening of the SS-11 by 5% or more. This closely matches Nelson's calculation.[251]

[249] Burrows, p. 246.
[250] Burrows, p. 248.
[251] Burrows, p. 248.

The resolution of KENNEN can also be inferred from images leaked to the public. One image was a 1984 computer-enhanced KENNEN image leaked to Jane's Defence Weekly by naval intelligence analyst, Samuel Loring Morison (**Figure 1.10**). The image shows the general layout of the Nikolayev 444 shipyard in the Black Sea. Under construction is a Kiev-class aircraft carrier (shown in the left side of the photo), then known as the Kharkov, along with an amphibious landing ship. Morison was brought to trial, convicted, and sent to prison in a controversial case.[252] The most recent suspected leak is a 2019 image posted by President Donald Trump via Twitter (**Figure 1.11**). Marco Langbroek, a satellite-tracker based in the Netherlands, calculated the position and capture angle of a current KENNEN satellite based on its orbit information. The match in capture angles appears to confirm that the satellite did indeed capture the leaked image.[253]

[252] Richelson, Jeffrey, "U.S. Satellite Imagery, 1960-1999," National Security Archive Electronic Briefing Book No. 13, George Washington University, https://nsarchive2.gwu.edu/NSAEBB/NSAEBB13/index.html

[253] Brumfiel, Geoff, "Amateurs Identify U.S. Spy Satellite Behind President Trump's Tweet," 2 September 2019, National Public Radio, https://www.npr.org/2019/09/02/756673481/amateurs-identify-u-s-spy-satellite-behind-president-trumps-tweet

KENNEN	HEXAGON
Resolution: 0.07 meters Mission length: 730 Capture: Digital	Resolution: 0.6-0.9 meters Mission length: 124 days Film load: 1,350 lbs
CORONA KH-4B	**GAMBIT KH-8**
Resolution: 1.09 meters Mission length: 25 days Film load: 80 lbs	Resolution: 0.1 meters Mission length: 30 days Film load: 52 lbs

Table 1.3. Technical specifications for KENNEN compared to the latest generations of HEXAGON, CORONA and GAMBIT satellites[254]

Supporting systems and ground-station network

As the first digital satellite for the United States, KENNAN was the first to work with a concert of electronic support equipment, including a communications satellite and a ground support network. In the late 1960s, the CIA was researching technology to develop a satellite with the capability to send imagery electronically to a ground station. One issue was how to store the imagery on the satellite and to then transmit it. If the satellite could only transmit the images while in view of a ground station, this would dramatically limit how many images could be sent each day. The solution they came up with was to look upward, instead of down. Rather than transmit signals directly down to the ground, the imagery satellite could send them upward to a communications relay satellite in a much higher orbit, and that satellite could relay the images to the ground. The approach would significantly increase available transmission time to the ground.

[254] "HEXAGON, America's Eyes in Space." Center for the Study of National Reconnaissance, September 2011. https://web.archive.org/web/20120916090954/http://www.nro.gov/history/csnr/gambhex/Docs/Hex_fact_sheet.pdf.

The communications satellite was ultimately named the Satellite Data System (SDS), and it was first launched in 1976. Two or three SDS satellites would operate at any given time. Once the visible light had been collected and transformed into an electric charge, the signals would then be transmitted to an SDS satellite. It could then send data to a distant ground station, even as KENNEN was capturing images on the other side of the planet.[255]

The SDS satellite would transmit the data to another component of the KENNAN support system: the ground support network. The SDS satellite transmitted KENNAN signals for initial processing to a ground station at Fort Belvoir, Virginia, about 20 miles south of Washington. The Mission Ground Site was officially the Defense Communications Electronics Evaluation and Testing Activity.[256] Another component of the KH-11 ground network is the Air Force Satellite Control Facility (renamed HQ, Consolidated Satellite Test Center in 1987). This was actually comprised of a number of Remote Tracking Stations located around the world. In 1976, the Remote Tracking Stations that made up the Air Force Satellite Control were located at Vandenberg Air Force Base, California; New Boston Air Force Station, New Hampshire; Thule Air Base, Greenland; Mahe Islands, Seychelles; Anderson AFB, Guam; and Kaena Point, Hawaii. Oakhanger, England served as an operating location.[257]

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[255] Dwayne A. Day, "Shadow dancing: the Satellite Data System," The Space Review, 26 February 2018. https://www.thespacereview.com/article/3440/1; Jeffrey Richelson, "*The Satellite Data System*," Journal of the British Interplanetary Society, 37,5 (1984), pp. 226-28.

[256] Richelson, 1990, p. 131, citing John Pike, "Reagan Prepares for War in Outer Space," CounterSpy, 7, 1 September-November 1982, pp. 17-22; James Bamford, "America's Supersecret Eyes in Space," The New York Times Magazine, January 13, 1985, pp. 39ff, as cited in

[257] Richelson, 1990, p. 131, citing Organization and Functions Chart Book, Air Force Satellite Control Facility, (Onizuka AFS, California: AFSCF, 1987), pp. 19-20.

Achieving yearlong satellite coverage

KENNEN's mission life would be much longer than its predecessors. The first satellite would remain in orbit for over two years, or 770 days to be exact. This was 509 days longer than its longest-lived predecessor, a HEXAGON satellite. This was due in part to its electronic method of transmitting data. KENNEN was not limited, as were its predecessors, by the amount of film that could be carried on board. The satellite also had a much higher orbit, which reduced atmospheric drag that would wear down components.[258] The second satellite of the KENNEN series was launched on June 14, 1978 and functioned for 1,166 days. The third was launched on February 7, 1980, had a lifetime of 993 days. A fourth KENNEN was sent up on September 3, 1981 (1,175-day mission life), and a fifth, on November 17, 1982 (987-day mission life). A sixth satellite, sent up on December 4, 1984, stayed in orbit until November 10, 1994, setting a new record for mission lifetime with 3,628 days. The seventh satellite, which had been intended to replace one of its aging predecessors, was lost on August 28, 1985, when its Titan 34D booster had a partial power failure just short of two minutes after lift-off.[259] This was replaced by an eighth launch on October 26, 1987 – that satellite, the last in the period of this case study (though not the last of the KENNEN series overall), would stay in orbit until June 11, 1992, for a lifetime of 1,690 days.[260]

These longer mission lives would significantly improve the continuity of coverage. Whereas under HEXAGON, there was no coverage for up to 117 days per year, under KENNEN the

[258] Richelson, 1990, p. 132.; Burrows, p. 227.
[259] Burrows, p. 249.
[260] Visual Satellite Observer's Homepage, http://satobs.org/seesat_ref/misc/KH-11_lifetime.pdf

United States reached full-year, 365-day coverage by 1977.[261] Since 1981, a pattern had been established in which two KH-11s were maintained in orbit, and when one was deorbited, it was replaced shortly thereafter by a new KH-11. The satellite replacing the deorbited satellite was then launched and made a few maneuvers to get the same period and desired plane spacing with the other. After this, joint operations began, with one satellite providing late-morning coverage and the other giving afternoon coverage. The combination of viewing angles produced was seen as a substantial aid in interpreting the images.[262]

KENNEN's operational capabilities gave a new agility to monitoring efforts. The inclination of the satellites, approximately 97 degrees, meant they flew in a sun-synchronous orbit, so that the sun angle was the same each time the satellite was over a target.[263] The satellite's downward-looking mirror could be flipped from side to side, allowing the area under observation to be changed from moment to moment. This expanded the menu of targets to not only the areas under the spacecraft but to the sides and for hundreds of miles in front. In addition to expanding the intelligence community's ability to monitor a given target, analysts believed it would complicate foreign denial and deception activities.[264]

This chapter has made the case that the path to KENNEN was not inevitable. The opportunity to make more modest technology design choices that might have directed the United States more

[261] Burrows, p. 242.
[262] Richelson, 1990, pp. 205-206, citing personal correspondence with Anthony Kenden.
[263] Vickers, Robert. "The History of CIA's Office of Strategic Research, 1967–81." Center for the Study of Intelligence, 2019. Central Intelligence Agency, p. 91.
[264] Richelson, Jeffrey. *The US Intelligence Community, Fifth Edition*. Philadelphia: Westview Press, 2008, pp. 178-179.

toward the temporal initiative arose from the beginning of the satellite age. Once satellites became a reality, the majority of the U.S. bureaucracy, and even a large segment of the science and engineering community, preferred to keep developing CORONA systems rather than invest in the leaps toward HEXAGON and KENNEN. Factors like the CIA's organizational culture of prizing cutting-edge technological solutions together with the visions of unrelenting individuals like Albert Wheelon and Edwin Land were instrumental in bringing to bear an intelligence environment characterized by the combination of high-resolution information together with uncertainty in the form of the temporal blind spot.

[Image removed due to copyright concerns]

Figure 1.10. A 1984 computer enhanced KH-11 photo leaked to Jane's Defence Weekly by naval intelligence analyst, Samuel Loring Morison. The image shows the general layout of the Nikolayev 444 shipyard in the Black Sea. Under construction is a Kiev-class aircraft carrier (shown in the left side of the photo), then known as the Kharkov, along with an amphibious landing ship. Morison was brought to trial, convicted, and sent to prison in a controversial case.[265]

[265] Richelson, Jeffrey, "U.S. Satellite Imagery, 1960-1999," National Security Archive Electronic Briefing Book No. 13, George Washington University, https://nsarchive2.gwu.edu/NSAEBB/NSAEBB13/index.html

[Image removed due to copyright concerns]

Figure 1.11. An image suspected to have been captured by a modern KENNEN satellite released by President Donald Trump via Twitter in 2019.

Chapter 2: Intelligence Foundations of Information and Uncertainty: The Practices and "Stories" of Imagery Analysts

Blind spots were interpreted not as neutral uncertainties, but as spaces where the Soviets "might be" doing something that would harm U.S. national security. The interpretation of satellite images as what "might be" is a legacy not of the military's interest in nuclear superiority, nor its advocacy for additional funding. Instead, this research shows that the practice arose from the analysts who interpreted satellite photos.

This chapter is thus dedicated to explaining the role and influence of the community of imagery analysts within the CIA's National Photographic Interpretation Center (NPIC). Without the benefit of computer memories, the analysts held a tradition of telling "stories" within an organizational culture of meritocracy that rewarded the richest and most detailed accounts. As imagery resolution improved and the volume of imagery expanded, this tradition of storytelling would persist and intensify; stories would become increasingly focused on and intertwined with the bigger strategic picture and issues of superiority in ways that contributed to strengthening arguments for modernization. This process is examined in three sections under the satellite programs of CORONA and GAMBIT, followed by HEXAGON, and finally by KENNEN.

CORONA and GAMBIT

As the first hands to receive, analyze and present information gathered from satellites, the intelligence community has played a foundational and often unacknowledged role in the process of domestic decision-making about nuclear cooperation, competition, and arms control. One

organization established just months after CORONA's first successful mission that would become part of the fabric of nuclear policy making and arms control was the National Photographic Interpretation Center (NPIC). The Center was established in January 1961 and led by the CIA. New information from satellites was used to facilitate agreement within the intelligence community on existing numbers of nuclear weapons and helped provide a basis to argue that arms control could be verified. Still, disagreement about the future and intentions remained, and the lingering temporal blind spot was used to sew doubt over the ability to track upgrades and modernization, thus contributing to the decisions to invest in new U.S. nuclear weapon programs.

While the NPIC started small, it quickly gained momentum. The group began as thirteen people under the leadership of Arthur Lundahl, regarded by historians as the person who at the time "new more about photo-interpretation that anyone in the United States."[266] He had combined his background in geology and his hobby as a photographer to become an expert imagery analyst during World War II. Lundahl firmly believed in the value of imagery analysis as a tradecraft to mitigate the effects of Soviet secrecy. He therefore designed the new group with a vision that it would eventually become a national center. As someone who understood how inter-service rivalry could limit the effectiveness of imagery information, Lundahl designed the skeleton of the group to avoid these divisions, and to strive for the elusive ideal of neutrality through joint staffing and management that blended the CIA with the military services. He lobbied for a large facility due to the space needs associated with the equipment for photo-interpreters, such as light tables, film storage, and a photo lab. Due to these space needs as well as the desire to remain

[266] O'Connor, pp. 23-24.

covert, from its inception, the group would be situated far from the CIA's main campus at Langley. The space was a decrepit building over a Ford dealership, known as the Steuart Building at 5th and K Street, N.W. in Washington, D.C. At the height of the U-2 program, the group at Steuart grew to 150 interpreters.[267] Under the satellite programs and as the NPIC, it would grow to about 1,300 employees.[268]

The methods, practices and culture that grew within the NPIC would have a key role in the origins and evolution of the arms control imaginary. During his last month in office, the debate over who would run the new photo-reconnaissance center (the CIA or the military services), came to Eisenhower's desk. His choice to have the NPIC be civilian-run and led by the CIA was based on the idea, advocated by Kistiakowsky, that interpreters should be careerists – people with scientific backgrounds who would learn the new language of imagery which could take years of experience to master, whereas military personnel would constantly rotate.[269] Indeed, as satellite programs advanced, Lundahl fostered a culture of meritocracy and encouraged ideas about mastery that shaped the practices of workers.

NPIC photo-interpreters would deal with the growing volume of information in two unique ways central to events that would follow – the practices were known as "shoeboxes" and "stories." Each interpreter would keep copies of photos of important targets for reference, or for unknowns and ongoing activity, within wooden boxes designed to hold five by eight-inch index cards. Next to this, analysts developed and shared "stories." Because computer memory was so expensive

[267] Richelson 2001, p. 29.
[268] O'Connor, "Introduction."
[269] Richelson 1990, pp. 63-64.

and unreliable, the database of information was held in the memories of the interpreters. Given that most of their time was spent in the process of looking at film on light tables and that time for producing the hand-written reports that would later be typed by secretaries was limited, the interpreters communicated among themselves by telling and retelling the stories of "finds" and "calls" on different missions. NPIC kept a database, but there was no way to query it. The skills of storytelling, remembering details precisely, and combining the photographs with the narrative of what changed over time became valued, together with the skill of telling these stories to U.S. leaders and policymakers. The NPIC thus developed a strong culture of meritocracy, prizing the best searchers and the best storytellers. [270]

Being a good briefer was an unwritten expectation for every new photo-interpreter in ways that were reinforced throughout the entire organization. When a mission came in, any significant find or call would be briefed to their peers, senior analysts, section chiefs, branch managers, and their division, and to Lundahl. In this briefing, it was not enough to interpret the photograph correctly. The interpreter was also expected to know the context surrounding the issue, the history of any previous activity in the area, and how the call or find changed their collective understanding of the intelligence problem. This format was learned by analysts from Lundahl, who briefed the president and Congress using this approach.[271]

The desire of NPIC analysts to be lauded for good storytelling went together with fears of getting the story wrong. In one instance, an imagery analyst built an elaborate theory about how some

[270] O'Connor, p. 65, 69.
[271] O'Connor, p. 66.

circular objects were evidence of rocket motors related to a certain missile system. The theory, if it could be proven, would have compelled the intelligence community to change how it thought about the weapon system. When an image with better interpretability was collected confirming the objects were a pile of discarded tires, NPIC therefore bestowed the analyst with the nickname "Mr. Firestone."[272] The sense of investment and caution is evident in recollections from managers and analysts of the time. Dino Brugioni, a senior manager at the NPIC during the CORONA program, recalled,

> *"Each day and each frame of film was a most rewarding adventure and satellite imagery became the most valuable intelligence source of physical information. We knew that our interpretation analysis had to be precise because we knew we were only a few steps away from the president, his policymakers, and Congress."*[273]

David Doyle, an imagery analyst and manager at NPIC described,

> *"The intensity of your analysis was the big variable. You took a difficult situation and you could spend literally weeks going over a couple frames of imagery if you were really looking for very, very subtle signatures. Other times, you could do many frames of imagery in a day if you were just looking for growths, such as new road construction..."*[274]

Over time, imagery resolution became increasingly central to NPIC's workflow and the goals of the organization. At first, the CORONA program was deemed essential for finding the disparate components of the Soviet nuclear missile program, a task which was placed at the center of the NPIC's agenda. Slowly at first, but then steadily, their locations were found, identified, and

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[272] O'Connor, pp. 107-108.
[273] Day, Dwayne A., John M. Logsdon, and Brian Latell. *Eye In the Sky: The Story of the Corona Spy Satellites.* Washington, D.C.: Smithsonian Institution Press, 1998, p. 220.
[274] Day et. al., p. 223.

plotted. By March 1964, the CORONA satellite had photographed 23 of the 25 Soviet ICBM complexes in existence; three months later it had photographed all of them." By 1968, the US intelligence community would write: "No new ICBM complexes have been established in the USSR during the past year."[275]

After determining the locations of the Soviet strategic force, imagery analysts would transition to using the higher-resolution imagery to address questions of function, operation, and parts of the weapon system. This period required more search and better resolution. Patterns began to emerge, and recognition turned into understanding. Photo interpreters began to associate which missile systems came from which test centers. Characterization of sites turned from possible to probable, and from probable to confirmed. With this, the comprehension of the Soviet strategic order of battle began to take shape.[276]

NPIC's growing value of high-resolution imagery transformed some of its practices in vivid ways that would extend the Center's growing focus on qualitative weapon attributes to other areas of the government. For example, after the GAMBIT KH-7 and KH-8 satellites were operational, NPIC missile analysts, Lt. John Merritt and Lou Kress, studied how the Soviet Union assembled missile silos until they could anticipate – based on silo components alone – the missile system that would be associated with a silo while it was still under construction. In the late 1960s, these analysts published a detailed report that chronicled the construction sequence and the number and kind of components. For photo interpreters, this reporting was a significant

[275] O'Connor, p. 67.
[276] O'Connor, p. 67.

step. Along with the report, the NPIC model shop build an SS-9 silo model, a Soviet heavy ICBM of concern to the United States for its perceived design to attack American Minuteman ICBM launch control centers, which at the time were a significant vulnerability of the Minuteman system.[277] The SS-9 toy model was used in more than 120 briefings, wherein the NPIC analysts would assemble the silo model from scratch, as they had seen and measured enough components from satellite imagery to correctly infer how it was assembled. The model, the report, and the briefings by these two interpreters contributed to convincing the intelligence community leadership and policymakers that NPIC could monitor the Soviet strategic missile silos with enough confidence to know if the Soviets were trying to change them.[278]

NPIC's focus on qualitative weapon capabilities and its value of high-resolution imagery also influenced the course of satellite technology innovation toward increasingly higher resolutions in accordance with the resolution initiative. Scientists and engineers, including the camera designers at Itek and Perkin Elmer and the satellite manufacturers at General Electric, Lockheed, and Martin Aircraft would visit NPIC, and the interpreters would brief them on the current intelligence they obtained from their technology. As O'Connor describes, "Lundahl's relationship with the manufacturers enabled NPIC's photo interpreters to directly influence future systems and reinforced the expectation that NPIC interpreters needed to understand the collection technology, its operational and technical limitations, and the criticality of teaching developers from actual examples."[279] NPIC's establishment and evolution in the wake of the first

[277] "R-36/SS-9 Scarp," Federation of American Scientists, https://fas.org/nuke/guide/russia/icbm/r-36.htm.
[278] O'Connor, p. 68.
[279] O'Connor, p. 63.

imaging satellites played a significant role in centering the intelligence and policy community on qualitative capabilities of weapons gleaned from GAMBIT's high-resolution imagery. Already by January 1964, NPIC's photo-interpreters were pushing toward more imagery with higher resolutions in ways that would continue and intensify the analytic and storytelling practices that were burgeoning during this period.[280]

[280] O'Connor, p. 68.

[Image removed due to copyright concern]

Figure 2.1. An early Richards tiltable light table with hand cranks used by NPIC analysts. *Photo credit: National Geospatial Agency.*

[Images removed due to copyright concern]

Figure 2.2. Left: 7-X tube magnifier, one of the principal photo-interpretation tools for the aircraft and KH-4 search mission. Right: Film cans. *Photo credit: National Geospatial Agency.*

Transformation of uncertainty

NPIC's work was also instrumental in establishing confidence in the ability to monitor and verify Soviet nuclear forces in the context of arms control. One step was the gradual convergence of disparate estimates of Soviet forces that existed throughout the intelligence community prior to the use of satellites. Because missile sites were such a high priority, the imagery was distributed not only to NPIC, but also to the Air Force, Navy and Army, so that each organization ended up conducting competing analyses.[281] As one of the primary supporters of the purported "missile gap," The Air Force insisted that the Soviets had deployed as many as 100 ICBMs and that these sites simply had not been overflown by the U-2. The CIA, Army and Navy, however doubted that any had been deployed, because none could be found.[282]

Coverage advances in the shift from the U-2 to CORONA provided more comprehensive coverage, with analysts disproving the missile gap and solidifying a systematic capability for detecting the presence or absence of a weapon system. By 1961, estimates that the Soviets had 50 to 200 ICBMs were revised down to 10 to 25 based on CORONA imagery.[283] As seen in **Figure 2.3**, after the successful launch of CORONA, the U.S. intelligence community was able to discern that the perceived missile gap did not exist. This is evident in the sharp downward revision of estimates from early to late 1961. In the years that would follow, CORONA would prove sufficient to detect the early emergence of new Soviet weapon systems, such as

[281] James Q. Reber, "Minutes of COMOR Meeting," 13 September 1960 (in Ruffner, 1995).
[282] Pedlow and Welzenbach, *The CIA and the U-2 Program*, p. 167.
[283] Day, D.A., J.M. Logsdon, and B. Latell. *Eye in the Sky: The Story of the Corona Spy Satellites*. History of Aviation Series. Smithsonian Institution Press, 1998, p. 217.

submarines and ABMs. The problem of divergent estimates further improved with the introduction of GAMBIT. **Figure 2.3** also shows how as satellites improved with the next iteration of CORONA, there was still some disagreement between the CIA and the Air Force. This changed from 1965 onward with the introduction of GAMBIT, when the CIA and Air Force began to consistently agree on estimates for present levels of launchers in the Soviet Union. The pattern of agreement over present levels persists throughout the decade as further improved versions of the satellites were deployed.

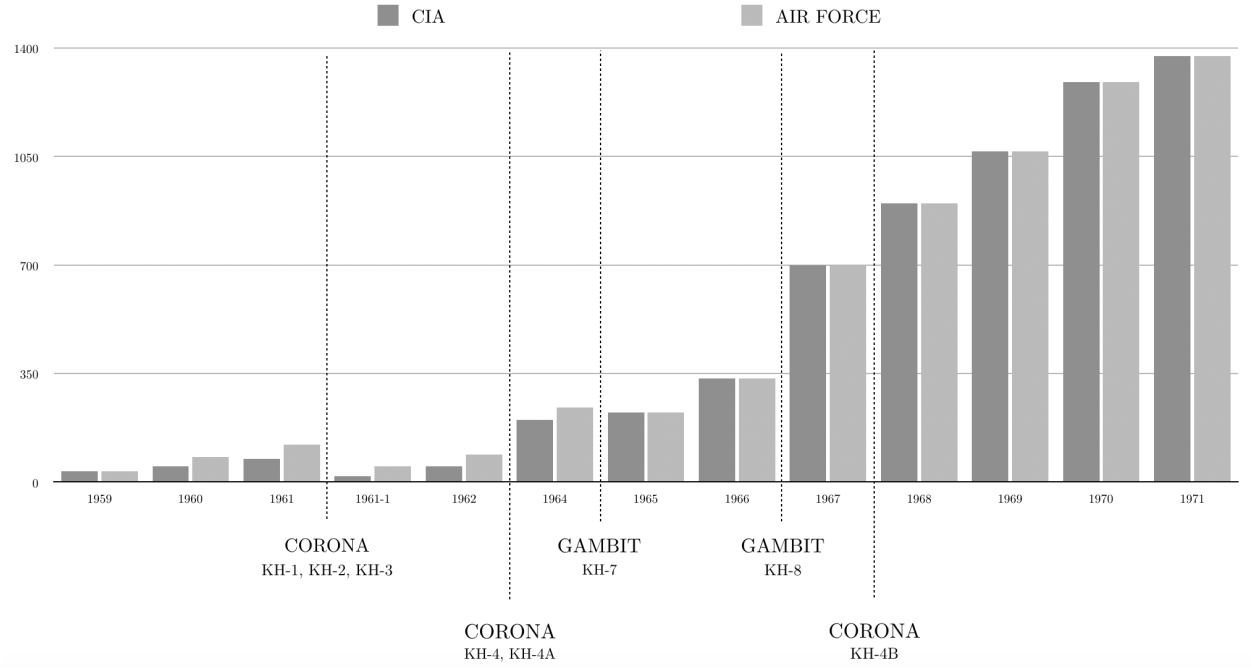

Figure 2.3. Yearly present-level estimates of Soviet silo-launchers of ICBMs by the Central Intelligence Agency and the U.S. Air Force from 1969 to 1971. *Source: National Intelligence Estimates, Central Intelligence Agency.*

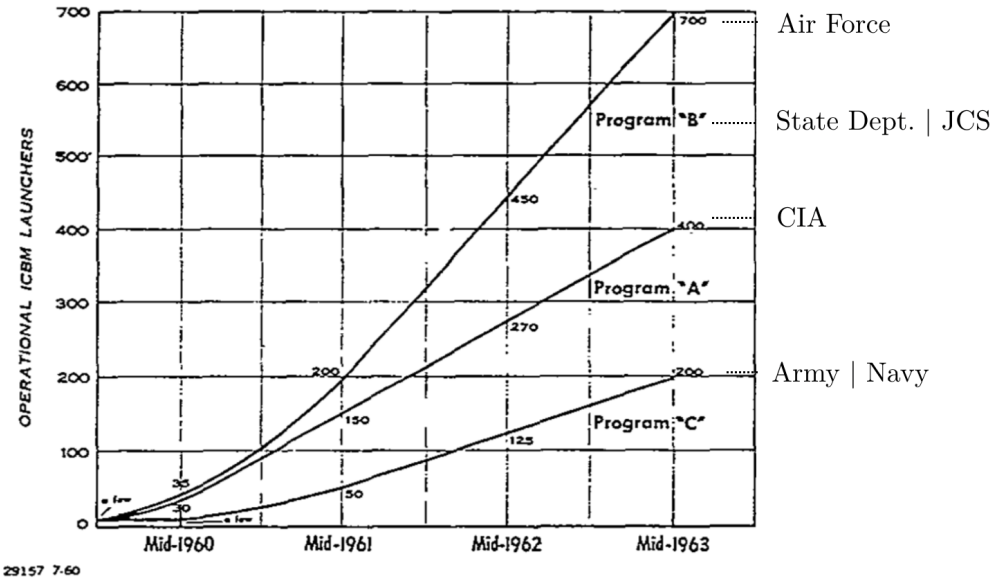

Figure 2.4. Illustration of organizational views of future/projected Soviet nuclear force development before the introduction of satellite imagery. *Source: National Intelligence Estimate 11-8-60 on Soviet Capabilities for Long Range Attack Through Mid-1965.*

As agreement over present levels of forces emerged in the intelligence community, the process was also reshaping uncertainty from being about the present to being about the future. Indications of this pattern began to emerge after the first CORONA images. Despite agreement on existing levels of forces, severe interagency differences remained in estimating Soviet intentions and likely courses of action in the future. **Figure 2.4** from November 1960, three months after the first CORONA imagery batch, shows the numbers of Soviet forces anticipated, and the drastic differences between what the Air Force expected and the more mid-line argument of the CIA and others. The chart indicates the beginning of the persistent issue that imagery could only ever prove current forces but that future forces would always be open to interpretation and uncertainty.

Remaining uncertainty in the form of the temporal blind spot was particularly instrumental in focusing attention on the risk of Soviet qualitative upgrades. CORONA and GAMBIT brought about a capability to detect weapon systems and to provide comprehensive counts, but imagery collection was still infrequent enough that qualitative changes could conceivably occur unnoticed in-between satellite imaging captures or missions. In effect, obtaining the information that could have been used to facilitate disarmament verification actually prompted a new set of concerns tied to strategic competition, as explored in the case studies of this research. Examples of new concerns cited by the intelligence community in their reporting included uncertainty over ICBM upgrades or substitution, adding multiple-independently targetable reentry vehicles (MIRVs) to missiles, and upgrading conventional surface-to-air missiles sites to anti-ballistic missile systems (ABMs).

This pattern would continue as preparations for SALT I became more concrete. A study of verification in September 1969 by the National Security Council Staff showed the most uncertainty about verification capabilities in areas that would be affected by the remaining temporal blind spot in satellite coverage. **Figure 2.5** shows the scale of uncertainty across weapon systems reflected in this report, including over land-mobile missiles, the potential of upgrades or substitutions for missiles, accuracy improvements, and upgrading surface-to-air missile sites to anti-ballistic missile capabilities. This uncertainty about qualitative upgrades connected to the temporal blind spot would be invoked in debates over individual weapon systems in SALT domestic debates as examined in the case studies.

For Land Mobile MR/IRBM and ICBM Launchers
If banned:
- with normal Soviet practices, we would detect deployments within 100 after 200 had been deployed.
- we would detect a clandestine build-up of fewer than 200–300 missiles if Soviets exercised force.
- Soviets could conceal 200–300 mobiles if they did not exercise force.

If limited:
- for limits on the order of 200, the Soviets might exceed permitted force by 200–400.
- for limits on the order of 1000–1500, Soviets probably could not exceed that by more than 500 and remain undetected.

For the Deployment of Additional Fixed Offensive Missile Launchers
- 100 illegal launchers might go undetected.
- 100–200 illegal launchers might not be detected until first few were operational.
- OSD/JCS doubt "suspicious new activity on large scale … could be positively identified as missile deployment if concealed under buildings or in mines.

For the Potential Upgrades or Substitutions | No real confidence on the detection of the installation of ICBMs into MR/IRBM Launchers; Soviets might be able to substitute SS–9s for SS–7s without US detection

For the Development of New Strategic Missiles
For ICBMs | State/CIA/ACDA believe we can confidently monitor ban on the development of a new ICBM. OSD/JCS disagree, believing Soviets could double missile payload and improve accuracy without our knowing it.
SLBMs and MR/IRBMs | Chances are "about even" that we would detect clandestine development of a new MR/IRBM or SLBM.

For Accuracy Improvements | (other than by changing re-entry vehicle shape) Virtually impossible to determine that the Soviets were improving accuracy through guidance system improvements.

MIRVs | State/CIA/ACDA believe we can monitor Soviet MIRV developments even if the Soviets do it clandestinely. OSD/JCS do not believe we can confidently monitor a MIRV test ban. OSD/JCS believe bans on multiple payloads in space and exoatmospheric penaid testing are mandatory collateral restrictions. State/ACDA/CIA believe these are desirable but not mandatory.

ABMs | Mobile Launchers - 100–150 mobile ABM launchers might escape detection for several years. (OSD/JCS believe the number could be substantially higher.)

Reload Capability | Might escape detection.

Radars | Disagreement over whether a clandestine ABM radar program could be detected. State/ACDA/CIA believe problems of radar deployment, operation so complex that we would detect large scale 5–10 clandestine radar program. OSD and JCS believe implementing a clandestine radar program is not as complex and difficult as State/ACDA/CIA believe.

Upgrading SAMs to ABMs | Upgrading SAM systems to give them some form of limited ABM capability … primarily through netting with existing ABM radars would be difficult if not impossible to determine. OSD/JCS believe Soviets could deploy clandestinely 5–10 new acquisition radars and take other actions to allow "covert deployment of a limited ABM capability."

Limiting ABM-associated Radars | State/ACDA believe a limit on number of ABM-associated radars is a mandatory collateral restriction to an ABM launcher limit. JCS believe that because it is not possible to differentiate unambiguously among radar types, an effective ABM radar limit is not practical.

Ballistic Missile Launchers/Submarines | Under conditions of maximum concealment, State/CIA/ACDA believe an illegal increase of 5–10 submarines could be detected within a year and certainly would be detected in a two-year period. JCS/OSD believe this assessment is optimistic and that we do not know what size of illegal increase or what period of time would be required for detection.

Figure 2.5. Findings of a Verification Panel Report presumed to be compiled by the verification working group. [284]

[284] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.

HEXAGON

The incorporation of HEXAGON into intelligence and imagery analysis workstreams intensified the community's focus on qualitative weapon advancements and a growing tendency toward overestimation in its communications to the policy community. HEXAGON dramatically increased the amount of imagery information. NPIC, in an environment of budget cuts, could not expand and coped by adapting its practices to focus on distilling "stories" from the volumes of imagery, which translated to an increasing focus on qualitative advancements of Soviet systems. HEXAGON's increased coverage allowed these stories to be both more comprehensive and detailed. These factors combined with external pressure being applied to the CIA not to underestimate Soviet forces as it had done in the past. The overall impact of these changes that arose in incorporating HEXAGON into the work of the intelligence community was more detailed and comprehensive "stories" about current Soviet modernization efforts together with future estimates skewed toward worst-case estimates. These changes would have visible effects during the weapon debates examined in the respective case study.

Resource constraints intensify the drive to find the "story" in the noise

As the NPIC entered the early 1970s, it was increasingly resource constrained. James Schlesinger, who started as DCI in February 1973 for a tenure that would last only six months, cut the CIA's budget and personnel, and these cuts extended to NPIC. While not many NPIC employees were let go, growth certainly stopped at this point, and Lundahl helped some former

employees find new positions elsewhere.[285] At the same time, HEXAGON was bringing in an unprecedented volume of satellite imagery. Whereas the first CORONA satellite mission in 1960 held a twenty pound a bucket of film, a HEXAGON bucket held about five hundred pounds. The film and its chemical emulsion had become considerably thinner, so even more photographs could be obtained from each pound of the KH-9's film. A satellite mission length had grown from less than one-day to more than 200 days in 1973.[286]

Compounding the challenges for analysts was the fact that HEXAGON's increases to imagery volume did not come with increases in computing power or digitization; much of the work was still done by hand. HEXAGON image frames were six and a half inches wide, and some were more than ten feet long. Each of these images could cover an area approximately sixteen by three hundred nautical miles, or roughly the straight-line distance between Washington, D.C. and Cincinnati, Ohio, and eight miles on either side of the line. The resolution on each of these photos at nadir was high enough that interpreters could identify what types of vehicles they were looking at. After the film arrived at NPIC, the exploitation process began with long scissors. Using the paper coverage plots for the mission to help identify where the imagery was obtained, the imagery analysts would first look at the locations with the priority questions. Often, there were so many priority questions, that multiple copies of the film were delivered to allow the imagery analysts to look at them simultaneously. This enabled the deployed missile imagery analysts to look at the film at the same time as the test range imagery analysts, the nuclear test imagery analysts, and the ground, air, naval, and air defense experts. Whiles these experts were

[285] O'Connor, pp. 74-75.
[286] O'Connor, p. 79.

assessing sets of known targets, the newer, lower-graded analysts were busy with long scissors, cutting and taping photography into rolls of contiguous search areas.[287] At this time, interpreters were writing paper reports on new targets in longhand. These reports, nicknamed "blip sheets," were compiled and keyed into a batch process. It often took all weekend for the NPIC mainframes to compile and print the work of the previous week, and this lag ensured that the database was perpetually out-of-date.[288]

The work overload was so intense that some imagery analysts resorted to a despised practice called "crab-eyeing." In NPIC culture, the analysts who made the "discovery" of a target or a significant activity got to write the report, do the briefings, and build his or her individual reputation. Therefore, some experienced interpreters, familiar with a region or favorite target, would come in early to watch new interpreters cut the film, checking the coverage plots to see which frame their favorite targets would be on, and asking or intruding to look at a particular target with their 7X magnifier.[289]

It was in this new environment that John Hicks succeeded Arthur Lundahl as director of NPIC upon his retirement. Hicks had worked closely with Lundahl as his executive officer for more than three years. In his earlier work on arms control issues, Hicks was an avid user of NPIC reporting. From that experience, he developed a sense that the wider intelligence community needed to understand the work at NPIC in terms unrelated to the technology and to the capabilities of the photography. Hicks wanted to transform all 'photo interpreters' into 'imagery

[287] O'Connor, p. 86.
[288] O'Connor, p. 77.
[289] O'Connor, p. 76.

analysts,' that is, to enable them to combine trained technical observation with thinking about the implications and context of the observation. He thus started a change at NPIC that took more than a decade to complete.[290]

The evolution of intelligence practices and the tendency toward worst-case analysis

In implementing this change, Hicks ran up against the issue that NPIC could not hire new people due to agency-wide budget constraints. Unlike the CIA's Directorate of Intelligence, the quality of an applicant's writing skills was not a critical factor in hiring imagery analysts. NPIC, with its reliance on "stories," was primarily an oral culture, and Hicks would have to rely on the center's existing workforce. To help realize his vision, Hicks brought in a contractor, Al Joseph, to teach a newswriting course to all the NPIC photo interpreters and their managers. Some took off running with the new skill set. Those who did not were assigned to search and support work, or to other organizations.[291]

Hicks wanted to take the "stories" that NPIC shared and used internally and make them part of the external reporting. Previously, NPIC analysts were trained to enter information only about individual targets into the database, and, as a result, some in NPIC came to think of the database as the final customer of their interpretation and analysis. Consequently, they were trained to write descriptions of physical changes, but not to relate the changes to differences in a force

[290] O'Connor, p. 75.
[291] O'Connor, p. 81-82.

capability or changes in a weapons system. The changes made by Hicks therefore added perspective and context to the usual target-focused reporting.[292]

The NPIC's shift toward a "newswriting" style of reporting intensified existing tendencies of seeking the "story" embedded in images and the practice of highlighting qualitative developments. The huge volume of HEXAGON imagery meant that each analyst had to cover larger areas in greater detail due to the higher resolution imagery they were now working with. Prioritization techniques included increasing reliance on the tradition of indexing to the "story" in order to relate and understand how individual targets related to the weapons systems or strategic manufacturing processes. Instead of focusing exclusively on the physical characteristics of their targets, they learned to look for evidence of changes to the target, the order-of-battle, or force structure. The successful imagery analysts were better able to fit their observations into context. They explained why their observations provided greater evidence for one analytic explanation or story over another. This change in mindset caused them to restrict their observations to those targets that helped them answer key intelligence questions.[293]

NPIC's shift to "newswriting" correlates with increasing qualitative detail and context in National Intelligence Estimates in the 11-3/8 series, which summarizes the latest developments and projects future trends in Soviet weapons and supporting systems related to strategic nuclear conflict. **Figure 2.6** indicates the nature of the change by comparing the topical sub-headings in the declassified versions of NIE 11-8-72, the last estimate before Hicks took over the post, and

[292] O'Connor, p. 81.
[293] O'Connor, pp. 87-88.

NIE 11-3/8-74 after his programmatic changes were underway. In addressing Soviet modernization efforts, the 1972 estimate states that "We have little evidence concerning the qualitative improvements to be incorporated in the three new ICBMs." This is stated despite later revelations that flight testing of the Soviets new set of land-based ICBMs, including the SS-16, SS-17, and SS-18 had begun within the 1970-1972 period. The 1974 estimate, on the other hand, gives detailed breakdowns of developments with each of these missiles, as well as developments for the SS-19. The use of HEXAGON's technological advances and the changes to imagery intelligence methodology and communications implemented by Hicks were likely both instrumental in bringing about these changes.

NIE 11-8-72: Soviet Forces for Intercontinental Attack
Present status of Soviet intercontinental attack forces
The principal types of intercontinental ballistic missiles
Soviet policy and future programs

NIE 11-3/8-74: Soviet Forces for Intercontinental Conflict
The USSR's current strategic situation
Factors influencing Soviet strategic policy
Historical trends in selected aspects of strategic forces
The question of Soviet strategic objectives
Present forces for intercontinental attack and prospects for their improvement

Figure 2.6. Comparison of headings in the declassified versions of NIE 11-8-72 and NIE 11-3/8-74.[294]

The use of HEXAGON not only translated into NPIC's stories becoming more detailed; it also contributed to their becoming more comprehensive. Intelligence analysts of this period broke down the components of nuclear weapon analysis into four main areas: research and development (R&D), production, inventory (deployment) and disposition. SALT I had generally

[294] NIE 11-8-72 and NIE 11-3/8-74

operated under the thesis that adequate verification could be maintained by monitoring the deployment and regulating certain parts of the disposition activities. HEXAGON would allow analysts the latitude to look outside these categories and develop a broader picture of the weapon production cycle.

HEXAGON's camera and software improvements made important contributions to reducing blind spots, which enabled analysts to monitor the broader weapon life cycle for changes. With both a longer mission life and a load of four film recovery buckets, HEXAGON could provide more frequent input depending on what GAMBIT or a previous batch of HEXAGON imagery revealed and still remain on orbit collecting photography. In addition, the new targeting software programs like CRYSPER, HAMPER, HSIM and TUNITY allowed HEXAGON to capture a higher volume of targets per mission. This meant that time-series collections could be maintained for a larger set of targets across the areas of production, maintenance, storage, deployment, and disposition. Overall, with HEXAGON providing frequent, high-resolution imagery for wider areas, there was less of a need to pick and choose where to focus monitoring resources amid the weapon life cycle, and analysts could develop more thorough understandings of behavior across categories.[295]

Together, these developments – including an increasing NPIC focus on indexing to the "story" to cope with high volumes of information and thus highlighting qualitative factors in reporting, a broadened scope of analysis covering more of the weapon life cycle, and external pressure that

[295] "A Paper on Protective Strategic Missile Basing: Its Relationship to Strategic Arms Limitations," October 1978. William E. Colby Papers (MC #113) Box 15, Folder 8, SALT, 1978. Seeley G. Mudd Manuscript Library, p. 1-13.

skewed projections of the future toward worst-case estimates – generated an intelligence foundation that was primed to support arguments for U.S. nuclear weapon modernization, even as arms control initiatives continued. Each of these changes stemmed from the high volumes of greater information introduced through the deployment and use of HEXAGON.

NIIRs and the continuation of the resolution initiative

A final facet worth consideration is how NPIC was changing with the use of HEXAGON in ways that further intensified a fixation on achieving higher resolution, thus continuing the central trend examined in this study. This fixation on resolution was largely furthered by Hick's initiative to develop the National Imagery Interpretability Rating Scale (NIIRS) (**Figure 2.7**).

The NIIRs scale came about for multiple reasons. One was through an initiative within NPIC driven by Hicks. By 1974, after years of increasing observations, NPIC analysts were making fewer new discoveries. The frequency, volume, and interpretability of satellite photographs in 1974 mean that much of the work shifted from discovery, to monitoring and comprehending what was happening at known targets. The questions coming to NPIC had less to do with finding new facilities and more to do with understanding ongoing activities and changes at known facilities. Increasingly, NPIC was expected to identify subtle changes and to explain how and why these facilities, forces, and strategic targets were changing.

Hicks wanted to remove some of the subjectivity of NPIC's interpretations. His goal was to help standardize how imagery analysts judged the interpretability of imagery. Instead of simply applying the metric resolution across all targets equally, Hicks introduced a scale based on the

degree of possible distinctions a trained observer could make from a particular image for an array of objects. NPIC interpreters and imagery scientists, with Bill Forster and David Gifford in the lead, took the basic correlation between the size of objects and quality of imagery needed to see them, to create this new interpretability scale in the fall of 1973. Hicks challenged the photo-interpreters to begin using this scale, after SALT I was ratified in 1972. The scale was refined and published in March 1974, and a variant remains in use today.[296]

Another motivating factor was the desire to increase standardization out of concerns related to arms control verification for the SALT I agreements. In late 1971 and early 1972, it was recognized that SALT would place special emphasis on knowing precisely what areas had been searched and the quality of imagery utilized. Those responsible, including COMIREX leadership tasked with organizing target selection and frequency, wished to be able to establish the status of confidence limits regarding the probability of the existence of a prohibited activity. In their words, they were looking for "improved means of measuring and quantifying the 'negation' function, as well as the detection and identification functions." In April 1972, a task team with staff from COMIREX, NPIC and the CIA was formed to devise improved means of measuring and accounting for the status of area search exploitation and target surveillance with emphasis on recording the interpretability and quality of imagery searched.

COMIREX leadership stated that a secondary objective was to develop an improved means of validating and updating collection requirements accounting, both for evaluation and mission

[296] O'Connor, pp. 79-81.

guidance purposes, based upon photo interpreter assessment of acquired photography.[297] This statement underlines the importance of NPIC's culture of stories and focus on resolution in influencing the now formalized embedding of standards concerning resolution that would be used to guide processes of decision-making about both imagery collection and satellite design.

Overall, under HEXAGON and together with the nature of the Soviet modernization program, NPIC's culture of meritocracy increasingly shifted from discovering new sites to a focus on discovering actions, such as missile upgrades and research, development and testing activity. Larger amounts of imagery at higher resolution meant that analysts had to increasingly rely on indexing to the "story." Instead of focusing exclusively on the physical characteristics of their targets, they learned to look at the equipment that was present, for evidence of changes to the target, the order-of-battle, or force structure. Hicks led NPIC in the transition from interpretation to analysis, with the development of the NIIRS scale, "news writing" style reporting, and a new set of methods geared toward focusing on critical qualitative significance of imagery. This cultural shift is reflected in NIE structure and content (see table) and in the nature of briefings given to policymakers. Together with external pressure applied to the CIA not to underestimate Soviet forces, these cultural shifts within NPIC connected to the use of HEXAGON likely exacerbated CIA tendencies to continually overestimate future projections of Soviet nuclear forces for decades to come. The process was further embedded through NPIC's development of the NIIRS scale, which further increased the fixation on resolution as a standard.

[297] "Memorandum, Subject: The National Area Exploitation File (NAEF) and the National Imagery Interpretability Rating Scale (NIIRS), From: Chairman, COMIREX," Central Intelligence Agency FOIA Reading Room, 15 March 1973, https://www.cia.gov/readingroom/docs/CIA-RDP79B01709A001400020002-4.pdf.

NIIRS 0	**NIIRS 1** Over 9.0m GRD	**NIIRS 2** 4.5-9.0m GRD	**NIIRS 3** 2.5-4.5m GRD	**NIIRS 4** 1.2-2.5m GRD
Interpretability of the imagery is precluded by obscuration, degradation, or very poor resolution	Detect a medium-sized port facility and/or distinguish between taxi-ways and runways at a large airfield.	Detect large hangars at airfields. Detect large static radars (e.g., AN/FPS-85, COBRA DANE, PECHORA, HENHOUSE). Detect military training areas. Identify an SA-5 site based on road pattern and overall site configuration. Detect large buildings at a naval facility (e.g., warehouses, construction hall). Detect large buildings (e.g., hospitals, factories).	Identify the wing configuration (e.g., straight, swept, delta) of all large aircraft (e.g., 707, CONCORD, BEAR, BLACKJACK). Identify radar and guidance areas at a SAM site by the configuration, mounds, and presence of concrete aprons. Detect a helipad by the configuration and markings. Detect the presence / absence of support vehicles at a mobile missile base. Identify a large surface ship in port by type (e.g., cruiser, auxiliary ship, noncombatant/ merchant). Detect trains on railroad tracks (not individual cars)	Identify all large fighters by type (e.g., FENCER, FOXBAT, F-15, F-14). Detect the presence of large individual radar antennas Identify, by general type, tracked vehicles, field artillery, large river crossing equipment, wheeled vehicles when in groups. Detect an open missile silo door. Determine the shape of the bow (pointed or blunt/rounded) on a medium-sized submarine (e.g., ROMEO, HAN, Type 209, CHARLIE 11, ECHO 11, VICTOR II/III). Identify individual tracks, rail pairs, control towers,
		KH-1 to KH-4 CORONA	***KH-4A CORONA***	***KH-4B CORONA***

NIIRS 5 0.75-1.2m GRD	**NIIRS 6** 0.4-0.75m GRD	**NIIRS 7** 0.2-0.4m GRD	**NIIRS 8** 0.1-0.2m GRD	**NIIRS 9** Less than 0.10m GRD
Distinguish between a MIDAS and a CANDID by the presence of refueling equipment (e.g., pedestal and wing pod). Identify radar as vehicle-mounted or trailer-mounted. Identify, by type, deployed tactical SSM systems (e.g., FROG, SS-21, SCUD). Distinguish between SS-25 mobile missile TEL and Missile Support Vans (MSVS) in a known support base, when not covered by camouflage. Identify TOP STEER or TOP SAIL air surveillance radar on KIROV-, SOVREMENNY-, KIEV-, SLAVA-, MOSKVA-, KARA-, or KRESTA-II-class vessels.	Identify the shape of antennas on EW/GCI/ACQ radars as parabolic, parabolic with clipped comers or rectangular. Identify the spare tire on a medium-sized truck. Distinguish between SA-6, SA-I 1, and SA- 17 missile airframes. Identify individual launcher covers (8) of vertically launched SA-N-6 on SLAVA-class vessels. Identify automobiles	Identify fitments and fairings on a fighter-sized aircraft (e.g., FULCRUM, FOXHOUND). Identify ports, ladders, vents on electronics vans. Detect the mount for antitank guided missiles (e.g., SAGGER on BMP-1). Detect details of the silo door hinging mechanism on Type III-F, III-G, and 11-H launch silos and Type III-X launch control silos. Identify the individual tubes of the RBU on KIROV-, KARA-, KRIVAK-class vessels. Identify individual rail ties.	Identify the rivet lines on bomber aircraft. Detect horn-shaped and W-shaped antennas mounted atop BACKTRAP and BACKNET radars. Identify a hand-held SAM (e.g., SA-7/14, REDEYE, STINGER). Identify joints and welds on a TEL or TELAR. Detect winch cables on deck-mounted cranes. Identify windshield wipers on a vehicle.	Differentiate cross-slot from single slot heads on aircraft skin panel fasteners. Identify small light-toned ceramic insulators that connect wires of an antenna canopy. Identify vehicle registration numbers (VRN) on trucks. Identify screws and bolts on missile components. Identify braid of ropes (I to 3 inches in diameter). Detect individual spikes in railroad ties.
KH-7 GAMBIT	***KH-9 HEXAGON*** ***U-2 aircraft***		***KH-8 GAMBIT***	***KH-11 KENNEN***

Figure 2.7. National Image Interpretability Rating Scales (NIIRS) (represented in meters as ground-resolved distance) connected to U.S. imaging satellites [298]

[298] "National Image Interpretability Rating Scales," Federation of American Scientists, Updated Friday, January 16, 1998, Accessed on February 1, 2021. https://fas.org/irp/imint/niirs.htm

KENNEN

The deployment of KENNEN would, like previous major satellite reconnaissance programs, have a transformational effect on NPIC, and in turn, on processes of intelligence and treaty verification. For NPIC, KENNEN was the beginning of the digital age, entailing deep institutional changes across imagery analysis technology, methods, and reporting. Despite such changes, NPIC's tradition of storytelling would persist, albeit in a different form, and intensify. The digitization of NPIC would ultimately result in a greater focus on "issues," incorporating the relationships between targets and their significance to U.S. nuclear strategy and arms control, rather than the previous emphasis on "targets," where stories focused more on the detailed development of a particular site.

Learning to meet the challenge of digitization

Already under HEXAGON, the NPIC computer system already had difficulties in coping with the volume of information produced by the satellite. These difficulties presaged future problems that would deepen when imagery arrived hourly instead of over intervals of weeks.[299] In spring 1973, NPIC created the Special Projects Working Group (SPWG) to think about how to solve these shortcomings. SPWG began to understand the volume of daily imagery that would come in and the opportunity for near-real time intelligence, it became more involved in shaping the future of technology. This new kind of imagery meant that display of an image and analysis of that

[299] O'Connor, Jack. *NPIC: Seeing the Secrets and Growing the Leaders, A Cultural History of the National Photographic Interpretation Center*, Alexandria, VA: Acumensa Solutions, 2015, p. 77.

image would someday be possible on the computer screen rather than producing hard-copy imagery. Although most imagery analysts had no experience working on computers, much less programming them, some of the more active analysts began to experiment with the computers as a way of viewing and exploiting the new imagery. They began to learn how to program the computers by learning to code.[300]

By the late 1970s, NPIC was working with both HEXAGON film-based photography and KENNEN digital imagery. The side effect of the new technology was dividing NPIC's analytic culture, straining the technology, and partitioning a divide among the imagery analysts between those willing to adapt to the new digital information load and those that preferred NPIC's traditional methods of working.[301]

KENNEN would also have an impact on collection and targeting. With a near-real-time satellite, clouds remained an issue, but imagery analysts and managers recognized that they could obtain imagery far more rapidly than before, so they started to focus their attention on ad hoc collection nominations instead of the standing collection deck.[302]

Despite all its challenges, NPIC leadership saw opportunity in the modernization process. The computer industry had started to change so quickly that the deliveries to NPIC, envisioned to be modern, were obsolete upon arrival. Soft copy workstations remained so expensive that it would be years before the government could benefit from the commercial computing revolution. NPIC

[300] O'Connor, pp. 92-93.
[301] O'Connor, p. 95.
[302] O'Connor, p. 114.

commissioned a study group on establishing a laboratory that could develop and assess technology designed to support imagery analysis. The challenges of strategic relocatable targes and the volume of information needed to provide intelligence on the issue meant that NPIC would need to more rapidly harness commercial technology developments. This led to his establishment of the National Exploitation Laboratory (NEL). It came to be composed of imagery scientists, former imagery analysts, and technologists. It brought in contract scientists and mathematicians to augment its staff and was funded by both DoD and the CIA. NEL provided an environment where the imagery analysts' expertise could be inserted more consistently and evenly into the various development processes.[303]

Changing leadership

KENNEN's impact on intelligence and arms control would also be shaped by new leadership at NPIC. In 1984, Rae Huffstutler was selected as NPIC's new director. He had a long experience working in arms control issues, having worked on Soviet strategic issues in the Office of Weapons Intelligence, including the development of Soviet strategic weapons systems. For many years, he had supported arms control negotiations and participated in the debates and disagreements registered in the National Intelligence Estimates. Huffstutler knew how the intelligence community and the arms control community used NPIC reporting to inform its discussions and negotiations. [304]

[303] O'Connor pp. 198-199.
[304] O'Connor, p. 141.

Huffstutler brought a clear understanding of the need for NPIC to provide direct, daily support to all the negotiations and to engage with the arms control staffs in the SALT monitoring discussions. His understanding of the value of imagery analysis in the arms control process led him to believe that NPIC could earn a "seat at the table."[305] He came to NPIC with a view that NPIC had issues to be resolved, including the need to address the digital modernization challenge related to the deployment of KENNEN, how to deal with looming Soviet intelligence challenges related to mobile missiles, or as Huffstutler called them, "strategic relocatable targets." His term would be instrumental for helping NPIC to understand that its expertise at dealing with fixed targets would become insufficient to warn and track strategic mobile missiles.[306]

Huffstutler's plan, in particular, was to "re-make" NPIC's efforts on strategic-relocatable targets and specifically, the SS-20s – the medium-range, solid-fueled missile was threatening for its MIRV capability and proximity to its intended targets. From the late 1970s, NPIC had followed the development and deployment of mobile missiles with one branch dedicated to following the SS-20 weapon system.[307] Success would mean integrating new technology and streamlining the exploitation, collection, reporting, and managerial processes. Importantly, the director said that success would require new talent.[308] New imagery analysts were recruited in 1982 and 1983 from college campuses. This not only meant they had more formal education on average, but also that they had more experience in using computers.[309] Statisticians were also brought in to

[305] O'Connor, p. 142.
[306] O'Connor, p. 142.
[307] O'Connor, pp. 142-143.
[308] O'Connor, p. 144.
[309] O'Connor, pp. 145-146.

support the imagery analysts. The statisticians made contributions that improved analysis and collection, and their successes led to their permanent emplacement in NPIC.[310]

In January 1986, Prime Minister Gorbachev announced Soviet willingness to eliminate all Soviet SS-20 medium-range ballistic missiles. NPIC had two months to search sixty percent of the Soviet landmass in order to verify the size of the SS-20 force.[311] Following Gorbachev's offer, the West was skeptical about the sincerity of the Soviet's proposal, wondering why they would negotiate the removal of one of the state's most capable and threatening weapons systems.

Changing verification requirements

The SS-20 issue captures the mutual shaping that takes place between reconnaissance technology and arms control verification requirements. Namely, that the capabilities of the technology were often used to determine how much information is sufficient, rather than requirements first being dictated and then designing technology around the challenge. For example, the task of ascertaining the validity of Gorbachev's proposal began with the request to NPIC to determine the *location* and *status* of all of the Soviet SS-20 regiments. The original plan for answering this question was actually to use HEXAGON imagery, given its particularly wide-area coverage, it was determined to be the most suitable system for the SS-20 search task.

The SS-20 search endeavor involved the plotting of tens of thousands of separate potential images, including their number, size, and sequence. Over the seven years prior to 1986, NPIC

[310] O'Connor, p. 199.
[311] O'Connor, p. 147.

had developed a sense of where the SS-20 could operate effectively. The operating areas for these bases covered about sixty percent of the Soviet Union – about 5.2 million square miles or the size of the area of the United States, India and Pakistan combined.[312] Planning involved factoring how near or far the satellite would be from the earth at a particular time, how much film remained on the satellite, how high the NIIRs level or resolution needed to be, how large an area needed to be imaged, and the likelihood of cloud cover at the time of collection. More images were planned than could be photographed, as collection managers would not know which areas would be cloud-covered.[313]

This planning was disrupted when the HEXAGON satellite for which the SS-20 planning was conducted exploded at a low-altitude upon its launch on 18 April 1986. By this time, KENNEN was planned to replace HEXAGON as the core system of U.S. satellite reconnaissance, so building an additional system was not an available option. Instead, NPIC faced the daunting task of adapting the SS-20 search plans made for HEXAGON to KENNEN's very different set of capabilities. In his account of NPIC's history O'Connor describes the task under HEXAGON as covering a football field with paper towel-sized squares. Under KENNEN, it would be postage stamps.

Given the deep challenges associated with adapting these search plans, U.S. leaders decided to scale back the amount of information it considered necessary for verification of Gorbachev's proposal. Instead, of seeking the location and status of all SS-20 units, NPIC was asked to

[312] O'Connor, p. 214.
[313] O'Connor, pp. 203-204.

determine how many deployed SS-20 bases and how many missiles the Soviets had.[314] This task was eventually even further reduced to ensuring the number of bases and that no new bases were under construction.[315] Evidently, the limits of satellite technology were used to define and whittle down arms control verification requirements.

Changing methods

NPIC thus adapted to its new technological limits. Without HEXAGON, NPIC analysts researched older film and worked to develop more in-depth knowledge about the SS-20 force.[316] NPIC's arms control staff, led by Tim Sample, devised a search strategy for the single operating KENNEN satellite. KENNEN's smaller capture area meant that despite its real-time capabilities, targets would have to be captured far less frequently and with a significantly increased temporal blind spot.[317]

Part of the confidence shown by creators of the new KENNEN search strategy grew from the NPIC's research experience with an earlier intense collection of selected Soviet SS-20 garrisons. This intense ad-hoc collection, nicknamed a "blitz," incorporated both the near-real-time and film return system and took place in a much smaller, single geographic area. It resulted in a much larger amount of information and intelligence that allowed for more detailed research.[318] After the earlier SS-20 blitz, imagery analysts reviewed all this imagery to get a sense of how the

[314] O'Connor, p. 203, 210-211.
[315] O'Connor, p. 217.
[316] O'Connor, p. 210.
[317] O'Connor, p. 212.
[318] O'Connor, p. 213.

bases operated, what routine operations looked like. This review was important, as it enabled an awareness of when activity differed from the norm. Although this analysis could have been developed without the standing collection being changed so radically, it would have taken much longer.[319]

The other outcome related to the localized SS-20 blitzes was an effort to use first-phase imagery analysis to tip off other intelligence sources. This proof of concept was a development that allowed one intelligence agency to make use of NPIC to gain additional information for its own collection. And NPIC would make use of the information from other intelligence sources to refine its imagery collection. In particular, the 24/7 environment of PEG, with its ability to contact the community and re-task imagery quickly was essential for this strategy.[320]
The work done with this second SS-20 blitz was one of the first examples where imagery analysts developed digital tools. These tools allowed them to develop methodologies that could be refined to apply to other problems where re-locatable targets were involved. Many younger, computer literate analysts took to the method over more established figures.[321]

Through June, July and August 1986, hundreds of imagery analysts worked overtime, nights, and weekends, but when the search was over, NPIC could verify that no new SS-20 bases were under construction in the Soviet Union. NPIC finished the search just before the August and September arms control meetings held in preparation for the October Reykjavik meeting where President Reagan and Soviet Premier Gorbachev agreed to the limits of the new treaty. NPIC's information

[319] O'Connor, p. 214.
[320] O'Connor, p. 214.
[321] O'Connor, p. 216.

was considered enough for the United States to judge that the Soviet's proposal was accurate, and the methods used in the process would have a permanent effect on imagery intelligence going forward.[322]

From "stories" to software

This new, experimental effort with the SS-20 missile units and KH-11 challenged imagery analysts in a new way. Previously, weapons systems reporting had been indexed to one location. Now, when these missiles left their bases, imagery analysts had to re-task rapidly, search expeditiously, and record temporary locations even though these new targets had no unique physical attributes other than a latitude and longitude – in other words, just a location. In the beginning, the imagery analysts were able to track and keep records of the kinds of activity they saw, but the cumulative number and record of observations at different locations, over time, soon strained the capability of their memories and the NPIC database system. As Rae had foreseen, the long NPIC practice of "indexing activity to the story" became insufficient for the challenge of this kind of strategic, re-locatable target. Imagery analysts working on mobile missiles needed a tool that could record locations, times, date, observations, and any other information that any imagery analyst thought significant.[323]

The Improved NPIC System, a new computer network that was part of NPIC's modernization program under KENNEN, had continued locational databases of installations, but they were essentially flat files or sequential notebooks that could not be easily searched or cross-indexed.

[322] O'Connor, p. 217.
[323] O'Connor, p. 214.

While queries could be written, they required a programmer's assistance, and they took far too long to get written, programmed, tested, debugged, and delivered. As often happened at NPIC, imagery analysts saw the need to create their own tools.[324]

The CIA's Directorate of Intelligence (OIA) had invested in a software package called Analyst, a program originally programmed in Smalltalk, a computer language invented by Alan Kay at Xerox's Palo Alto Research Center. This early object-oriented language was flexible enough to enable the creation of a relational database. An NPIC imagery analyst, Ken Whitson, met with his OIA counterpart, Donny Armistad, who had been experimenting with this program. Between them, they developed an early version of a relational database to track the SS-20s. Their approach was valued given that the form that captured the input could easily be modified as their observations sharpened. [325]

More importantly than tracking and reporting of daily activity, the records kept in Analyst could be queried, and imagery analysts and NEL statisticians could ask different questions of the data over time, over distances, and at different locations. After a large number of observations was compiled, imagery analysts began to discern patterns of activity. Whitson's and Armistad's efforts meant that NPIC analysts could go disseminate information more quickly and accurately to the arms control community. [326]

[324] O'Connor, p. 214.
[325] O'Connor, p. 215.
[326] O'Connor, p. 215.

The use of Analyst also had a deep effect on the culture and practices of NPIC. The amount and frequency of information had now made obsolete NPIC's long-standing tradition of verbal "storytelling." Analysts' memories were being gradually replaced by computer memories. At the same time, the tradition of stories did not fully disappear, but rather helped shape the new practices of NPIC. This new kind of computer-based database reportedly allowed imagery analysts to focus more on "issues" than "targets," and to discover and understand the relations among targets. This meant greater attention to ascertaining when activity at one target was a precursor for future activity at another target. Whitson's and Armistad's work accelerated the discoveries of the relationships among targets and enabled analysts to learn more about the operations of the force more quickly. Their software development also eased the challenge of applying statistical analysis to NPIC's analysis work.[327] Together, these influences would contribute to a further intensification of NPIC's contributions to National Intelligence Estimates that spoke to broader questions of strategy and intentions and an even further departure from NPIC's early work that merely gave the facts of construction developments on the ground.

Turning up the volume on strategy and intentions in National Intelligence Estimate reporting

These changes within NPIC track with a continued evolution of National Intelligence Estimate (NIE) reporting to focus increasingly on nuclear warfighting strategy and Soviet intentions. This shift had become noticeable to the extent that the DCI was compelled to respond to criticism of the 1979 NIE on Soviet Capabilities for Strategic Nuclear Conflict (11-3/8-79) with remarks

[327] O'Connor, p. 215.

stating that "NIEs should be void of policy and force planning recommendations" and that "in the interest of objectivity should be free from policy influence."[328] While the NIEs indeed claimed no specific policy recommendations, they offered a picture of Soviet nuclear forces that was increasingly ominous in a way that would make implicitly clear what the reasonable U.S. response to such actions should be.

The primary impact of the use of high-resolution imagery from KENNEN is the continued focus of U.S. analysts and NIE drafters on MIRV-ing and silo hardening. The observation of such activities, which could ultimately only be tallied through high-resolution satellite imagery, were used as the basis of the claim that "the number of Soviet weapons with good counterforce capabilities is increasing rapidly," which was used as evidence for the broader claim that "Soviet strategic capabilities will continue to grow relative to those of the United States and NATO."[329] The 1980 estimate stated that the Soviets "have a massive, well-disciplined R&D organization, with a large number of new programs, as well as an expanding production capability, all of which provide options for future force growth and improvement."[330]

Drafters of the 1979 estimate neglected to mention that the total number of Soviet land-based ICBMs had peaked in 1976 and was gradually declining.[331] As discussed in case study 2, this was part of a broader pressure toward overestimation within which such details were minimized

[328] "Talking points for the DCI, Subject: Net Assessments and NIE 11-3/8-79," 10 March 1980, Central Intelligence Agency, https://www.cia.gov/readingroom/docs/CIA-RDP81B00401R002300080004-8.pdf.
[329] NIE 11-3/8-79, Soviet Capabilities for Strategic Nuclear Conflict Through the 1980s, p. 3, 5.
[330] NIE 11-3/8-80, Soviet Capabilities for Strategic Nuclear Conflict Through the Late 1980s, p. A-2.
[331] Cochran, Thomas, William Arkin, Robert Norris, and Jeffrey Sands. *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons*. Harper and Row, 1989.

or omitted. In his study of CIA overestimation in 1989, Franklyn Holzman asserted that since 1983, the CIA has acknowledged that Soviet weapons procurement growth has been flat since 1975, not increasing, and that the rate of growth in overall defense spending since 1975 actually dropped, from 4-5 percent to 2 percent per year. Nevertheless, the CIA did not make the necessary corrections in its figures for years to follow. For example, the CIA has pegged Soviet defense spending, as a percentage of Soviet gross national product (GNP), at 15-17 percent for recent years, but Holzman shows that the figure should have been closer to approximately 8-10 percent.[332]

Information acquired from high-resolution imagery in general, and during this period, from KENNEN in particular was also used within NIE discussion of parity and superiority. The 1980 NIE specifically asks, "what does 'parity' or 'superiority' mean, and what condition prevails today?" The drafters of the estimate specified two categories of relevant indicators: (1) *static indicators*, such as the number of units, their size, range capability; and (2) *quasi-dynamic indicators* which describe the fighting or destructive potential of the forces, which included lethal area potential (LAP) or the area of land in which reinforced concrete buildings would be leveled, and hard-target potential (HTP), or the potential to attack targets with hardness comparable to those of missile silos.[333]

The estimate never explicitly states that the Soviets are superior. However, it makes clear that across all of these areas, with the exception of the number of warheads, that the Soviets were

[332] Holzman, Franklyn, "Politics and Guesswork: CIA and DIA Estimates of Soviet Military Spending," *International Security* 14, no. 2 (Fall 1989): 102.
[333] NIE 11-3/8-80, p. A-4.

ahead of the United States. The large majority of the information used to make these claims was only possible through high-resolution satellite imagery, given that the calculations ultimately depended on the ability to identify the specific type of missile that has been deployed on the ground.[334]

Summary

This chapter has detailed the constructed nature of the information about Soviet nuclear weapon developments that was used to make decisions about U.S. nuclear policy, force planning, and arms control. Building on the first chapter, which showed how a focus on achieving ever-higher imagery resolutions came to dominate the satellite development process, this chapter has shown how the meritocratic culture of imagery analysts was instrumental in propelling that process. In addition, imagery analysts drive to tell the best and most detailed "story" possible contributed to trends of increasing levels of focus on qualitative weapon factors. These changes contributed to turning up the volume on qualitative information and detail within National Intelligence Estimates and other intelligence reporting which were used by U.S. decision-makers at the National Security Council-level and within Congress. As will be shown in the case studies to follow, this qualitative detail, together with uncertainty from remaining blind spots, helped strengthen and elevate arguments for U.S. modernization that were primarily leveraged by military, conservative, and pro-nuclear voices.

[334] NIE 11-3/8-80, p. A-4, A-7.

Chapter 3. Case Study:
SALT I under CORONA and GAMBIT, 1960-1972

This chapter features a case study of the first round of the Strategic Arms Limitation Talks (SALT I). The talks took place under the CORONA and GAMBIT satellite programs and resulted in two arms control agreements: the 1972 Interim Agreement and the Anti-Ballistic Missile (ABM) Treaty. The case study reveals a pattern of using information from high-resolution satellites to establish arms control limits and advance arguments for modernization. This occurs together with the use of uncertainty stemming from satellite blind spots to build arguments about what "might be" happening in between image captures to extinguish prospects for banning and eliminating certain categories of weapons.

Some of the weapon systems dealt with under SALT I were treated as established and enduring. As detailed in the introductory chapter, as the Arms Control and Disarmament Agency (ACDA) approached the mid-1960s, its agenda had already shifted away from nuclear disarmament proposals to a focus on setting limits. Therefore, at the outset of SALT I, the options under consideration for intercontinental-ballistic missiles (ICBMs) and submarine-launched-ballistic missiles (SLBMs) included continuing to race with the Soviets toward achieving superiority, or in the domain of arms control, to cap numbers at higher-than-current levels, to freeze numbers at current levels, or to mutually reduce numbers together with the Soviets. The case finds that high-resolution satellite imagery information was used to strengthen the case for limits at high numbers in the face of opposition from superiority adherents within the military establishment.

Other newer or emerging weapon systems are treated as pending during this period. The development of these systems was juxtaposed with the serious consideration of eliminating or banning them. Under SALT I, these systems included multiple-independently targetable reentry vehicles (MIRVs), anti-ballistic missile defenses (ABMs), and mobile ICBMs. High-resolution imagery information about Soviet threats was used to build arguments for retaining and modernizing these systems. In addition, arguments invoking the remaining temporal blind spot were used to destroy proposals to ban MIRVs, ABMs, and mobile missiles.

This combination of developments had the effect of simultaneously establishing arms control limits as a policy option within U.S. politics while also contributing to limiting the scope of controls as doors were left open for qualitative advancement and modernization.

Nuclear strategy overview

The development of satellites intensified emerging trends in nuclear force planning and nuclear strategy. In the late 1950s, the growing realization that imaging satellites would soon be realized, together with their early use, was instrumental for further increasing already large and growing nuclear weapon target lists. These developments also strengthened Air Force arguments for a counterforce nuclear strategy. As the Soviets developed an increasingly survivable force, alternative visions would receive greater consideration. A burgeoning epistemic community on arms control, which through its advocacy of qualitative advancements over quantitative buildups, would find success in this space, particularly as satellites were advanced to increasingly high resolutions in ways that would support the community's key propositions.

In the early 1950s and prior to satellites, one leading idea in the debate over nuclear war planning and strategy was 'massive retaliation.' Massive retaliation was based on the idea of an indiscriminate threat to respond to any communist-inspired aggression, however marginal the confrontation, in the form of a massive nuclear strike against the center of the antagonizing state. The doctrine stemmed from concern that the West was being dragged into fighting Cold War conflicts according to ground rules laid down by others. Numbers and distinctions about whether the response would be nuclear or conventional and how many nuclear weapons would be used were deliberately blurred.[335]

Some opponents of massive retaliation took issue with the notion of putting the threat of genocide at the center of U.S. strategy. One alternative doctrine put forth was 'limited war.' Among the objectives sought by proponents of limited war was to find ways to fight wars in the nuclear age along traditional lines, concentrating on an effort to destroy an adversary's armed forces rather than its civilian population. In the process they began to explore the possibility of developing capabilities for "counter-force" rather than "counter-city" strikes.[336] While 'limited war' was ultimately seen by many as unrealistic under the argument that Soviet leadership was unlikely to show such restraint, those opposed showed more openness to counterforce ideas. To the Air Force, counterforce was appealing for the perceived opportunity it provided for actually defeating the enemy in a more traditional and heroic imagination of warfare, and for fighting a

[335] Freedman, Lawrence and Jeffrey Michaels. *The Evolution of Nuclear Strategy: New, Updated, and Completely Revised*. London: Palgrave Macmillan, 2019, p. 133, 139.
[336] Freedman, Lawrence and Jeffrey Michaels. *The Evolution of Nuclear Strategy: New, Updated, and Completely Revised*. London: Palgrave Macmillan, 2019, p. 198, 199.

total rather than limited war.[337] In 1955, the Air Force Association warned of the obsolescence of 'massive retaliation' and demanded the 'ability and the determination to apply our airpower the instant active aggression becomes evident on the part of the Soviet Union.'[338]

The problem with the Air Force's reliance on counterforce was that there was no reliable means to determine the location of Soviet nuclear forces, particularly its emerging ballistic missile force. Despite growth of the planned U.S. nuclear offensive from a few dozen targets in 1948 to more than 2,500 in 1960, the secure achievement of the ability to disarm the Soviet Union appeared to the Air Force to remain just beyond reach. In the late 1950s, a government think tank known as the Weapons Systems Evaluation Group and the Air Force produced pessimistic assessments of present and future U.S. capability to successfully locate, target, and destroy Soviet nuclear delivery forces.[339] Secretary of Defense McNamara would argue together with other defense leaders in 1961 that, "What has made counterforce unattractive to the U.S. even from the purely military point of view has been Soviet secrecy which has been able to keep the location of even quite large missiles hidden from the U.S."[340]

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[337] Freedman and Michaels 2019, p. 198-200.

[338] George E. Lowe, The Age of Deterrence (Boston: Little, Brown & Co., 1964), pp. 100-1, as cited in Freedman and Michaels, The Evolution of Nuclear Strategy: New, Updated, and Completely Revised, 2019, p. 200.

[339] WSEG Report No. 50, Evaluation of Strategic Offensive Weapons Systems, 27 December 1960, Appendix E to Enclosure A, The Feasibility of Achievement of Counterforce Objectives, OSDFOI, pp. 64-81; John K. Gerhart, Memo to AFCCS, Subject: Analysis of the Problem of Finding and Striking Soviet Mobile Missiles, 7 November 1960, Folder 4-5, Missiles/Space/ Nuclear, Box 36, White Papers, LC. as cited in Rosenberg 1983, p. 67.

[340] "Memorandum From Secretary of Defense McNamara to the National Security Council," Foreign Relations of the United States, 15 May 1961, Washington National Records Center, RG 330, OSD Files: FRC 65 A 3464, Atomic 400.112 8 Apr 61. https://history.state.gov/historicaldocuments/frus1961-63v07/d22

The Air Force had increasingly come to recognize the value of overhead reconnaissance for developing and defending a strategy that employed counterforce. Despite not having control of timing or routing of U-2 flights, Air Force target planners made the most of the information they provided.[341] Richard Leghorn, an advocate of photoreconnaissance who wore many positional and organizational hats throughout his career, would influence the process of linking satellite-imaging technology to counterforce. His background as a physics graduate of MIT and his career in the military working in aerial photography put him at a central node in the network of scientists and military leaders knowledgeable about photographic reconnaissance.[342] In 1951, he was assigned as chief of reconnaissance systems within the Air Force, where his duties were to survey the requirements for reconnaissance and assess possible systems. As he refined his views on intelligence in 1951–52, Leghorn had begun to advocate for counterforce. Leghorn realized that intelligence on Soviet strategic assets was key. In his words, "Our qualitative intelligence and reconnaissance capabilities constitute the primary problems, and without extraordinary action, these might delay adoption at operational planning levels of strategies with emphasis on counterforce operations."[343]

Satellite reconnaissance, in this sense, served as a scaffolding for an approach to offensive nuclear strategy that the Air Force already preferred. In his account of the history of nuclear strategy, Lawrence Freedman describes how the interest in counterforce that emerged in the 1950s was spurred by the growth in nuclear stockpiles, which planners interpreted to mean that a variety of offensive missions could be considered, together with indications that satellite

[341] Rosenberg, p. 50.
[342] Dienesch 2016, p. 96.
[343] Dienesch 2016, p. 104.

reconnaissance would be realized technologically in the near future. Freedman points to a statement by Leghorn in 1954, commenting on a 1954 news report that the military were studying earth satellites, where he noted that: "The present state of the aeronautical art makes the satellites feasible in the not-too-distant future. A few simple calculations, assuming lenses no larger than those now used in aerial photography, show that these might see, and return to earth by electronic means, gross details of larger military installations."[344]

With satellites on the horizon, counterforce began to weave its way into the structure of nuclear arsenals. In 1959, a sub-committee under the National Security Council examined how a nuclear war in 1963 might be waged. Its tasks were to determine (1) what targets must be destroyed or neutralized and (2) what retaliatory forces would be required. Air Force planners favored a counterforce strategy which, while targeting government, industrial, military, and communications control centers, awarded priority to strikes against Soviet nuclear delivery capabilities. Army planners advocated the reverse, favoring a countervalue strategy. The subcommittee compromised by recommending a mix of military and industrial targets and enough weapons carriers to achieve a 75 to 90 percent assurance of striking them, which served to justify new U.S. nuclear force additions. In February 1960, President Eisenhower approved this "optimum mix." The 1960 decision would shape nuclear arsenals in several ways, two of which were to cause them to further grow and diversify. As Joint Chiefs historian Walter Poole

[344] Freedman, Lawrence and Jeffrey Michaels. *The Evolution of Nuclear Strategy. New, Updated and Completely Revised, 4th ed*. Palgrave Macmillan, 2019, p. 202.

notes, while the number of city targets remained constant, the prevailing perception was that counterforce required matching every Soviet capability with a corresponding U.S. increase.[345]

As John F. Kennedy assumed the Presidency, he rejected Eisenhower's policy of massive nuclear retaliation in favor of what Kennedy deemed a more credible strategic concept, flexible response, which he believed offered a proportional range of nuclear and conventional strike options calibrated to deter multiple levels of Soviet military aggression. Kennedy's priority was "decreasing the reliance on nuclear weapons to deter limited aggression that had been so prominent a feature of the Eisenhower administration's strategy."

Although Kennedy exercised the rhetoric of flexible response, in practice he seemed to accept much of the strategic logic of the Eisenhower administration's policy of massive retaliation.[346] Although Kennedy called for a military ready "to deter all wars, general or limited, nuclear or conventional, large or small" in 1961, under Secretary Robert McNamara, the Department of Defense never developed a doctrine for waging limited nuclear war.[347] Instead, it first experimented with a counterforce targeting policy, which the administration hoped would limit wartime damage to the United States and allow for intra-war bargaining. After studies revealed that policy's infeasibility—a U.S. preemptive counterforce strike would still result in the deaths

[345] Poole, Walter S. "JCS and National Policy, Vol. VIII, 1961-1964," Office of Joint History, Office of the Chairman of the Joint Chiefs of Staff, pp. 27-28.
[346] Benkowski, James E. "Old Problems in New Posture Reviews? The Lessons of Flexible Response for Today." SAIS Review of International Affairs 39, no. 2 (2019): 67.
[347] Francis J. Gavin, "The Myth of Flexible Response: United States Strategy in Europe during the 1960s," *The International History Review* 23, no. 4 (2001), 855.; John F. Kennedy, "Special Message to the Congress on the Defense Budget," The American Presidency Project, March 28, 1961, http://www.presidency.ucsb.edu/ws/?pid=8554.

of 28 million Americans and 60 million Western Europeans—Secretary McNamara retreated toward a hybrid countervalue-counterforce targeting regime under the rubric of "assured destruction."[348] Declaratory U.S. nuclear strategy under Kennedy—flexible response—grew detached from U.S. policy, which stayed largely consistent with that of the Eisenhower administration through the mid-1960s.[349]

McNamara soon became aware of the problems with his counterforce-centric approach. It offered no sure way to bring a war to a successful conclusion, contained potential for escalation, provided no answer to the question of sufficiency, and was a recipe for an arms race. Even more disturbing to McNamara was evidence that the U.S. Air Force also believed that the efforts were about creating a first-strike capability. The Air Force had come to associate counterforce with the capacity to fight and win a nuclear war. They therefore embraced the new doctrine with enthusiasm, to an extent that dismayed McNamara. When Daniel Ellsberg was drawing up new SIOP guidance in 1961, he was told that the USAF was prepared to go along with his approach, because it helped make the case for the new B-70 long-range bomber, and also required an accuracy that the Air Force's Minuteman ICBMs could provide but the Navy's Polaris SLBMs could not. Expensive new programs were forwarded with a 'counterforce' label attached.[350]

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[348] David Alan Rosenberg, "Constraining Overkill: Contending Approaches to Nuclear Strategy, 1955–1965," in "'More Bang for the Buck:' U.S. Nuclear Strategy and Missile Development 1945-1965," Naval History and Heritage Command, January 12, 1994. https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/m/more-bang-buck.html.
[349] Benkowski, James E. "Old Problems in New Posture Reviews? The Lessons of Flexible Response for Today." SAIS Review of International Affairs 39, no. 2 (2019): 70.
[350] Freedman, p. 373.

In 1963, McNamara moved abruptly away from avoiding cities to threatening their destruction. He emphasized the futility of a counterforce-centric strategy based on the growing survivability of Soviet forces, noting that as the Soviets continue to harden and disperse their ICBM force and build up their missile submarine force, "the prospects for 'damage limiting' by counterforce attacks may not hold great promise."[351] He introduced the idea of "assured destruction" as the ability to: "Deter a deliberate nuclear attack upon the United Sates by maintaining the ability to inflict unacceptable damage upon any aggressor, even after absorbing a surprise first strike."[352] With this criterion he sought to demonstrate that the burst of missile production that marked the start of the Kennedy Administration had created a sufficiency of forces, and that there was no need for further crash programs or major build-ups of any kind.[353]

Despite these changes and strategic argumentation for limiting nuclear forces and moving toward assured destruction, old ideas about the importance of quantitative competition endured throughout the 1960s. As Freedman describes: "As we have seen during the 1950s, the idea of an arms race was recast from being about numbers to being about technology. The fact that it still mattered [in the early to mid 1960s] who had more missiles demonstrated the persistence of the old model." The persistence of such thinking, together with other factors explored within this

[351] "Draft Memorandum From Secretary of Defense McNamara to President Johnson," Foreign Relations of the United States, 6 December 1963, National Archives and Records Administration, RG 218, JCS Records, JMF 7000 (3 Jan 64) Sec 1A. https://history.state.gov/historicaldocuments/frus1961-63v08/d151
[352] Freedman, p. 383.
[353] See Freedman, p. 383, and for an example of McNamara's argumentation against greater numbers of missiles: "Draft Memorandum From Secretary of Defense McNamara to President Johnson," Foreign Relations of the United States, 6 December 1963, National Archives and Records Administration, RG 218, JCS Records, JMF 7000 (3 Jan 64) Sec 1A. https://history.state.gov/historicaldocuments/frus1961-63v08/d151

case study, including high-resolution satellite advances, would contribute to both the quantitative and qualitative nuclear weapon build-up throughout this decade.

Established weapon systems: ICBMs and SLBMs

From the beginning of the CORONA program in 1960 until 1967, consideration of arms control limits centered largely on ICBMs. At the time, the United States and the Soviet Union were primarily competing in this area. The Soviets would not deploy their first ballistic missile submarines, MIRVs, ABMs, or mobile missiles until after this window, and long-range bomber aircraft were not seriously considered for inclusion in arms control under the Johnson administration given that bombers were not seen as a first strike weapon and were therefore not given much attention during these early years.[354]

Early optimism and skepticism about the verifiability of arms control limits

In 1964, ACDA made a formal case for the value of satellites to its arms control agenda. By this time, it had become clearer that the CORONA program would endure despite the early technical glitches that were then being worked out. Near the outset of President Johnson's tenure in January 1964, ACDA released a study titled, "*The Contribution of Satellite Photography to the*

[354] "Draft Memorandum from Secretary of Defense McNamara to President Johnson." Foreign Relations of the United States, September 22, 1966. Johnson Library, National Security File, Agency File, Department of Defense, FY 68–72 Strategic Offensive and Defensive Forces, Box 18. https://history.state.gov/historicaldocuments/frus1964-68v10/d139.

Verification of Current Arms Control and Disarmament Proposals." The study coincided with the launches of mature versions of the CORONA system and very early versions of GAMBIT.[355]

ACDA asserted that CORONA and GAMBIT capabilities were sufficient to meet the needs of arms control verification. The agency claimed that the United States had now developed a satellite system able to furnish "reasonable quality and reasonably timely" photography of any area in the world, having at this point produced usable photography of approximately 90 percent of the Soviet Union. ACDA argued that this system was the most important single U.S. intelligence asset that effectively provided the unilateral verification capability of the Open Skies proposal as envisioned by President Eisenhower back in 1955. ACDA believed the photography would be particularly valuable for the investigation of suspect locations related to the growth of the Soviet nuclear weapon program, noting that construction and even tunneling and digging operations, requiring the dumping of spoil, would be readily apparent.

There were some recognized limitations. ACDA believed the photography was sufficient to locate and describe military installations to the point of detailing "the dimensions and probable functions of buildings." It noted however that the "extent of usage at any time" could not be determined.

[355] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Johnson) to Secretary of State Rusk and Secretary of Defense McNamara; Subject - Possible Disclosure of Satellite Reconnaissance." Foreign Relations of the United States, January 21, 1964. Johnson Library, National Security File, Intelligence File, TKH Jan. 1964–Feb. 1965, Box 1. https://history.state.gov/historicaldocuments/frus1964-68v10/d6.

Such limitations did not detract from ACDA's overall optimism about the value of satellites for arms control. While details of the report remain classified, with respect to land-based missiles, ACDA asserted that, "*satellite photography has permitted the identification of all or nearly all the fixed launch facilities for strategic missile systems in the U.S.S.R. and would provide an effective check on Soviet declarations of such bases as well as initiation of new launch site construction*."[356]

The Joint Chiefs responded with great skepticism to ACDA's proposal. They saw intelligence as a supplementary tool, believing that measures such as aerial surveillance and unscheduled on-site inspections were needed. In a memo to Secretary of Defense McNamara, they argued against the use of U.S. intelligence technologies for verification, believing that such resources should only be relied upon to cross check information and data obtained from a "completely sufficient" inspection system, and to establish priority for the type and area of inspection.[357]

The Joint Chiefs' argument about the necessity of on-site inspections served as a useful bulwark against arms control, as Soviet leadership had made it clear on numerous occasions that inspections were not an option. For instance, at the Eighteen Nation Disarmament Conference in Geneva on 21 January 1964, when U.S. representatives presented a freeze proposal involving on-

[356] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Johnson) to Secretary of State Rusk and Secretary of Defense McNamara; Subject - Possible Disclosure of Satellite Reconnaissance." Foreign Relations of the United States, January 21, 1964. Johnson Library, National Security File, Intelligence File, TKH Jan. 1964–Feb. 1965, Box 1. https://history.state.gov/historicaldocuments/frus1964-68v10/d6.

[357] "Memorandum From the Joint Chiefs of Staff to Secretary of Defense McNamara." Foreign Relations of the United States, February 22, 1964. Washington National Records Center, RG 330, OASD/ISA Files: FRC 68 A 4023, 388.3 (January-February 1964). https://history.state.gov/historicaldocuments/frus1964-68v11/d12.

site inspection, Soviets dismissed it as "inspection without disarmament."[358] By insisting on inspections, U.S. military leadership could therefore outsource the blame for the lack of progress on arms control to the Soviets.

One reason the Joint Chiefs' arguments held weight in 1964 was the pervasiveness of both resolution and temporal blind spots. CORONA missions still suffered failures, and the one GAMBIT mission during this time returned blurry photos. Director of Central Intelligence McCone continued to resist ACDA's optimism by expressing concern for the U.S. ability to verify declarations without on-site inspections.[359] In mid-1964, he responded to ACDA:

> *"…I remain concerned about the reliance placed on unilateral means to verify declarations and to help police controls over production and launcher construction… our present means are inadequate in some areas… I continue to think it important that the number of on-site inspections to check undeclared facilities be large enough to protect against the perishability of intelligence and the danger of its compromise." [360]*

McCone's concerns were made more severe by what appeared in imagery to be a dynamic Soviet development program for ICBMs, which had brought three new missiles into the picture in the

[358] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968." Joint History Office, 2012, p. 81.
[359] "Letter From Director of Central Intelligence McCone to the Director of the Arms Control and Disarmament Agency (Foster)." Foreign Relations of the United States, May 21, 1964. Johnson Library, National Security File, Subject File, Disarmament, ACDA Publications, Vol. III, Box 12. https://history.state.gov/historicaldocuments/frus1964-68v11/d28.
[360] "Letter From Director of Central Intelligence McCone to the Director of the Arms Control and Disarmament Agency (Foster)." Foreign Relations of the United States, May 21, 1964. Johnson Library, National Security File, Subject File, Disarmament, ACDA Publications, Vol. III, Box 12. https://history.state.gov/historicaldocuments/frus1964-68v11/d28.

two years, including speculation that the Soviets might be experimenting with multiple warheads.[361]

Even State Department leadership remained hesitant over arms control based on concerns about verifiability. Ambassador at Large Llewellyn Thompson expressed doubt over many of the proposals raised by ACDA, especially with regard to the possibility of extending a freeze to mutual reductions. Thompson maintained that a freeze was most realistic, and conservatively argued that before even this possibility could be broached, the United States' verification capabilities would need to be carefully examined.[362]

Through the following year, ACDA continued to press for a freeze and reductions. In July 1965, ACDA circulated a plan to (1) freeze the numbers and characteristics of strategic nuclear delivery vehicles, (2) reduce U.S. and Soviet delivery vehicle inventories by about 700 each, and (3) explore the foregoing possibilities during an 18-month cessation of launcher construction.[363]

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[361] "Memorandum for the Record by Director of Central Intelligence McCone; Meeting with the President." Foreign Relations of the United States, July 24, 2964. Central Intelligence Agency, DCI (McCone) Files, Memo for the Record, 7/9/64–10/10/64, Box 2. https://history.state.gov/historicaldocuments/frus1964-68v10/d39.

[362] "Memorandum From the Ambassador at Large (Thompson) to the Acting Director of the Arms Control and Disarmament Agency (Fisher)." Foreign Relations of the United States, November 28, 1964. Department of State, S/S-RD Files: Lot 68 D 452, Committee of Principals, August-December 1964. Secret; Limit Distribution. https://history.state.gov/historicaldocuments/frus1964-68v11/d52; "Memorandum from the Acting Deputy Under Secretary of State for Political Affairs (Thompson) to the Director of the Arms Control and Disarmament Agency (Foster)." Foreign Relations of the United States, December 10, 1964. Johnson Library, National Security File, Name File, Spurgeon Keeny Memos, Box 5. https://history.state.gov/historicaldocuments/frus1964-68v11/d55.

[363] Memo, Dir, ACDA, to Cmte of Principals, 16 Jul 65, JCS 1731/880, JMF 3050 (20 Jul 65) sec. 1 as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968." Joint History Office, 2012. https://www.jcs.mil/About/Joint-Staff-History/

They argued that the latest National Intelligence Estimate showed that the Soviets had been unable to conceal large-scale deployments and that verifiability was possible.[364]

The Joint Chiefs continued to resist the idea that U.S. intelligence alone could verify a cessation of ICBM launcher construction and asked that President Johnson be so advised. The 1965 National Intelligence Estimate, they pointed out, acknowledged that detection of large-scale violations could not be guaranteed. The text stated,

> "*Even in the face of determined Soviet concealment efforts, there is a good chance that violations involving large-scale testing or deployment would be detected, but this cannot be guaranteed. In view of our limited capabilities to detect the early phases of weapons programs, we cannot assure detection sufficiently timely to preclude attainment by the Soviets of a significant lead in acquiring an increased strategic capability*."[365]

The Joint Chiefs believed more specifically that the Soviets could start and sustain 25 to 40 single-silo sites annually with a low risk of detection.[366] As a result, they believed Washington "would find it politically and psychologically difficult to make any meaningful response to a suspected but unproven violation."[367] Though ACDA and the State Department pressed President

[364] Dept. of State *Bulletin*, 11 Oct 65, p. 583. Memo, Dir, ACDA, to Pres, 4 Jan 66, Att to Memo, ASD(ISA) to CJCS, 5 Jan 66, JCS 1731/907, JMF 3050 (5 Jan 66), as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 81.
[365] "National Intelligence Estimate 11-8-65: Soviet Capabilities for Strategic Attack." Central Intelligence Agency, June 23, 1965. https://www.cia.gov/library/readingroom/document/cia-rdp78t04759a000500010015-6.
[366] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 82.
[367] Memo, DASD(ISA) to CJCS, 9 Aug 65, JCS 1731/880-1; JCSM-633-65 to SecDef, 14 Aug 65, JCS 1731/880-2; JMF 3050 (20 Jul 65) sec. 1 as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 81.

Johnson to voice support for a moratorium in his State of the Union address, he ultimately did not make any such announcement.[368]

This pattern of opposition between ACDA and the Joint Chiefs would persist. In March 1966, ACDA proposed (1) ascertaining privately whether the Soviets were interested in coupling significant reductions with a freeze while (2) conducting a technical experts' discussion of guidelines common to a freeze and a reduction. The State Department, the NSC Staff, and the AEC concurred.[369] With respect to a freeze, as ACDA proposed a draft letter for Premier Kosygin from President Johnson proposing an 18-month moratorium on constructing fixed, land-based offensive and defensive missile launchers to be verified by "our respective national capabilities." The Joint Chiefs positioned themselves in opposition toward both a freeze and toward reductions. They managed to suppress the effort by highlighting verification concerns with other weapon systems. For example, they argued that verification of a moratorium would be imperative because the Soviets stood to widen their lead in ballistic missile defense and gain an advantage in developing MIRV warheads. Ultimately, no letter went to Premier Kosygin.[370]

In addition to their long-stated concerns about verification, the Joint Chiefs also managed to destabilize ACDA's proposal for reductions through arguments based on strategy. In July 1966, General Wheeler's Special Studies Group submitted a wargaming analysis, claiming that reductions as small as 15 percent could prevent the United States from accomplishing assured

[368] JCSM-14-66 to SecDef, 7 Jan 66, JCS 1731/907-1; Memo, ASD(ISA) to Joseph Califano, 7 Jan 66, JCS 1731/907-2; JMF 3050 (5 Jan 66) sec. 2, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 82.
[369] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 83.
[370] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.

destruction, and that at the same time, the Soviets would retain their assured destruction capability even through reductions exceeding 50 percent. The study argued that a freeze alone would be more advantageous to the United States in 1967 than in 1969, because of the accelerating Soviet buildup, but a freeze-and-reduce combination in 1967 would benefit the U.S.S.R..[371] The Joint Chiefs judged these conclusions revealed "*even more clearly the complex and potentially destabilizing nature of arms control proposals having [a strategic nuclear delivery vehicle] freeze and reductions as their basis*."[372]

ACDA would eventually drop its push for reductions in favor of limits above existing levels as a more "realistic" option. Given the resistance to reductions from the military establishment, and President Johnson's seeming reluctance to press ahead without their endorsement, on 13 January 1967, ACDA circulated a less ambitious plan simply to "level off" strategic offensive and defensive missile forces at approximately current levels (i.e. launchers that were either operational or already under construction).[373] The Joint Chiefs again expressed "serious reservations" about ACDA's proposal, including that it relied upon unilateral U.S. intelligence. They suggested informing the Soviets early in discussions that a freeze must be accompanied by appropriate on-site verification procedures.[374] Therefore, as 1967 began, U.S. leaders, guided by

[371] SM-290-66 to Chmn, SSG, 1 Apr 66, JMF 3050 (22 Mar 66). Rpt by CJCS SSG, "Freeze and Reduction of Offensive and Defensive Systems," 31 Jul 66, JMF 3050 (10 Mar 65) sec. 2B. Forwarded to SecDef via CM-1663-66 to SecDef, 5 Aug 66, JCS 1731/862-10, same file, sec. 2, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.
[372] JCSM-574-66 to SecDef, 10 Sep 66, JCS 1731/862-13, JMF 3050 (10 Mar 65) sec. 2., as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.
[373] Memo, Actg Dir, ACDA, to Cmte of Principals, 13 Jan 67, JCS 1731/957, JMF 755 (13 Jan 67) sec. 1, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.
[374] Memo, SecDef to CJCS, 18 Jan 67, JCS 1731/957-2; JCSM-30-67 to SecDef, 19 Jan 67, JCS 1731/957-1; JMF 755 (13 Jan 67) sec. 1. Printed in Foreign Relations: 1964–1968, vol. 11, pp. 426-429. Gen. McConnell wanted to provide detailed comments while the U.S. position was still in a formative

ACDA's initiatives, had started to converge toward limits on ICBMs as the leading policy proposal, but firm opposition from the Joint Chiefs prevented forward movement.

Imagery advances and the dissolution of opposition to ICBM limits

By the late 1960s, a mature CORONA program and a refined GAMBIT program would coincide with increased confidence expressed by the intelligence community toward arms control verification. In February 1967, the CIA issued a Special National Intelligence Estimate which took a more systematic examination of U.S. intelligence capabilities to monitor "certain limitations" of Soviet strategic weapons programs. Both resolution and coverage improvements had further reduced blind spots and some uncertainties in classifying observations as weapons or benign objects.[375] While still cautious, the estimate expressed growing confidence over verifiability, stating that "*in the continued absence of a large-scale Soviet program of deception and concealment we believe that we would almost certainly detect any extensive new deployment in strategic forces, although the Soviets probably could effect small-scale increases without our knowledge.*"[376] The CIA's use of the wording "almost certainly" was a confident choice that

stage, but the Chiefs decided against doing so. CSAFM-F-15-67 to JCS, 18 Jan 67; Dec on JCS 1731/957-1, 18 Jan 67, same file; as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 85.

[375] Message, [Redacted] 14562, MGen R. E. Greer, Dir/SP, to BGen J. L. Martin, DNRO Staff, 25 Mar 64 and Message, Spectre 2061, NPIC to AF Processing Lab (AFSPPL), 27 Mar 64 as cited in Perry, "A History of Satellite Reconnaissance Volume IIIA - GAMBIT," p. 136.

[376] "Special National Intelligence Estimate, SNIE 11–10–67, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Foreign Relations of the United States, February 14, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d169.

would begin to change the debate over verification by making clear the CIA position that on-site inspections were likely unnecessary for detecting militarily significant violations.

The Joint Chiefs were pressured to alter their position on verifiability of fixed land-based systems based on the CIA's report. Just a few weeks after the estimate, after making some minor adjustments, ACDA re-circulated its leveling-off plan. The Joint Chiefs advised Secretary McNamara and President Johnson that ACDA's latest version as a whole still was "*not in the national security interest of the United States*." They acknowledged, however, that the CIA's report on verifiability described U.S. capabilities as "*adequate now for timely detection of increases in…fixed ICBM and MR/ IRBM launch sites of known characteristics.*" Consequently, although still advocating on-site inspection, they did not object to a satellite-verified agreement on offensive systems that was confined to a freeze on fixed, land-based offensive systems.[377]

This change reflects a significant shift in the Joint Chiefs' position, which ultimately carried through other dimensions of the SALT negotiations. As recounted by one JCS historian:

> *"[A]rms control was one area in which the Joint Chiefs of Staff still wielded major influence. Since a treaty stood no chance of Senate ratification if they opposed it, the Joint Chiefs appeared to possess an untrammeled veto. That appearance, however, was not entirely accurate. For example, when the intelligence community concluded that the number of offensive launchers could be verified without on-site inspection, the Joint Chiefs of Staff really had no choice but to reverse their position."*[378]

[377] Memo, ActgDir, ACDA, to Cmte of Principals, 3 Mar 67, JCS 1731/966, JMF 755 (13 Jan 67), sec. 1. Memo, ASD(ISA) to CJCS, 7 Mar 67, JCS 1731/966-1; JCSM-143-67 to SecDef, 14 Mar 67, JCS 1731/966-2; same file, sec. 2. Distribution of JCSM-143-67 to the White House and the Committee of Principals is recorded in Memo, M. W. Roche to CJCS, 24 Mar 67, N/H of JCS 1731/966-2, 28 Mar 67, same file; as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 85.
[378] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 89.

This change is notable given that the military services were at the same time actively pushing for new nuclear weapon systems. Up until 1968 when McNamara rejected it, the Joint Chiefs were recommending starting a new "advanced ICBM program" at a cost of $79 million in FY 69. McNamara also rejected the Joint Chiefs' recommendation that year to procure a prototype "ballistic missile ship" for $120 million in FY 69.[379] These proposals indicate that military service leaders were still striving for a larger and more diverse nuclear force when the CIA's analysis of verification was released. The success of such proposals would run counter to a U.S. initiative to establish missile limits or reductions, given that existing systems were not yet slated for retirement. The Joint Chiefs' change of opinion is therefore most likely attributable to their reluctant acceptance of CIA assertions on the verifiability of arms control, which the Joint Chiefs had positioned as their primary argument against the measure.

With the Joint Chiefs' objections muted, Johnson was left unhindered to express willingness toward the Soviets to engage in arms control using unilateral satellite verification. In an April 1968 letter to Chairman Kosygin, President Johnson addressed what he described as "the long overdue question of our discussion in regard to offensive and defensive ballistic missiles." Johnson emphasized the urgency of the issue, stating that "each passing month increases the difficulty of reaching agreement on this matter as, from a technical and military point of view, it is becoming more complex." An early draft of the letter stated a belief that "meaningful strategic

[379] "Draft Memorandum from Secretary of Defense McNamara to President Johnson," Foreign Relations of the United States, January 15, 1968, Washington National Records Center, OASD/ISAFiles: FRC 330 72 A 1499, 320.2 1968 I–35149/68 8 Feb 1968. https://history.state.gov/historicaldocuments/frus1964-68v10/d200

arms control constraints…can be adequately verified by relying on our respective national capabilities."[380] While this line along with other technical and strategic details were ultimately removed from the final, simplified version that went to Kosygin, the drafts point to the gradual solidification of the U.S. position on verification even if the administration was not yet ready to press the view with the Soviets.[381]

An updated version of the CIA's Special National Intelligence Estimate in 1968 revealed an even greater increase in their confidence to verify fixed ICBMs. At this point, the CIA wielded a mature GAMBIT program across both KH-7 and KH-8 satellite designs. Imagery resolution had continued to advance due to more consistent GAMBIT flights, and coverage improved with KH-8's increased film capacity that allowed for more imagery from GAMBIT missions. The CIA's report stated:

> *"We have a high degree of confidence in our ability to detect fixed strategic offensive missile sites. It is highly unlikely that any ICBM launch complexes remain undetected, and we believe we have accounted for all the launch sites in the MRBM/IRBM force. Virtually all operation sites in the present ICBM force were detected…prior to becoming operational…Assuming the Soviets continue to follow current construction and deployment practices, it is highly unlikely that a strategic missile site would reach operational status before being detected."*[382]

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[380] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Bohlen) to Secretary of State Rusk." Foreign Relations of the United States, April 5, 1968. Washington National Records Center, RG 383, Central Policy File: FRC 86 A 5, Folder 2915. https://history.state.gov/historicaldocuments/frus1964-68v11/d231.

[381] The final letter delivered to Kosygin removed much of the strategic and technical details in earlier drafts. See Tab B within footnote 39 compared to "Letter from President Johnson to Chairman Kosygin." Foreign Relations of the United States, May 2, 1968. Department of State, Pen Pal Correspondence: Lot 77 D 163, Special U.S.-U.S.S.R. File, Pen-Pal Series, 1968. https://history.state.gov/historicaldocuments/frus1964-68v11/d237

[382] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://dp.la/item/09fb021f99dfeed2e70e1b06f519afb7.

The advances of GAMBIT and CORONA, together with ACDA's position and CIA confidence, helped formalize the U.S. position on verification articulated to the Soviets that the United States was prepared to consider placing "*maximum reliance*" on national means of verification for strategic offensive and defensive weapon systems.[383] Shortly following the release of the CIA's 1968 verification assessment, an interagency working group put forth a draft U.S. opening position on SALT. The position included the cessation of construction on new strategic offensive land-based missile launchers, and that neither side would be permitted to deploy more than 1,200 ICBM launchers. The position also stated that enlarging existing silos, changing basic external configuration of silos and other launchers, and the relocation of launchers would be prohibited. The position also attempted to extend the construction freeze to IRBMs (ranges greater than 1,000 km) and to prohibit the retrofitting of existing IRBM launchers to accommodate ICBM missiles.[384]

The CIA's 1968 report still expressed lingering uncertainties on the verifiability of ICBMs related to the remaining temporal blind spot. It noted that the Soviets could "*probably*" retrofit new or improved ICBMs into old silos without detection. It also noted that while the installation

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[383] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Bohlen) to Secretary of State Rusk." Foreign Relations of the United States, April 5, 1968. Washington National Records Center, RG 383, Central Policy File: FRC 86 A 5, Folder 2915. https://history.state.gov/historicaldocuments/frus1964-68v11/d231.

[384] "Paper Prepared by the Interagency Working Group, 'STRATEGIC MISSILE TALKS PROPOSAL.'" Foreign Relations of the United States, July 31, 1968. Johnson Library, Clifford Papers, Kosygin-Talks with Soviet Union (2), Box 22. https://history.state.gov/historicaldocuments/frus1964-68v11/d264; "Paper Approved by the Executive Committee of the Committee of Principals: Strategic Missile Talks Proposal." Foreign Relations of the United States, August 14, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269#fn:1.5.6.2.778.30.6.3.

of ICBMs into IRBM silos would require "*considerable modification*," U.S. intelligence could not necessarily confirm the fact or extent of a retrofit program.[385] Defense planners homed in on this deficiency. In a memo to President Johnson, they argued that while they now had confidence in the United States' ability to monitor fixed systems, "*we have low confidence that we can verify the prohibition against upgrading IR/MRBM launchers to an ICBM capability."* This assertion was used to justify DOD's position that it "*would consider [Soviet] failure to provide us with adequate assurances, as needed, as constituting grounds justifying our withdrawing from the agreement."*[386]

Concerns related to remaining satellite blind spots were also used to strengthen arguments for modernization in the context of the Minuteman III, a new MIRV-ed variant of the Minuteman II. These arguments were intertwined with uncertainty related to Soviet MIRV and ABM developments as examined later in this chapter. For example, in his case to the Senate for the Minuteman III, Secretary of Defense McNamara pointed to the potential of a large Soviet ICBM force with a substantial hard target kill capability that might be able to destroy a large number of U.S. Minuteman missiles in their silos. To this he added that an extensive, effective Soviet ABM defense might then be able to intercept and destroy a large part of residual U.S. warheads, including those carried by submarines. Fears of the Soviet ability to achieve an effective MIRV and ABM capability undetected within satellite blind spots were present throughout these

[385] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://dp.la/item/09fb021f99dfeed2e70e1b06f519afb7.
[386] "Memorandum From Secretary of Defense Clifford to President Johnson; Subject: Proposal for Limiting Strategic Offensive and Defensive Systems." Foreign Relations of the United States, August 13, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d268.

debates and pointed to as a reason for hedging against such possibilities. While McNamara noted that there was no evidence of these developments yet, the implication was that such activities were possible. Such statements would help lay the groundwork for future investment and momentum with the Minuteman III program. In the Secretary's words, "Fortunately, we can convert the entire force to Minuteman III, increase the number of warheads each Minuteman missile could carry, emplace the entire Minuteman III force in super hard silos, and/or protect the Minuteman force with an ABM defense."[387]

While the Johnson administration did not have an opportunity to move forward with its position due to the Soviet invasion of Czechoslovakia, the U.S. bureaucracy was solidifying its position on the viability of satellite-based verification for limits on fixed offensive systems. Secretary of State Dean Rusk countered lingering arguments about the "imperfection" of verification by satellites by arguing that in all cases, the U.S. could be confident in its ability to detect violations before they could measurably alter the strategic balance. He asserted that even in areas where U.S. intelligence capabilities are lowest, it would still be in American interest to propose limitations since "*potential violations would not significantly affect our security and the limitations would provide inhibitions to Soviet actions which they might otherwise freely undertake if no agreement existed."*[388]

[387] "Statement by Secretary of Defense McNamara," Congressional Record, Senate, June 13, 1968, p. 17214-17215.

[388] "Memorandum From Secretary of State Rusk and the Director of the Arms Control and Disarmament Agency (Foster) to President Johnson." Foreign Relations of the United States, August 15, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269.

Extension of limits to ballistic missile submarines

In the late 1960s, nuclear-armed ballistic missile submarines were becoming a new area of development and competition. Given that the Soviet Union lagged nearly 10 years behind U.S. ballistic missile submarine development, submarines were largely absent from arms control discussions until the late 1960s. The first Soviet ballistic missile submarine became operational in 1968, by which time the United States had fielded over 40.[389] While there was an early push by some for submarines to be included in arms control, even to the extent of eliminating them (on the basis of arguments rooted in strategy rather than verification), Navy leadership firmly objected to such suggestions. For instance, in March 1965, the Joint Chiefs conducted a study analyzing proposals for freezing offensive and defensive systems on the basis of wargaming. One of its findings was that *eliminating* submarine-launched ballistic missiles "*would appear to be an attractive segment to explore for arms control agreements*." Navy leadership objected to this statement, and it was then revised to note that the large damage potential of bomber-delivered weapons overshadowed the small yield of Polaris.[390]

As it became clear that the Soviet Union was close to fielding its own submarine-based nuclear capability, the CIA analyzed the verifiability of submarines as part of its 1967 Special National Intelligence Estimate. Language on submarines is not declassified, but a subsequent presentation by Director of Central Intelligence Helms to President Johnson clarified some aspects of CIA capabilities at the time. Given that the report was rife with the language of estimation and

[389] Cochran, Thomas, William Arkin, Robert Norris, and Jeffrey Sands. *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons*. Cambridge: Ballinger Press, 1989.
[390] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 82.

caveats, Johnson asked for a translation into a number reflecting odds. Addressing nuclear-armed submarines, Helms responded that "*as to detecting units of an entirely new class before IOC, we have put the odds in the 65% to 85% bracket. As to detecting new units of an existing class before delivery to the fleet, we put the odds about even; 50–50.*"[391]

This relatively weak level of confidence in verifiability prompted doubts among defense planners about the feasibility of including submarines in arms control. Early in October 1967, Secretary McNamara solicited the Joint Chiefs' views about an NSC and State proposal that included, among other measures, limiting SLBM launchers to those that were operational or under construction. The Joint Chiefs found these proposals objectionable because they considered sea-based systems to be "*unverifiable*," and because they believed the proposal "*failed to protect assured destruction and damage-limiting capabilities*," and "*did not provide for continued U.S. strategic superiority.*"[392] ACDA acknowledged the persistent difficulty of verifying via satellites the deployment of sea-based or mobile land-based strategic missile launchers, but still supported the possibility of an agreed limitation to these weapons.[393]

[391] "Letter From Director of Central Intelligence Helms to the President's Special Assistant (Rostow)," March 18, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d175.
[392] Memo, SecDef to CJCS, 4 Oct 67, JCS 1731/983; Notes to Control, "JCS 1731/983," 25 and 30 Oct 67; JCSM-598-67 to SecDef, 2 Nov 67, JCS 1731/983-1; JMF 755 (13 Jan 67) sec. 2., as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 86.
[393] "Memorandum From the Deputy Under Secretary of State for Political Affairs (Bohlen) to Secretary of State Rusk." Foreign Relations of the United States, April 5, 1968. Washington National Records Center, RG 383, Central Policy File: FRC 86 A 5, Folder 2915.
https://history.state.gov/historicaldocuments/frus1964-68v11/d231.

The CIA's updated 1968 release of the Special Estimate put forth a significantly more confident assessment than Helms' 1967 briefing to Johnson. The report stated

> "*We probably would be able to identify units of a new class prior to delivery to the fleet (i.e., during the 6-12 month fitting-out period after launch) … we believe our current missile submarine order-of-battle is highly accurate. Once new units have joined the fleet, they seldom escape detection for very long. While a modest buildup in missile submarine strength could, therefore, escape detection for a time, a more extensive buildup almost certainly would be detected before a significant number of units had joined the fleet. The Soviets could increase the number of launch tubes by modifying existing submarines; we believe that we could detect such modifications during the retrofit period. Our ability to distinguish between a new cruise missile submarine and a ballistic submarine is high*."[394]

This increase in the CIA's confidence to verify submarines – a mobile target that was subject to previous concerns about verifiability – appears to be the result of satellite advances through the maturation of CORONA and deployment of GAMBIT KH-8, which occurred over the interim period. The satellite had more than twice the film capacity of its predecessor, two recovery capsules (meaning imagery could be recovered in the middle of a mission rather than only at the end), and an extended mission life. Together with the increased reliability of CORONA missions by this time, NPIC would have had the regular coverage necessary to comprehensively monitor a ballistic missile submarine force.[395]

The 1968 CIA report appears to have played a role in facilitating ACDA's efforts to achieve an agreed position for the forming SALT process. Following the CIA's report, ACDA circulated an

[394] "SNIE 11-13-68, 18 Jul 68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://catalog.archives.gov/id/7327189.
[395] Perry, "A History of Satellite Reconnaissance Volume IIIA – GAMBIT," p. 231.

arms control proposal that included, among other limits, prohibiting the construction of new missile submarines after a fixed date, as well as the placement of additional launchers on existing submarines (although missile improvements and retrofitting would be allowed). The Joint Chiefs agreed that "*on balance*" and with "*essential modifications*," the ACDA proposal defined an acceptable framework. They objected that construction of missile submarines could not be discovered until a few were already at sea, but did not actively attempt to obstruct ACDA's proposed limits in this area.[396] McNamara and Johnson were already supporting advances to the Navy's Poseidon submarine force and Polaris SLBMs, so the most likely explanation for this lack of resistance appears to have been the Navy's recognition that submarine force expansions were widely seen as a necessary component for a secure second strike, and that this leg was not in great jeopardy on the arms control table.[397] A domestic consensus position emerged by August 1968, which for submarines included a ban on new construction after a fixed date, with no limit on retrofitting existing submarines. The position also called for a ban on replacing submarines for a period of at least five years, until a new agreement could be reached. All provisions were agreed to be verified by national technical means.[398]

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[396] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 87.

[397] "Draft Memorandum from Secretary of Defense McNamara to President Johnson," Foreign Relations of the United States, Januray 15, 1968, Washington National Records Center, OASD/ISA Files: FRC 330 72 A 1499, 320.2 1968 I–35149/68 8 Feb 1968. https://history.state.gov/historicaldocuments/frus1964-68v10/d200

[398] "Paper Prepared by the Interagency Working Group, 'STRATEGIC MISSILE TALKS PROPOSAL.'" Foreign Relations of the United States, July 31, 1968. Johnson Library, Clifford Papers, Kosygin-Talks with Soviet Union (2), Box 22. https://history.state.gov/historicaldocuments/frus1964-68v11/d264; "Paper Approved by the Executive Committee of the Committee of Principals: Strategic Missile Talks Proposal." Foreign Relations of the United States, August 14, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269#fn:1.5.6.2.778.30.6.3.

Early efforts to exclude long-range bomber aircraft

Despite their treatment as established weapon systems, long-range bomber aircraft were not seriously considered for inclusion in arms control under the Johnson administration. Bombers were seen as part of an effort to wage nuclear war once it had already begun, rather than as a first strike weapon, as well as a means to force an adversary to divert resources to defend against aircraft that might otherwise be used for offensive systems.[399] In the context of early analyses of a strategic weapons freeze between the United States and the Soviet Union, the Joint Chiefs' Special Studies Group had found that eliminating bombers would lessen American capabilities far more than Soviet capabilities, particularly given that the United States maintained a significant lead in bomber deployments.[400] Despite the objective availability of measures to verify bombers via satellites, as a result of strategic disinterest across decision-making groups in controlling them, bombers were not addressed in the early scope of SALT, and the CIA's Special National Intelligence Estimates in 1967 and 1968 did not examine their verifiability. The Johnson administration came up with many variations for SALT packages, but common to all of them was the principle that bombers should not be included in an agreement.[401]

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[399] "Draft Memorandum from Secretary of Defense McNamara to President Johnson." Foreign Relations of the United States, September 22, 1966. Johnson Library, National Security File, Agency File, Department of Defense, FY 68–72 Strategic Offensive and Defensive Forces, Box 18. https://history.state.gov/historicaldocuments/frus1964-68v10/d139.

[400] CM-442-65 to JCS, 2 Mar 65; SM-214-65 to Chmn, Special Studies Group, 10 Mar 65; JMF 3050 (10 Mar 65) sec. 1. Rpt by CJCS Special Studies Group, "The Security Implications of a Freeze on Strategic Offensive and Defensive Systems," 1 Dec 65, same file, sec. 1A, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 82.

[401] "Paper Prepared by the Interagency SALT Steering Committee." Foreign Relations of the United States, May 30, 1968. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–139, National Security Study Memoranda, NSSM 28. https://history.state.gov/historicaldocuments/frus1969-76v32/d14#fn:1.5.4.4.8.50.62.2.

Despite early exclusion of bombers from the SALT framework, the Johnson administration still foresaw a complex role for them in the negotiations. They anticipated that the Soviets might raise the issue and questioned whether the U.S. should be prepared to accept limits on bombers or air defense if the Soviets insisted. They also questioned whether agreement could be reached on the definition of the systems to be included.[402]

Nixon, Kissinger, and the constricting of the U.S. arms control bureaucracy

As the Nixon administration took office, there was a growing imbalance between U.S. and Soviet forces. While the United States had not built any ICBM launchers since 1967, the Soviets had been adding 250 ICBM launchers per year since then, building up from 300 in 1966, to 1,300 by 1970. Each time imagery from satellites was delivered showing a seemingly relentless build-up of ICBM silos, U.S. decision-makers wondered when the Soviet build-up would ever stop.[403] Along with the ICBM buildup, satellite images were also showing steady increases in Soviet nuclear-armed submarines. In 1969, the Soviets began building seven or eight strategic submarines with 112 to 128 missile launchers each year – the annual addition being equal to the

[402] "Paper Prepared by the Interagency SALT Steering Committee." Foreign Relations of the United States, May 30, 1968. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–139, National Security Study Memoranda, NSSM 28. https://history.state.gov/historicaldocuments/frus1969-76v32/d14#fn:1.5.4.4.8.50.62.2.
[403] Smith, Gerard. *Doubletalk: The Story of the First Strategic Arms Limitation Talks*. Garden City: Doubleday & Company, Inc, 1980, p. 105.

size of its SLBM fleet in 1968.[404] This appears to have contributed to a growing urgency among the U.S. bureaucracy, including the defense establishment, in restarting the SALT process.[405]

From the beginning of his tenure, Nixon recognized the political dimensions of verification and his ability to interpret and determine standards of adequacy. Having campaigned on a platform of restoring U.S. nuclear superiority, Nixon came at the issue of arms control with a great deal of caution and attention to the verifiability of prospective control measures. He wrote to Gerard Smith, his appointed Director of ACDA that "...I will accept limitation on our forces only after I have assured myself of our ability to detect Soviet failure to implement limitations on their own forces in sufficient time to protect our security interests...I recognize that this may not be obtainable with 100 percent assurance; but the margin of uncertainty must be reasonable. I will make this judgement."[406]

A central individual in SALT under the Nixon administration was Henry Kissinger as the President's National Security Advisor. He viewed SALT not only as an arms control process, but as a potential channel through which to resolve a wide variety of issues with the Soviet Union, including problems in Vietnam. This hope of using SALT as a bargaining chip with the Soviets appeared endangered to Kissinger by the fact that the State Department, Congress and the media were pushing for SALT to begin immediately as Nixon took office. For this reason, Kissinger

[404] Smith, Gerard. *Doubletalk: The Story of the First Strategic Arms Limitation Talks*. Garden City: Doubleday & Company, Inc, 1980, p. 105.
[405] "Paper Prepared in the Department of Defense." Foreign Relations of the United States, February 6, 1969. Ford Library, Laird Papers, Box 22, SALT, Chronological File. https://history.state.gov/historicaldocuments/frus1969-76v32/d2.
[406] Letter from President Nixon to the Director of the Arms Control and Disarmament Agency (Smith), Washington, July 21, 1969, Foundations of Foreign Policy, p. 89.

quickly sought to reduce the role of these external forces and consolidate power over the negotiations within the White House.[407] ACDA Director Gerard Smith recalls: [408]

> *"A serious flaw was that Kissinger…had too much influence. I must say that he had us all buffaloed. Nothing could go forward without his approval, be it a press release, a briefing of the North Atlantic Council or an interagency study on a major aspect of the negotiation… At times, he seemed to be the only one in the cast of SALT characters who was free to take initiatives. Presumably he was at all times consulting with the President and merely passing on his wishes, but it seemed quite clear that Kissinger was often acting as a principal, not an agent."*

Kissinger himself confirms these suspicions in his memoirs, recalling that the President only cared about the broadest outlines and political consequences of SALT decisions, and thus Kissinger took on a great deal of the decision-making responsibilities. Nixon seldom made SALT decisions at National Security Council meetings, instead taking them before or after meetings, with Kissinger's counsel, then circulating decisions as National Security Decision Memoranda (NSDMs). Kissinger created and used the "Verification Panel" – a group composed of the Deputy Secretary of Defense, the Chairman of the Joint Chiefs, the Under Secretary of State, the Director of ACDA, the Director of the CIA and the Attorney General – to inform and prepare himself to brief the President and to guide NSC meetings in the direction he deemed desired by the President.[409] Kissinger was decently versed in the technicalities of the issues, including verification, due in part to advising from scientists of the Dotey group, drawn from the arms control epistemic community, which he kept private.

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[407] Kissinger, Henry. *The White House Years*. Boston: Little, Brown, 1979, p. 138.
[408] Smith, *Doubletalk*, p. 109.
[409] Smith, *Doubletalk*, pp. 110-111.

Blind spots and fears of clandestine modernization

A new verification study produced under the Nixon administration solidified concerns that the Soviet Union could modernize or upgrade its forces in ways that could go undetected due to satellite blind spots. In September 1969, the Verification Panel released a paper that laid out current capabilities and uncertainties related to the unique verifiability of each weapon type (see **Figure 3.1**).[410] The paper again expressed confidence in the ability to detect the development of new ICBMs. However, with respect to possible illegal deployment of additional fixed offensive systems, the paper cited that approximately 100 launchers could go undetected and that 100–200 launchers might not be detected until first few were operational. This concern was framed in terms of the possibility of a deception campaign, with OSD and the JCS expressing doubt that new activity on a large scale could be identified as missile deployment if concealed under buildings or in mines. The report also expressed a lack of confidence in the ability to detect the installation of ICBMs into IRBM launchers or the substitution of new ICBMs for older designs (e.g., placing SS-9s into SS-7 silos), reflective of the remaining temporal blind spot.

Arguments about the risk of clandestine modernization within blind spots were also expressed for submarines.[411] The Verification Panel report noted that under conditions of maximum concealment, the CIA, State Department, and ACDA believed an illegal increase of 5–10

[410] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.

[411] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://dp.la/item/09fb021f99dfeed2e70e1b06f519afb7.

submarines, equating to hundreds of launchers, could be detected within a year and certainly would be detected in a two-year period. The Joint Chiefs and OSD believed this assessment was overly optimistic, arguing that the size of illegal increase or period of time required for detection were unknown. The picture for submarine-launched ballistic missiles was less optimistic, noting that chances were "about even" that intelligence would detect clandestine development of a new missile.

For established weapon systems of ICBMs and SLBMs, the Verification Panel's report helped solidify confidence in the verifiability of limits, but uncertainties about substitution and modernization within blind spots were used to leave both areas open to modernization and MIRV-ing, as examined in the respective section of this case study.

For Land Mobile MR/IRBM and ICBM Launchers
If banned:
- with normal Soviet practices, we would detect deployments within 100 after 200 had been deployed.
- we would detect a clandestine build-up of fewer than 200–300 missiles if Soviets exercised force.
- Soviets could conceal 200–300 mobiles if they did not exercise force.

If limited:
- for limits on the order of 200, the Soviets might exceed permitted force by 200–400.
- for limits on the order of 1000–1500, Soviets probably could not exceed that by more than 500 and remain undetected.

For the Deployment of Additional Fixed Offensive Missile Launchers
- 100 illegal launchers might go undetected.
- 100–200 illegal launchers might not be detected until first few were operational.
- OSD/JCS doubt "suspicious new activity on large scale … could be positively identified as missile deployment if concealed under buildings or in mines.

For the Potential Upgrades or Substitutions | No real confidence on the detection of the installation of ICBMs into MR/IRBM Launchers; Soviets might be able to substitute SS–9s for SS–7s without US detection

For the Development of New Strategic Missiles
For ICBMs | State/CIA/ACDA believe we can confidently monitor ban on the development of a new ICBM. OSD/JCS disagree, believing Soviets could double missile payload and improve accuracy without our knowing it.
SLBMs and MR/IRBMs | Chances are "about even" that we would detect clandestine development of a new MR/IRBM or SLBM.

For Accuracy Improvements | (other than by changing re-entry vehicle shape) Virtually impossible to determine that the Soviets were improving accuracy through guidance system improvements.

MIRVs | State/CIA/ACDA believe we can monitor Soviet MIRV developments even if the Soviets do it clandestinely. OSD/JCS do not believe we can confidently monitor a MIRV test ban. OSD/JCS believe bans on multiple payloads in space and exoatmospheric penaid testing are mandatory collateral restrictions. State/ACDA/CIA believe these are desirable but not mandatory.

ABMs | Mobile Launchers - 100–150 mobile ABM launchers might escape detection for several years. (OSD/JCS believe the number could be substantially higher.)

Reload Capability | Might escape detection.

Radars | Disagreement over whether a clandestine ABM radar program could be detected. State/ACDA/CIA believe problems of radar deployment, operation so complex that we would detect large scale 5–10 clandestine radar program. OSD and JCS believe implementing a clandestine radar program is not as complex and difficult as State/ACDA/CIA believe.

Upgrading SAMs to ABMs | Upgrading SAM systems to give them some form of limited ABM capability … primarily through netting with existing ABM radars would be difficult if not impossible to determine. OSD/JCS believe Soviets could deploy clandestinely 5–10 new acquisition radars and take other actions to allow "covert deployment of a limited ABM capability."

Limiting ABM-associated Radars | State/ACDA believe a limit on number of ABM-associated radars is a mandatory collateral restriction to an ABM launcher limit. JCS believe that because it is not possible to differentiate unambiguously among radar types, an effective ABM radar limit is not practical.

Ballistic Missile Launchers/Submarines | Under conditions of maximum concealment, State/CIA/ACDA believe an illegal increase of 5–10 submarines could be detected within a year and certainly would be detected in a two-year period.
JCS/OSD believe this assessment is optimistic and that we do not know what size of illegal increase or what period of time would be required for detection.

Figure 3.1. Findings of a Verification Panel Report presumed to be compiled by the verification working group. [412] Colors indicate measures deemed mostly verifiable by satellites (green), possibly verifiable (orange), or difficulty to verify (red).

[412] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.

Nixon administration's use of verifiability to shape the U.S. opening position on SALT

The 1969 report formed the basis of understanding on verification as the Nixon administration worked to solidify a U.S. opening position. As formal negotiations scheduled to begin on 16 April 1970 approached, there was still no domestic consensus. Kissinger thus developed a strategy for dealing with the disagreement, deciding to organize positions along the lines of four different "packages" – Option A, B, C and D – that each roughly aligned with the views of opposed domestic organizations (**Figure 3.2**). For fixed ICBMs, limits were the same across Options A, B and C, with Option D including reductions. These four options were presented at an NSC meeting on 8 April 1970.

As Kissinger proceeded to present the four options and entertain the views of the various organizations represented, he recalls,

> *"…[the discussion] had all the elusiveness of a Kabuki play. Each department invoked complicated technical arguments in which the same facts were used to produce radically different conclusions... All of this feinting and posturing was performed before a President bored to distraction. His glazed expression showed that he considered most the arguments esoteric rubbish; he was trying to calculate the political impact and salability of the various options, of which only the broad outlines interested him."*[413]

Kissinger himself preferred Option B, believing it would give the United States the greatest flexibility for modernization. Indeed, Option B allowed research, development and modernization across the areas of ICBMs, SLBMs, ABMs, and MIRVs, compared to other options that included bans or reductions. He believed Option B would arrest the Soviet offensive

[413] Kissinger, *White House Years*, p. 542.

buildup, which he viewed as the most urgent concern, and would provide a ceiling from which later reductions could be negotiated. He made sure that under Option B the United States would freeze ABMs – which Congress was in the process of killing anyway – in exchange for a Soviet freeze on offensive weapons that they were still building.[414] Yet, by having limited ABM systems around national capitols, the so-called National Command Authority (NCA) option, the U.S. would be able to continue research and development. Kissinger also saw MIRV as a crucial technological development wherein lay the U.S. counterweight to the growing Soviet numbers.[415]

	Offensive systems	**Defensive systems**	**Other**
Option A, supported by DOD and the Joint Chiefs	Limit ICBMs and SLBMs to the U.S. total of 1,710 (with freedom to mix) and freeze bombers (527 for the U.S. and 195 for the Soviets)	"Safeguard"-level of ABM (twelve sites)[416]	MIRVs permitted
Option B, supported by Kissinger	Same as Option A	ABM limited to National Command Authorities (NCA, i.e., Washington and Moscow) or banned	MIRVs permitted
Option C, supported by ACDA	Same as Option A	Same as Option B	MIRVs banned
Option D, supported by DOS and ACDA	Reduction from 1,710 ICBMs and SLBMs by 100 per year until both sides reach a level of 1,000 by 1978	Same as Option B	MIRVs permitted

Figure 3.2. The four SALT options assembled by Kissinger and considered by U.S. decision makers at a National Security Council meeting on April 8, 1970[417]

[414] Kissinger, *White House Years*, p. 543.
[415] Kissinger, *White House Years*, p. 549.
[416] The Safeguard Program was an anti-ballistic missile (ABM) system designed to protect Minuteman ICBM silos from attack.
[417] "Memorandum of Conversation, SALT," April 8, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–109, NSC Minutes Originals 1970. Top Secret; Sensitive. The meeting was held in the Cabinet Room. According to the President's Daily Diary, this NSC meeting took place from 9:36 to 11:19 a.m. (Ibid., White House Central Files). https://history.state.gov/historicaldocuments/frus1969-76v32/d65.

Despite this view, Kissinger did not deem it wise to openly advocate for Option B. He recalled: *"… had Option B been put forward as our preferred position, all hell would have broken loose both in the Congress and in the bureaucracy. It would have been claimed that we had never even "explored" a ban on ABM and MIRV. It would have had a tepid reception in the Pentagon, which while not eager to build "Safeguard," was not prepared to embody its convictions in an offer to limit it…".*

In the midst of this domestic bargaining process, verifiability appears to have been used a tool to shape the perception of an objective and reasonable path forward among the four options. During the NSC Meeting, President Nixon proceeded with a line of questioning to Director of Central Intelligence Richard Helms that tailored to the already-formed preference of Option B. The questions were clearly intended to convince others in the room rather than for his own knowledge. Nixon asked Helms whether submarines and ICBMs were easy to verify, and Helms replied in the affirmative. Nixon then asked about verification effectiveness for ABMs, and Helms replied that these are also fairly easy to verify. Nixon summarized that obviously MIRV is the toughest problem, noting the CIA's assertion that it was straightforward to detect the presence of tests but not verify the exact characteristics or the number of missiles that have MIRV potential.[418] The implication was that MIRVs must be allowed.

[418] "Memorandum of Conversation, SALT," April 8, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–109, NSC Minutes Originals 1970. Top Secret; Sensitive. The meeting was held in the Cabinet Room. According to the President's Daily Diary, this NSC meeting took place from 9:36 to 11:19 a.m. (Ibid., White House Central Files). https://history.state.gov/historicaldocuments/frus1969-76v32/d65

In order to satisfy the need for perceived domestic consensus building, Kissinger recommended to the President Options C and D be taken as opening positions. He describes his reasoning:

"[Doing so] would respond to Congressional and bureaucratic supporters of MIRV and ABM ban; it would give us the positive public posture of having favored comprehensive limitations. If the Soviets accepted the proposals, we would have made a major step forward. If the Soviets rejected them, as a I firmly expected, we could then put forward Option B from a much stronger domestic and bureaucratic position… The President agreed. On 10 April I issued instructions accordingly."

Kissinger then effectively set up the transition from Option C and D toward Option B through a backchannel that would play a major role in the negotiations. He told Soviet Ambassador Anatoly Dobrynin privately that the U.S. delegation would present several comprehensive proposals at Vienna, but that if the Soviets decided they were interested in a more limited agreement in the interim, the United States was prepared to explore it.[419] Unsurprisingly, as negotiations began on 16 April, with the U.S. delegation presenting Option C and D, the offensive limitations in both schemes were quickly rejected by the Soviet negotiators, whereas the proposal to limit ABMs to national capitols was accepted quickly.

With this series of events, the prospect for reductions in ICBMs and SLBMs was eliminated on the basis of Soviet refusal, as facilitated by Kissinger. Objectively, the Soviets' rejection of the U.S. proposals concerning offensive systems was unsurprising: Even the U.S. proposals for limitations (versus mutual reductions) essentially required a reduction of the Soviet missile force while leaving the U.S. bomber force – then three times larger than the Soviet force – intact. However, Kissinger's maneuvering through the backchannel with Dobrynin further diminished

[419] Kissinger, *White House Years*, p. 545.

the prospect for mutual offensive ICBM reductions by privately communicating to the Soviets that the United States would be open to foregoing the request for reductions. Kissinger would direct his national security staff to rally support for the agreement based on the notion that it would keep the growing imbalance from worsening.[420]

Using verifiability and uncertainty to exclude long-range bomber aircraft

The Nixon administration's early efforts to formulate a position explored the inclusion of bombers. By this time, it was becoming clear to defense planners that the U.S. lead in heavy bombers would gradually erode over time if left unchecked.[421] The Office of the Secretary of Defense expressed support for consideration that bombers and air defense be included. Decision-makers were attuned to the fact that the Soviets had previously indicated an interest in bombers by saying that they wished to discuss "*armaments*" rather than merely "*missiles*."[422]

Nixon ultimately decided against including bombers in the opening proposals of SALT, with the Joint Chiefs having used verifiability concerns to push them off the table. General Wheeler asserted that the verification "problem" had been looked at closely in the past and that for many reasons, including the problem of defining bombers, would present the most difficult aspect of an arms control agreement. This issue of a definition for bombers was purposefully tied to verifiability. The Joint Chiefs viewed that there "*were uncertainties in new verification*

[420] Kissinger, *White House Years*, pp. 1232-1233.
[421] Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 82.
[422] "Minutes of a Review Group Meeting." Foreign Relations of the United States, June 12, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–109, NSC Minutes Originals 1969. https://history.state.gov/historicaldocuments/frus1969-76v32/d17.

capabilities which were neither operative now nor had the full confidence of some military technical experts." As Kissinger wondered aloud whether these objections were peculiar to bombers or whether they applied to all the options, General Allison replied that his concerns were directed at this particular proposal.[423] As a result of domestic indecision and push back from defense planners, the Nixon administration did not assess the verifiability of bombers in its 1969 Verification Panel Working Group Paper, and it did not include bombers in its opening talks with the Soviets in Helsinki from November to December 1969.

Because of Soviet insistence, bombers were worked into the U.S. negotiating options formulated by Kissinger. Each of his four options (Option A, B, C and D) in 1970, included a freeze on bombers, which at the time meant approximately 527 for the United States and 195 for the Soviets, alongside limits to ICBMs and SLBMs. The Soviet response to the U.S. proposals in Vienna retained bombers, with the specific Soviet position calling for a ceiling on the aggregate number of ICBMs, SLBMs and heavy bombers. They offered no numbers, but they insisted on counting all systems capable of reaching the U.S.S.R. by virtue of their geographical deployment – in other words, all U.S. bombers in Europe and on aircraft carriers.[424]

Over the latter half of 1970, as the SALT negotiations stalled due to parallel issues in Vietnam and in Berlin, the Soviets would use their leverage to push for the SALT process to settle for an

[423] "Minutes of a Review Group Meeting, White House Situation Room, NSSM 28— 'Stop Where We Are' Proposal." Foreign Relations of the United States, June 19, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H–Files), Box H–038, Review Group, SALT "SWWA" 6/19/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d20.
[424] Kissinger, *The White House Years*, p. 545.

ABM-only agreement (i.e. without any offensive limitations for bombers or missiles).[425] Kissinger and Nixon had become wary of coming Congressional pressure to halt ABM spending given their view of it as "*ineffectual and menacing to strategic stability*," while Kissinger viewed the ABM program as a key bargaining chip in getting Soviets to halt their offensive buildup.[426] The continued delay with the Soviets served to erode U.S. domestic support for a comprehensive agreement, with views in the U.S. bureaucracy converging toward settling for an ABM agreement alone.[427] Public pressure for an ABM-only agreement at this time was also building. In January 1971, Kissinger claims that "*the New York Times accepted the Soviet ABM offer for us*," condemning the President's insistence on linking offensive and defensive weapons.[428]

When the dust finally settled, bombers were no longer in the picture. Nixon's goal had been to convince the Soviets that an ABM agreement must be negotiated together with offensive limits before domestic pressures removed all U.S. bargaining leverage on ABMs from the negotiations. An eventual breakthrough emerged via Kissinger's backchannel with Soviet Ambassador Dobrynin in May 1971, which was achieved in part due to Soviet perception of Nixon's determination to move forward with the Safeguard ABM system despite its unpopularity, as well as Kissinger's threat to move discussions on both SALT and Berlin from the backchannel into official channels. This strain on the negotiations effectively caused them to be stripped down to

[425] Kissinger, *The White House Years*, p. 556.
[426] Kissinger, *The White House Years*, p. 799.
[427] Kissinger, *The White House Years*, p. 806.
[428] "Russia's SALT Offer." *The New York Times*, January 17, 1971. https://www.nytimes.com/1971/01/17/archives/russias-salt-offer.html?searchResultPosition=1; Kissinger, *The White House Years*, p. 811.

what decision-makers on both sides considered their most essential elements, which included the Soviets effectively dropping their claim that U.S. aircraft based abroad must be counted.[429]

Bending verification rules to allow for modernization

The issue of modernizing silo-based launchers and missiles was complicated by the American desire to limit Soviet modernization while pursuing its own upgrade of the Minuteman III. At first, the Americans were keen on the Soviets' suggestion that the agreement text prohibit any dimension increases to silos, seeing this as the easiest to verify.[430] However, this provision was intercepted by DOD which asserted that the new Minuteman III would require a dimension increase to US silos. This resulted in a changed American position for the agreement text to prohibit any "significant increase," defined as an increase greater than 10-15 percent of the present dimensions of silo launchers. The Soviets ultimately accepted this language along with the gains they had made on submarines. The optical capabilities of GAMBIT would allow for this measurement. To enhance confidence in verification, Nixon directed negotiators to ask for corollary constraints to be imposed on offensive systems, including a ban on relocation of existing ICBM silos or their modification in externally observable ways and a ban on construction of new silos for IRBMs.[431] This was an example of the U.S. administration taking

[429] Kissinger, *The White House Years*, p. 820.
[430] "Memorandum of Conversation between Brezhnev, Aleksandrov, Sukhodrev, Nixon and Kissinger." Foreign Relations of the United States, May 23, 1972. National Archives, Nixon Presidential Materials, NSC Files, Box 487, President's Trip Files, The President's Conversations in Salzburg, Moscow, Tehran, and Warsaw, May 1972, Part 1. https://history.state.gov/historicaldocuments/frus1969-76v14/d263.
[431] "National Security Decision Memorandum 69; Subject: Strategic Arms Limitation Talks." Foreign Relations of the United States, July 9, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–208, National Security Decision Memoranda, NSDMs 51–100. https://history.state.gov/historicaldocuments/frus1969-76v32/d94.

measures to mitigate verification uncertainty stemming from the temporal blind spot, whereas in other cases, such uncertainty would be used to push the weapon out of the scope of negotiations.

A final way that high imagery resolution was leveraged was to compel an urgency to conclude an agreement sooner than might have happened otherwise, despite less favorable terms for the United States. At an NSC meeting on 8 March 1971, CIA Director Helms reported that the U.S.S.R. now deployed 2.5 to 3 times more missile throw-weight than the United States and was attaining a 20 percent lead in ICBM launchers.[432] Helms also reported possible progress on MIRVs, discussing a satellite image showing "*canisters sitting near the SS–9 silos which [had] clusters of three warheads instead of a single warhead*."[433] A few months later, a special CIA report showed from satellite imagery that the Soviets were building two new types of silos indicated by differences in the site configuration and diameter of the silos. The CIA speculated that the new silos could be aiming to provide increased survivability for the existing SS–9 and SS–11 ICBMs, noting that concrete was observably thicker than in older silos, with steel reinforcements on the sides. Another possibility cited was that one or both of the two new types of silos may be for new missile systems which have not yet been tested.[434] The observation of these developments was used by Kissinger and Nixon toward the end of the negotiations to hold

[432] Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 95.
[433] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, March 8, 1971. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74. https://history.state.gov/historicaldocuments/frus1969-76v32/d137.
[434] "Minutes of a National Security Council Meeting, Subject: SALT," June 30, 1971. Source: National Archives, Nixon Presidential Materials, NSC Institutional Files (H–Files), Box H–110, NSC Minutes, Originals, 1971–6/20/74. Top Secret; SALT; Nodis; Codeword. The meeting took place in the Roosevelt Room at the White House. https://history.state.gov/historicaldocuments/frus1969-76v32/d170.

together dwindling support from the U.S. right-wing and the Joint Chiefs, which saw the emerging SALT offensive terms as increasingly imbalanced.

Arguments about limits and modernization within Congress

Because of the way Kissinger tightly managed much of the SALT process, there was little opportunity for U.S. leaders outside the circle of members present at National Security Council meetings to weigh in until the agreements were fully drafted. Nixon and Kissinger were careful to ensure that the documents went before Congress with unified support from the State Department and Defense Department leadership, and with verifiability assurances from the intelligence community. The SALT I Interim Agreement and the ABM treaty therefore faced little organized opposition in Congress. Still, the arguments made in Congressional debates in these later stages are reflective and consistent with those spun within the earlier NSC level debates. This continuity, including it continuation to later decades, points to the resilience of these arguments and the strength they were afforded through the use of satellite information and blind spots.

The importance of verifiability to achieve broader approval for the U.S. position on SALT was asserted frequently through Congressional hearings that followed the first circulated drafts of the agreements. As Chairman of the Committee on Foreign Relations presiding over the SALT hearings, Senator J.W. Fulbright of Arkansas stated, “I think that [verification] one of the

principal reasons why both sides felt they could enter into this agreement."[435] Other Senators, such as Hugh Scott of Pennsylvania asked, "The question I had is this: Will the national means of inspection be enough? Is there adequate certainty that cheating can be avoided?" Secretary Rogers replied, "Yes; we are fully convinced that that is the fact, Senator. This is a matter that was very carefully considered by our negotiators and all who worked in the field and there is no doubt in my mind that they will be adequate." [436] The Chairman of the Senate Armed Services Committee, Senator John C. Stennis, also proceeded with similar lines of questioning about verifiability.[437]

At the same time, assertions about the availability of information for verification were often directly linked with arguments about how that information also proved the necessity of modernization. During the hearings for the Senate Committee on Foreign Relations, Chairman of the Joint Chiefs Admiral Thomas Morrer requested three assurances in connection with the Chiefs' support of the agreements. The first assurance was "a broad range of intelligence capabilities and operations to verify Soviet compliance in a strategic arms limitation environment." Under this assertation, the Chiefs not only expected careful monitoring of Soviet compliance, but also "information on Soviet strategic activity, capabilities, and achievements as insurance against both technological and strategic surprise and for use in follow-on arms

[435] Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, p. 106.
[436] Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, p. 37.
[437] "Senate Armed Service Committee Hearings on SALT I, June-July 1972, June-July 1972," SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, p. 113.

limitation negotiations." The second assurance Morrer requested linked to monitoring and the avoidance of surprise was "aggressive improvements and modernization programs." Morrer asserted that the United States should maximize strategic capabilities within the constraints established by the ABM treaty and the Interim Agreement, including planning for rapid augmentation of strategic forces beyond the constraints of the treaty and agreement to be made in the event of abrogation, withdrawal, or collapse of negotiations. And the third assurance was "vigorous research and development programs" where the Chiefs expected the United States to maintain the "technological superiority" of weapons and to continue testing to insure the effectiveness of new and existing nuclear weapons systems.[438]

Importantly, during Congressional hearings on the SALT agreements, there were at times explicit recognition of this relationship between information being used for verification on one hand and to design and justify modernization on the other. In his line of questioning of Secretary of Defense Laird, Senator Fulbright, pointed to an old quote of McNamara's assertion that the U.S. buildup in the early 1960s was "necessitated by a lack of accurate information" but that as information improved, each side further reacted to the buildup of the other. Fulbright then asserted to Laird,

> *"With this verification being as reliable as our government believes it is, and certainly the intelligence community believes it is, and you apparently believe it is, if we proceed*

[438] "Statement Of Adm. Thomas H. Moorer, U.S. Navy, Chairman, Joint Chiefs of Staff; Accompanied by Lt. Gen. Royal S.
Allison, U.S. Air Force, Assistant to The Chairman for Strategic Arms Negotiations, And Col. Robert M. Lucy, U.S. Marine Corps, Legal Adviser, Legislative Assistant to The Chairman, JCS," Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, p. 69-70.

> *with this very substantial buildup, they will certainly know all about it. Even without the verification, it seems to me, as Secretary McNamara said, inevitably what you are doing is triggering a comparable buildup by them… Therefore, the end result is we are both resuming the arms race and there is no particular advantage to either."*[439]

Laird offered little in terms of a direct response. Such exchanges show that while there may have been some awareness of the competing effects of higher quality information in the nuclear policy making process, little was done to act on it. Strengthened by information from high-resolution satellites, the arguments about arms control limits and the arguments about the need to leave room within the agreements for the United States to pursue "technological superiority" and modernization withstood the Congressional hearings as the SALT I agreements went onward to win broader domestic Congressional approval.

[439] Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, p. 105-106.

Pending weapon systems: MIRVs, ABMs, and mobile ICBMs

In the early 1960s, U.S. leaders held a different set of assumptions for certain new and emerging weapons systems, including MIRVs and ABMs, that shaped a different set of possible decisions: instead of facing the question of whether to race, limit, or reduce as in the case of ICBMs and SLBMs, the question was whether to develop and modernize or to cancel and ban these systems. Both MIRVs and ABMs would ultimately persist, with imagery playing a role in strengthening the cases of those who supported development and modernization. In the case of mobile missiles, imagery information and blind spots would be used in accordance with the desires of military and pro-nuclear leaders: they were initially used to push for a ban, but once military leadership determined that it wanted to retain mobile missiles as a deployment option, a ban was pushed out of the scope of SALT I.

The linking of MIRVs and ABMs

The fate of MIRVs and ABMs were often linked by strategic perspectives and justifications. In his analysis of nuclear weapon innovation, Evangelista assesses that MIRV technology arose in the United States "from many independent and seemingly unrelated goals and decisions."[440] One justification for their continued development was to assure that U.S. missile forces would be able to penetrate a Soviet ABM defense, which was assumed would exist by the late 1970s. Gerard Smith, Director of the Arms Control and Disarmament Agency and a proponent of MIRV and

[440] York, "Multiple-Warhead Missiles," p. 131 in Evangelista 1988, p. 68.

ABM bans, highlights the inconsistency that even as it became clear ABMs would be controlled under SALT, MIRV programs would persist. Smith notes that MIRVs could be considered as the leading lost opportunity of the SALT negotiations. [441]

Next to these strategic justifications for MIRVs and ABMs, satellite imagery blind spots were used to form arguments about verification uncertainty as further reason for the United States to retain and develop these systems. For MIRVs, the resolution of early CORONA satellites would have made identifying precise missile types and extracting their dimensions difficult. Even as GAMBIT models emerged making missile-type identification possible, decision-makers wavered over the lingering uncertainty of whether intelligence could determine which missiles were MIRV-ed and which were not. For ABMs, given that the Soviets deployed a large anti-aircraft network, experts were initially uncertain of the ability to distinguish between conventional surface-to-air missile (SAM) sites and ABM systems.[442] The CIA and Air Force disagreed on the precise nature of the early developments they observed in satellite imagery, and this contributed to doubts over verifiability.[443]

Perceptions and arguments about incapacities to verify MIRVs and ABMs via satellites played a role in early efforts to keep these systems out of the scope of SALT. In May 1966, ACDA

[441] Smith, *Doubletalk*, pp. 154-155.
[442] "Intelligence Memorandum: U.S.S.R. Pushing Ahead with Antimissile Defenses for Moscow (Prepared by the Office of Current Intelligence and Coordinated with OSI, OPR, and ONE)." Foreign Relations of the United States, May 18, 1966. Johnson Library, National Security File, Intelligence File, TKH Jan.–July 1966, Box 1. https://history.state.gov/historicaldocuments/frus1964-68v10/d130.
[443] "Memorandum From Director of Central Intelligence Helms to President Johnson." Foreign Relations of the United States, December 1, 1966. Johnson Library, National Security File, Intelligence File, Miscellaneous CIA Intelligence Memoranda, Box 14. https://history.state.gov/historicaldocuments/frus1964-68v10/d147.

drafted a letter from President Johnson to Premier Kosygin proposing a moratorium on constructing missile launchers, including defensive systems, to be verified by "*our respective national capabilities*." The Joint Chiefs insisted that insufficient verification posed the threat of allowing the Soviets to gain an advantage in developing MIRV warheads and that the Soviets stood to widen their lead in ballistic missile defense. The Joint Chiefs asked that President Johnson be apprised of their views, and no letter went to Premier Kosygin.[444]

This combination of continuing to learn new information about Soviet ABMs but in ways that left uncertainty due to blind spots would contribute to the resilience of arguments to retain and advance the U.S. ABM program. In January 1967, President Johnson announced publicly that the Soviet Union had begun to construct a limited ABM defense system around Moscow and officially called for SALT. He and Soviet Premier Alexei Kosygin met at Glassboro State College in New Jersey, where Johnson said they must gain "*control of the ABM race*" and framed his arguments to the Soviets in terms of avoiding a mutually costly and futile arms race. [445] Shortly afterward, ACDA circulated a plan to simply "level off" strategic offensive and defensive missile forces at approximately current levels.[446] The Joint Chiefs objected on the basis of uncertainties in detecting the conversion of anti-aircraft sites to ABM systems and the general

[444] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.
[445] "Strategic Arms Limitations Talks/Treaty (SALT) I and II," Foreign Relations of the United States, Office of the Historian, https://history.state.gov/milestones/1969-1976/salt.; "Letter From President Johnson to Chairman Kosygin." Foreign Relations of the United States, January 21, 1967. Johnson Library, National Security File, Rostow Files, Kosygin, Box 10. https://history.state.gov/historicaldocuments/frus1964-68v11/d178#fn:1.5.6.2.522.14.6.
[446] Memo, Actg Dir, ACDA, to Cmte of Principals, 13 Jan 67, JCS 1731/957, JMF 755 (13 Jan 67) sec. 1, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.

principle of using satellite-based verification to support an agreement.[447] They also opposed any discussion of MIRVs, arguing that continuing their development offered the best guarantee against a Soviet surprise.[448]

While U.S. understanding of the Soviet ABM problem was murky, it nevertheless evolved into a driver for some U.S. leaders to pursue arms control with a new impetus. Secretary of Defense McNamara carefully studied the CIA's National Intelligence Estimates and corresponding imagery, noting that after several false starts, the Soviets appeared to be deploying one type of system around Moscow and another type of system, designated "Tallinn" across the northwest approaches to the Soviet Union and at a few other locations. He interpreted this wide scale effort to mean that U.S. ABM development would merely lead to the further expansion of Soviet offensive forces, which imagery also showed as rapidly growing, leaving the United States no better off than before.[449] In December 1966, Ambassador Thompson initiated a series of exchanges with the Soviets over the question of reaching a mutual understanding on ABMs.[450] The Soviets countered that ABM limits could only be considered simultaneously with "*a*

[447] Memo, SecDef to CJCS, 18 Jan 67, JCS 1731/957-2; JCSM-30-67 to SecDef, 19 Jan 67, JCS 1731/957-1; JMF 755 (13 Jan 67) sec. 1. Printed in *Foreign Relations: 1964–1968*, vol. 11, pp. 426-429. Gen. McConnell wanted to provide detailed comments while the U.S. position was still in a formative stage, but the Chiefs decided against doing so. CSAFM-F-15-67 to JCS, 18 Jan 67; Dec on JCS 1731/957-1, 18 Jan 67, same file, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 85.

[448] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), pp. 84-85.

[449] "Draft Memorandum from Secretary of Defense McNamara to President Johnson." Foreign Relations of the United States, December 22, 1966. Washington National Records Center, OSD Files: FRC 330 70 A 4662, 471.94 ABM (Nov & Dec) 1966. https://history.state.gov/historicaldocuments/frus1964-68v10/d160.

[450] "Memorandum of Conversation: U.S.-Soviet Discussion of Strategic Nuclear Weapons." Foreign Relations of the United States, January 18, 1967. Washington National Records Center, RG 383, Central Policy File: FRC 86 A 5, Folder 3541. https://history.state.gov/historicaldocuments/frus1964-68v11/d174.

solution of the problem of offensive means of delivering nuclear weapons and in close association with the problem of general and complete disarmament."[451] Thus began the early makings of the SALT framework and its central exchange of offensive and defensive limits.

Lingering skepticism over the verifiability of new and emerging weapon systems

The acceptance by the Joint Chiefs on the verifiability of fixed ICBMs did not translate to newer, pending weapon systems. The CIA's 1967 Special National Intelligence Estimate determined that it would "*almost certainly*" detect any large-scale MIRV test program but could not always expect to assess accurately the test objectives or even the precise nature of the system being tested. The CIA saw "*no prospect of determining whether MIRVs (if developed) or other significant improvements had been incorporated in deployed offensive missiles.*"[452] Comments from the CIA following up on the report noted that determining the extent of the retrofit of MIRVs into existing, deployed missile sites would be "*virtually impossible*."[453]

Next to this grim assessment of verifiability, Secretary of Defense McNamara would argue for the strategic value of the United States continuing to develop MIRVs. He noted in an assessment

[451] "Memorandum of Conversation: U.S.-Soviet Discussion of Strategic Nuclear Weapons." Foreign Relations of the United States, January 18, 1967. Washington National Records Center, RG 383, Central Policy File: FRC 86 A 5, Folder 3541. https://history.state.gov/historicaldocuments/frus1964-68v11/d174.
[452] "Special National Intelligence Estimate, SNIE 11-10-67, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, February 14, 1967. Foreign Relations of the United States. https://history.state.gov/historicaldocuments/frus1964-68v10/d169.
[453] "Memorandum to Holders of SNIE 11–10–67." Foreign Relations of the United States, March 2, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d172.

presented to President Johnson those calculations had convinced him and the services of the superiority of MIRVs over single, large megaton weapons for attacking cities or military targets and that therefore, the best way to increase the effectiveness of U.S. forces would be to put MIRVs on Minuteman and Poseidon.[454]

The view of verifying ABMs was more optimistic, but still rife with uncertainty. As with ICBMs, the CIA's 1967 Special National Intelligence Estimate appears to have played a significant role in generating agreement on the verifiability of ABMs despite remaining blind spots.[455] In March 1967, as ACDA re-circulated its leveling-off plan after making some minor surgery, the Joint Chiefs acknowledged that the new SNIE described U.S. capabilities as "adequate now for the timely detection of increases in fixed ABM-capable launch sites and radars…" Consequently, although still advocating on-site inspection, they withdrew their objection to a unilaterally verified agreement on limiting ABMs.[456] Notably, the 1967 Special Estimate specified a lingering vulnerability that chances of determining whether a SAM system had been provided with significant ABM capabilities were then "about even," along with the assertion that detection capabilities were expected to improve. While this issue was bypassed

[454] "Draft Memorandum from Secretary of Defense McNamara to President Johnson." Foreign Relations of the United States, January 15, 1968. Washington National Records Center, OASD/ISA Files: FRC 330 72 A 1499, 320.2 1968 I–35149/68 8 Feb 1968. https://history.state.gov/historicaldocuments/frus1964-68v10/d200.

[455] "Special National Intelligence Estimate, SNIE 11–10–67, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Foreign Relations of the United States, February 14, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d169.

[456] Memo, ActgDir, ACDA, to Cmte of Principals, 3 Mar 67, JCS 1731/966, JMF 755 (13 Jan 67), sec. 1. Memo, ASD(ISA) to CJCS, 7 Mar 67, JCS 1731/966-1; JCSM-143-67 to SecDef, 14 Mar 67, JCS 1731/966-2; same file, sec. 2. Distribution of JCSM-143-67 to the White House and the Committee of Principals is recorded in Memo, M. W. Roche to CJCS, 24 Mar 67, N/H of JCS 1731/966-2, 28 Mar 67, same file, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 85.

under the Johnson administration, it would reemerge under Nixon as opponents sought to sink an ABM-ban using arguments about the inability to verify a ban on ABMs.

Using satellite blind spots and uncertainty about clandestine MIRV-ing to diminish a MIRV ban

Progress on the MIRV ban would stall through 1968. The CIA's 1968 report essentially repeated the findings of the previous year that detecting testing was possible, but that detecting the actual incorporation of MIRVs into deployments was not possible.[457] The 1968 Pentagon had been opposed to a MIRV ban, and proponents of a ban didn't want to take on the DOD in a MIRV fight right at the start. They feared that the Pentagon could have stopped SALT before it even started. Proponents hoped that the dynamics of the negotiations would gradually bring the two governments to realize the advantages of MIRV control and the weakness of an agreement that did not ban them.[458] President Johnson ultimately ruled out the inclusion of a MIRV ban in SALT and left open the door to modernization through MIRV-ing and other measures. In Johnson's draft proposal for SALT, the controls on missiles specified that "no additional restrictions would be imposed upon technological improvements of launchers or missiles already deployed including increasing the hardness of existing silos and deployment of MIRV's, or the retrofitting of existing launchers with new missiles."[459]

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[457] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Foreign Relations of the United States, July 18, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d257.

[458] Smith, *Doubletalk*, p. 158.

[459] "Memorandum From Secretary of State Rusk and the Director of the Arms Control and Disarmament Agency (Foster) to President Johnson." Foreign Relations of the United States, August 15, 1968. Johnson

As Nixon took office, DOD still had little interest in banning MIRVs, but the threat of Soviet advances in the area left the door to MIRV control open. From 1968 to 1970, the CIA's National Intelligence Estimates would paint an increasingly grim view of the Soviet MIRV development effort. In August 1968, the Soviets began testing the SS-9 Mod 4, which for the first time, carried three warheads instead of one. By April 1970, they had conducted 17 tests, which was about the usual number for a missile before it goes into operational deployment. Telemetry intelligence did not help bring about a consensus view about whether the three warheads were MIRVs or the less worrisome multiple re-entry vehicles (MRVs).[460] NPIC had established an "SS-9 Variant Committee" to track the issue. The committee reported that photography of the SS-9 R&D facilities at the Tyuratam test site showed unusually high levels of activity with about "20-25 vehicles and electronic vans" at the instrumentation facilities that were known to be associated with the SS-9.[461] The 1970 NIE stated that there were "indications that the Mod 4 is being deployed," and the 1971 estimate featured the intelligence community's continued belief that the Soviets will develop MIRVs, noting the expectation that a flight test program would soon begin involving a new missile MIRVs and with better hard target capabilities.[462] The NIEs further framed the issue in terms of a broader shift in the nature of Soviet nuclear force development efforts. The estimate asserted,

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Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269.

[460] "NIE 11-8-71 Soviet Forces for Intercontinental Attack," Central Intelligence Agency, 21 October 1971, https://www.cia.gov/readingroom/docs/DOC_0000283820.pdf

[461] "Memorandum for Executive Director NPIC from Chief, Imagery Exploitation Group, NPIC, Subject: SS-9 Variant Committee," Central Intelligence Agency Freedom of Information Act Reading Room, 17 February 1970, https://www.cia.gov/readingroom/docs/CIA-RDP78B05703A000800020007-9.pdf

[462] NIE 11-8-70, p. *** and NIE 11-8-71, p. ***.

> *"…it is not in new types of weapon systems or in gross numbers of launchers that the most significant developments in Soviet forces for intercontinental attack will probably lie during the next several years. Rather it is in the qualitative improvements to present systems, and of these the most important are in accuracy of missiles and multiple re-entry vehicles for them."*[463]

This framing contributed to a perception of the 'inevitability' of Soviet MIRV development. While proponents of a MIRV ban, such as Gerard Smith, Director of ACDA, were quick to clarify that this was the case only if the Soviets and Americans did not mutually agree to ban them, such caveats often fell on deaf ears. For example, when Richard Helms, Director of Central Intelligence, briefed top decisionmakers on the issue at a National Security Council meeting, he used the wording of "inevitability" to describe the Soviets' MIRV development efforts as observed through imagery and other intelligence. After the meeting, a concerned Smith requested that someone check with Helms about his intent behind that statement. The response was, "Helms stated that he thought he was simply agreeing that it was 'inevitable' that the Soviets would develop a true MIRV in the absence of an effective flight test ban and that he was not reversing his position on [the CIA's] ability to monitor a MIRV test ban."[464] The CIA likely recognized the taboo nature of mentioning an unpopular MIRV ban in front of the Nixon administration which clearly opposed it, leaving Smith and other proponents of a ban in a small minority.

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[463] "National Intelligence Estiamte 11-8-70 Soviet Forces for Intercontinental Attack," Central Intelligence Agency, p. 8.

[464] Washington National Records Center, RG 383, ACDA Files, FRC 383–98–0089, Director's Files, Smith's Files, Smith Correspondence: SALT Delegation Guidance on Conversations with Soviet Representatives, April–July 1970.

MIRVs were examined in the Verification Panel's September 1969 paper, indicating a clear division in views about verifiability. The State Department, the CIA, and ACDA believed that intelligence could monitor MIRV developments based on monitoring testing; the OSD and the Joint Chiefs did not. They asserted that bans on multiple payloads in space and exoatmospheric penaid testing were mandatory collateral restrictions, which were actions they did not want to restrict based on their own research and development efforts. The State Department, the CIA, and ACDA believed these additional controls were desirable but not mandatory.[465]

Following this assessment, ACDA Director Smith strongly argued the need for a MIRV test ban based on the notion of a threshold of verifiability. He argued that "at some point in MIRV testing, the development of this new weapons system will be sufficiently advanced as to make a verification of its non-deployment an impossibility without on-site inspection of such an intrusive nature that we, let alone the Soviets would probably not be willing to accept it."[466] His conviction to work toward a ban was based on an understanding that MIRVs were a key U.S. bargaining chip in SALT, and that MIRVs were a decisive asymmetry which could prevent reaching meaningful controls on offensive forces with the Soviets.[467]

Most of the defense establishment remained firmly opposed to a MIRV test ban, and officials stoked doubt in the administration over its verifiability. For instance, Secretary of Defense Laird

[465] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.
[466] Smith, *Doubletalk*, p. 159.
[467] Smith, *Doubletalk*, p. 156.

raised questions in debates over the subject as to whether the Soviets were much further along in MIRV development than the intelligence community thought.[468] More generally, Laird was skeptical of the intelligence community's capabilities to calculate the present balance of forces and doubted that the performance of a SALT agreement could be monitored with confidence.[469] Members of his department elaborated a number of obscure techniques which they said the Soviets could use to develop and deploy MIRVs without full-range testing. By 1970, Smith believes Laird lost his stomach for a MIRV ban "if he ever had one."[470] The Joint Chiefs flatly opposed a MIRV ban, believing that it would eliminate the main U.S. advantage over the Soviets and could not be verified by national means.[471] Owing in part to these concerns, the Nixon administration seemed unclear as to the state of Soviet MIRV developments and were suspicious of them gaining ground.[472]

Kissinger, who believed that MIRVs should be both retained and left uncontrolled, worked to subtly counter the proposal to ban them and guide the process to his desired conclusion. In the pivotal meeting on April 8, 1970, where U.S. leaders discussed the various 'packages' of options, Kissinger invoked counterforce in arguing that the United States needs MIRVs "if we believe the Soviets could have enough ICBMs to knock out Minutemen using single warheads alone and that they might use their ICBMs this way." To this he added that MIRVs would be

[468] Smith, *Doubletalk*, p. 28 and 160; "Memorandum for the Record, Subject: NSC Meeting on ABM." Foreign Relations of the United States, November 12, 1971. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, National Security Council Minutes Originals 1971 thru 6–20–74. https://history.state.gov/historicaldocuments/frus1969-76v32/d211.
[469] Smith, *Doubletalk*, p. 113.
[470] Smith, *Doubletalk*, p. 161.
[471] Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 85.
[472] Smith, *Doubletalk*, p. 160.

required "if we believe they are needed to hedge against substantial clandestine or rapid post-abrogation upgrading of Soviet ballistic missile defense," which can be viewed as capitalizing on the uncertainty surrounding the attempts to muddle ABM verification with issues related to SAM sites.

In addition to voicing these strategic concerns, Kissinger also invoked verification uncertainty against the case to ban them. In the same presentation, he noted that "MIRV verification is extremely difficult," which supported his aim that MIRVs remain outside the scope of the treaty. Defense officials leapt to his support. Deputy Secretary of Defense David Packard asserted that "if we keep MIRVs, we can live with more uncertainties. MIRV overcomes the SAM upgrade problem." Paul Nitze, a defense advisor, asserted the inevitability of Soviet MIRV development and argued that a MIRV ban was not acceptable.[473]

Inaccurate claims about verification and uncertainty were also allowed to sit in the air unchallenged. A common strategy for countering the proposed MIRV ban within the U.S. bureaucracy rested on asserting that MIRVs were essential for countering a clandestine ABM effort. This argument was made repeatedly despite the CIA's assertion that an ABM ban would be easily verifiable.[474]

[473] "Memorandum of Conversation, Subject: SALT." Foreign Relations of the United States, April 8, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–109, NSC Minutes Originals 1970. https://history.state.gov/historicaldocuments/frus1969-76v32/d65.
[474] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, March 8, 1971. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74.
https://history.state.gov/historicaldocuments/frus1969-76v32/d137.

Because of this debate and uncertainty, MIRVs received a low-profile treatment in the opening rounds of negotiations with the Soviets, and the issue was treated with extreme caution by both sides. The U.S. delegation was instructed not to raise the issue. The Soviets had some reason to believe that the United States was ready to reach MIRV limitations that would not require on-site inspection based on exchanges with officials in the Johnson Administration, yet they did not raise the issue out of a desire to continue advancing their own MIRV program. [475]

The Nixon administration eventually used concerns over verifiability to remove MIRVs from consideration in SALT. The administration was under pressure by both the public and Congress to include MIRVs in the agreement. Kissinger stated that he favored a MIRV ban "*if it could be verified,"* with the implication being that on-site inspections would be required, a measure the Soviets still strongly opposed.[476] The U.S. position therefore included a request for on-site inspection for MIRV verification.[477] While this placated the public and Congress, experts recognized that it was a maneuver to destroy a MIRV ban, given the strong Soviet opposition to on-site inspection. Although ACDA and the AEC had done some work on techniques for on-site inspection, there was little preparatory discussion at high levels about the specifics of such inspection or about what if any advantages it might offer over satellites.[478] Discussion in June 1970 show that both the Americans and the Soviets viewed on-site inspections as fruitless. Each side believed that stockpiling was the bigger problem and that MIRV warheads could simply be

[475] Smith, *Doubletalk*, p. 167.
[476] Smith, *Doubletalk*, p. 169.
[477] Smith, *Doubletalk*, p. 170.
[478] Smith, *Doubletalk*, p. 171.

put on missiles as soon as inspectors departed.[479] With the Soviet rejection of the U.S. on-site inspection proposal, the prospects of a MIRV ban were effectively destroyed.[480]

The argument about the uncertainty and risks connected to the perceived inability to verify MIRVs persisted in Congressional hearings on the Interim Agreement text. Jerome H. Kahan, a senior fellow at the Brookings Institution, made the unchallenged and unquestioned assertion to senators that a ban on MIRV deployments would "involve intrusive on-site inspection, and, apart from this stumbling block, would probably be unacceptable to both sides on strategic policy grounds." While he acknowledged that it might be possible to place restraints on missile testing to prevent both sides from advancing and deploying MIRVs, he vaguely asserted that "this would probably prove difficult to formulate and negotiate" because the U.S. would raise verification concerns while the Soviets would see the measure as freezing them in an inferior position.[481] Despite the technical inaccuracies and inconsistencies, this argument was allowed to endure.

Satellite advances support limits and modernization over ban for ABMs

[479] "Memorandum From Helmut Sonnenfeldt of the National Security Council Staff to the President's Assistant for National Security Affairs (Kissinger)." Foreign Relations of the United States, June 6, 1970. National Archives, Nixon Presidential Materials, NSC Files, Box 877, SALT, SALT talks (Vienna), Vol. IX, May 10–June 12, 1970. https://history.state.gov/historicaldocuments/frus1969-76v32/d80; "Notes of a Verification Panel Meeting." Foreign Relations of the United States, June 24, 1970. Washington National Records Center, RG 330, OSD Files: FRC 330–76–076, Box 12, U.S.S.R., 388.3. https://history.state.gov/historicaldocuments/frus1969-76v32/d85.

[480] Smith, *Doubletalk*, pp. 174-175.

[481] "Prepared Statement of Dr. Jerome H. Kahan," Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, p. 214.

The prospects of an ABM ban continued to be hindered at this time in part by increasing optimism about the verifiability of ABM limits due to satellite advances. The CIA's 1968 update to the Special Estimate, containing information acquired via GAMBIT advances, held a more confident assessment than previous reports. It stated that U.S. intelligence had been able to detect the deployment of the two latest Soviet strategic defensive missile systems, the Moscow ABM system and the SA-5 (Tallinn system), well before those systems reached initial operational capability. The Moscow system had been identified as a possible ABM system in 1963 and this estimate was made firm in 1965; the Tallinn system was identified in 1964, three years before reaching operational capability. The report noted that these systems can be "*readily identified*," and that the intelligence community was confident that virtually all sites had been located. While the report expressed confidence that any deployment of a new system would be detected at an early stage, it left reservations on the ability to guarantee analyses of the capabilities of a new system. The authors of the report noted that over the next few years, they expected capabilities to collect information bearing on ABMs would continue to increase as the result of anticipated improvements in photographic, electronic, and other data collection systems.[482]

This optimism about the verifiability of limits was not shared by the Joint Chiefs. While the CIA's report appears to have further convinced the Joint Chiefs of the verifiability of confining ABM deployments to a set and equal number of fixed land-based launchers and associated radars, they would continue to push for on-site inspections based on insistent concerns about

[482] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://dp.la/item/09fb021f99dfeed2e70e1b06f519afb7.

SAM site upgrades. Late in July 1968, ACDA had circulated a proposal that included, among other limits, a set and equal number of ABMs.[483] In response, the Joint Chiefs advised Secretary Clifford that U.S. intelligence could verify ABM launchers of known characteristics, but that on-site inspection would still be needed to spot the upgrading of anti-aircraft defenses into ABMs.[484]

However, as the coming years would reveal, JCS opposition toward a ban was much stronger than their opposition toward limits. Following the exchange of these views, the Johnson administration's draft position on ABMs consisted of a set and equal number of fixed, land-based ABM launchers and associated radars, as well as a total prohibition on deployment of mobile ABM systems, both land-based and sea-based. There would be no other constraints on the characteristics of the ABM systems deployed. The limitations were proposed to be verified by national means.[485] In response, military leaders continued to express concern over the ability to verify the prohibition against upgrading defensive missile systems to an ABM capability, but they did not attempt to actively obstruct the position.[486]

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[483] Memo, Actg Dir, ACDA, to Cmte of Principals, 31 Jul 68, JCS 2482/9, JMF 750 (29 Jun 68) sec. 1. Memo, DepSecDef to CJCS, 2 Aug 68, JCS 2482/9-1, same file, sec. 2. The former is printed in *Foreign Relations: 1964–1968*, vol. 11, pp. 659–661, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 87.

[484] Essentially, they were repeating the conclusions of SNIE 11-13-68, 18 July 1968, printed in *Foreign Relations: 1964–1968*, vol. 11, pp. 646–648, as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 87.

[485] "Paper Prepared by the Interagency Working Group, 'STRATEGIC MISSILE TALKS PROPOSAL.'" Foreign Relations of the United States, July 31, 1968. Johnson Library, Clifford Papers, Kosygin-Talks with Soviet Union (2), Box 22. https://history.state.gov/historicaldocuments/frus1964-68v11/d264; "Paper Approved by the Executive Committee of the Committee of Principals: Strategic Missile Talks Proposal." Foreign Relations of the United States, August 14, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269#fn:1.5.6.2.778.30.6.3.

[486] "Memorandum From Secretary of Defense Clifford to President Johnson; Subject: Proposal for Limiting Strategic Offensive and Defensive Systems." Foreign Relations of the United States, August 13,

Using satellite blind spots and uncertainty about SAM upgrades to diminish an ABM ban

By the time of Nixon's inauguration, the domestic mood had changed significantly from the mid-1960s when Congress actively supported ABM appropriations to the extent that Defense Secretary McNamara felt they were forced upon him. By 1969, opposition to ABM was growing in the Congress as well as in the academic and scientific groups that comprised the arms control epistemic community.[487] Despite this opposition, Nixon believed that relinquishing the U.S. ABM program entirely would leave the U.S. in an "inferior" position overall given its already lower levels of delivery systems.[488]

A growing number of voices in the U.S. Congress were pushing for a ban on the technology. As put forth by Representative Jeffrey Cohelan of California in 1969, "ABM threatens to escalate the arms race and is not necessary to strong bargaining position with the Soviets; that it would probably not save lives in case of a Soviet nuclear attack; that it is not necessary to our defense against China; that the ABM would cost enormous sums that could be better spent at home; and that even if built that it would probably not work very well for very long."[489] Cohelan was backed by numerous other voices, primarily Democratic leaders, who fought against efforts to dedicate funds to the U.S. ABM program and preferred that the technology be banned.

1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d268.

[487] Kissinger, *White House Years*, p. 205.

[488] "Memorandum of Conversation, Subject: SALT." Foreign Relations of the United States, April 8, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–109, NSC Minutes Originals 1970. https://history.state.gov/historicaldocuments/frus1969-76v32/d65.

[489] Congressional Record, House, February 26, 1969, p. 4546.

At the beginning of 1969, ACDA director Gerard Smith would argue for his belief that new developments in weapons that risked upsetting the strategic balance – such as ABMs – should be banned rather than limited. Smith often invoked verifiability as a reason that a ban made more sense. He argued that with a limit, *"…the problem would be that we couldn't control developments. A total ban on ABM would be easier to verify. We could have high confidence in it.*"[490] Smith also used verifiability to argue for a more comprehensive agreement that included controls or bans on more weapon systems and types, stating once that *"if all moves in a game are prohibited, it would be easier to detect violations than if some moves were allowed."* He used blind spots to argue for elimination and a ban, standing in contrast to those who believed that blind spots and uncertainty should mean no weapon controls at all.[491]

U.S. defense planners' positions on ABMs would vary widely during the course of negotiations under the Nixon administration. By 1969, DOD had come to view arms control as more urgent, believing that the Soviets' successful development of ABMs could represent a threshold which, if crossed, would be irreversible.[492] At the same time, DOD continued to view a U.S. ABM capability, along with ABM research and development, as essential to U.S. security. At the

[490] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, March 8, 1971. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74. https://history.state.gov/historicaldocuments/frus1969-76v32/d137.

[491] "Minutes of a Review Group Meeting, White House Situation Room, NSSM 28— 'Stop Where We Are' Proposal." Foreign Relations of the United States, June 19, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H–Files), Box H–038, Review Group, SALT "SWWA" 6/19/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d20.

[492] "Paper Prepared in the Department of Defense." Foreign Relations of the United States, February 6, 1969. Ford Library, Laird Papers, Box 22, SALT, Chronological File. https://history.state.gov/historicaldocuments/frus1969-76v32/d2.

outset of the process under Nixon, Secretary of Defense Laird argued for an ABM option giving both sides a right to deploy interceptors and radars in unlimited numbers at one ICBM site.[493] This position would later shift to a twelve-site system known as "Safeguard," and with budgetary and public pressure, down to a four-site Safeguard system. Kissinger and Nixon agreed with the defense establishment's conclusion that the United States should go forward with ABM, even if on a more limited scale. Despite public opposition to the program, Kissinger considered it "*highly dangerous*" to stop programs where the U.S. was superior without any Soviet reciprocity.[494]

Following these initial exchanges of views, the Verification Panel's 1969 Paper would cite numerous problems with ABM verification. The report stated that upgrading conventional surface-to-air missile systems to give them some form of limited ABM capability – primarily through netting with existing ABM radars – would be "*difficult if not impossible to determine.*" OSD and the Joint Chiefs believed that the Soviets could deploy clandestinely 5–10 new acquisition radars and take other actions to allow "covert deployment of a limited ABM capability." They also believed that it was not possible to differentiate unambiguously among radar types and an effective ABM radar limit was not practical. The paper also raised the concern that 100–150 mobile ABM launchers might escape detection for several years (OSD and the Joint Chiefs believed the number could be substantially higher).[495]

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[493] Smith, *Doubletalk*, p. 352.
[494] Kissinger, *White House Years*, p. 205.
[495] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.

This concern, formed on the basis of the remaining blind spots from high-resolution satellites, formed the core of the argument against an ABM ban. The argument did not articulate a problem with verifying limits, despite some of the same technical issues coming into play. Rather, the argument focused on the "covert deployment of a limited [Soviet] ABM capability" that might take place within the temporal blind spot if the United States were to pursue a ban.

Following this assessment of verifiability, there was a great deal of posturing among competing perspectives over the possible paths that were beginning to take shape. The options proposed following the Verification Panel's report were either to have (1) a "Safeguard"-level of ABM (i.e., a proposal for twelve sites covering ICBM fields), (2) an ABM system limited to National Command Authorities (NCA, i.e., Washington and Moscow), or (3) to have a complete ban on ABM systems. Defense planners preferred the Safeguard program but supported NCA because this would at least keep ABM technology alive and provide a basis for future expansion.[496] State and ACDA preferred no ABM program at all, continuing to argue that this would simplify verification, but they accepted NCA because it was symmetrical with the program of the Soviet Union and therefore "negotiable." Even more, they favored NCA because of their belief that it would lead to their preferred option of a complete ABM ban since Congress would kill the NCA program.[497] Kissinger saw it as important that the administration responded to Congressional and bureaucratic supporters of an ABM ban.[498]

[496] Kissinger, *White House Years*, p. 542.
[497] Kissinger, *White House Years*, p. 542.
[498] Kissinger, *White House Years*, p. 544.

The Nixon administration would take pains in the following months to keep the U.S. ABM program alive while dealing with mounting pressure to eliminate it. In April 1970, as ACDA proposed a moratorium on the ABM program, Kissinger and defense planners would insist on moving it forward to avoid the collapse of negotiations.[499] At one point that same month, Nixon sent a note to Kissinger that Smith had better support ABM or resign as Director of ACDA.[500] Smith reportedly took the note with caution but continued to advocate privately for an ABM ban. Kissinger's preferred position was that both sides be allowed to maintain the deployments they were already building – for the United States, these were ICBM-focused sites, and for the Soviets, a Moscow-focused site. Sensing little Congressional support for an NCA system, Kissinger tolerated the ban proposal, believing that the Soviets would likely reject it, thus putting the United States in a stronger position to argue for keeping existing sites.[501]

Arguments about modernization, including the need to achieve U.S. ABM technological prowess and to counter a perceived 'inevitable' Soviet ABM development effort, remained tied to the NCA option. Strategically, it was acknowledged even by defense planners that an NCA option made little sense. From August to September 1970, the Joint Staff assessed that NCA systems would help the Soviet Union more than the United States. Still, defense planners would argue that NCA defense would be better for the United States than zero ABMs.[502] They believed that

[499] Kissinger, *White House Years*, p. 535.
[500] Kissinger, *White House Years*, p. 539.
[501] Kissinger, *White House Years*, pp. 548-549.
[502] Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 93.

banning ABMs would end the Soviets' need to spend considerable resources on countermeasures, and that it could "*seriously harm*" U.S. research and development efforts.[503]

Verifiability would directly enter the debate over an ABM ban versus NCA in early 1971. In March, Smith made the case to Kissinger arguing that banning ABMs would serve U.S. security interests better than NCA by being advantageous in terms of verifiability, ease of definition, public appeal, economics and effect upon the strategic arms competition. Smith would also argue that the British and French saw an ABM ban as means to increase the effectiveness of their nuclear deterrent against the Soviets, and that NCA would likely mean battle with Congress.[504]

The Joint Chiefs made the opposing case for an NCA ABM defense instead of a ban, using blind spots and arguments about uncertainty to bolster strategic arguments. SALT, they said, should be viewed as a step-by-step process toward establishing a new superpower relationship. Consequently, in the first step, neither side should resort to a "*dramatic*" measure such as ban. The Joint Chiefs believed that even under an ABM ban, the Soviets could retain early warning and search radars, as well as their air defense system. They therefore believed that the verification problems of defining and distinguishing air defense from ABM radars would

[503] Memo, Ambassador Smith to Kissinger, 4 Mar 71, JCS 2482/106-4; ACSAN-69-71 to Kissinger, 5 Mar 71; JMF 752 (4 Jan 71) as cited in Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 95.

[504] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, March 8, 1971. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74. https://history.state.gov/historicaldocuments/frus1969-76v32/d137.

remain.[505] Systematic construction on SAM sites would have been a suspicious and useful red flag, but the Joint Chiefs expressed concern that such changes could occur so quickly or be so subtle that they could take place in between satellite missions and escape detection. In this manner, the remaining temporal blind spot was used to help destroy the prospects for an ABM ban.

Some believed that the concerns about clandestine upgrades of SAM sites were exaggerated and unfounded. Smith points out that the U.S. delegation was to learn over the course of the negotiations that Soviet technicians evidently believed the upgrading of SAMs for an ABM role was not a realistic possibility, and that some Soviets, especially the military, were suspicious that U.S. attempts to insert SAM-upgrade provisions were an effort to use SALT to restrict Soviet air defenses. In spite of these concerns, there would be no serious Soviet objection to a prohibition on SAM upgrading, even though it was thought to be "*superfluous*."[506]

New information from satellites adds impetus to U.S. ABM research and development

A CIA report in June 1971 based on imagery intelligence showed that the Soviets were making new efforts to improve the capabilities of the ABM system deployed at Moscow. Developments included constructing launch complexes and radars oriented toward protecting the city against the U.S. Polaris threat from the Mediterranean and the Indian Ocean. Imagery also showed "*an*

[505] Memo, Ambassador Smith to Kissinger, 4 Mar 71, JCS 2482/106-4; ACSAN-69-71 to Kissinger, 5 Mar 71; JMF 752 (4 Jan 71) as cited in Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 95.
[506] Smith, *Doubletalk*, pp. 132-133.

extensive ABM developmental effort" at the Sary Shagan missile test center on a possible new system.[507]

For those opposed to a ban, including Nixon and defense officials, the briefing was used as a springboard for underscoring the importance of not falling behind the Soviets down an inevitable technological development path. Through questioning, Nixon elicited a statement from DCI Helms following the briefing that the Soviets were ahead in ABM deployment but behind in technology. He then turned to the Office of the Secretary of Defense, which painted a rosy picture of the state of the U.S. ABM technology development program. They stated that, "*it's coming well. We've had live intercepts in the past year. The test record is very satisfactory—in fact, above average. Construction is moving. There are no problems in the radar. The problem is to get the whole system working together with the computers. For this we'll need one full year at Grand Forks*." Nixon took the Soviet progress observed via imagery together with the perceived need to maintain U.S. technological superiority in ABMs to hold the position that ABMs must be maintained. In the same NSC meeting, he stated, "The big push on the Hill will be to ban ABMs completely. We have to fight this. The Soviets would go on regardless of what we agreed on ABM." [508]

[507] "Briefing by Acting Director of Central Intelligence Cushman: Developments in Soviet Strategic Forces Related to SALT." Foreign Relations of the United States, June 28, 1971. National Archives, Nixon Presidential Materials, NSC Institutional Files (H–Files), Box H–110, NSC Minutes, Originals, 1971–6/20/74. https://history.state.gov/historicaldocuments/frus1969-76v32/d170.

[508] "Minutes of a National Security Council Meeting," Foreign Relations of the United States, March 8, 1971, National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74.
https://history.state.gov/historicaldocuments/frus1969-76v32/d137.

The ABM ban proposal was officially killed in August 1971 on Nixon's orders, using the excuse of privileging SALT as a whole rather than fixating on an ABM ban. By this time, Smith had achieved success in opening the doors to a ban with the Soviets through private discussions, within which the Soviets expressed interest in moving toward a complete ban.[509] Around this time, some Pentagon officials saw a tactical opportunity in tying the ban proposal to a new call for reductions in ICBMs, fully aware of the non-negotiability of such a measure at the time.[510] This left Nixon the excuse to order Smith to abandon the ABM ban proposal given the risk of jeopardizing the corresponding offensive agreement with the Soviets.[511] Nixon issued orders to abandon the ban on 12 August 1971.[512]

Once the ban was defeated, the final configuration of the ABM agreement was formed out of compromise between the Soviets and the Americans. The United States insisted that it be permitted two ABM sites (either the two under construction at Malmstrom and Grand Forks, or one of those plus Washington), while the Soviet system be confined to the existing one around Moscow. The Soviets proposed equality, with each side being free to protect its capital and an equivalent number of missiles. This led to the final compromise of each side having one capitol defense site and one ICBM defense site.

[509] Smith, *Doubletalk,* pp. 262-263.
[510] Smith, *Doubletalk,* p. 260.
[511] Smith, *Doubletalk*, Appendix 5.
[512] "National Security Council Decision Memorandum 127." Richard Nixon Presidential Library, August 12, 1971. National Security Council Institutional Files, Box H-208. https://www.nixonlibrary.gov/sites/default/files/virtuallibrary/documents/nsdm/nsdm_127.pdf.

During Congressional hearings on the ABM treaty, advocates of the agreement strongly asserted the argument about the verifiability of ABM limits based on high-resolution satellite information advances. In questioning ACDA director Gerard Smith, Senator Charles H. Percy of Illinois asked whether there was "any possibility that potential difficulties in identifying just what the specific purpose of a radar may be, by national means, could prohibit the construction of space activity or air defense related radars?" He also asked whether it was "likely that the Soviets will continue to develop even more formidable SAM systems, which because of their own complexity and advance technology could be a potential enlargement of the Soviet ABM systems and which we might not be able to identify as such?" Smith replied that "We believe that national means of verification will be adequate to distinguish between ABM radars and air defense and space tracking radars. There are a number of parameters, such as location, orientation, size, power and signal characteristics, which taken together, should provide sufficient in- formation to make this distinction…" On upgrading SAM sites, Smith asserted that "we are confident that our national means of verification will be able to distinguish between ABM and SAM systems."[513]

Some Congressional leaders such as Senator Jackson challenged the choice to go with NCA systems rather than to ban ABMs altogether. In the Senate Armed Services Committee hearing on SALT I, Senator Jackson asked, "Why did we propose such a low number when we know or

[513] "Questions by Senator Percy and answers by Ambassador Smith," Strategic Arms Limitation Agreements, Hearings before the Committee on Foreign Relations, United States Senate, Ninety-Second Congress, Second Session on Executive L, 92D Congress, 2D Session, June 19, 20, 21, 26, 28 and 29, and July 20, 1972, pp. 54-55.

should have known that it would be totally inadequate for the defense of Minuteman? You see, I would have argued for zero ABM, instead of an ineffective ABM."[514]

The crux of Smith's response was that it was determined that a small system was preferable to zero while offensive missiles were still under an interim rather than definitive limitation. The implied view was that the ABM treaty's allowance of research and development allowed for a hedge against possible Soviet superiority in offensive systems. Indeed, in the effort to secure Congressional support for the negotiated agreement, Secretary of Defense Laird would emphasize to the Senate Foreign Relations Committee that the "site defense prototype development program [NCA]…preserves the option to deploy a terminal defense of U.S. ICBMs should that ever become necessary" and that the program "will provide for earlier availability of developmental hardware, earlier development of software, and earlier test and demonstration."[515] Smith and Laird's answers and arguments ultimately hinged on the ability to verify ABM limits in the interim, while modernization proceeded steadily forward.

Strategic interests and verification challenges align to support a mobile missile ban

A final weapon system that emerged along with concerns about its verifiability during the 1966 to 1967 period was mobile ICBMs. The CIA's 1967 Special National Intelligence Estimate indicated a tentative ability to monitor the emergence of a mobile missile force but gave no

[514] "Senate Armed Service Committee Hearings on SALT I, June-July 1972, June-July 1972," SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, p. 131.
[515] Senate Foreign Relations Committee Hearings on SALT I, June 1972, in SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, American Enterprise Institute for Public Policy Research, p. 84.

promises about the ability to verify total counts or modernization efforts. The report noted that, "*Intelligence could probably identify a land-mobile offensive system, for example, but it would be difficult to determine the magnitude of such a force."* [516] When Director of Central Intelligence Helms was prompted by President Johnson to clarify this statement, Helms replied that,

> *"We can quote no discrete odds for detection in the early stages of deployment. Our word 'possible' in this context simply means that we are not certain of being able to detect nor do we feel it is impossible that we will detect. Your mathematical friends define this use of "possible" as "non–zero probability." As to extensive deployment of these weapons systems we feel our chances of detecting are greater than even and less than overwhelming—say in the general bracket 65% to 85%..."* [517]

This uncertainty contributed to the stalling of decisions over whether to include mobile missiles in the SALT framework. The Joint Chiefs favored the inclusion of mobile missiles in any arms control measure out of concerns that the Soviets would advance such a force. However, the Chiefs did not believe mobile missiles could be verified by satellites, and therefore vouched for their inclusion along with on-site inspections.[518] Early in October 1967, Secretary McNamara

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[516] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Foreign Relations of the United States, July 18, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d257; "Special National Intelligence Estimate, SNIE 11–10–67, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Foreign Relations of the United States, February 14, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d169.

[517] "Letter From Director of Central Intelligence Helms to the President's Special Assistant (Rostow)," March 18, 1967. Johnson Library, National Security File, National Intelligence Estimates, 11–67—U.S.S.R., Box 4. https://history.state.gov/historicaldocuments/frus1964-68v10/d175.

[518] JCSM-311-66 to SecDef, 9 May 66, JCS 1731/928-1; Memo, M. W. Roche to CJCS, 26 Aug 66, JCS 1731/928-2; JMF 3050 (2 May 66), as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 84.

solicited the Joint Chiefs' views about an NSC and State Department proposal that included, among other measures, limiting any mobile launchers to those that were operational or under construction to be verified by national technical means. The Chiefs found these proposals objectionable because they considered mobile land-based systems to be "*unverifiable*" by satellites alone.[519] The proposal stalled without their support.

The CIA's 1968 update to the Special National Intelligence Estimate showed a gradually increasing confidence in detecting road-mobile missiles that can be attributed to a mature CORONA program and a rapidly advancing GAMBIT KH-8 program. The CIA noted in the report that although the Soviets were testing strategic missiles which lend themselves to mobile deployment, it believed that no such weapons had yet achieved operational capability. The CIA was concerned that it would be extremely difficult to establish an accurate order-of-battle on mobile weapons since their positions could be changed frequently and they could be kept under cover. On the other hand, it recognized that the poor condition of many Soviet highways would limit areas where road-mobile launchers could operate. The CIA believed that this would establish a defined though extremely large area for surveillance. Overall, the CIA believed that it might not recognize the existence of a Soviet mobile missile system in the early stage of deployment, but that it would eventually identify the system.[520]

[519] Memo, SecDef to CJCS, 4 Oct 67, JCS 1731/983; Notes to Control, "JCS 1731/983," 25 and 30 Oct 67; JCSM-598-67 to SecDef, 2 Nov 67, JCS 1731/983-1; JMF 755 (13 Jan 67) sec. 2., as cited in Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 86.

[520] "Special National Intelligence Estimate, SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://dp.la/item/09fb021f99dfeed2e70e1b06f519afb7.

These factors, namely confidence in the ability to detect the presence of mobile missiles, but not in characterizing the magnitude or order-of-battle of the force, evidently contributed to a decision to push for a ban on mobile missiles to be verified by national technical means. Buttressing this decision was the fact that the United States had none of its own plans to deploy strategic mobile missiles. Late in July 1968, an interagency working group completed and ACDA circulated a proposal that included, among other measures, forbidding mobile launchers. The Joint Chiefs argued that a ban on mobile launchers would remain difficult to verify prior to substantial deployment, and in another display of inconsistency, they proposed to prohibit the production as well as the deployment of mobile land-based missiles.[521]

Shortly following these assessments, the draft U.S. position developed by the Johnson administration on SALT at the end of July 1968 included a complete ban on the deployment of mobile land-based, strategic offensive missile systems (ranges greater than 1,000 km) to be verified by national technical means.[522] DOD, in August 1968, noted in response to the SALT agreement framework taking shape and Johnson's position that "*We also have low confidence that national means of verification would permit us to monitor the terms of the agreement as they*

[521] Poole, Walter S. "JCS and National Policy, Vol. IX, 1965-1968" (2012), p. 87; "SNIE 11-13-68, U.S. Intelligence Capabilities to Monitor Certain Limitations on Soviet Strategic Weapons Programs." Central Intelligence Agency, July 18, 1968. National Archives Catalog. https://catalog.archives.gov/id/7327189.
[522] "Paper Prepared by the Interagency Working Group, 'STRATEGIC MISSILE TALKS PROPOSAL.'" Foreign Relations of the United States, July 31, 1968. Johnson Library, Clifford Papers, Kosygin-Talks with Soviet Union (2), Box 22. https://history.state.gov/historicaldocuments/frus1964-68v11/d264; "Paper Approved by the Executive Committee of the Committee of Principals: Strategic Missile Talks Proposal." Foreign Relations of the United States, August 14, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d269#fn:1.5.6.2.778.30.6.3.

pertain to mobile offensive systems."[523] Taking this as caution rather than outright objection, in September 1968, President Johnson approved a negotiating position that included a prohibition of mobile land-based missiles, for which the Joint Chiefs expressed tentative support.[524]

Mobile ICBM ban disintegrates as strategic interests waver

At the beginning of 1969, U.S. defense leaders had begun to shift its views on the necessity and promptness of arms control negotiations, expressing concerns over land-mobile missiles and MIRVs. It believed that a delay in initiating talks would allow the Soviets to cross certain thresholds in these categories that might then foreclose certain options for limitations and create complications for verification.[525] DOD believed that the Soviets might deploy land-mobile ICBMs and MIRVs earlier than previously estimated, as well as resume the deployment of ABM launchers. Defense planners believed these actions represented thresholds, which if crossed, would be irreversible, and would have to be considered in formulating agreements. Such concern likely motivated more flexibility from the military establishment than they might have otherwise exhibited.

[523] "Memorandum From Secretary of Defense Clifford to President Johnson; Subject: Proposal for Limiting Strategic Offensive and Defensive Systems." Foreign Relations of the United States, August 13, 1968. Johnson Library, National Security File, Intelligence File, Arms Limitation Talk, Box 11. https://history.state.gov/historicaldocuments/frus1964-68v11/d268.

[524] SOURCE

[525] "Paper Prepared in the Department of Defense." Foreign Relations of the United States, February 6, 1969. Ford Library, Laird Papers, Box 22, SALT, Chronological File. https://history.state.gov/historicaldocuments/frus1969-76v32/d2.

The Verification Panel's 1969 report specified that banning mobile missiles would produce less uncertainty than trying to set limits. The report estimated that under normal Soviet practices, a ban on mobile missiles would come with an ability to detect deployments within 100 after 200 had been deployed, and that in the context of a *clandestine* build-up, the Soviets could conceal 200 to 300 units. Under a set of limits (rather than a ban) on the order of 200 units, the Soviets might exceed permitted force by 200 to 400. For limits on the order of 1000 to 1500, Soviets probably could not exceed that by more than 500 and remain undetected.[526]

Along with the fact that the U.S. had no mobile missile program of its own, the Verification Panel's report appears to have encouraged decision-makers to move in the direction of banning mobile missiles. By early 1970, both the Joint Chiefs and Kissinger agreed that a ban on mobile missiles should be pursued.[527] The Verification Panel also came to full agreement that despite the possibility of clandestine deployment, a ban on land mobile missiles of both intercontinental and intermediate range could be adequately verified by national technical means. The panel placed an emphasis on the ability of verification to deter cheating in this area.[528]

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[526] "Paper Prepared by the National Security Council Staff." Foreign Relations of the United States, September 29, 1969. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–004, Verification Panel Meetings—Status Report 9/29/69. https://history.state.gov/historicaldocuments/frus1969-76v32/d33.

[527] ACSAN-56-70 to CJCS, 14 Mar 70, JCS 2482/74, JMF 752 (14 Mar 70), as cited in Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), pp. 89-90.

[528] "Paper Prepared by the National Security Council Staff: ANALYTICAL SUMMARY, SALT ISSUES AND OPTIONS." Foreign Relations of the United States, March 23, 1970. National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–027, NSC Meeting 3/25/70 SALT. https://history.state.gov/historicaldocuments/frus1969-76v32/d58.

By 1971, the consensus on banning mobile missiles began to disintegrate based on strategic concerns. Concerned about the diminishing U.S. ABM program, at an NSC session in January 1971, General Allison encouraged other members of the Joint Chiefs to consider alternatives to ABMs, which he believed included mobile ICBMs, hardened silos, a revised employment doctrine, and increased MIRV loads.[529] These assertions appear to have roots in a JCS study from November 1969, which specified a "*mobility concept*" wherein "*mobile forces tend to prevent the initiator of a counterforce strike from gaining a decisive advantage*" and "*the relative immunity of these forces to disarming attacks enhances stability and could improve force potential.*"[530] Secretary of Defense Melvin Laird also began to assert in March 1971 that the United States needed to preserve the option of land-based mobile missiles because of "new information we have on the Soviet momentum on their larger systems."[531] This was supported by General John D. Ryan, Chief of Staff, USAF.[532] This emerging resistance among U.S. defense planners toward banning mobile missiles, combined with Soviet resistance to the proposal, effectively removed mobile missiles from consideration in later stages of the SALT negotiations.

[529] ACSAN-52-71 to CJCS, 26 Feb 71, CJCS 388.3 SALT (Jan-Jun 71). Dec On JCS 2482/107-2, 26 Feb 71, JMF 752 (31 Jan 71), as cited in Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 94.

[530] "Study Prepared by the Joint Chiefs of Staff, VOLUME I. SUMMARY, PART I. CONCEPT OF LIMITED STRATEGIC NUCLEAR WAR." Foreign Relations of the United States, November 28, 1969. Washington National Records Center, OSD Files: FRC 330–75–103, 320.2, Strategic (28 Nov 69). https://history.state.gov/historicaldocuments/frus1969-76v34/d129.

[531] "Minutes of a National Security Council Meeting," Foreign Relations of the United States, 8 March 1971, National Archives, Nixon Presidential Materials, NSC Files, NSC Institutional Files (H-Files), Box H–110, NSC Minutes Originals 1971 thru 6–20–74. https://history.state.gov/historicaldocuments/frus1969-76v32/d137

[532] Poole, Walter S. "JCS and National Policy, Vol. X, 1969-1972," (2013), p. 98.

Conclusion

This case study has demonstrated the ways that information and uncertainty were co-constitutive in the shape that nuclear arms control took during its first decade. As satellite technology improved, the increased information quality and quantity were used to establish arms control characterized by limits. For established weapon systems like ICBMs and SLBMs, new arguments about verifiability were used to make a case for limits over continued buildup and the pursuit of superiority. For pending weapon systems like MIRVs and ABMs, blind spots were used by conservative and pro-nuclear forces to depict stories about what "might be" going on in the gap between images. Those narratives assumed the worst case and were used to obtain support to retain and advance U.S. weapon systems. Next to this, imagery information about Soviet MIRV and ABM developments were used to fuel arguments for advancing respective U.S. programs.

Established systems: ICBMs and SLBMs

For established weapon systems, resolution advances and improved information were successfully leveraged to establish limits, a measure that was still in contention through the early 1960s. In the case of ICBMs, imagery resolution increased to allow precise counting of fixed ICBMs and the differentiation of missile types. For SLBMs, resolution advances improved the ability to distinguish ballistic missile submarines from other types and to detect modifications during the retrofit period. More frequent imagery, particularly through the deployment of

GAMBIT KH-8 and its larger film load and longer mission life, increased the intelligence community's confidence in the ability to verify total counts for submarines.

These developments were successfully leveraged by ACDA to pressure the Joint Chiefs to withdraw their insistence for on-site inspections, a position that up to that point had guaranteed the stalling of the arms control given Soviet refusal to allow inspectors. Because the core of the Joint Chiefs' arguments against limits revolved around the inability to verify limits without inspectors, this position shift is most likely attributable to the improvements in verifiability that came with CORONA and GAMBIT. This is supported by evidence that at the time of the position shift, the military services were still pushing for new nuclear weapon systems, including new land and sea-based systems. The success of such proposals would run counter to a U.S. initiative to establish missile limits or reductions, given that existing systems were not yet slated for retirement. The Joint Chiefs' change of opinion is therefore most likely attributable to their reluctant acceptance of CIA assertions on verifiability.

As the treaty solidified, further advances in high resolution satellite imagery would be used to facilitate mixing provisions between ICBMs and SLBMs and allow for more controlled qualitative upgrades. The limitation of missile numbers that accommodated the different and diverging force compositions of each side represented the realization of core ideas as envisioned by the arms control epistemic community. However, such precision in the ability to monitor limits did not just enable or propel restraint; it provided a scaffolding for both sides to pursue modernization and qualitative upgrades within the scope of arms control.

Pending systems: MIRVs, ABMs, and mobile ICBMs

For the pending weapon systems of MIRVs and ABMs, blind spots were more instrumental than imagery information and were used to argue for the necessity of retaining and advancing these areas. No matter how good satellites became, they could only ever supply pictures, not resolve disputes about their interpretation. These blind spots worked to the advantage of conservative and pro-nuclear forces who were able to leverage them into stories about what "might be" going on in between images. Those narratives assumed the worst case and were used to obtain support to retain and advance U.S. weapon systems.

For MIRVs, which U.S. leaders – apart from ACDA director Gerard Smith – strongly favored to keep developing, an argument using blind spots and uncertainty was used with little grounding to help remove them from the scope of arms control. The constructed story was that the Soviet Union would be able to secretly MIRV its missile force within the temporal blind spot; the United States would have little knowledge of the scale or scope of Soviet MIRV capacity, which to some was a means of securing a first-strike capability. The Nixon administration built a story about verification that was consistent with this package: they asserted that submarines, ICBMs, and ABMs were easy to verify and therefore limit, but that MIRV's were "obviously" the toughest problem, despite the CIA's assertion that it could verify a MIRV ban as long as testing programs were to immediately cease. This constructed story was used to propel the administration's preferred arms control agenda.

The issue of MIRV verification might have objectively been solved by determining that missiles of a certain type were MIRV-capable through testing data, and then monitoring a ban or limits on those missile types via satellite imagery, which is a method that would later be adopted under SALT II. The temporal blind spot would hold little relevance under such a scheme. Especially as GAMBIT models emerged with high resolutions, missile-type identification became possible. Opponents of a MIRV ban effectively obscured the issue by simply claiming that overhead imagery could not determine which missiles were MIRV-ed and which were not. The spreading of this incomplete and flawed narrative along with the perceived futility and unacceptability of on-site inspections was instrumental in preventing MIRVs from being included within the scope of SALT proposals. The argument survived from early NSC meetings until the final Congressional hearings that approved the SALT agreements without a MIRV ban.

Blind spots and stories of uncertainty were also effectively used in the case of ABMs. Defense leaders raised concerns related to the temporal blind spot about covert SAM site upgrades to illicit ABM systems, arguing that this was a reason the U.S. should pursue ABM technology regardless of whether the Soviets were interested in a ban. While these concerns later proved unfounded, an ABM ban could not be recovered. Indeed, Gerard Smith would testify to Congress that their concerns about the verifiability of SAM upgrades to ABMs were unnecessary, with satellite capabilities having given the intelligence community high confidence in the verification of ABMs.

Next to blind spots and the stories of uncertainty they were used to weave, new information from satellites also played a role in the retention and advancement of pending weapon systems over

cancellation and banning. As new information and details about the Soviet arsenal were revealed, this information was used to augment arguments for parity and thus for modernization. It was an oft repeated refrain throughout the U.S. bureaucracy that continued MIRV advancement was essential for maintaining U.S. security. Imagery information had been used to depict a detailed picture of Soviet forces, showing that the Soviets were numerically ahead in every missile area except for MIRV numbers. This package of information therefore made the retention of MIRVs appear essential, lest the United States relinquish the sole area where it had an advantage. This argument carried through the NSC debates to Congress, painting a MIRV ban as unthinkable despite the strong support for the measure by the leader of the SALT negotiations and ACDA, Gerard Smith.

Imagery information was also used to fuel U.S. ABM development and modernization despite heavy opposition to the program within the U.S. Congress. Nixon and Kissinger used imagery information of the Soviet ABM program to make the case that ABMs represented an 'inevitable' technological development that the United States must actively meet. Nixon took the Soviet progress observed via satellite imagery together with the perceived need to maintain U.S. technological superiority in ABM development to hold the position that ABMs must be maintained and advanced.

Mobile ICBMs faced different outcomes given that during this period, military and pro-nuclear leaders did not desire their development. For other weapon systems, blind spots and uncertainty were used to justify modernization. In the case of mobile ICBMs, blind spots were used to assert the salience of a ban over limits, given the relative ease of verifying a ban. While this would later

change as U.S. strategic interests in mobile missiles grew, the argument for a ban held enough weight to satisfy Congressional challengers during this period.

The case of mobile ICBMs is thus reflective of the ways that outcomes for nuclear forces during this period strongly tracked with military desires. While outcomes did not always exactly align with military aspirations, the White House often viewed the Joint Chiefs as an essential constituency from which support (even if reluctant or partial) for any arms control measure must be acquired. The case of mobile ICBMs during this period is thus an early indication of a pattern that would persist for decades to come.

This case study shows that satellite information and blind spots were used to do much more than help establish early arms control measures. The new information indeed helped strengthen the case for the verifiability and salience of arms control limits against those seeking superiority in the case of ICBMs and SLBMs. However, high-resolution imagery capabilities were used to help establish these early limits in ways that allowed for the setting of corollary constraints that allowed both sides to conduct mutually-monitored qualitative upgrades. In the case of MIRVs and ABMs, this high-resolution information was used to make the case that Soviet advancements in these areas were adept and inevitable. Next to this, the remaining temporal blind spot was used to argue against the sensibility of banning MIRVs and ABMs on the basis of the story that the Soviets would merely pursue the measures anyway, adding MIRVs or upgrading SAM sites to ABMs in ways that satellite imagery could not be guaranteed to detect. The result was that despite achieving the first Soviet-US bilateral arms control measures through the SALT Interim

Agreement and the ABM treaty, the agreements were structured in a way that allowed modernization and advancements across all weapon systems.

Chapter 4. Case Study: SALT II under HEXAGON, 1972-1976

While the HEXAGON satellite program was a clear technological success from the view of its operational history, its impact on intelligence, strategy, and the process of arms control was more heterogenous. Emerging at the start of the preparation process for the second round of the Strategic Arms Limitation Talks (SALT II), the HEXAGON satellite was designed to blend the wide-area search potential of CORONA with the high-resolution of GAMBIT. HEXAGON dramatically increased the volume and frequency of imagery intelligence and information about the Soviet modernization program. Chapter 2 discussed how these changes contributed to the transformation of NPIC's reporting to focus on qualitative advances, even though the Soviet modernization process had been ongoing throughout the 1960s. This case study thus shows how these changes were capitalized upon by those seeking U.S. superiority to claim that the SALT process and arms control were failing the United States in the face of rampant Soviet modernization efforts.

The case study looks at three domestic debates over weapon systems: (1) Silo-based ICBMs and MIRVs, (2) Cruise missile systems, and (3) Land-based mobile missiles. The case study shows how advocates for further investment in U.S. nuclear weapon programs had an ample basis with which to claim the need for the United States to fund new weapon programs rather than reduce weapons. HEXAGON's advancements also increased the ability to verify hard-to-track systems like cruise missiles and mobile missiles, which effectively empowered advocates of these systems that sought to destroy the prospects for banning these categories of weapons by helping them make the case that such weapons could be responsibly developed, limited, and verified.

The chapter thus supports the argument of this study – that high resolution information strengthened arguments for modernization and limits over reductions or bans – by showing how the greater precision and volume of HEXAGON imagery information contributed to these outcomes.

Nuclear strategy overview

A central strategic challenge of SALT II was to reconcile the asymmetries between U.S. and Soviet forces left in the wake of the SALT I Interim Agreement. The debate over nuclear strategy during this period centered on the idea of "essential equivalence" and attempts to define metrics for ascertaining parity. Information from HEXAGON was used to generate increasingly detailed national intelligence estimates that elaborated qualitative factors of the Soviet nuclear weapon modernization program and leaned toward depicting Soviet aspirations as seeking a superior position. Both of these developments played a role in the debate over essential equivalence and contributed to its further complication, the muddling of its objectives, and ultimately the undoing of SALT II together with the continued qualitative and quantitative development of the U.S. nuclear force such that it would only reach its peak warhead loading in 1987.[533]

[533] Chochran, Thomas, William Arkin, and Milton Hoenig. *Nuclear Weapons Databook, Volume I, U.S. Nuclear Forces and Capabilities*. National Resources Defense Council. Cambridge: Ballinger Publishing Company, 1984.

SALT I had codified unequal aggregates in missile numbers given U.S. superiority in MIRV technology. The military establishment and leaders in an increasingly right-leaning Congress opposed the Soviet Union's quantitative advantage in launchers and demanded that SALT II rectify the imbalance. Negotiators faced a dilemma: if equal ceilings were established at the American level, the Soviet Union would have to undertake an essentially unilateral reduction of its forces. If they were set at the Soviet level, the United States would acquire the right to a buildup for which it had no program or strategic theory.[534] Decision makers also faced the question of how strategic equality and parity should be defined: by numbers of vehicles, launchers, throw-weight, or megatonnage.[535]

The Pentagon came up with the term "essential equivalence" to capture the idea that some though not all distinctions might matter. This was defined as conferring 'no unilateral advantage to either side.' According Schlesinger, essential equivalence was important 'for symbolic purposes, in large part because the strategic offensive forces have come to be seen by many – however regrettably – as important to the status and stature of a major power.'[536] Schlesinger's successor in the Carter Administration, Harold Brown, also accepted that essential equivalence was important if only for political purposes, stating that it "guards against any danger that the Soviets might be seen as superior – even if the perception is not technically justified."[537]

[534] Kissinger, *Years of Renewal,* p. 253.
[535] ACSAN-135-72 to CJCS, 14 Aug 72, Moorer Diary, as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 56.
[536] Freedman, pp. 522-523.
[537] Secretary of Defense Harold Brown, Department of Defense Annual Report Fiscal year 1979 (Washington, DC: 2 February 1978), p. 5, cited in Freedman, p. 523.

Many of the debates of this period centered on the definition of parity in armaments. It was perceived within the U.S. government that any disparity permitted by SALT could embolden the Soviet Union's foreign policy while restraining that of the United States. As explained by Lawrence Freedman, this view exaggerated the importance of parity, encouraging the tabulation of strategic credits and debits and the codification of difference between the two states. Given that there was no self-evident index of military power, the impression of balance could vary according to which measure was chosen. The more an index was sought, the more difficult calculations became. Two popular measures became *equivalent megatonnage*, which acknowledged that destructive power does not grow proportionately with yield and indicated counter-city potential, and *lethality*, which indicated counter-force potential.[538] As Freedman describes, "The greater the concern with factors that shape force effectiveness (target structure; defenses; reliability; tactics; as well as accuracy, yield, and numbers of warheads) the more complicated the analysis became, and the more unknowables and unquantifiables were involved."[539]

While it was never clear that any particular disparities in forces that were already at such high levels actually mattered, National Intelligence Estimates of this period, for which HEXAGON imagery was a primary component, painted an increasingly vivid picture of the qualitative factors at play. Beginning in 1973, NIEs included graphical charting of total Soviet throw-weight, warhead loadings and megatonnage, whereas previous estimates of the 1960s had largely just focused on numbers of missile launchers.

[538] Freedman, p. 523.
[539] Freedman, pp. 525-526.

A related in challenge in generating coherent objectives out of the debate over essential equivalence had to do with the lack of agreement over Soviet intentions. The intelligence community was split over whether the Soviets were seeking parity, which would make *essential equivalence* a reasonable goal for SALT II, or whether they were seeking superiority, in which case some U.S. organizations saw the need to directly compete, even if it meant a continued arms race. Despite the fact that various agencies and organizations were using the same imagery and intelligence information, each drew different conclusions about this question. The State Department argued that the Soviets had "more modest expectations for their strategic programs" and that they were not seeking superiority. Rather the State Department saw the Soviets undertaking "vigorous strategic force improvements with a view to achieving incremental advantages where possible but, above all, to avoid falling behind the US in a strategic environment increasingly characterized by qualitative competition – and thus losing the position of rough equivalence with the US which they have achieved in recent years through great effort."[540]

U.S. Air Force leadership took an opposite view. They believed that a "realistic calculation of nuclear fatality exchange ratios in a war [in 1976] would probably show the USSR emerging with considerably more than a twenty-to-one advantage."[541] They not only asserted that the Soviets were seeking superiority, but that they were directly using the SALT process to achieve it, specifying that "….shortly after the signing of the SALT I agreement, the Soviets began

[540] NIE 11-3/8-76, p. 4.
[541] NIE 11-3/8-76, pp. 5-6

unambiguous testing of four new ICBM systems, at least three of which are now being deployed."[542]

The CIA, as usual took a middle of the road approach, but its position gradually shifted more toward the Air Force view. In 1974, under Director of Central Intelligence William Colby, the CIA's position articulated in its National Intelligence Estimate was heavily moderated, stating for example that, "We doubt that Moscow has firmly settled on either accepting parity or a decision to seek clear-cut strategic superiority, in part because these concepts are difficult to relate to the practical choices of policy on weapons systems, budgets, and negotiating tactics. Rather, we believe Moscow is pursuing a strategic policy which is simultaneously prudent and opportunistic, aimed at assuring no less than the continued maintenance of comprehensive equality with the U.S. while at the same time seeking to attain some degree of strategic advantage if U.S. behavior permits."[543] By 1976, Under DCI George Bush and in the aftermath of the Team B exercise, the tone of the estimate had changed, stating "The Soviets' belief in the eventual supremacy of their system is strong. They see their forces for intercontinental conflict as contributing to their ultimate goal of achieving a dominant position over the West, particularly the United States, in terms of political, economic, social, and military strength…In our view, the Soviets are striving to achieve war-fighting and war-survival capabilities which would leave the USSR in a better position than the US if war occurred. The Soviets also aim for intercontinental forces which have visible and therefore politically useful advantages over the US."[544]

[542] NIE 11-3/8-76, p. 19
[543] NIE 11-3/8-74, p. 10.
[544] NIE 11-3/8-76, p. 3.

The NPIC's cultural and reporting shifts toward contextualized, qualitatively focused reporting in the wake of HEXAGON tracks with these shifts in tone. While the NPIC's use of HEXAGON information was unlikely to be the sole reason for this shift, it can arguably be seen as a major contributor. The most plausible counter explanation for the CIA's shift in tone is that it was the Soviets' transition toward qualitative modernization that actually compelled the CIA to change its narrative. However, the Soviets had been steadily "modernizing" its force since the 1960s with the development of new heavy missiles like the four-warhead version of the SS-9, multiple warhead versions of the SS-11, and the SS-13 as the first solid propellent ICBM, holding a 600-kiloton warhead. The Soviets were also rapidly deploying around 200 to 300 new launchers per year throughout the 1960s. Despite all of these developments together, the CIA never asserted the Soviets were seeking a superior position. This study thus argues that the CIA's shift toward a more pessimistic outlook is better explained as a combination of the influence of changes within NPIC attributable to its use of HEXAGON together with external pressures applied to the CIA to be more suspect in its analysis.[545]

This shift was significant in the context of domestic decisions over U.S. nuclear force modernization. The military establishment was clearly ready to build up to the Soviet Union's higher levels of forces. Secretary Schlesinger stated in a National Security Council meeting that "the pressure is on Congress to provide the essential equivalence they insist we must have. Today we spend only $8 billion on strategic forces—we probably spend that much on food stamps… We could go up easily… And with about $2 billion a year more we could undertake

[545] Chochran, Thomas, William Arkin, Robert Norris, and Jeffrey Sands. *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons*. Harper and Row, 1989, p. 102.

significant new programs."[546] The Joint Chief argued that should the Soviets refuse to agree to equal aggregate numbers of nuclear forces, the United States still had options to achieve equality by building up. They asserted that "we could retain the Polaris submarines and B–52s, take B–52s out of mothballs, and build more B–1s and Tridents. The point is that it is much more important to achieve agreement on equal aggregates of central systems, even at the 2500 level, than it is to accept an agreement which is asymmetrically in favor of the Soviets in numbers of launchers." They argued that the proposal "…provides for essential equivalence from a military as well as political image point of view."[547] The external effort to push CIA intelligence estimates higher and toward worst-case scenarios was closely connected to this thinking and argumentation by the military establishment.

The debate over essential equivalence showed that NPIC's "stories" mattered in the context of decisions about U.S. nuclear strategy and questions of force modernization and expansion. As Freedman argues, the focus on essential equivalence "pushed strategic theory into quite the opposite direction from the 1960s, away from the emphasis on rationality and the construction of unambiguous deterrent threats to concern with the imperfection of cognitive and decision processes and the consequent inadequacy of perceptions of military strength, no matter how well they had been constructed."[548] He holds that what ultimately mattered was not the complex calculations of nuclear force planning and conflict, but rather on how "simple-minded politicians

[546] "Minutes of a Meeting of the National Security Council," 24 January 1974, Foreign Relations of the United States, 1969–1976, Volume XXXIII, SALT II, 1972–1980, https://history.state.gov/historicaldocuments/frus1969-76v33/d47.
[547] "Memorandum From the Chairman of the Joint Chiefs of Staff (Moorer) to the President's Assistant for National Security Affairs (Kissinger)," 2 May 1973, 1969–1976, Volume XXXIII, SALT II, 1972–1980, https://history.state.gov/historicaldocuments/frus1969-76v33/d22.
[548] Freedman, p. 526.

and other amateurs in military matters might perceive matters. Their views on the military balance could not be expected to reflect arcane and complex calculations. If visible disparities did matter, it was in the crude and quantifiable measures, such as delivery vehicles."[549] As the same time, there is evidence that a focus on individual threat perceptions were overblown. Empirical work on the topic found that, in a variety of relevant publics (in Europe, Japan, and in the Middle East), there was a lack of agreement on which superpower was ahead, and that a large number of respondents believed that the question had little point because the two superpowers could so easily destroy each other. [550] It was within this space of ambiguity that the CIA's shift in tone took on more significance, giving arguments for new U.S. nuclear weapon programs a steadier foundation to stand on.

The focus on essential equivalence would endure through the rest of the decade. U.S. leaders would leverage the concept to depict arms control as the only prudent path forward, thereby contributing to the embedding of the notion of arms control as the "answer" to all of the strategic confusion and uncertainty. During this decade, essential equivalence would be used to structure the arms control as part of a story of progress and toward a more stable future. A speech by Secretary of State Cyrus Vance in 1979 called "*Meeting the Challenges of a Challenging World*" shows this story clearly. He states: "We should harbor no illusion that we could return to the earlier era. Neither side will permit the other to hold an exploitable strategic advantage…With the stakes so high, we know that both of us will do whatever is necessary to keep from falling behind. That is why essential equivalence has become the only realistic strategy in today's

[549] Freedman, pp. 525-526.
[550] Freedman, pp. 525-526.

nuclear world. This rough balance can also serve the cause of stability—even if some find it unsettling compared with our earlier supremacy… Only when both sides perceive a balance, as is now the case, can we hope for real arms control progress.[551] In this "story of progress," lost was the fact that even though there may have been a perceived balance, both sides were still actively modernizing their nuclear forces.

[551] "Address by Secretary of State Vance, Meeting the Challenges of a Challenging World" 1 May 1979, Foreign Relations of the United States, 1977–1980, Volume I, Foundations of Foreign Policy, https://history.state.gov/historicaldocuments/frus1977-80v01/d118.

Established weapon systems: ICBMs and MIRVs

Treated as a pending weapon system in the previous case study, MIRVs are assessed here as an established weapon system. The State Department had previously supported a ban. However, after the passage of time, analysts felt both sides had made technological strides in ways that made using a MIRV test ban for verification inadequate. Both could now conceivably deploy MIRVs with low chances of detection by either satellites or signals intelligence. The State Department therefore changed its position from a ban to a freeze. The Joint Chiefs and the Department of Defense strongly preferred to continue development and to set more tailored limits such as limits on the Soviets' ability to MIRV heavy ICBMs.[552]

The fates of ICBMs and MIRVs became increasingly intertwined due in large part to continued issues of verifiability. Strategic missiles and MIRV technology are therefore treated in tandem within this case study. The case examines how high-resolution imagery information was employed to support missile and MIRV modernization and expansion over deep reductions.

The 1970s saw changes in how U.S. leaders thought about verification. There had previously been insistence, particularly by the military establishment, that MIRVs were not verifiable and should be left uncontrolled. As the Soviets progressed with their own MIRV program, U.S.

[552] CM-2351-73 to DJS, 3 Mar 73, JCS 2482/190; SM-114-73 to CJCS, 7 Mar 73, JCS 2482/190-1; JMF 752 (3 Mar 73), as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 56; Kissinger, *Years of Upheaval*, p. 267; "Memorandum from the President's Assistant for National Security Affairs (Kissinger) to President Nixon," Foreign Relations of the United States, Washington, undated, National Archives, Nixon Presidential Materials, NSC Files, Box 889, SALT, SALT TWO–I–Geneva, April 1973. https://history.state.gov/historicaldocuments/frus1969-76v33/d29.

leaders changed their position and decided that corollary measures could be developed to enable MIRV verification via HEXAGON. These measures developed around HEXAGON's capabilities were the last nail in the coffin of a freeze on MIRV development. The system effectively enabled both sides to continue developing MIRVs in a controlled and verifiable manner, removing one of the primary barriers to enacting limits and continued modernization instead of a freeze or a ban.

At the same time, the more detailed qualitative analysis from NPIC achieved with the use of HEXAGON helped fuel the arguments of those in the U.S. government and epistemic community pushing against deeper reductions in missile numbers or banning new types of weapons, including cruise missiles and mobile missiles. This contributed to maintaining the status quo of retaining large numbers of weapons and continued nuclear weapon modernization.

New rules: Devising a solution for the verified limitation of MIRVs

From the U.S. perspective, the strategic theory about MIRVs was muddled and confused. The Soviets had the potential to MIRV up to 2,500 missiles, yet U.S. leaders were initially unwilling to consider giving up its advantage in MIRV numbers by including them in arms control measures. Still, U.S. leaders grappled with the illogic of overkill and the arbitrarily high numbers under negotiation. In a discussion with President Ford who had just assumed office and was trying to understand why the U.S. had MIRV-ed so many missiles, Secretary of Defense James Schlesinger and General George Brown, Chairman of the Joint Chiefs of Staff, explained that any number of MIRV-ed missiles above about 600 represented so much overkill that the

numbers didn't really matter anymore. President Ford inquired why the United States had MIRV-ed so many missiles, stating, "It sounds like we are doing the wrong thing." General Brown replied, "Someone did the wrong thing many years ago."[553]

This strategic confusion contributed to delays in resolving unanswered questions about whether and how to limit MIRVs under the SALT process. Under SALT I, the CIA and ACDA had supported establishing a MIRV testing and deployment ban. This was a feasible path at the time given that the Soviets had yet to successfully test a missile with MIRVs. By the time the SALT II process was underway, this had changed. The Soviets had begun successfully testing MIRV-ed land-based ICBMs and the capability was assessed to be around the corner.[554] Underlining the centrality of the issue, Kissinger asserted privately, "Unless they can satisfy us that our national technical means can distinguish their MIRVs, we will not accept their approach."[555]

U.S. leaders thus settled on a set of "counting rules" that worked around HEXAGON's temporal blind spots and allowed the verification of MIRV limits via imaging satellites. The crux of the system was that if a launcher was tested with an ICBM or an SLBM equipped with MIRVs, all launchers of that type were to be counted under a specified MIRV launcher limit. At the time of SALT II's final stage of drafting, this included for the United States, the Minuteman III ICBM,

[553] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, October 7, 1974. Ford Library, National Security Adviser, NSC Meetings, Box 1, NSC Meeting, October 7, 1974. https://history.state.gov/historicaldocuments/frus1969-76v33/d76.
[554] National Intelligence Estimate 11-3/8-73, Soviet Forces for Intercontinental Attack, Central Intelligence Agency, p. 5.
[555] "Minutes of a Meeting of the National Security Council," Foreign Relations of the United States, March 5, 1975, ord Library, National Security Adviser, NSC Meetings File, Box 1. https://history.state.gov/historicaldocuments/frus1969-76v33/d94

Poseidon C-3 SLBM, and Trident C-4 SLBM; and for the Soviet Union, the RS-16 (SS-17), RS-18 (SS-19), RS-20 (SS-18) ICBMs and RSM-50 (SS-N-18) SLBM.

The counting-rules system was verifiable for a specific reason: The Soviets needed to upgrade the launchers of older silo-based missiles with single warheads in order to use them for newer MIRV-ed variants. U.S. leaders had previously worried that the Soviets would be able to "sneak" MIRV-ed missiles into single-warhead silos. On 14 September 1974, Director of Central Intelligence Colby briefed the newly settled President Ford on the visibility of silo conversions. He explained that there were indications that approximately 900 silos would be converted to host new MIRV-ed missiles and that each type of missile had unique silo signatures. At the time, satellites showed UR-100 (SS-11) silos being converted to host RS-18 (SS-19) MIRV-ed ICBMs, and R-36 (SS-9) silos being converted to host RS-20 (SS-18) MIRV-ed ICBMs. Secretary Kissinger asserted during the meeting that these observables provided confidence that an agreement on MIRV limits was verifiable.[556] The need for the Soviets to convert missile silos was necessitated by the limits set by the Interim Agreement. Even though it was deemed less costly to dig new silos than to modify old ones, because the Interim Agreement prohibited the construction of new launchers, the Soviets were forced to conduct silo conversions in order to deploy their newly MIRV-ed missile variants.[557]

[556] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, September 14, 1974. Ford Library, NSC Institutional Files, Box 8, NSC Meeting 9/14/74–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d74.
[557] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, September 14, 1974. Ford Library, NSC Institutional Files, Box 8, NSC Meeting 9/14/74–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d74.

HEXAGON was well-suited to supporting the counting-rules system. It returned imagery toward the low end of the 0.6-to-1.2-meter range specified by the National Photographic Intelligence Center as necessary for target characterization, and it did so at more frequent rates than CORONA. Given the long time horizons for silo conversion – several months to over a year – frequency was not an urgent issue, but high-resolution photographs over wide areas at regular intervals would have been essential to tracking construction activity and allowing analysts to determine the nature of the conversion. For example, Director of Central Intelligence Colby featured a satellite image at a National Security Council meeting in 1974: one image showed silo components for the RS-16 (SS-17) at a complex for single-warhead missiles, indicating that MIRV conversion was taking place, and another showed "*massive new segments*" that were being installed in an old UR-100 (SS-11) silo in order to prepare it for the RS-18 (SS-19) MIRV-ed system.[558]

HEXAGON was also instrumental in resolving a stumbling block in solidifying the counting-rules system concerning the Soviet's SS-18 missile. The Soviet Union wished to employ the SS-18 in both single-warhead and MIRV-ed configurations. This was resolved by the Soviets agreeing to keep the two types of SS-18's in separate areas. Fields with the MIRV-ed SS-18s required collateral equipment not needed by the simpler single-warhead missiles, and this equipment could be detected by satellites.[559]

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[558] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, September 14, 1974. Ford Library, NSC Institutional Files, Box 8, NSC Meeting 9/14/74–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d74.

[559] "SALT II Progress." *New York Times*. May 27, 1975. https://www.nytimes.com/1975/05/27/archives/salt-ii-progress.html?searchResultPosition=3.

In effect, the counting-rules system developed around HEXAGON's capabilities was the last nail in the coffin of a freeze on MIRV development. The system effectively enabled both sides to continue developing MIRVs in a controlled and verifiable manner, removing one of the primary barriers to enacting limits and continued modernization instead of a freeze or a ban.

Kissinger proposed equal missile ceilings at the level of 2,500 delivery vehicles (requiring a Soviet reduction of some 150 delivery vehicles), of which 1,320 could be MIRVs. He chose the latter number because it was precisely the number of MIRVs in the United States' own program. While the United States did not have the plans or resources to build up to the 2,500 ceiling, Kissinger believed the ceilings would at least impose some — albeit limited — constraint on the Soviet Union.[560] Over the course of negotiations, the Soviets would actively build up their MIRV-ed systems to the new limit, causing some onlookers from Congress and the public to question the value of SALT II.

Using imagery information to argue for the infeasibility of reductions

Framing the debate on MIRVs was the debate over what to do about the missiles themselves: the choices in contention were to reduce missiles, freeze them, or set limits that would allow both sides to build up to a given ceiling. The two debates were intricately linked. The counting-rules system developed to preserve MIRV development activities and maintain verifiability by satellites also worked to lock in MIRV and missile modernization programs. At the same time, frequent, high-volume imagery information from HEXAGON tracking these modernization

[560] Kissinger, Henry. *Years of Renewal*. New York: Simon & Schuster, 1999.

efforts served as fuel for U.S. domestic actors that desired a competitive narrative to support further buildup, and it worked as evidence against those arguing for reductions.

At the time, the core of the arguments against strategic missile reductions were rooted in arms control ideas about crisis stability. During this decade leaders of the military services were actually pressing for reductions. The Joint Chiefs had actually determined that equal aggregates as low as 1,700 would be strategically acceptable, as long as the United States possessed a significant bomber force.[561] In a meeting of the SALT Verification Panel, Deputy Secretary of Defense William Clements argued, "we would seek agreement on some program of reductions. Our goal must be to bring about some program of reductions." Pointing to the defense establishment's fixation on the Soviets' superior throw-weight, Admiral Thomas Moorer, Chairman of the Joint Chiefs of Staff, stated that, "You can't reduce throw-weight without reducing delivery vehicles." Kissinger, invoking principles of stability, countered, "My goal is to understand what the hell we are talking about. Reductions may be great but if they were all in submarines, for example, you would have the damnedest most vulnerable world you've ever seen." In, the same meeting, he would state more generally that, "In a MIRVed world, reductions make you more vulnerable."[562]

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[561] JCS 2482/228-2, 14 Feb 74, and Decisions On, 15 and 20 Feb 74; Memo, VADM Weinel to CJCS, "Equal Aggregate Levels—1,700 Vs 2,000," 19 Feb 74; SM-104-74 to DJS, 20 Feb 74; DJSM-525-74 to Dir, J-5, 15 Apr 74, JCS 2482/228-4; JMF 756 (16 Jan 74) sec. 2. Rpt by SAGA, "An Analysis of Aggregate Levels of Central Systems," Jun 74, JMF 756 (16 Jan 74) filed separately, as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 66.

[562] "Minutes of a Meeting of the Verification Panel." Foreign Relations of the United States, August 15, 1973. National Archives, Nixon Presidential Materials, NSC Institutional Files (H–Files), Box H–108, Verification Panel Minutes, Originals, 3/15/72–6/4/74 [3 of 5]. https://history.state.gov/historicaldocuments/frus1969-76v33/d34.

Alongside this idea that reductions would be strategically unwise, information acquired through HEXAGON imagery was leveraged to support arguments that the Soviets were unwilling to reduce, even if the United States were to adopt reductions as a firm position. In 1973, the Soviet Union was estimated to have about 2,200 launchers (2,050 of which were missiles versus bombers) and the United States 2,100 (1,700 of which were missiles versus bombers). The United States did not have a plan or program to match superior Soviet launcher numbers. In spite of this, the figures led some U.S. decisionmakers to spout the belief that any mutual reductions would require the Soviets to make drastic reductions that were sure to be rejected. For example, Senator Henry Jackson, who was often in line with the defense establishment, supported reductions down to 1,760.[563] In a private memo to President Nixon, Kissinger criticized Jackson's proposals for reduction by arguing that the reductions would be one-sided and "unacceptable to the Soviets," requiring them to reduce more than twice as many of their existing launchers as the United States and that a missile reductions-only program "places no real restraint" on new Soviet programs, especially their MIRV capacity.[564]

Such arguments that took Soviet actions, constructed via imagery information, and positioned them to forestall reductions was also supported by voices throughout the U.S. government and epistemic community. By the time of SALT II, arms control was receiving more widespread

[563] "Letter From Senator Henry Jackson to President Nixon." Foreign Relations of the United States, January 29, 1974. National Archives, Nixon Presidential Materials, NSC Files, Box 891, SALT, SALT TWO–I–Geneva, Jan. 1974. https://history.state.gov/historicaldocuments/frus1969-76v33/d50.
[564] "Letter from President Nixon to Senator Henry Jackson." Foreign Relations of the United States, March 8, 1974. National Archives, Nixon Presidential Materials, NSC Files, Box 891, SALT, SALT TWO–I–Geneva, January 1974. https://history.state.gov/historicaldocuments/frus1969-76v33/d56. See footnote 1 comments concerning Kissinger's annotations of Jackson's letter.

attention within the broader U.S. government and nuclear research community. Polling indicates that the public neither knew very much about SALT II nor considered it particularly important.[565] Therefore, together with Congress, groups like the Committee on the Present Danger were more influential in shaping the fate of the treaty and nuclear arms control. Within this environment, new information from HEXAGON was used within arguments by the Committee and its allies about the Soviets foreseeably achieving strategic superiority. Modernization and new U.S. weapon programs were positioned as an answer to deal with the existing "imbalance" and rectify the course of arms control. This would in turn propel the continued intertwining of modernization and arms control.

The Committee on the Present Danger would prove to be an influential force among those pushing to unravel SALT II. Founded on November 11, 1976, the board members consisted of a bipartisan group of political elites. The committee also included Ronald Reagan, along with individuals that would go on to take up posts in his administration such as Richard Allen as his national security adviser, William Casey as Director of Central Intelligence, and Jeane Kirkpatrick as representative to the United Nations, and John Lehman as Secretary of the Navy.[566] The committee focused its attention on the "upper echelon of American opinion leaders," and at its height had a mailing list of only 13,000 names.[567] From 1976 through 1979, the committee members participated in 479 television and radio programs, press conferences,

[565] Krepon, Michael and Dan Caldwell, "The Politics of Arms Control Treaty Ratification," New York: St. Martin's Press, 1991, p. 320.
[566] Shribman, David. "Group Goes from Exile to Influence." *New York Times*, November 23, 1981. https://www.nytimes.com/1981/11/23/us/group-goes-from-exile-to-influence.html.
[567] Krepon and Caldwell, p. 325. [footnote 103]

debates, public forums, and speaking engagements. They distributed more than 2000,000 copies of its pamphlets and reports.[568]

The Committee held the view that the Soviets were seeking strategic superiority and that SALT II was helping them get there. In 1977, the committee published its first pamphlet, "What is the Soviet Union up to?" Drafted by Richard Pipes, the report warned that "The ultimate Soviet objective – a Communist world order – requires the reduction of the power, influence, and prestige of the United States," and that "Soviet nuclear offensive and defensive forces are designed to enable the USSR to fight, survive and win an all-out nuclear war should it occur."[569] In July 1977, the Committee formally weighed in on SALT II with its pamphlet "Where We Stand on SALT." The Committee contended that "from the beginning of SALT at Helsinki in 1969, the Soviet objective has been to extend its gains in relative posture while encouraging maximum restraint upon U.S. programs."[570] In the debate over whether these gains and superiority in general actually mattered, Paul Nitze claimed that it was principally U.S. strategic superiority that caused the Soviet Union to back down in the Berlin crisis of 1961 and the Cuban missile crisis of 1962.[571]

The technical footing of the Committee's arguments rested on information extracted by NPIC from HEXAGON imagery. One of the Committee's primary concerns was American inferiority with respect to missile throw-weight. In "Where We Stand on SALT," the Committee aimed to

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[568] Krepon and Caldwell, p. 326. [footnote 105]
[569] Krepon and Caldwell, p. 325. [footnote 104]
[570] Tyroler, Charles. *Alerting America: The Papers of the Committee on the Present Danger.* Washington: Pergamon-Brassey's, 1984, p. 17.
[571] Krepon and Caldwell, pp. 304-305.

substantiate its claims of Soviet relative superiority by pointing out that the United States' MIRVed land-based ICBMs had an aggregate throw-weight of 1.25 million pounds, whereas the Soviets had 5.2. million pounds, or more than four times that of the United States. This information had been steadily incorporated into National Intelligence Estimates (NIEs) as NPIC threaded its "stories" together to get a complete picture of missile types and deployments together with their warhead loadings. By 1974, throw-weight information appeared regularly through graphical charting in NIEs.

According to groups like the Committee and its Congressional sympathizers, the answer to the imbalance imposed by the SALT process was U.S. modernization and investment in new weapons programs. The report also made a concerted case against SALT II's ban on developing mobile missiles, arguing that proceeding with the proposed MX program "could significantly reverse the unfavorable trends in the U.S.-Soviet nuclear balance which would otherwise continue unchecked."[572] Opponents of SALT II also argued that the three-year ban on the deployment of cruise missiles and mobile ICBMs would create an impetus not to deploy those weapons.[573] In this way, HEXAGON's information was used to buttress arguments for investment in the U.S. nuclear arsenal, including missiles and MIRVs, as well as new systems like mobile land-based and cruise missiles.

On the opposite side of the Committee on the Present Danger, groups lacked a coherent position in ways that preventing the mounting of a solid defense of SALT II. There were groups such as

[572] Tyroler, Charles. *Alerting America: The Papers of the Committee on the Present Danger.* Washington: Pergamon-Brassey's, 1984, pp. 18, 21.
[573] Krepon and Caldwell, pp. 304-305.

the Religious Committee on SALT which consisted of twenty-seven religious organizations that collectively represented more than 50 million people. Yet the potential impact of its large network was dampened by limited financial resources, having a budget of less than $20,000 for a two-year period.[574] Groups such as Pugwash supported the ratification of SALT II, but were unenthusiastic about its contents. In 1979, the group released a statement noting, "We regret that the present treaty is inadequate from the point of view of real disarmament: it does not halt the production of the strategic nuclear weapon systems or programs now in course of development; each of the parties remains free to add thousands of new nuclear warheads to their already excessive arsenals of nuclear overkill."[575]

Team B's use of HEXAGON information

The use of Soviet actions as a reason to forestall reductions and to oppose bans was part of a larger controversy during this period about the accuracy of U.S. intelligence estimates of Soviet nuclear forces. During the early 1970s, there was a tremendous amount of criticism and pressure applied to the CIA not to underestimate Soviet nuclear force projections. The estimative capabilities of the CIA were attacked, dismantled, and reconfigured, ultimately resulting in overestimates in predicting the future of Soviet forces. As described by Anne Cahn in her study of the attacks against the CIA during this period, "*For opponents of détente in the 1970s, the CIA was never a target per se, but threat assessments that didn't paint a bleak enough picture of the*

[574] Krepon and Caldwell, p. 329.
[575] "Mexico City Pugwash Conference." *Bulletin of the American Academy of Arts and Sciences* 33, no. 3 (1979): 12-21. Accessed May 6, 2021. doi:10.2307/3822950.

impending danger posed by the Soviets were."[576] A multi-year pressure offensive against the CIA, together with the developing tendency within NPIC toward a heavy focus on qualitative aspects of Soviet modernization described in Chapter 2, would contribute to the Agency over-estimating future nuclear forces in the Soviet Union.

Throughout the 1960s, the CIA's accuracy in estimating ground-truth force levels had been growing, but it consistently underestimated levels of future Soviet forces. Although this tendency had been corrected by 1970, the previous underestimates would stick in the minds of opponents of détente. Albert Wohlstetter, a conservative scholar, published his findings of alleged underestimation of Soviet deployments, though his data were carefully selected to stop just before the planned U.S. buildup. Soon after, U.S. National Intelligence Estimates dealing with Soviet forces were the focus of a concerted attack by conservative opponents of détente.[577] Among these opponents were leaders in the military. According to former CIA director of strategic research Noel Firth, when Elmo Zumwalt was chief of naval operations, he sent a lieutenant commander or commander over to the CIA for six months to check on the CIA's supposed underestimation. When the six months were over, the naval officer said the problem for him was how to write his report to Zumwalt explaining that everything was okay with the CIA's estimating process and not ruin his own career in the process.[578]

President Nixon also proved to be formidable enemy of the CIA and heavily critical of their lenient assessments of Soviet intentions. He was outraged when the agency argued that the

[576] Cahn, Anne. *Killing Detente: The Right Attacks the CIA*. Penn State University Press, 1998, p. 1.
[577] Cahn, Anne. Killing Detente: The Right Attacks the CIA, 1998, p. 89.
[578] Cahn, Killing Detente: The Right Attacks the CIA, 1998, p. 91.

Soviets had neither the intention nor the technology to launch a knock-out nuclear first strike. That conclusion came as part of a set of formal estimates on Soviet strategic forces, all of which Nixon rejected. "*Useless*," he wrote in the margins of a memo from Helms on Moscow's nuclear capabilities.[579] Nixon would later write that "*it was no secret that I was dissatisfied with the CIA, with its reports and particularly with their appraisals of Soviet strength and our other problems around the world… I wanted to get rid of some of the deadwood and so forth. And they knew it*."[580] Nixon worked to cripple the CIA partially by outsourcing the work to James Schlesinger. Some believe that the collapse of the CIA as a secret intelligence service began on the day Richard Helms left and Schlesinger arrived at headquarters. Schlesinger spent seventeen weeks as Director of Central Intelligence, and in that time, he purged more than five hundred analysts and more than one thousand people.[581] He also started the process of eliminating the Board of National Estimates and the Office of National Estimates, which were later salvaged by his successor, William Colby.[582]

Following this development, the President's Foreign Intelligence Advisory Board make a case to President Ford that National Intelligence Estimates were "seriously misleading in the presentation of a number of key judgments and in projecting a sense of complacency unsupported by the facts." Their testimony is a clear example of high-resolution imagery information and blind spots being used to support multiple contending arguments. For example, they argued with respect to Soviet ICBM capabilities and the survivability of the U. S.

[579] Weiner, Tim. *Legacy of Ashes: The History of the CIA*. New York: Knopf Doubleday Publishing Group, 2008, p. 343.
[580] Weiner, Tim. Legacy of Ashes: The History of the CIA, 2008, p. 374.
[581] Weiner, Tim. Legacy of Ashes: The History of the CIA, 2008, p. 376.
[582] Cahn, Killing Detente: The Right Attacks the CIA, 1998, p. 106.

Minuteman force, "the data is inconclusive and has been very differently interpreted by the experts," and with regard to Soviet antisubmarine capabilities, that the NIE wrongly assumed U.S. submarines will remain invulnerable given that they had "observed Soviet experiments in submarine detection and trailing which are not yet understood by the U.S. intelligence community and which give very serious pause to this optimistic judgment." [583]

The significance of these differences of interpretation is underlined by the importance that PFIAB and other attached to the NIEs as the basis for nuclear force structure and policy decision-making. George Anderson, Chairman of PFIAB, wrote to Ford: "The National Intelligence Estimates should be among the most important documents issued by the intelligence community. They are the natural backdrop to guide the Department of Defense in formulating force levels and R&D programs and should serve Congress in their authorization and appropriation hearings. Certain of them also serve as the foundations from which to derive arms limitation negotiating positions. Underlying each of these objectives is the presumption that the NIE will substantially influence the thought processes of key Government decision-makers regarding Soviet military capabilities."[584]

Part of this pressure on the CIA came through an experiment known as Team B. By 1976, opponents of détente, acting through the President's Foreign Intelligence Advisory Board, had

[583] "Letter From the Chairman of the President's Foreign Intelligence Advisory Board (Anderson) to President Ford," Foreign Relations of the United States, August, 8, 1975, https://history.state.gov/historicaldocuments/frus1969-76v35/d155.
[584] "Letter From the Chairman of the President's Foreign Intelligence Advisory Board (Anderson) to President Ford," Foreign Relations of the United States, August, 8, 1975, https://history.state.gov/historicaldocuments/frus1969-76v35/d155.

mobilized Team B, a group tasked to provide an alternative assessment to the CIA's National Intelligence Estimate. Team B was stacked with well-known hardline experts on Soviet strategic military and political affairs, led by Harvard political historian Richard Pipes. While it was provided with the same intelligence and imagery as Team A, Team B came to wildly different conclusions about Soviet intentions. Unsurprisingly, Team B concluded that the Soviet Union surpassed the United States in overall military strength and was bent on a first-strike policy.[585]

The report took observations gleaned from high-resolution satellite imagery and used it as a basis for worst case estimates. The report cited the recent development of Soviet MIRV technology, coupled with a rapid modernization of ICBM and SLBM targeting capabilities to argue that the NIE was underestimating the impact of the sophistication, effectiveness and threat of numerical superiority that missile program was posing.[586] The report also complained that the NIE did not adequately address the issues surrounding the planned Soviet deployment of the SS-X-16 mobile missile system. Because it was built off the SS-20 platform (an intermediate range nuclear missile), it was argued that the SS-20 could be quickly and covertly converted into the longer range SS-16 in times of crisis, and would be a backdoor around the SALT I Treaty.[587] The report also used observations of Soviet ABM construction to argue that since the Soviet ABM research and development was continuing at a pace similar in size and scope it was before the ABM Treaty in 1972, it was likely that Soviet ABM technology was greater than the NIE concluded it was.[588]

[585] Cahn, Killing Detente: The Right Attacks the CIA, 1998, p. 4.
[586] Team B Report. p. 21. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf
[587] Team B Report, p. 26. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf
[588] Team B Report, pp. 35-37. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf

The CIA's Office of Strategic Research's (OSR) view was that the Team B report was a political polemic on Soviet intentions that ignored economic constraints and had no hard evidence to support it.[589] The Senate Select Committee on Intelligence later examined the experiment: its report, issued in early 1978, was highly condemnatory of the Team B report and largely sided with CIA.[590]

Despite vindication by the Senate, the damage to the CIA was long lasting. Scholars have pointed to the effect of the pressure and criticism as evident in that until the end of the Cold War, every estimate of Soviet strategic nuclear forces over-stated the rate at which Moscow was modernizing its weaponry.[591] From 1974 through 1986, every year's NIE 11-3/8 over-estimated the rate of Soviet strategic force modernization. Historians assess that one result of the Team A/Team B exercise could have been a tendency by CIA OSR to err on the high side of its Soviet strategic force projections, although never to the extent of those done by the military services. The State Department was often the lone dissenter on the low side, leaving CIA in the middle. A long-running inside joke captures how these differences were perceived throughout the bureaucracy: "The State Department's Bureau of Intelligence and Research felt the Russians were not coming; the CIA thought the Russians were coming but couldn't get here; the Defense Intelligence Agency believed the Russians were coming and were almost here; and the Air Force

[589] Vickers, Robert. "The History of CIA's Office of Strategic Research, 1967–81." Center for the Study of Intelligence, 2019. Central Intelligence Agency, pp. 104-105.
[590] Vickers, Robert. "The History of CIA's Office of Strategic Research, 1967–81." Center for the Study of Intelligence, 2019. Central Intelligence Agency, p. 106.
[591] Weiner, Tim. Legacy of Ashes: The History of the CIA, 2008, p. 344.

felt the Russians were already here and working in the State Department."[592] After the attacks against the CIA in the 1970s, its estimative process would err too high for decades to come. Ironically, at the same time that the intelligence community began to take a more ominous view of Soviet strategic objectives and capabilities, Soviet leaders were beginning to cut back on the rate of growth in defense spending, although this did not become apparent until the early 1980s.[593]

External pressure upon the CIA and NPIC is also evident through persistent disagreement registered in National Intelligence Estimates about the future and Soviet intentions. In NIE 11-3/8-76, "Soviet Forces for Intercontinental Conflict Through the 1980s," although there is consensus on present levels of forces, the estimate contains multitudes of footnotes denoting dissent from the main text on predictions for the future. Differing opinions were registered over Soviet military objectives and doctrines, the Backfire bomber, radars and antiballistic missiles, surface-to-air missiles, civil defense, particle-beam-weapons research, Soviet attitudes toward SALT and the ABM treaties, defense expenditures and the ICBM force. As summed up by Anne Cahn in her analysis, "*There was hardly a paragraph in the estimate with which the entire intelligence community concurred*."[594]

One fact that became clearer during the 1970s was that intelligence information from satellites was increasingly divorced from predictions made about Soviet intentions and objectives. Bush

[592] Cahn, Killing Detente: The Right Attacks the CIA, 1998, pp. 89-90.
[593] Vickers, Robert. "The History of CIA's Office of Strategic Research, 1967–81." Center for the Study of Intelligence, 2019. Central Intelligence Agency, pp. 107-108.
[594] Cahn, Killing Detente: The Right Attacks the CIA, 1998, p. 186.

himself wrote to all U.S. government recipients of the National Intelligence Estimate that, "*The production of NIE 11–3/8–76 has disclosed a wide range of views within the Intelligence Community on the question of Soviet objectives for strategic forces, a question on which very little hard evidence is available.*"[595] This spoke to the issue that predictions of the future were being made from satellite imagery that could only show the present. Still, HEXAGON's information was used as fuel by actors in various factions of the U.S. bureaucracy to buttress a view of Soviet intentions that aligned with the strategic interests of their organizations and supported the weapon modernization programs they wished to move forward.

Blind spots and attempts to discredit SALT II and the reductions argument

At the same time, the temporal blind spot was used by CPD, treaty opponents within the military establishment and Congress to discredit SALT II. Treaty opponents noted that the agreement called for ceilings on the numbers of launchers and not on the actual numbers of missiles. Therefore, the Soviets could legally increase the number of missiles in their stockpile and since several of the Soviet systems were "reloadable," the Soviets could achieve superiority over the United States. Missile transfers and maintenance was detectable to an extent, but due to remaining blind spots, NPIC was far from being able to surveil Soviet bases in the continuous way that would be needed to create tallies of missiles rather than launchers. Another argument was that the vastness of the USSR combined with its nature as a closed society placed it in a

[595] "Memorandum from the Director of Central Intelligence (Bush) to Recipients of National Intelligence Estimate 11–4–77." Foreign Relations of the United States, January 18, 1977. Central Intelligence Agency, National Intelligence Council, Job 79R00603A: O/DDI Policy Files, Box 7, NIE 11–4–77: Final with Distribution List. https://history.state.gov/historicaldocuments/frus1969-76v35/d173.

much better position to cheat on the agreement than the United States. [596] Perhaps unintentionally, this pointed to the real difficulties that NPIC was having behind the scenes in keeping up with search tasks that would be necessary to detect undeclared sites as a form of cheating.

Overall, these attacks were less rooted in the viability of SALT II's verification provisions than they were in the significance of potential cheating for a treaty that they viewed as already in the Soviet's favor. The temporal blind spot was therefore a useful scapegoat for the broad claim that SALT II was fundamentally untenable by the notion that the Soviets could cheat no matter what the provisions ultimately were. The criticisms of the Committee on the Present Danger in terms of strategic position and verifiability were likely contributors to the increasingly unfavorable public views toward SALT as the 1970s progressed. SALT II was increasingly viewed as a circus of conflict over superiority and verification which could have increased public aversion. **Figure 4.1** depicting SALT II cartoons in a variety of daily newspapers points to mixture of humor and antipathy held in the public eye (for those who paid any attention at all).

[596] "Responding to Soviet Violations Policy," Memorandum from Secretary of Defense Caspar Weinberger to President Ronald Reagan, December 9, 1985, 9, cited in Caldwell, pp. 113-114; Krepon and Caldwell, p. 305.

Figure 4.1. Cartoons from the 1970s related to SALT II.[597]

[597] Seely G. Mudd Manuscript Library, David L. Aaron Papers [ML.2015.002], MC275, Box 9.

Ignoring the influence of imagery information and blind spots

Objectively, it would have been well within the U.S. interest to curb the development of new missile programs through both quantitative and qualitative limits given the speed at which the Soviets were making strides. HEXAGON imagery revealed four new ICBM designs underway by the early 1970s: the SS-16 (a road-mobile ICBM), SS-17, SS-18, and SS-19. All except the SS-16 had demonstrated MIRV capability. The Soviets viewed these four types as "modernized" versions of existing missiles and could be observed in imagery converting existing silos to host the new missiles. The imagery and Soviet public statements often stood in stark contrast to one another. As one report put it: On 9 July 1973, Soviet authorities signed to press an editorial in the journal KOMMUNIST that U.S.-Soviet relations passed a historic and fundamental turning point for the better. The same day, the Soviets conducted a flight test of a MIRV system on board the SS-17 ICBM.[598]

However, those seeking U.S. superiority worked against the prospect of missile reductions. Meeting records show that the defense establishment, despite recognizing the threats posed by new Soviet nuclear weapon programs, were reluctant to allow restrictions to new generations of strategic missiles. When Fred Ikle, Director of ACDA, raised the possibility of restraining new

[598] Kissinger, *Years of Upheaval,* p. 270; "Soviet Strategic Arms Programs and Detente: What Are They Up To?" Central Intelligence Agency, August 1, 1973. https://www.cia.gov/library/readingroom/document/0000268106.

generations of missiles, defense leadership, including Secretary Schlesinger and Depute Secretary Clements responded with concern.[599]

There was clearly some awareness of within the U.S. intelligence of a potential action-reaction cycle in nuclear armaments that worked to inhibit reductions as described in National Intelligence Estimate reporting. While looking on through HEXAGON, U.S. intelligence analysts speculated in a Special National Intelligence Estimate in 1973 that Soviet weapon programs were driven by what the Soviets could observe themselves, with satellite imagery likely serving as a source of information next to publicly available Congressional records. Therefore, U.S. intelligence analysts speculated that Soviet determination to carry their weapon modernization programs forward was likely reinforced by their direct perceptions of U.S. weapon development activity through intelligence. In the early 1970s, the Soviets would have been able to observe U.S. MIRV development and accuracy improvement for Minuteman and Poseidon; in the years to come, the Trident and the B-1.[600] This awareness permeated even top U.S. defense leadership, even if it was not viewed as something that needed to be corrected. U.S. Secretary of Defense James Schlesinger said in 1974: "*What [the Soviets] decide to deploy affects our deployments. In effect, they are choosing our deployments.*"[601]

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[599] "Minutes of a Meeting of the Verification Panel." Foreign Relations of the United States, February 15, 1974. National Archives, Nixon Presidential Materials, NSC Institutional Files (H–Files), Box H–108, Verification Panel Minutes, Originals, 3–15–72 to 6–4–74 [4 of 5]. https://history.state.gov/historicaldocuments/frus1969-76v33/d54.

[600] "Soviet Strategic Arms Programs and Detente: What Are They Up To?" Central Intelligence Agency, August 1, 1973. https://www.cia.gov/readingroom/document/0000268106.

[601] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, September 14, 1974. Ford Library, NSC Institutional Files, Box 8, NSC Meeting 9/14/74–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d74.

Still, any awareness of the action-reaction dynamics was not acted upon and was at times swept under the rug. The numbers that ultimately ended up in the SALT II text were equal aggregates of 2,400, with a plan to "reduce" to 2,250 by 1981. In effect, both sides were allowed to build up over the course of SALT II implementation rather than undertake any meaningful reductions. Acceptance of this high number by U.S. leadership is explained by the apathy toward various levels of weapons within a state of overkill, together with a space of cohesion between the advocates of arms control and the advocates of superiority that helped U.S. leaders agree and rationalize the amounts to themselves. The following exchange during a National Security Council meeting underlines this intersection of views:

> ***Kissinger**: "… what difference does it make whether the ceiling was 2400 or 2200. There's no difference. When people say we have negotiated to leave a machine gun in everyone's hands, that is nonsense. An overkill capability exists at any level."*
>
> ***Schlesinger**: "We should stay away from that argument publicly. We are trying to get our defense budget passed, and if we tell them we have overkill, it won't help."*[602]

The high estimates of the Soviet deployments under its modernization program using information gleaned through HEXAGON imagery were also used to paint these decisions as an arms control success. In the aftermath of President Ford's negotiations with the Soviet Union at Vladivostok, he stated, "We put a cap on the arms race. Sure, we would have liked to have gotten 1700 or 2000, but these were negotiations. I was looking at the estimates of the intelligence community and when I saw that the minimum, median, and maximum were all higher than the limit we negotiated, I see that where we ended up was very good. If the public is given this

[602] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, December 2, 1974. Ford Library, NSC Institutional Files, Box 1, SALT. Top Secret; Sensitive; Nodis. https://history.state.gov/historicaldocuments/frus1969-76v33/d90.

information, I think they will agree."[603] In hindsight, it is known that the CIA overestimated Soviet intelligence reports from 1974 onward. HEXAGON imagery was essentially used to construct an illusion and a story that arms control was progressing, even as it was becoming increasingly obscured.

[603] "Minutes of a Meeting of the National Security Council, Subject: SALT." Foreign Relations of the United States, December 2, 1974. Ford Library, NSC Institutional Files, Box 1, SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d90.

Pending weapon systems: cruise missiles and mobile ICBMs

Cruise missiles

Another major debate under SALT II was whether to ban, limit, or leave unregulated cruise missiles. They were considered a "gray-area" system given the lack of consensus over whether they should be treated as strategic versus tactical weapons. Arguments claiming unverifiability were initially used to strengthen arguments for the pursuit of U.S. superiority in early attempts to keep cruise missiles out of SALT II. Later, as the Soviets pushed cruise missiles into the scope of the treaty, HEXAGON's advances that slightly enhanced the ability to detect cruise missile presence in imagery were effectively leveraged by cruise missile proponents to argue against a ban. While HEXAGON's advances made verification for cruise missile systems conceivable, there were many ambiguities which were leveraged by opponents of detente to stall SALT II.

Cruise missiles were considered a gray-area system given inherent features that muddled their status as a strategic weapon, and therefore confused the issue of whether they would need to be included within the scope of SALT II. One issue was that they had large-scale conventional applications. Secretary of Defense Schlesinger asserted in 1975 that "*we are tremendously excited about the possibilities for conventional cruise missiles*" and that the definition of a cruise missile for the purposes of nuclear arms control would be controversial.[604] Cruise missiles also possessed a wide variety of ranges, which presented classification issues. This was even further

[604] "Minutes of a Meeting of the National Security Council." Foreign Relations of the United States, September 17, 1975. Ford Library, National Security Adviser, NSC Meetings File, Box 2. https://history.state.gov/historicaldocuments/frus1969-76v33/d105.

complicated by their ability to be deployed on mobile launchers like aircraft, ships and submarines.

Cruise missile technology advancement was primarily initiated by internal U.S. influences, although the strategic need was often unclear. The Air Force wanted long-range air-launched cruise missiles (ALCMs) to improve bomber capabilities but would not push this project too forcefully from fear of jeopardizing congressional support for the B-1 which, because it was able to get much closer to targets, would need only short-range attack missiles.[605] The Navy was pressing for a long-range SLCM, but no other agency judged SLCMs preferable to additional Poseidon and Trident missiles.[606] Defense leaders largely rallied around the need for cruise missiles as a general hedge against future threats to bomber penetration capabilities.[607] Kissinger made the case to preserve the cruise missile development program as a bargaining chip for SALT II, and with the support of Department of Defense leaders, the program was saved.[608]

[605] The B-1 program was indeed canceled by the Carter Administration, which argued that the cruise missile, carried by the existing B-52 bomber, made the B-1 unnecessary.
[606] DJSM-947-75 to CJCS, 9 Jun 75, w/att Note by Capt. Charles O. Pringle, USN, 10 Jun 75, CJCS 756 SALT (1 Jan -30 Jun 75), as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 77.
[607] "Memorandum From the President's Assistant for National Security Affairs (Kissinger) to President Ford." Foreign Relations of the United States, July 24, 1975. Ford Library, NSC Institutional Files, Box 5, Verification Panel Meeting, 7/24/75–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d100; DJSM-947-75 to CJCS, 9 Jun 75, w/att Note by Capt. Charles O. Pringle, USN, 10 Jun 75, CJCS 756 SALT (1 Jan -30 Jun 75), as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 77.
[608] Kissinger, *Years of Upheaval*, p. 273.

As further evidence of the internal drivers of U.S. modernization efforts toward cruise missiles, in 1973, the Soviet Union tabled a proposal that called for banning new types of nuclear weapon systems, including cruise missiles, stating,

> *"To ensure a more effective curbing of the strategic arms race, the sides will not carry out new major strategic defensive arms programs, will ban development and deployment of new types of strategic offensive arms which could increase the risk of outbreak of nuclear war, and will also assume the obligation to exercise restraint in fields not limited by the understanding…the sides will ban the development, testing and deployment of certain types of strategic offensive weapons, such as:*
>
> *(a) new types of strategic aircraft;*
> *(b) long range air-to-surface missiles;*
> *(c) intercontinental cruise missiles and sea-based cruise missiles, specially designed to strike land targets;*
> *(d) strategic ballistic missiles on waterborne vehicles other than submarines;*
> *(e) strategic ballistic missiles on airborne platforms;*
> *(f) any fixed or mobile devices for launching ballistic missiles, which could be emplaced on the seabed or ocean floor or in the subsoil thereof, including the territorial sea and internal waters."*[609]

U.S. leaders did not concur. They opposed constraints on air-launched and surface ship-launched cruise missiles and would only support a ban on intercontinental-land-based cruise missiles. They also supported "equal limits" for SLCMs at or below the current Soviet level of 450 to 460.[610]

[609] Memorandum From William Hyland of the National Security Council Staff to the President's Assistant for National Security Affairs (Kissinger), Foreign Relations of the United States, April 6, 1973, National Archives, Nixon Presidential Materials, NSC Files, Box 889, SALT, SALT TWO–I–(Geneva), April 1973. https://history.state.gov/historicaldocuments/frus1969-76v33/d19

[610] Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, pp. 58-59.

Unverifiability and the movement to ban cruise missiles

Against this backdrop were the severe and unprecedented verification issues that came with cruise missiles. Cruise missiles are relatively small and mobile vehicles, and during this era were about seven meters in length and 70 centimeters in diameter. Logistics support required for cruise missiles is not nearly as extensive as for ballistic missiles. This meant that both the weapon and its supporting infrastructure were not reliable signatures for verification. On top of this, cruise missiles were designed to carry either conventional or nuclear warheads with no ready means of distinguishing between a conventional and a nuclear-armed missile. The same cruise missiles can be delivered by aircraft, launched from the ground or fired from submarines or other ships.[611]

Objectively, a ban on cruise missiles would have been more reliably verifiable than limits. This would only require detecting a single new cruise missile in any of the phases of production, testing or deployment in order to have evidence of a violation.[612] Counting during the production phase would be much more difficult than in the case of ballistic missiles because of the cruise missile's smaller size and its indistinguishability from other types of tactical weapons. Monitoring testing and range limits would also be more difficult than with ballistic missiles. Because cruise missiles fly at a relatively low altitude, they cannot be monitored confidently from the surface outside the Soviet Union. In addition, just as with aircraft, the range of a cruise

[611] Tsipis, K., D.W. Hafemeister, P. Janeway. *Arms Control Verification: The Technologies That Make It Possible*. Pergamon-Brassey's International Defense Publishers, 1986, pp. 204-206.
[612] Tsipis, K., D.W. Hafemeister, P. Janeway. *Arms Control Verification: The Technologies That Make It Possible*. Pergamon-Brassey's International Defense Publishers, 1986, p. 206.

missile can be extended by reducing the payload, and cruise missiles can be tested at reduced ranges or by reversing the direction mid-course. Satellites could more reliably pick up stray evidence of testing in the context of a ban, especially if it was conducted on a level that would be strategically significant.[613]

U.S. domestic positions on cruise missiles reflected this landscape of strategic uncertainty and verification uncertainty. CIA Director William Colby and Fred Ikle, Director of ACDA, preferred to ban cruise missiles outright. Colby preferred a ban because it would aid verification; Ikle because it would close a channel of competition. But Deputy Secretary Clements and General Brown favored counting cruise missiles under the agreement, on grounds that a ban would make Congress less likely to fund cruise missile research and development. The United States enjoyed a ten-year lead in cruise missile technology, Clements observed, and he believed that advantage should be preserved. Yet, Kissinger replied, "*we had begun the cruise missile program for bargaining purposes, and we were becoming enamored with them*."[614]

The Soviets expressed some concerns over cruise missile verification, but never treated it as a dealbreaker. At one point, the Soviets expressed concern that the United States might deploy as many as 11,000 warheads (alleging that 12 ALCMs could be loaded on each B-52 and 32 on each B-1), far above the intended constraints in SALT II.[615] However, the Soviets did not press

[613] Tsipis, *Arms Control Verification,* 1986, pp. 204-206.
[614] MFR by LTG Rowny, "VP Meeting on SALT, Saturday, 17 May 75," 20 May 75, CJCS 756 SALT (1 Jan-30 Jun 75), as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 76.
[615] *Foreign Relations: 1969-1976*, Vol. XXXIII, pp. 453-455; Ford, *A Time to Heal*, pp. 303-304; Msg, CJCS 8838 to General Rowny, 13 Aug 75, CJCS 756 SALT (Jul 75-Feb 76), as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, pp. 77-78.

the issue in negotiations, evidently preferring to press for constraints on U.S. cruise missile development efforts and believing that limits would be verifiable by monitoring the U.S. appropriations and procurement process.

There was public support for a cruise missile ban on the basis of potential strategic instability and verifiability. The media portrayed the cruise missile as the latest measure in a series of dangerous developments that jeopardized détente. As described by the New York Times in 1975, "For thirty years, from the atom bomb to the MIRV multiple warhead, American inventive genius has sought increased security for the country through a series of technological marvels that, when inevitably acquired by the Soviet Union, have heightened the nation's danger. The latest, the cruise missile, has yet to be flight-tested. But it already threatens the negotiations for a historic ten-year Strategic Arms Limitation Treaty (SALT II), placing in doubt Leonid Brezhnev's thrice-postponed 1975 visit to the United States and, with it, the future of détente.[616]"

Within this frame, some civil society thinkers expressed support for a cruise missile ban on the basis of verifiability.[617] There was a sense that once significant testing had occurred, verification of a cruise missile limitation agreement would be virtually impossible.[618] The issue was also linked in the public-eye to the issue of MIRVs. One article reported that the essential transaction needed was an American offer to delay flight-testing of the long-range cruise missile in return

[616] "SALT II Threatened by Nuclear Arms Race." *New York Times*, October 21, 1975. https://www.nytimes.com/1975/10/21/archives/salt-ii-threatened-.html?searchResultPosition=1.
[617] "SALT II Threatened by Nuclear Arms Race." *New York Times*, October 21, 1975. https://www.nytimes.com/1975/10/21/archives/salt-ii-threatened-.html?searchResultPosition=1.
[618] "SALT II at Risk." *New York Times*, November 19, 1975. https://www.nytimes.com/1975/11/19/archives/salt-ii-at-risk.html?searchResultPosition=2.

for a slowdown in the rate of deployment of Moscow's new MIRVed ICBMs, thus gaining time to negotiate a SALT II agreement before a point of no return was reached.[619]

Yet the administration would continue to resist. Richard Garwin stated in a meeting in December 1974, "If there are systems which are not limited in the next agreement, it seems to me they must be banned. I am thinking, for example, of intercontinental cruise missiles. In that case, limits on flight testing can be used as an aid to verification." Kissinger avoided a direct answer and claimed that the Soviets would be against such a measure.[620]

Invoking high-resolution imagery and blind spots information to justify cruise missile development and modernization

High-level meeting records show that the White House found it increasingly difficult to overrule the military establishment on cruise missiles, led by Schlesinger's voice. A conversation in September 1975 between Henry Kissinger and other high-level officials shows the ways that the cruise missile issue had grown roots in defense establishment thinking.[621] Notably, while the public-facing story of cruise missiles centered on the importance of U.S. technological superiority, privately, Schlesinger expressed highly specific objectives for cruise missiles, such

[619] "SALT II at Risk." *New York Times*, November 19, 1975; Kleiman, Robert. "Crisis in Détente." *New York Times*, October 14, 1975. https://www.nytimes.com/1975/10/14/archives/crisis-in-detente.html?searchResultPosition=22.

[620] Memorandum of Conversation, Foreign Relations of the United States, December 19, 1974, National Archives, RG 59, Lot File 81D286, Records of the Office of the Counselor, Box 6, SALT, Nov–Dec 1974. https://history.state.gov/historicaldocuments/frus1969-76v16/d102

[621] "Memorandum of Conversation, Subject: SALT." Foreign Relations of the United States, September 19, 1975. National Archives, RG 59, Lot File 81D286, Records of the Office of the Counselor, Box 6, SALT, July–Oct. 1975. https://history.state.gov/historicaldocuments/frus1969-76v16/d194.

as hitting the port city of Murmansk in the far northwest of Russia in case the Soviets were to invade Norway. The conversation also highlights the distress Kissinger felt at the blurring between strategic and conventional war brought on by cruise missile development, together with the difficulty he perceived in attempting to overrule Schlesinger.

At the same time, Schlesinger reportedly worked to further the case for U.S. technological superiority and cruise missiles specifically through a public information campaign. In October 1975, The Economist ran an article that made the case for cruise missiles to continue being developed, which the White House administration saw as the handywork of Schlesinger.[622] The headline of the article read "If a missile deal makes the Americans give up the new weapon [i.e., cruise missiles] that counterbalances Russia's lead in megatonnage, it will be worse than no deal at all." The article went on to make a case for qualitative superiority, citing cruise missiles as a way to get there. "The Americans have in the past compensated for Russian pre-eminence in numbers and throw-weight by developing superior technology: such things as greater accuracy, and MIRVs. Now the Russians have MIRVs and are improving their accuracy to something near American standards. The cruise missile is a major element by which the United States can make up for Russian superiority in other areas. It is important that the Americans should not bargain away their lead here merely for the sake of having a SALT II document to sign. Something is not always better than nothing."[623]

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[622] "Memorandum of Conversation." Foreign Relations of the United States, October 7, 1975. Ford Library, National Security Adviser, Memoranda of Conversations, 1973–1977, Box 15. https://history.state.gov/historicaldocuments/frus1969-76v16/d200.

[623] "Carry on cruising." *Economist*, October 4, 1975, 13+. *The Economist Historical Archive, 1843-2015* (accessed May 8, 2021). https://link-gale-com.ezproxy.princeton.edu/apps/doc/GP4100842593/ECON?u=prin77918&sid=ECON&xid=8972a6cf.

This sentiment of cruise missiles being justified by specific Soviet advances observed through high-resolution imagery carried through into Congressional debates. For example, on May 6, 1976:

> *"As a major alternative approach to penetration of formidable Soviet air defenses, including tens of surveillance radars, hundreds of ground radar and thousands of interceptors and SAM's, we are continuing development of the strategic cruise missile... air-launched cruise missiles may be required to complement the pure penetrating bomber in advanced threat environments, but the extent of the need depends on how the threat evolves."*[624]

This type of argument, a common throughout the case studies, again features quantitative information about Soviet forces that could only have been gleaned from high-resolution satellite imagery and uses it as a justification for U.S. investment and modernization of, in this case, the air-launched cruise missile.

In the case of cruise missiles, blind spots and uncertainty were used in the case against limits as well as against a ban. As noted in The Economist article, "Their small size, their ability to be launched from almost anything and their similarity to small, unmanned aircraft would create almost insurmountable verification problems… so even a fairly mild SALT limitation would amount to selling the same horse twice: not only would it restrict an American nuclear-war weapon, but it would probably rule out a conventional-war one as well."[625]

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[624] Congressional Record, Senate, p. 12745, May 6, 1976, citing House Armed Services Committee, 94-8, page 303.

[625] "Carry on cruising." *Economist*, October 4, 1975, 13+. *The Economist Historical Archive, 1843-2015* (accessed May 8, 2021). https://link-gale-com.ezproxy.princeton.edu/apps/doc/GP4100842593/ECON?u=prin77918&sid=ECON&xid=8972a6cf.

This two-pronged approach of using both high-resolution satellite information and blind spots was also evident in Congress. For instance, Senator Robert Griffin of Michigan, in making a case against a cruise missile ban, argued using high-resolution satellite information that "The Soviet Union already has deployed hundreds of gigantic sea-launched cruise missiles on nuclear submarines and other naval vessels…it is estimated that they could be modified to travel 1,200 miles or more." Invoking remaining blind spots and uncertainty, he asserted, "these modifications could be made without any change in the external appearance of the missile itself."[626] Senator Thomas McIntyre, speaking for the Committee on Armed Services, acknowledged that cruise missile limits were not unilaterally verifiable with confidence in contrast to a comprehensive ban, but he pointed to similar ideas as those identified by Griffin as justification for the necessity of the continued U.S. pursuit of cruise missile programs.[627]

Arguments of improved verifiability to support the pursuit of cruise missiles

HEXAGON's advancements reinforced support for these measures and influenced the way cruise missiles would be counted and managed under SALT II, as well as subsequent generations of arms control treaties. HEXAGON's temporal advancements introduced an important capability for verifying cruise missile provisions. While still far from closing the many verification gaps related to cruise missiles, HEXAGON's more frequent imagery, covering larger areas at high resolutions provided a means to indirectly verify cruise missiles by monitoring

[626] Congressional Record, Senate, May 26, 1976, p. 15621-15622.
[627] Congressional Record, Senate, May 26, 1976, p. 15622.

intentions surrounding delivery platforms. For example, the United States was confident that the Soviets had never mounted cruise missiles internally – they were external and visible. Installation of internal launchers would be a major effort, probably requiring the flight of eligible bombers to central facilities for conversion. Under this assumption, U.S. intelligence analysts could use HEXAGON to track bomber behavior to ensure that systematic conversions were not taking place.[628] Temporal advancements were also important for verifying intent around the Backfire bomber. Satellite imagery at increased frequency was seen as necessary to watch for an increased rate of manufacture of Backfire production, and to monitor the absence of re-fueling tankers or tanker training exercises that might indicate an intercontinental mission.[629]

HEXAGON's advancements in achieving high resolution over wide areas also supported the monitoring of cruise-missile delivery platforms. For aircraft, the United States and Soviet negotiators settled on the idea of requiring "*functionally related observable differences*" in order to distinguish heavy bombers carrying ALCMs. For instance, the Soviet Bear bombers used for reconnaissance had a large radar installation projecting from the underside in place of bomb-bay doors. Such a feature would be noticeably absent if conversion had taken place. The United States would make sure that B-52s not carrying ALCMs would be configured differently from those that do. For surface ships, both intelligence and defense leaders had confidence that ships with SLCMs could be verified because launchers could be seen on their decks.[630] For these tasks,

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[628] Milburn and Watman. "SALT II: Verification," 1979, General CIA Records, Central Intelligence Agency.
[629] Milburn and Watman. "SALT II: Verification," 1979, General CIA Records, Central Intelligence Agency.
[630] "Minutes of a Meeting of the National Security Council." Foreign Relations of the United States, January 8, 1976. Ford Library, National Security Adviser, NSC Meetings File, Box 2. https://history.state.gov/historicaldocuments/frus1969-76v33/d114.

HEXAGON's ability to view small details over large areas would support the need to search for activity indicating system conversions across an array of heavy bomber sites related to basing, production and maintenance and repair.

Outcomes and impact of arguments using high-resolution imagery and blind spots

The treaty outcome for cruise missiles was most significantly shaped by an oversight. Given that cruise missiles were initially seen as a peripheral issue, they were not explicitly discussed during the pivotal meeting between Ford and Brezhnev in Vladivostok in 1974 where the essential framework for SALT II was largely decided. In the aftermath of the meeting, the Soviets claimed that they understood that cruise missiles would be counted in the agreed aggregate total of 2,400 systems each. The United States insisted that it understood the 2,400 limit only applied to ballistic missiles.[631] The Soviet position also insisted on a cross-cutting ban on cruise missiles with ranges above 600 kilometers deployed on aircraft other than heavy bombers, on submarines, and on land. This stalemate would drag on for years. By early 1976, sensing that the cruise missile issue risked perpetually stalling SALT II, Kissinger began steering the U.S. bureaucracy toward accepting the Soviet position. He insisted that Brezhnev, whose influence was in decline, would need a U.S. concession on the 600-kilometer ban in order to tell the Politburo that he "*got something*."[632]

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[631] "Memorandum From the President's Assistant for National Security Affairs (Scowcroft) to Vice President Rockefeller." Foreign Relations of the United States, January 29, 1975. Ford Library, NSC Institutional Files, Box 9, NSC Meeting, 1/29/75, SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d92.

[632] "Minutes of a Meeting of the National Security Council." Foreign Relations of the United States, February 11, 1976. Ford Library, National Security Adviser, NSC Meetings File, Box 2. https://history.state.gov/historicaldocuments/frus1969-76v33/d130.

The U.S. concession on cruise missiles roughly aligned with its ambivalence toward certain deployment modes. The U.S. strategic SLCM program had little strategic utility; even with a 3,000-kilometer range limit, SLCM submarines were seen as less survivable than the U.S. ballistic missile submarine force because they must approach much closer to Soviet shores to launch their missiles. Similarly, defense planners believed the ballistic missile submarine force could satisfy any requirements for a more survivable theater tactical nuclear capability to replace the current theater nuclear-capable tactical aircraft. With respect to intercontinental range land-based cruise missiles, there had been some minor interest in DOD in preserving the option to develop recallable land-based intercontinental cruise missiles as well as in deploying long-range land-based cruise missiles as tactical weapons in Europe. However, at the time, there was no anticipation of deploying such systems before 1985.[633] The position the United States landed on, which it found itself backed into by Soviet pressure and which roughly aligned with U.S. strategic interests, was that each side would count long range air-launched cruise missile systems and would ban sea-launched and land-launched systems above 600 kilometers.

This analysis argues that the combination of pressure from the military establishment, a measurable level of public support, and arguments about the feasibility of cruise missile verification, advocates of cruise missiles won the debate to the extent that limits – rather than a ban – were included in the SALT II text. Like the case of MIRVs, the desire of U.S. leaders to

[633] "Memorandum From the President's Assistant for National Security Affairs (Kissinger) to President Ford." Foreign Relations of the United States, July 24, 1975. Ford Library, NSC Institutional Files, Box 5, Verification Panel Meeting, 7/24/75–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d100.

maintain their technological lead over the Soviets in cruise missile technology contributed to destroying the prospects of a ban. Verification advances brought on by HEXAGON played into the hands of cruise missile advocates by providing an argument for the verifiability of cruise missiles – even if such verification was far from foolproof. The ability to indirectly verify cruise missiles by monitoring heavy bombers, as well as the ability to verify the presence or absence of long-range cruise missile variants at sea and on land afforded by HEXAGON helped advocates of cruise missile limits combined with continued (and unregulated) research and development efforts.

Later statements by the Carter administration provide evidence of the intertwining of the competing interests of pursuing U.S. technological superiority and modernization and verification uncertainty. A report by the administration asserted that the process of designing SALT,

> *"…takes into account the degree to which the advantages conferred on the U.S. by a particular provision outweigh the disadvantages caused by problems of verification. In such cases, we must consider the potential gains to the U.S. of being allowed the flexibility to take certain actions, even though allowing the Soviets the same options may complicate verification. Cruise missile limitations constitute a prime example of such a situation."*[634]

Proponents of a ban on cruise missiles maintained through 1976 that verification of cruise missile limits was shaky. The head of ACDA, Fred Ikle, lamented that most of the cruise missile limits under discussion were "*essentially unverifiable*" and that large numbers of the existing

[634] "Carter Administration Report on Verification of the Proposed SALT II Agreement, 23 February 1978," SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, p. 539.

Soviet cruise missiles, particularly their sea-based cruise missiles, have capabilities substantially in excess of 600 kilometers if they choose to modify them through unobservable changes in the guidance or payload elements. He asserted, "*We could not—in all honesty—tell the American people that we could hold the Soviets to these cruise missile limits through national technical means*."[635] Still, these provisions on cruise missile limits were wound into the fabric of SALT II more deeply with each passing month due to U.S. defense leaders' enthusiasm for them. Ultimately, these verification ambiguities were capitalized on by opponents of détente and SALT II to derail the treaty's ratification.

[635] "Memorandum From the Acting Director of the Arms Control and Disarmament Agency (Lehman) to President Ford." Foreign Relations of the United States, August 6, 1976. Ford Library, National Security Adviser, Kissinger-Scowcroft West Wing Office Files, Box 21, SALT, Chronological. https://history.state.gov/historicaldocuments/frus1969-76v33/d140.

Mobile-land-based ICBMs

The third major debate under SALT II was whether to ban, limit or leave unregulated mobile missiles. U.S. intelligence analysts had reason to believe that a Soviet mobile missile force might emerge gradually and subtly. This gradual deployment process, combined with concealment measures, presented complications for monitoring and verification. CORONA's shortcoming and hopes for HEXAGON were anchored in past failures to adequately monitor mobile IRBMs. HEXAGON would present solutions to some, though not all, mobile missile monitoring challenges by improving coverage and reducing the temporal blind spot. Despite these advances, monitoring uncertainty related to time gaps remained. Banning mobiles was seen as a solution to the verification problem, and this position was pushed forward by those in the intelligence community. At the same time, defense leaders used HEXAGON's advances to argue against a ban and to leave open the prospects for research and development on a U.S. mobile missile system. Like the previous case study, arguments about unverifiability connected to the remaining temporal blind spot were leveraged by proponents of U.S. superiority to leave open the door to modernization in this emerging area of nuclear weaponry.

Through the SALT I process, the United States had attempted to place a hold on Soviet efforts toward a land-mobile ICBM system, first through a failed attempt to solidify a mobile-missile ban, and ultimately through a unilateral statement appended to the Interim Agreement text. The statement specified that the U.S. delegation would withdraw its demand to ban mobiles in the interest of concluding the Interim Agreement. It noted that while, the delegation had agreed to

defer the question of limiting these weapons to SALT II, the United States would consider the deployment of mobile ICBMs during the period of the Interim Agreement as inconsistent with its objectives.

In the early 1970s, both the Soviet Union and the United States were researching mobile ICBM systems, but the Soviets were further along. The Soviets were engaged in a covert testing program with a mobile version of the SS-16 ICBM. They were working to conceal developments surrounding the missile, which the U.S. noted with suspicion in a 1973 Special National Intelligence Estimate.[636] Honing in on Plesetsk, a central Soviet nuclear weapon development site, HEXAGON and GAMBIT imagery captured several indicators of the mobile missile development program: evidence of equipment similar to that used by previous intermediate-range mobile systems, the use of launch sites for the SS-16 that were previously used with intermediate-range mobile systems, and ground support equipment in the area that employed extensive concealment.[637]

Continuing from the SALT I process, the U.S. domestic position on mobile missiles began in favor of a ban, but it would later be complicated by the emergence and evolution of the MX mobile missile program. In 1972, there was broad U.S. domestic support for a total ban on land-

[636] "Soviet Strategic Arms Programs and Detente: What Are They Up To?" Central Intelligence Agency, August 1, 1973. https://www.cia.gov/library/readingroom/document/0000268106.
[637] "Interagency Intelligence Report: A Soviet Land-Mobile ICBM, Evidence of Development and Considerations Affecting a Decision on Deployment." Central Intelligence Agency, October 1, 1974. General CIA Records. https://www.cia.gov/library/readingroom/document/cia-rdp79r01099a001600080003-0.

mobile ICBMs, including support from the Joint Chiefs of Staff.[638] Later in the 1970s, and discussed in Case 3 of this study, the MX program would complicate this position. The MX missile was conceptualized as essentially a bigger Minuteman with enough accuracy and warhead payload that even a few surviving missiles were expected to destroy enormous numbers of any remaining Soviet force. In 1971, the Air Force started a development process combining two ongoing research programs – the ICBM-X and SABRE concepts – into a single platform known as "Missile, Experimental", or MX. At the time the specifications were fixed in February 1972, MX was to be based in existing Minuteman silos.[639] It was only in 1976, when the MX program would be threatened with extinction on the grounds of vulnerability, that proposals for various mobile deployment designs would emerge and complicate the U.S. domestic position on mobile missiles.

Learning to detect mobile ICBMs in satellite imagery

In the early 1970s, the United States intelligence community was still gradually building an understanding of the task of mobile missile monitoring via satellites. Under CORONA and GAMBIT, analysts had developed a detailed understanding of the Soviet IRBM network, including fixed-field deployment sites for platform-launched missiles.[640] CORONA imagery was

[638] ACSAN-176-72 to CJCS, JCS 2482/171; CSAM 89-72 to JCS, 12 Oct 72; SM-535-72 to CJCS and ACSAN, 19 Oct 72, JCS 2482/171; JMF 751 (3 Aug 72) sec. 1. as cited in Poole, Walter S. "The Joint Chiefs of Staff and National Policy, 1973-1976." Office of Joint History, 2015, p. 57; Kissinger, *Years of Upheaval*, p. 267.

[639] MacKenzie, Donald. Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance. Cambridge: MIT Press, 1990. GET PAGE NUMBERS

[640] "Summary of MRBM and IRBM Fixed Field Sites USSR." National Photographic Interpretation Center, April 1967. Central Intelligence Agency. https://www.cia.gov/library/readingroom/docs/CIA-RDP78T04759A006400010017-9.pdf.

used to map the network, followed by GAMBIT captures to understand the nature of deployments.[641] However, this task proved to be qualitatively different from the task of actually detecting mobile missiles in the field, given that the IRBM field sites had more numerous and more visible equipment such as the leveling blocks, oxidizer and fuel trailers, and mobile service cranes that came with platform-launched systems.[642]

Analysts began developing signature sets for mobile missiles across the areas of production, testing and deployment. In terms of production, in 1971, satellites observed the Soviets constructing an additional missile assembly building in the SS-16 portion of the production plant at Votkinsk. The increased capacity indicated that space for a force larger than that needed to replace the SS-13 was planned. The Soviets had also erected permanent shelters over approximately 800 feet of railroad track at Votkinsk.[643]

In terms of testing, there were a number of novel signatures emerging at the Plesetsk testing facility. Satellites captured unusual railcars and a flatcar, used as one method of transporting the SS-14 mobile IRBM, carrying a canister at the SS-16 assembly and checkout area at Plesetsk. Analysts speculated that the railcars might be used to transport the mobile version of the SS-16

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[641] "Graphic Record of Search of Soviet MR/IRBM Complexes and Selected Division Headquarters." Central Intelligence Agency, June 1, 1970. https://www.cia.gov/library/readingroom/docs/CIA-RDP78T04759A009600010088-6.pdf.

[642] "Summary of MRBM and IRBM Fixed Field Sites USSR." National Photographic Interpretation Center, April 1967. Central Intelligence Agency. https://www.cia.gov/library/readingroom/docs/CIA-RDP78T04759A006400010017-9.pdf.

[643] "Interagency Intelligence Report: A Soviet Land-Mobile ICBM, Evidence of Development and Considerations Affecting a Decision on Deployment." Central Intelligence Agency, October 1, 1974. General CIA Records. https://www.cia.gov/library/readingroom/document/cia-rdp79r01099a001600080003-0, p. 8.

missile and its ground support equipment. While the signatures were somewhat ambiguous, analysts reasoned that none of this activity would be required for the development of a silo-based version of the SS-16. The railcars would, however, be consistent with a program to conceal support equipment for a mobile missile system. The key element of a mobile-launch unit that was not yet positively identified at Plesetsk at the time of reporting in 1974 was the SS-16's transporter-erector-launcher (TEL) – the most important piece of ground support equipment. [644]

In terms of deployment, analysts had not yet observed signs of the SS-16 in the field but were preparing to identify signatures of mobile ICBM units. They reasoned that a mobile ICBM unit might include: a TEL, resupply vehicles, mobile communications vans, support vehicles and armored personnel carriers.[645] There was evidence at Plesetsk suggesting the Soviets were considering both road-mobile and off-road deployment concepts, but there was no clear evidence to suggest that shelter-based (i.e. shell game) or rail-mobile systems were under development.[646] For road-based deployment concepts, one possibility foreseen was a scheme that used fixed-launch sites and a main support base. U.S. intelligence analysts believed that any of the Soviet's Strategic Rocket Forces installations, including those for ICBMs and IRBMs, that had adequate support facilities could serve as a support base for a mobile system. Missile units could be rotated among various fixed field sites, perhaps as far as 50 miles from the support base. Satellites could observe revetments near the SS-16 area at Plesetsk which suggested to U.S. analysts that the Soviets were considering the use of fixed-field sites for the mobile version of the SS-X-16. Another deployment possibility was the use of any area with minimal

[644] Ibid, p. 10.
[645] Ibid, p. 12.
[646] Ibid, p. 18.

infrastructure, such as a road intersection, for a launch point. There were many unimproved road networks, especially in the forest regions of the Soviet Union, and some of those areas were rail-served, indicating that support bases could be established there. The Soviets have used both prepared and unprepared areas as launch points for the SS-12 Scaleboard. Initially the SS-12 TELs were used on concrete pads within the permanent facilities. Later operations shifted to isolated field positions and now the permanent sites apparently are being utilized as support bases, rather than primary launch areas.[647]

In the Soviet Union, the intelligence task of searching for mobile missiles was limited by geographic and technical factors but was still vast and deeply challenging. About one-fourth of the USSR, or over 2 million square miles, was considered suitable for deployment of land-mobile ICBMs (see **Figure 4.2**). Most Soviet railways and all-weather roads were located in this area, which comprised the European USSR, the North Caucasus, the Ural Mountains, western Siberia, and Kazakhstan. Also concentrated in this area were most IRBM and ICBM complexes and regional nuclear storage facilities – installations that were dependent on the transportation network.[648] Mobile missiles were dependent on high load-bearing surfaces. The SS-16, for example, is in the 40 metric ton weight class (not including the TEL or resupply vehicle). The standing weight limitation for vehicles on Soviet road networks as a whole was six metric tons per single axle, whereas the SS-16 carried nearly seven metric tons per axle. On roads with a "capital" surface (such as cement or asphalt concrete) the single-axle limit was 10 metric tons, but these roads were located in areas of high population density and were heavily traveled –

[647] Ibid, p. 19.
[648] Ibid, p. 29.

conditions that a missile unit would want to avoid. The transportation network tapered off toward the central part of the USSR and became only a narrow band along the Trans-Siberian railroad in eastern Siberia.[649]

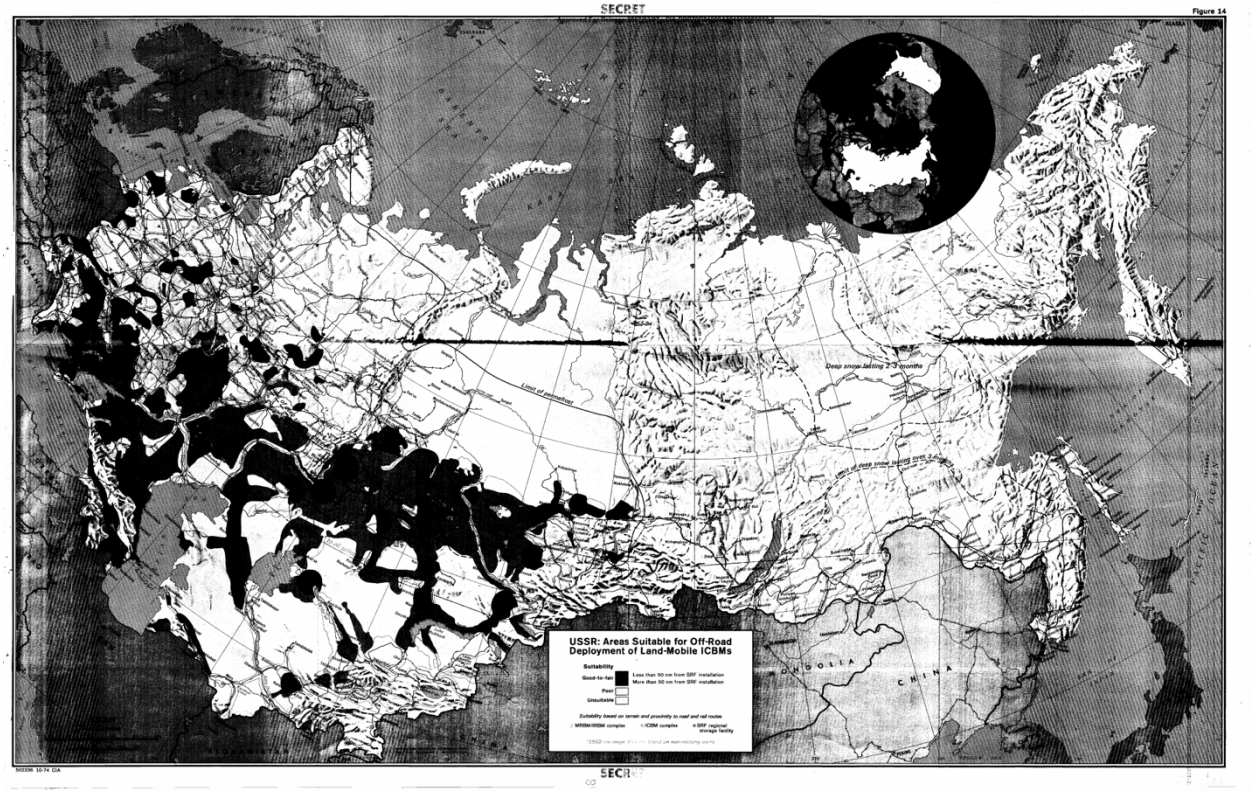

Figure 4.2. Areas deemed suitable for off-road deployment of land-mobile ICBMs[650]

Much of the remaining portion of the Soviet Union was considered "entirely unsuitable" for cross-country movement of mobile ICBMs due to terrain obstacles. Large low areas around the

[649] Ibid, p. 23.
[650] Ibid, p. 31.

Valday Hills, west and north of Moscow, and in the western Ukraine were swampy. Other natural obstacles included loose sand and dunes in Soviet Central Asia; mountains in the southern Ukraine, in the Caucuses, in eastern Siberia, and along the southern border with China and Afghanistan; and the dense forest stretching along the entire northern part of the country. Deep snow and permafrost made most of eastern Siberia and the northwestern USSR unsuitable for deployment of mobile ICBMs. In the spring and summer this area became a quagmire when the surface layers thaw and the underlying permafrost prevented drainage. Much of this area also had snow accumulating over one foot deep and lasting three to six months of the year. Operation on country roads would be limited by the load capacity of the bridges, most of which had load limits from 5 to 7 metric tons. Snow and rain on country roads and launch positions also presented obstacles for movement to assigned launch positions.[651] Still, analysts argued that deployment of mobile missiles off but near the main roads in some of these rural areas would be possible.[652]

Mobile missiles also came with an inherent set of operational constraints and signatures that analysts were preparing to be able to detect. For instance, physical security was considered more difficult to maintain with mobile missile units than with fixed-based deployment, requiring additional security personnel and placing additional demands on operating crews.[653] Mobile systems would also require more maintenance than fixed systems because movement, vibration, and exposure to the elements resulting in more frequent equipment failures. This indicated both that the missiles would not be able to travel too far from support facilities and that there would

[651] Ibid, p. 23.
[652] Ibid, p. 29.
[653] Ibid, p. 23.

be relatively frequent movement among the operational force, due to the need to return regularly to base, which might have been detectable.[654]

U.S. intelligence analysts had reason to believe that a Soviet mobile missile force might emerge gradually and subtly. Operating costs for a mobile system would probably be three to four times those for a fixed system, due to the need for increased maintenance and the greater personnel requirements, and higher cost for transportation, command and control, training, security and support. In addition, mobile missiles came with a set of special command and control problems not experienced with fixed missile systems. It was difficult, for example, to make mobile communications systems as reliable, secure and redundant as fixed systems and to ensure uninterrupted control of mobile launchers by higher echelons of command. Because of these constraints, U.S. analysts believed only a portion of a mobile missile force would be available for launch at any given time, except during period of crisis, because part of the force would be undergoing maintenance or moving to new positions. [655] U.S. intelligence estimated the Soviets might deploy about 30 launchers in 1977 and have some 120 in the field by 1980. If the Soviets were to maximize their efforts, they might deploy about 25 launchers in 1976 and have about 275 by 1980.[656]

[654] Ibid, p. 23.
[655] Ibid, p. 23.
[656] Ibid, p. 24.

Verification uncertainty

This gradual deployment process, combined with concealment measures, presented complications for monitoring and verification. In 1975, the Director of Central Intelligence Colby estimated that if there were no extensive concealment measures for deployment, U.S. intelligence with HEXAGON and other NTM systems could recognize mobile ICBM deployments within a year, by which time the Soviets could have deployed 25 to 100 launchers. After 200 launchers were deployed, he believed U.S. intelligence could probably estimate the extent of deployment within about 100. With larger deployments, U.S. intelligence might still have to consider that as many as 100 launchers might remain undetected. Over time, this number might decrease, since opportunities to identify characteristic deployment signatures would probably increase. Colby estimated that monitoring problems would be compounded if the Soviets deployed the SS-20 IRBM in a mobile configuration. This missile was a two-stage derivative of the SS-16 ICBM and used some of the same support equipment. Consequently, it would be difficult to distinguish between the two missiles when deployed.[657]

CORONA's shortcoming and hopes for HEXAGON were embedded in the failure to adequately monitor early versions of mobile IRBMs. In 1969, the ability of photo interpreters to discover mobile offensive missile system signatures at the test ranges was questionable. The Soviets had claimed to have mobile ballistic missile capabilities since l965, and the amount of telemetry transmitted during SS-14 firings had dropped, suggesting that deployment either was underway.

[657] "DCI Congressional Briefing: Monitoring a SALT Agreement," April 16, 1975. General CIA Records. Central Intelligence Agency. https://www.cia.gov/library/readingroom/document/cia-rdp84b00506r000100120020-0.

However, no mobile IRBM facilities or clues to deployment plans could be identified at test ranges or in the field, including for the SS-12, SS-14 and SS-15. Part of this difficulty could be attributed to the fact that none of these systems were ever deployed in large numbers. Still, analysts believed their small sizes made mobile systems difficult to pinpoint on CORONA imagery, even after deployment patterns had been determined, and it was sometimes difficult to establish whether an identified site was occupied. The U.S. intelligence community believed it would take a high-resolution surveillance system like HEXAGON to provide a confident judgement on the extent and character of mobile missile deployment.[658]

Given that the SS-16 never reached full operational deployment, nor did earlier Soviet attempts at mobile IRBMs, HEXAGON's real abilities to detect mobile ICBMs remained untested during this period. In theory, HEXAGON would have introduced significant improvements to mobile missile detection by reducing both the resolution and temporal blind spots. With regard to resolution, HEXAGON's ability to hold high resolutions at oblique angles and over wide areas would have supported identifying mobile missiles in the field.

HEXAGON's temporal advances would have been instrumental for developing an understanding of mobile missile deployment patterns. While CORONA could detect major changes in known facilities – such as the construction of buildings, the clearing of land, or the extension of roads – changes in activity levels were generally only detectable over an extended period of six months or more. CORONA's short mission life made it less able to wait out bad weather, which meant

[658] "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/88.pdf.

occasionally going for longer periods without useable imagery. An OSD study described HEXAGON as a more cost-effective search vehicle than CORONA with its high resolution providing adequate intelligence on one-half to two-thirds of the high-resolution targets that were then covered by GAMBIT. The implication of HEXAGON was thus that it would free up GAMBIT from search duties, allowing it to be optimized for technical intelligence analysis, while HEXAGON remained primarily responsible for tasks like searching for mobile missiles. [659]

Despite these advances, monitoring uncertainty related to time gaps remained. An interagency intelligence report in 1974 specified that extensive real-time satellite reconnaissance coverage – as opposed to the film drop system of HEXAGON – would help to improve monitoring of mobile missile force movements. However, even with real-time monitoring, analysts harbored a fear that movement could be accomplished at night, under cloud cover, or by the use of camouflage. This would be less of a problem with a ban in place, given the difficulty of permanently hiding not just mobile missiles but all of their support equipment as well. Under arms control limits, however, the remaining temporal blind spot would continue to hold real challenges for accurately estimating and tracking force size.[660]

[659] "Evaluation of the BoB Statements Regarding Value of HEXAGON." National Reconnaissance Office, March 31, 1969. Declassified HEXAGON Records, National Reconnaissance Office. https://www.nro.gov/Portals/65/documents/foia/declass/HEXAGON%20Records/88.pdf.
[660] "Interagency Intelligence Report: A Soviet Land-Mobile ICBM, Evidence of Development and Considerations Affecting a Decision on Deployment." Central Intelligence Agency, October 1, 1974. General CIA Records. https://www.cia.gov/library/readingroom/document/cia-rdp79r01099a001600080003-0, p. 22.

Support for a mobile missile ban and the use of blind spots

Banning mobiles was seen as a solution to the verification problem, and this position was pushed forward by those in the intelligence community. Director of Central Intelligence Colby argued that the U.S. ability to monitor precise numerical limits under SALT II—both the aggregate limit and MIRV sublimit—depended on measures such as whether mobile ICBMs were allowed or banned. The CIA would continue to press the notion that a ban on mobiles would ease verification challenges in Verification Panel meetings and through National Security Council discussions.[661]

U.S. domestic opposition to a ban was grounded in a desire to keep options for a U.S. mobile missile system open. The Soviets, likely recognizing the high cost and technical difficulty of mobile systems, eventually came around to the initial U.S. position to ban land-mobile missiles. Meanwhile, U.S. defense leaders, along with Secretary Kissinger and President Ford, had been moving in the opposite direction. By the mid-1970s, they feared that the Soviets were too far "*ahead*" and that the United States needed to reserve the right to catch up, despite the current lack of domestic support for land-mobile systems. Defense leaders were expected to argue for a U.S. mobile missile program in light of "new Soviet developments in anti-submarine warfare" which could allegedly threaten the U.S. sea-based deterrent. U.S. leaders had become wary that

[661] "Memorandum From the President's Assistant for National Security Affairs (Kissinger) to President Ford." Foreign Relations of the United States, July 24, 1975. Ford Library, NSC Institutional Files, Box 5, Verification Panel Meeting, 7/24/75–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d100.

R&D funding would be jeopardized by a mobile missile ban, or worse, by Congress finding out that the U.S. delegation had rejected a Soviet offer for a ban.[662]

The public reacted strongly and negatively to U.S. defense leaders' proposals for a domestic mobile missile system in 1974. In addition to the complex land and targeting issues, an argument put forth was that the Soviet Union would be unable to ignore this trend and would be under increasing pressure to replace many of its vulnerable silos with a second generation of mobile, MIRVed missiles both on the land and at sea.[663] There was recognition that land-mobile missiles were difficult to count and verify, and that the success of SALT II would be greatly compromised if they were allowed.[664] The issue was also placed in the frame of demonizing SALT II more broadly. After one press conference, the New York Times stated that,

> *"President Ford now has confirmed that the Vladivostok agreement on strategic offensive nuclear arms legitimizes a further build-up, quantitative and qualitative, by both sides... The qualitative arms race involving greater accuracy, higher yield-weight ratios, replacement of missiles and bombers by new generations of more advanced arms and the introduction of land-mobile missiles and submarine-launched cruise missiles can go on unhindered. If this is 'putting a cap on the arms race,' then shrimp can whistle—as a former Soviet leader, Nikita Khrushchev, was fond of saying."*[665]

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[662] "Memorandum From the President's Assistant for National Security Affairs (Kissinger) to President Ford." Foreign Relations of the United States, July 24, 1975. Ford Library, NSC Institutional Files, Box 5, Verification Panel Meeting, 7/24/75–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d100.

[663] "Vladivostok's Gaps." *New York Times*, December 18, 1974. https://www.nytimes.com/1974/12/18/archives/vladivostoks-gaps.html?searchResultPosition=1.

[664] Kleiman, Robert. "For a National Debate on Military Policies." *New York Times*, February 12, 1974. https://www.nytimes.com/1974/02/12/archives/for-a-national-debate-on-military-by-robert-kleiman.html?searchResultPosition=3.

[665] "Spurring the Arms Race." *New York Times*, December 4, 1974. https://www.nytimes.com/1974/12/04/archives/spurring-the-arms-race.html?searchResultPosition=4.

Congressional leaders would also use the inability to verify mobile ICBMs as part of the argument toward foregoing the MX missile program and banning the program. For example, as part of a case against the MX, Representative John F. Seiberling made the argument that, "Mobile ICBMs would be extremely difficult to verify by "national technical means" (i.e., by spy satellite) and would be next to impossible to count accurately without on-site inspection… Mobile ICBMs loaded on trucks or railway cars might be easily camouflaged or stored in garages and moved at night. All of this would create nightmares for the arms control community trin got negotiate meaningful and verifiable limits on the numbers of strategic weapons."[666]

Support for a mobile missile ban began to coalesce, and would later solidify in the late 1970s, due to the combined weight of several factors. The CIA continued to emphasize the serious verification problems associated with land-mobile missile systems. At the same time, ACDA and the State Department argued that public and Congressional acceptability of SALT II would be enhanced substantially by including a ban on mobiles. Kissinger expressed privately to Ford in 1975 that in spite of U.S. defense leaders' concerns, there was no strong rationale for mobile ICBM deployment in the United States. He believed that the principal strategic rationale for developing a mobile missile—as a hedge against future vulnerability of not only silo-based ICBMs, but SLBMs and bombers as well—was an extremely unlikely contingency during the life of SALT II. Kissinger also pointed out the practical problems associated with mobile systems, including that the United States did not have the land availability or the political support to deploy a mobile system.

[666] Congressional Record, House, March 17, 1976, p. 6818.

HEXAGON capabilities and the unraveling of the mobile missile ban

At the time, OSD projected an operational capability for a U.S. mobile ICBM system (air- or land-based) by 1985. Kissinger believed that although this could probably be moved up by two or three years under an accelerated development schedule, it would be virtually impossible to get the required funds from Congress over the next few years. He therefore recommended to Ford that it would be in the U.S. interest for the 10 years of the agreement to agree to a combined ban on air- and land-mobile ICBM systems. However, in view of the "*strong DOD interest*" in doing development work on mobile ICBM systems, Kissinger argued that the U.S. delegation should confirm the apparent Soviet position that the ban applies only to deployment, but not to development and testing.[667] Here again, we see visions of arms control and technological superiority finding cohesion in leaving the door open to research and development on land-based-mobile missiles.

Following these discussions, defense leaders reversed their position from SALT I on the unverifiability of mobile missiles, leveraging the reconnaissance advancements of HEXAGON as part of their final push against a ban. During a National Security Council meeting in July 1975, President Ford expressed concern that the Soviets' large land mass would pose insurmountable problems to mobile missile detection by satellites, which was concerning considering that they were farther along than the United States in terms of development. Here,

[667] "Memorandum From the President's Assistant for National Security Affairs (Kissinger) to President Ford." Foreign Relations of the United States, July 24, 1975. Ford Library, NSC Institutional Files, Box 5, Verification Panel Meeting, 7/24/75–SALT. https://history.state.gov/historicaldocuments/frus1969-76v33/d100.

Secretary of Defense Schlesinger insisted that satellites would be able to detect patterns of mobile missile deployment in the Soviet Union, and that therefore the United States should not give up research and development on its own mobile missile system. Despite the absence of supporting documentation from the intelligence community, Schlesinger argued that "*we will be able to determine the number and location*" of Soviet mobile missiles. He layered this argument with strategic incentive, asserting that if the Soviets were to draw down fixed systems in order to replace them with mobile systems, overall Soviet throw weight would decrease, and the United States would benefit. Schlesinger's argument was that while the U.S. Congress was admittedly against mobile missiles within the United States, there was space to change minds. He asserted, "Mr. President, I agree there is presently a predilection against land mobiles in the Congress. But if we worked on the stability argument, I believe we could turn them around."[668]

While a temporary ban on mobiles was agreed domestically, the position ultimately left the door open to research and development. As in the case of cruise missiles, positions on verification shifted with strategic desires, and satellite imaging capabilities were invoked in the process to help make the case that allowing research and development on mobiles could be conducted in a reasonable and responsible manner.

Satellite blind spots were used in this space to justify leaving open the possibility of research and development for a U.S. mobile ICBM program. Team B's complaints that the Soviet's brewing SS-20 program could be quickly and covertly converted into the longer-range SS-16 in times of

[668] "Minutes of a Meeting of the National Security Council." Foreign Relations of the United States, September 17, 1975. Ford Library, National Security Adviser, NSC Meetings File, Box 2. https://history.state.gov/historicaldocuments/frus1969-76v33/d105.

crisis given that both systems were built off of the same platform.[669] Such worst-case possibilities were seen as a backdoor out of SALT that justified the United States continuing to keep the door open to a future mobile ICBM program by retaining research and development efforts.

There is also evidence that information from HEXAGON was being used to shape the characteristics, direction and magnitude of the early ideas for the U.S. MX mobile missile program. According to an Air Force paper that was read into the Senate Congressional Record, MX was in a "very fluid state." The paper noted that "It is reasonably certain that, if implemented, MX 'would be somewhat larger than Minuteman to lessen the throw weight imbalance. But, as currently envisioned, MX would give us far less throw weight than needed to fully offset what would be available to the Soviets if they opt for massive deployment of the SS-19s and SS-18s. The synergistic effect of advanced technology in nozzle technology, materials, staging, propellants, and other elements makes it possible to design MX 'with several times the sider several matters pertaining to the throw weight of Minuteman.'"[670]

This argument about throw weight disparities, constructed using HEXAGON information, persisted at higher levels of government. In a memo to Kissinger, Helmut Sonnendfeldt, as Counselor of the Department of State and member of the National Security Council staff, noted "As regards the MX issue, I think it is off the mark to worry about "signals" to the Soviet Union. As you know, I am comfortable with the existence of the program, precisely because it is a

[669] Team B Report, p. 26. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf
[670] Congressional Record, Senate, June 5, 1975, pp. 17461-17462.

reminder to the Soviets of the prospects if they prove unwilling to address the problem of throw-weight disparity in SALT."[671]

Yet through 1977 and the end of this case study, it was still undetermined whether the United States would proceed with the MX program. During a discussion with senators in November 1977, Secretary Vance noted that "there is no determination at this point that [the MX] is the direction in which we ought to go. We simply don't know enough yet about what the general situation will be, what the state of development will show." His words preface the developments that would take place in years to come, as information gleaned under the KENNEN satellite program would be used to depict this "state of development" in future justifications for the MX mobile missile program.[672]

Conclusion

HEXAGON's development, propelled by the desire for high-resolution imagery over wide areas, strengthened the voices of those seeking U.S. superiority and the resistance they posed to reductions and bans. In the weapon debates that comprised SALT II, HEXAGON's dramatic increase to the volume and frequency of imagery intelligence and the subsequent transformation of NPIC's reporting to focus on qualitative advances were capitalized upon by adherents to

[671] "Memorandum From the Counselor of the Department of State (Sonnenfeldt) to Secretary of State Kissinger," Foreign Relations of the United States, December 3, 1976, National Archives, RG 59, Records of the Office of the Counselor, Lot File 81D286, Box 3, Chronological File. https://history.state.gov/historicaldocuments/frus1969-76v35/d116

[672] "Vanke and Warnke Discuss the Status of SALT, 3 and 29 November 1977," SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, pp. 503-504.

technological superiority. Opponents of détente used details around throw-weight, warhead numbers, and new Soviet systems that emerged with HEXAGON coverage, a change that was one of perception more than actual change, to claim that the SALT process and arms control was failing the United States in the face of rampant Soviet modernization efforts. Many also used this same information to argue for further investment in U.S. nuclear weapon programs as a counter to those seeking reductions.

HEXAGON's advancements also increased the ability to verify hard-to-track systems like cruise missiles and mobile missiles, which effectively empowered advocates of these systems that sought to destroy the prospects for banning these categories of weapons by helping them make the case that such weapons could be responsibly developed, limited, and verified. At the same time, remaining verification uncertainty due to blind spots was used to bolster the case for retaining and investing in pending weapon programs like cruise missiles and mobile ICBMs.

Established systems: ICBMs and MIRVs

The counting rules system developed during this period to enable the verification of MIRV numbers via satellites bolstered the case for limits at higher numbers over a freeze and reductions. While this system could have arguably been developed under earlier reconnaissance systems, including CORONA, GAMBIT, or even under cooperative aerial reconnaissance, HEXAGON's wide area capture capabilities at high resolution would have made monitoring changes to the large number of targets more feasible. The significance of the counting-rules system was that it transformed MIRVs from a runaway security issue threatening strategic

stability to a manageable part of a "normal" nuclear force structure. MIRV numbers could now be verified and controlled. Gone was the impetus and urgency to work toward banning them.

HEXAGON's new information was also utilized in the public and Congressional sphere to weaken the case for SALT II and to argue in support of U.S. modernization and technological superiority. Groups like the Committee on the Present Danger (CPD) and their allies in Congress were most influential in this process. Within this environment, new information from HEXAGON was used to argue that the Soviets were achieving strategic superiority, particularly by invoking specific figures about superiority in aggregate throw-weight. Such information was derived through HEXAGON's ability to track the details of Soviet missile upgrades and the corresponding changes to cumulative force measures like aggregate throw weight and total warheads. The high levels of Soviet forces in these areas were also used to shift the blame for avoiding reductions to the Soviets – in the view of some U.S. leaders, it was the Soviets' fault that reductions were not possible because the Soviets had built so many new weapons and were unlikely to want to dismantle them. Reductions, they argued, would be a non-starter and should therefore not even be brought up lest the U.S. risk losing ground on other more modest and more attainable objectives.

At the same time, remaining satellite blind spots were used by CPD, treaty opponents within the military establishment and Congress to discredit SALT II and make the case for pursuing U.S. technological superiority unhindered. SALT opponents complained that the agreement called for ceilings on the numbers of launchers and not on the actual numbers of missiles, and that with "reloadable" missiles, the Soviets could achieve superiority over the United States. Overall, these

attacks were less rooted in the viability of SALT II's verification provisions than they were in the significance of potential cheating for a treaty that they viewed as already in the Soviet's favor. The temporal blind spot was therefore a useful scapegoat for the broad claim that SALT II was fundamentally untenable by the notion that the Soviets could cheat no matter what the provisions ultimately were. The case of MIRVs and ICBMs under SALT II thus shows that blind spots were not only useful leverage for limits over bans, but also for superiority over limits. The result was that they were often used to skew arms control in the direction of modernization, qualitative build-up and competition over restraint and cooperation.

Pending systems: cruise missiles and mobile ICBMs

Intelligence generated with HEXAGON, together with arguments about verifiability and unverifiability, was also used to clear the path for U.S. weapon development in new categories. In the case of cruise missiles, arguments claiming unverifiability were initially used to strengthen the case for U.S. technological superiority in early attempts to keep cruise missiles out of SALT II. Later, as the Soviets pushed cruise missiles into the scope of the treaty, HEXAGON's advances that slightly enhanced verifiability were effectively leveraged by proponents of cruise missiles to argue against a ban on the technology under the notion that they could be controlled under SALT II and developed responsibly. While HEXAGON's advances made verification for cruise missile systems conceivable, there were many ambiguities which were leveraged by opponents of detente to stall SALT II.

Interlaced with this debate over verification, information and blind spots were used to make the case for retaining the U.S. cruise missile program over calls to cancel it and ban the technology under SALT II. The Soviets were known to be behind the U.S. in cruise missile technology development, but this didn't stop proponents in the arms control epistemic community and in Congress from pointing to imagery information of Soviet developments with shorter range cruise missiles as "evidence" of the potential for a dangerous, capable, and long-range Soviet cruise missile program. Next to this, proponents of the cruise missile pointed to the particularly severe verification challenges as reason that a ban was irresponsible and that the United States must continue its advancement of cruise missile technology.

In the case of mobile missiles, HEXAGON would present solutions to some, though not all, mobile missile monitoring challenges by advancing temporal coverage and reducing the temporal blind spot. Despite these advances, monitoring uncertainty related to time gaps remained. Banning mobiles was seen as a solution to the verification problem, and this position was pushed forward by a small number of actors. At the same time, defense leaders actually used HEXAGON's temporal advances to argue against a ban and to leave open the prospects for research and development on a U.S. mobile missile system. Similar to the debate over cruise missiles, positions on verification shifted with strategic desires, and satellite imaging capabilities were invoked in the process to help make the case that allowing research and development on mobiles was reasonable and responsible.

As U.S. ambitions for its own mobile ICBM program became increasingly concrete during this period, the debate over mobile missiles would begin to grow in complexity: arguments about

verification would become increasingly intertwined with the arguments about how mobile ICBMs affected strategic stability and the course of arms control, with satellite information and blind spots both used to build a case for their status as an essential ingredient of the U.S. nuclear force. During this period, claims about the Soviets fielding a covert mobile ICBM program by upgrading its mobile IRBMs within the remaining temporal blind spot were used to fuel fears and incentivize U.S. mobile ICBM initiatives. This pattern extends into the following case study and will thus be further examined.

Overall, HEXAGON represented an attempt to "have it all" in one satellite. The satellite's high resolution and wide-area capture capabilities brought unprecedented volumes of new information to bear on the intelligence and decision-making process. At the same time, the satellite retained a temporal blind spot, leaving the nature of uncertainty largely unchanged. Together with the NPIC practices examined in Chapter 2, this translated to significant increases in the level of qualitative weapon details that diffused through intelligence reporting into the U.S. policy debate. Such detail was readily absorbed into the arguments of those seeking to push against ICBM reductions, retain MIRVs, and advance a new cruise missile and mobile ICBM force. These resulting arguments were thus more nuanced in their discussions of how particular U.S. modernization efforts would solve deterrence problems or maintain strategic stability than they might have been had they had to rely on system numbers alone. Next to this, because HEXAGON continued on the path of the resolution initiative, the temporal blind spot endured, allowing the pattern of arguments about verification uncertainty as a reason for retaining and advancing weapons to persist.

Chapter 5. Case Study:
START and INF under KENNAN, 1976-1987

The KENNEN satellite program was the United States' first real-time satellite and its first digital satellite. The deployment of the technology would come with changes across U.S intelligence and information infrastructure as a new computer architecture was introduced. Like the HEXAGON program before it, KENNEN emerged despite widespread bureaucratic apathy and even opposition due to the concerted efforts of a small number of individuals who believed in the value of real-time information, as well as those who simply wanted to push reconnaissance to edge the technological limits of the decade.

KENNEN emerged as SALT II was crumbling under the structural and political challenges detailed in the previous chapter; this case study therefore focuses on the implementation of KENNEN in the late 1970s next to the Strategic Arms Reduction Treaty (START) and Intermediate Range Nuclear Forces Treaty (INF) processes under the Reagan administration. The case study ends in 1987, as this is when KENNEN's successor, the LACROSSE program, would be deployed and further change the reconnaissance and information landscape.

The case study looks at three major debates over weapon systems and how the use of KENNEN information influenced U.S. domestic positions on limits, reductions, and bans and the direction and intensity of modernization. The first section on established systems looks across strategic weapon systems including ICBMs, MIRVs and interlinked ABM issues. The debate over START shows KENNEN information and the digitization process being leveraged in ways that drove a continued focus on limits intertwined with modernization. KENNEN information was

used to depict Soviet external threats to help leave open room for U.S. qualitative investment and modernization within the START framework.

The second section on pending systems looks at mobile ICBMs and IRBMs, where both faced the prospect of a ban. For mobile ICBMs, the issue of Soviet "hardening" of its missile and control sites observed in KENNEN imagery would become a severe concern of U.S. officials in addition to old worries about superior Soviet throw-weight and warhead numbers. This contributed to a durable argument the United States own mobile missile initiatives, meaning that despite the growing domestic resistance toward the MX and Midgetman programs, the weapon systems would persist until after the end of the Cold War. The case of intermediate-range ballistic missiles (IRBMs) stands as an exception in this study. This is the only case where blind spots and verification issues were successfully leveraged as part of an effort to codify a ban on a category of weapon within a treaty. This analysis shows how this process can be attributed to several factors connected to the issue being based in Europe rather than the United States and why the case does not contradict the findings of this study.

Nuclear strategy overview

The defense establishment together with groups like the Committee on the Present Danger (CPD) were focused on one particular scenario which they elevated to dominate the debate over the future of nuclear strategy. Developed by Albert Wohstetter, though often associated with Paul Nitze, and publicized by like-minded colleagues within CPD, it pointed to a surprise attack by Soviet ICBMs directed against U.S. missile silos, effectively eliminating the ICBM force.

Colin Gray claimed that the question of what to do about this growing vulnerability of fixed-site, land-based missile forces, in the 1980s, would be "the question of the decade." Gray claimed that the loss of one leg of the triad would be "an event so momentous that its anticipation should be the occasion for a fundamental review of strategic doctrine." As Lawrence Freedman assesses, it was more the case that a change in strategic doctrine was needed to make the event "momentous," for under established concepts the hypothetical loss of the land-based leg was more than compensated for by the bombers and SLBMs available to retaliate.[673]

This hypothetical scenario and issue of the vulnerability of the land-based ICBM force was linked in the minds of some to bigger problems related to the possible dynamics of a nuclear conflict. Senator Jackson framed the problem in terms of a Soviet first strike on U.S. ICBM and bomber bases. In his view, the U.S. president would have only one option: to annihilate Russian cities, "knowing full well, however, that the Russians could strike back at our populated centers far more effectively, killing more people, virtually wiping out our population." This was seen to undermine deterrence because the Russians might conclude that no American president would ever order such an action.[674] Helping Jackson develop his ideas was Richard Perle, a student of Wohlstetter's who shared his mentor's focus on American vulnerabilities.[675]

It was within this discussion that Herman Kahn's ideas about 'escalation dominance' would gain ground. William Van Cleave, an advisor to Ronald Reagan, encouraged a shift in the terms of

[673] Freedman, Lawrence and Jeffrey Michaels. *The Evolution of Nuclear Strategy: New, Updated and Completely Revised*. Springer, 2019, pp. 573-574.
[674] Freedman, pp. 574-575.
[675] Freedman, p. 575.

reference of the debate over strategy away from that of assured destruction towards theories of escalation dominance, in which the key question was the burden of responsibility for escalating to higher levels of violence: "[I]instead of the simple model of aggressive Soviet first strike and U.S. retaliation, we may face a situation where the Soviets could strike first and still retain their own assured destruction retaliatory force, leaving the United States in a position of being the initiator of nuclear war against a civilian populace and the Soviet Union being in the position of retaliator."[676] The scenario involved an analysis of the military balance that was described as dynamic rather than static, by considering the consequences of successive strikes.[677] According to Herman Kahn's original formulation, escalation dominance "is a capacity, other things being equal, to enable the side possessing it to enjoy marked advantages in a given region of the escalation ladder."[678]

Given the United States was far from possessing conventional and nuclear superiority to the Soviet Union across the spectrum of warfighting capabilities, escalation dominance was not a realistic course for a comprehensive nuclear strategy. Instead, the Reagan administration absorbed notions of escalation dominance while leaning into the established policy of flexible response, having been adopted by NATO back in 1967. Flexible response sought to address the Soviet Union's conventional weapon superiority by explicitly including the option of first use of nuclear weapons and 'deliberate escalation.' Tactical nuclear weapons were assumed to deter enemy use of tactical nuclear weapons, to balance the Soviet Union's conventional superiority,

[676] Senate Armed Services Committee, Hearings on Military Implications of the Treaty on the Limitation of Anti-Ballistic Missile Systems, and the Interim Agreement on Limitation of Strategic Offensive Arms (Washington, DC: USGPO, 1972), p. 579, cited in Freedman, p. 575.
[677] Freedman, p. 576.
[678] Kahn, Herman, *On Escalation: Metaphors and Scenarios*, Routledge, 1st edition, October 15, 2009.

and to provide linkage to US strategic nuclear weapons. Both the strategies of flexible response and the idea of escalation dominance sought to increase options "downward" in the ladder of escalation.[679] In 1983, Reagan asserted in an address to the nation on defense and national security, "…we must remain constant in preserving the nuclear deterrent and maintaining a solid capability for flexible response."[680] Secretary of State George Schultz described, "We and our allies would not agree to "no first use" of nuclear weapons, since the threat of first use of even battlefield nuclear weapons constituted an all-important equalizer against the Soviets' conventional advantage. We needed the capacity to respond with flexibility to any potential threat, and we wanted the Soviets to know that we had that flexibility."[681]

The policy of flexible response came with its own set of deep-seated challenges related to crisis stability.[682] The debate over the implementation of flexible response would also strain transatlantic relations, as the United States emphasized conventionalization and greater defense efforts by the Europeans, while European leaders did not want to spend more on defense in directions geared primarily toward U.S. interests.[683]

The new emphasis on flexible response under the Reagan administration therefore had an effect of directing arguments for U.S. modernization in new directions. Schlesinger supported

[679] P. 132.
[680] "Address to the Nation on Defense and National Security," Ronald Reagan, March 23, 1983. https://teachingamericanhistory.org/library/document/address-to-the-nation-on-national-security/
[681] Schultz, George P. *Turmoil and Triumph: My Years as Secretary of State*, New York: Charles Scribner's Sons, 1993, p. 247.
[682] Krell, Greg, "The Controversy about 'Flexible Response,' Bulletin of Peach proposals, Vol. 17, No. 2, Special Issue: Alternative Approaches to Security Policies (1986), p. 139.
[683] P. 138.

modernization of the nuclear arsenal in ways that made employment more precise and less damaging, and thus more appropriate in the context of flexible response and for maintaining credible for deterrence.[684] This would lead to developments like the Tomahawk cruise missile and the Pershing ballistic missile, which sparked protests in Europe, as well as arguments for the MX missile to both reduce U.S. vulnerability to a disarming first strike and to be able to better threaten Soviet hard targets.[685]

As examined in Chapter 5 in the case study analysis devoted to START and INF, information from KENNEN was used to make specific arguments about the necessity of U.S. modernization programs that were connected to concerns about ICBM vulnerability and the subsequent ideas of escalation dominance and flexible response that grew from this concern. The chapter shows how such arguments were used in Congressional debates to sustain weapon programs that might otherwise have been subject to cancellation.

Established weapon systems: ICBMs and MIRVs

START ultimately achieved modest reductions and limits across launchers and warheads. But competition in throw-weight and MIRVs, a dynamic that had been sustained and intensified by satellite information, continued with relatively little restraint. Imagery analysts' increasingly successful tracking of Soviet mobile missile programs through KENNEN contributed to the growth of the target list of the U.S. nuclear warfighting plan, known as the Single Integrated

[684] Freedman, p. 592.
[685] Freedman, p. 595.

Operating Plan (SIOP). This larger target list, together with new information from KENNEN about Soviet ABM developments, fueled the illusion of significant Soviet ABM advances and was used to argue for both U.S. defensive modernization (i.e., the Strategic Defense Initiative) and offensive modernization (i.e., the MX missile program). In Congress, arguments invoking the information from KENNEN arose repeatedly throughout the late 1970s and early 1980s as part of arguments to make the case for modernization over the alternatives of cancelling programs and seeking reductions through arms control. This information cycle and process worked to strengthen the case for limits and modernization over bans across a wide range of missile and warhead development initiatives.

From SALT to START

SALT II had been deeply unpopular with the incoming Reagan administration. Many members had come from the Committee on the Present Danger (CPD) and had thus expended great effort toward ensuring that SALT II never gained a firm footing. Early in Reagan's term, as he was formulating his approach to nuclear weapons, he asked of his council, "What can the Soviets really do that prevents us from telling them now that we cannot go along with SALT II?" Richard Allen, assistant to the President for National Security Affairs, responded, "It would indicate to the rest of the world that we are against the SALT process. We've all been imprisoned by the SALT language. We need some new categories, e.g., Strategic Arms Reduction Talks. They would be known as START."[686]

[686] "US-USSR Standing Consultative Commission (SCC)," 22 May 1981, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 41.

The ideas of the CPD, including its rejection of SALT II and advocacy for new U.S. weapon programs, was the jumping off point for START. This was evident in Reagan's pick for the director of the Arms Control and Disarmament Agency, Eugene Rostow, who had been a leader within CPD. In one of his first briefings to Reagan on START, he asserted, "Much more is at stake than my comfort in the START negotiations …Who is going to believe in our nuclear guarantee if we cannot credibly deter the huge and menacing Soviet ICBM force or their SS-20s?"[687] This thinking of the need for dramatic changes in approach thus shaped START in marking a clear departure from SALT II; Whereas SALT II had allowed both sides to build upward, the majority of early START proposals required substantial and asymmetrical reductions from the larger Soviet nuclear force, while also leaving room for U.S. strategic modernization.

New information, new force-level requirements

New methodologies developed under KENNEN during the transition to the digital age contributed to the growth of target lists in the Soviet Union. Previously, weapons systems reporting had been indexed to one main base location. Now, with the growth of mobile missile infrastructure together with the locations of "strategic relocatable targets," target lists became larger and more fluid. When mobile missiles left their bases, imagery analysts had to re-task rapidly, search expeditiously, and record temporary locations even though these new targets had no unique physical attributes other than a latitude and longitude. Tracking these locations over time led analysts to understand force behavior and patterns of movement and contributed to a

[687] "East-West Trade; Strategic Forces," 17 August 1981, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 71.

growing volume of targets.[688] These methods developed for the SS-20 were also useful for other relocatable targets such as non-deployed missiles, which also worked to increase target lists. New storage sites and even rail lines that could be used to transport extra missiles to launching areas were now actively observed and included as targets for both imaging and in nuclear war planning.[689]

In their study of the evolution of SIOP over decades, Desmond Ball and Robert Toth show that the number of Soviet mobile or relocatable targets grew drastically during the course of developing SIOP-6, with a particular increase in mobile C3 facilities and mobile ICBMs. In 1984, when the initial version of SIOP-6 was current, there were some 4,000 relocatable targets in the National Strategic Target List (NSTL).[690] This process of growth had likely started in the late 1970s as the Soviet mobile missile force started to burgeon. During the mid-l980s, the Soviets fielded numerous mobile C3 systems, including mobile command posts, mobile communication systems, and mobile satellite ground stations.[691] In 1985, the SS-25 road-mobile single-warhead ICBM became operational, and deployment of the SS-24 rail-mobile 10-warhead ICBM began in 1987.[692] According to Air Force intelligence estimates, fully half of all Soviet strategic targets could be mobile by the end of the century, including two-thirds of the ICBMs. In addition, the target list consisted of mobile air defense batteries, bombers scattered among smaller airfields, submarines hidden up coastal inlets, and conventional forces of soldiers and tanks moved out of their barracks. In 1985, the CIA established a Mobile Missile Task Force

[688] O'Connor, p. 214.
[689] Talbott, p. 289.
[690] *Air Force Magazine,* Vol. 67, No. 12 (December 1984), p. 23.
[691] DoD, Soviet Military Power 1988, pp. 17, 45, 61.
[692] DoD, Soviet Military Power 1988, p. 47.

Intelligence Requirements and Analysis Working Group to study the problem of locating and targeting Soviet mobile missiles.[693] The Air Force also initiated a Relocatable Targets Capability Program. And in 1987 the Pentagon formulated a Defense Department-wide Relocatable Targets Master Plan keyed to the development of sensors, C3 architectures, and force structure necessary to put at risk these Soviet mobile ICBMs and C3 systems going forward.[694]

The technical details of this process show a clear link between the practices and capabilities achieved under KENNEN and the new, larger target lists in SIOP. Identifying small, camouflaged mobile targets would not have been possible without the high-resolution imagery KENNEN afforded. The NIIRS scale states that Level 5 imagery (0.75-1.2 meters) was necessary to "distinguish between SS-25 mobile missile TEL and Missile Support Vans (MSVS) in a known support base, when not covered by camouflage." Identifying targets in unknown locations under camouflage would have required an even higher resolution, which KENNEN gradually achieved during this period. Even more significant for this process than the higher resolutions brought by KENNEN was the process of digitization and the incorporation of new computer tools. New software programs like NPIC's Analyst program were necessary to maintain these larger, more fluid target lists that could no longer be managed through "stories" and the memories of imagery analysts. With a new digitized database system, the number of stories and the number of targets could now grow with much less constraints.

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[693] Gregory A. Fossedal, "U.S. Said to be Unable to Verify Missile Ban," *Washington Times,* November 18, 1987, p. 6; and Rowland Evans and Robert Novak," What About the Hidden SS- 20"" *Washington Post,* November 18, *1987,* p. *25.*

[694] Ulsamer, "Missiles and Targets."; Ball, Desmond, and Robert C. Toth. "Revising the SIOP: Taking War-Fighting to Dangerous Extremes." *International Security* 14, no. 4 (1990): 77-78.

Sources indicate that advances to the KENNEN system were largely designed around continuing to track mobile missile targets. Observers from this time in the mid to late 1980s noted that a network of four KH-12s was planned, which, together with the maneuverability of the satellites, were intended to ensure that images could be obtained of any spot in the Soviet Union within twenty minutes of transmission of the order.[695] A major task of the KH-12s is to track Soviet mobile ICBMs.[696]

Using imagery information to justify new U.S. nuclear modernization

The picture of the U.S.-Soviet strategic force balance that arose from the use of KENNEN was deeply unsettling to U.S. decision-makers. In Congress, arguments invoking the information arose repeatedly throughout the late 1970s and early 1980s as part of arguments to make the case for modernization over the alternatives of cancelling programs and seeking reductions through arms control.

The case for U.S. missile and warhead modernization based on Soviet nuclear force developments was sustained as KENNEN entered the picture in 1976. This is captured in a case made by Representative John J. Lafalce to the House of Representatives, where he describes in detail information compiled through satellite imagery to call for maintaining Minuteman III production until the MX could be developed. His testimony included a litany of detail. In addition to citing each of the Soviets new land-based missile and the number of tests, he

[695] Burrows, p. 307.
[696] "Tracking Mobile Soviet Weapons Seen as KH-12 Task," *Aerospace Daily,* April 17, 1985, p. 269; Ball, Desmond, and Robert C. Toth. "Revising the SIOP: Taking War-Fighting to Dangerous Extremes." *International Security* 14, no. 4 (1990): 79.

described their qualitative characteristics and MIRV technology, noting that, "If all the new ICBMs are deployed as expected, the USSR will have almost twice its present throw weight, and the warheads would increase to about 7,000 with a yield of one or two megatons."[697]

Similar arguments about superior Soviet throw-weight justifying the U.S. investment in its missile force persisted in Senate debates. On 27 July 1977, Senator George Mitchell of Maine, argued, "It seems to me since January we have been taking steps to weaken our defense effort. The President is talking about cutting the budget $5-$7 billion. We canceled our big carriers. We are proposing troop withdrawals from Korea. We closed down the Minuteman III production line. We scrapped the B-1. We are closing bases all over the country. My question is: Have you seen any weakening in the resolve of the Soviet Union?" This put Paul Warnke, director of ACDA, in the position of having to repeatedly present U.S. modernization of new and pending programs as a defense against such accusations. He made the case to Mitchell that the measures mentioned did not represent unilateral weakening. He instead identified them as choices among possible options. "…we are, of course, going ahead with the cruise missile program. I have already expressed to you the apprehension the Soviets expressed about the military potential of the cruise missile. We are proceeding with our development of the so-called MX, which would be a new generation of ICBMs. That unquestionably will continue unless there are some arms control arrangements which make it prudent on our part to discontinue these programs."[698]

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[697] Congressional Record, House, January 26, 1976, p. 896.

[698] Testimony of ACDA Director Paul C. Warnke. U.S. Congress, House of Representatives, Committee on Armed Services, Hearing on H.R. 8390 and Review of the State of the U.S. Strategic Forces, 95th Cong., 1st sess., 1977 (Printed in SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, p. 487).

What changed with KENNEN was that the new information landscape, including the more numerous set of Soviet targets in SIOP, was used to paint U.S. as distinctly inferior. Senator Strom Thurmond of South Carolina argued using KENNEN data in 1980 to press such a case. As evidence, he submitted for the record a report titled, "An Air Force Study: U.S. Now Strategically Inferior." The report cited comments by commander of the Strategic Air Command, General Richard H. Ellis to the Senate Armed Services Committee, which noted that while a rough strategic nuclear equivalence existed between the United States and the Soviet Union in mid-1977 and the early 1978-time frame, today "an adverse strategic imbalance has developed and will continue for several years to come."

Ellis told the Senate Armed Services Committee that his report was the summary of "a great many computer runs, using a highly sophisticated model," with the best available intelligence – "national intelligences estimates, RISOP-SIOP target data bases, JCS approved force capabilities and force lay-down principles as established in the joint Strategic Target Planning Staff." He said the study used relative U.S. and Soviet measurements of the mid-1977 levels and "then compared them to our capabilities today as well as those projected for our 1985 and 1989." Not until after 1985 will the programs approved in the FY '80 budget "being to ease the imbalance," Ellis said.

Both Senator Thurmond and General Ellis emphasized that the answer to the problem of inferiority was modernization. Thurmond stated in his testimony, "Unilateral arms restraint by the United States such as cancellation of the B-1 bomber, stretch-outs of the MX, Trident and cruise missile programs and a multitude of other ill-conceived actions have brought us to the

point where we are now strategically inferior – and I repeat inferior – to the Soviet Union." Ellis stressed that to ensure a trend to "ease the imbalance" continues after 1985, the MX, ALCM and Trident programs must not only not be allowed to slip further, "where possible and practical, they should be accelerated."[699]

Imagery information also fueled the illusion of Soviet ABM advances and was used to argue for both U.S. defensive and offensive modernization.[700] The 1982 NIE of Soviet strategic forces noted that, "We are particularly concerned about the growing potential for widespread deployment of defenses against ballistic missiles well beyond the limits of the ABM treaty using ABM systems currently in development. The Soviets' air defenses are undergoing significant changes, and they will have improving capabilities to threaten current types of bombers at low altitude and, to a lesser extent, cruise missiles."[701]

A trend of using observations of Soviet ABM "advancements" to argue for U.S. strategic modernization programs would continue into the 1980s. An unclassified joint Department of State and Department of Defense October 1985 publication, "Soviet Strategic Defense Programs," argued that the Soviets were "upgrading and expanding the world's only operational ABM system around Moscow." It also pointed to construction of the Krasnoyarsk ballistic missile detection and tracking radar that supposedly violated the ABM Treaty; "extensive research" into advanced technologies for ballistic missile defense including laser weapons,

[699] Congressional Record, Senate, March 18, 1980, p. 5689.
[700] "Soviet Strategic Defenses," 7 October 1985, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 379.
[701] NIE 11-3/8-82, p. 7.

particle beam weapons, and kinetic energy weapons; modernization of Soviet strategic air defenses; and improvements in Soviet passive defenses by maintaining deep bunkers and blast shelters for key personnel, and enhancing the survivability of some offensive systems through mobility and hardening. The authors of the report concluded that "given the long-term trend in Soviet offensive and defensive force developments," the United States must "modernize our offensive nuclear forces in order to ensure the essential military balance in the near term, and to provide the incentives necessary for the Soviet Union to join us in negotiating significant, equitable, and verifiable nuclear arms reductions."[702]

Observations from satellite imagery concerning Soviet ABM developments were also used to justify the Strategic Defense Initiative (SDI). Reagan saw this program as the potential answer to balance his desires for a secure and technologically superior United States together with a vision for nuclear disarmament. The State and Defense report also concluded that "we must act now to start constructing a more reliable strategic order for the long term by examining the potential for future effective defenses against ballistic missiles. The Strategic Defense Initiative is a prudent and necessary response to the ongoing extensive Soviet anti-ballistic missile effort, including the existing Soviet deployments permitted under the ABM Treaty. The SDI provides a necessary and powerful deterrent to any near-term Soviet decision to expand rapidly its ABM capability beyond that permitted by the ABM treaty." [703]

[702] Soviet Strategic Defenses," 7 October 1985, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 379.
[703] Soviet Strategic Defenses," 7 October 1985, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 379.

Pending weapon systems: Mobile ICBMs and Mobile IRBMs

The outcomes for the two central pending weapon systems for this period, mobile ICBMs and mobile IRBMs differed greatly, despite the only major difference between the systems being a matter of range. For mobile ICBMs, a ban was considered and even submitted as part of the formal U.S. position. However, information from KENNEN about the Soviet ICBM program would be used to help sustain the case for the United States' own mobile missile initiative: the Midgetman and the MX. Such data would be used both at the National Security Council level and Congressional level to resist a ban and keep on life-support U.S. mobile missile programs that were increasingly diminished by budget constraints and public opposition. In addition, the matter of Soviet "hardening" of its missile and control sites observed in KENNEN imagery would be used together with old worries about superior Soviet throw-weight and warhead numbers to increase durability of the argument for the MX program. The result was that despite the domestic resistance toward U.S. mobile missile program, they would both persist until the end of the Cold War.

The debate over intermediate-range nuclear forces presents an exception to the outcomes for other debates in this study. KENNEN's blind spots and verification limitations were ultimately leveraged as a reason to completely ban intermediate range forces rather than limit them to low numbers. This section argues that the ultimate difference was several factors connected to the issue being based in Europe rather than the United States. These factors, which were not present in the other cases in this study, included European pressure for disarmament, an international propaganda battle specific to the European theater, and lesser U.S. domestic interest in the matter

given that the weapons were based in and targeted at sites in Europe rather than the United States.

Mobile ICBMs: Addressing ICBM vulnerability with the MX and Midgetman programs

For much of the Reagan administration's tenure, a mobile ICBM ban was in contention. In the words of an administration official in May 1985, "…we've been tied up in knots on this issue for four years and we still are."[704] One problem seen as central to the question of whether mobile ICBMs were necessary concerned the vulnerability of ICBMs. The defense establishment, together with groups like the Committee on the Present Danger (CPD), focused on ICBM vulnerability and elevated the issue to dominate the debate over the future of nuclear strategy. Developed by Albert Wohstetter, though often associated with Paul Nitze, and publicized by like-minded colleagues of the CPD, the nightmare scenario pointed to a surprise attack by Soviet ICBMs directed against U.S. missile silos, effectively eliminating the ICBM force. Colin Gray claimed that the question of what to do about the growing vulnerability of ICBMs in the 1980s would be "the question of the decade." Gray claimed that the loss of one leg of the triad would be "an event so momentous that its anticipation should be the occasion for a fundamental review of strategic doctrine." As Lawrence Freedman assesses, the threat was more imagined than actual, for under established concepts, the hypothetical loss of the land-based leg was more than compensated for by the bombers and SLBMs available to deliver a retaliatory second strike.[705]

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[704] Gelb, Leslie H., "U.S. Official Split on Mobile Missiles," The New York Times, May 10, 1985, https://www.nytimes.com/1985/05/10/world/us-official-split-on-mobile-missiles.html?searchResultPosition=5

[705] Freedman, Lawrence and Jeffrey Michaels. *The Evolution of Nuclear Strategy: New, Updated and Completely Revised*. Springer, 2019, pp. 573-574.

The U.S. government's answer to the problem of ICBM vulnerability would come to settle on mobile missiles. Reagan would respond to the issue by appointing a Commission on Strategic Forces consisting of defense and intelligence leaders and experts and chaired by Lieutenant General Brent Scowcroft. The Scowcroft Commission's report, issued on 6 April 1983, argued that a more stable structure of ICBM deployments would exist if both sides moved toward more survivable methods of basing than is possible when there is primary dependence on large launchers and missiles. The commission believed that this meant mobile basing along with moving toward an ICBM force structure in which potential targets are of comparatively low value – missiles containing only one warhead. The two requirements meant a small, mobile missile. The Commission therefore recommended that a "single-warhead missile weighing about fifteen tons (rather than the nearly 100 tons of MX) may offer greater flexibility in the long-run effort to obtain an ICBM force that is highly survivable."[706] This missile program would come to be known as Midgetman.

The Commission also recommended that in the meantime while Midgetman was being developed, that deploying the large throw-weight, MIRVed Missile Experimental (MX) was "essential to remove the Soviet advantage in ICBM capability and to help deter the threat of conventional or limited nuclear attacks on the alliance." It argued that deploying the MX was necessary to encourage the Soviets to move toward the more stable regime of deployments and

[706] "Report of the President's Commission on Strategic Forces." Massachusetts Institute of Technology, April 1983. http://web.mit.edu/chemistry/deutch/policy/1983-ReportPresCommStrategic.pdf.

arms control.[707] The mobile ICBM programs was strongly supported by the Joint Chiefs, and by General Jones, then the Air Force Chief of Staff, who emphasized the need to keep open the option for a mobile M-X.[708]

The MX had originally been proposed as a mobile program in the 1970s as way to address the perceived vulnerability of U.S. land-based ICBMs, but its large size, designed to mirror the Soviet's own heavy missiles, greatly complicated mobile basing options. The MX program therefore underwent numerous structural evolutions over the course of its existence, including early mobile deployment designs, a switch to novel silo-based concepts such as closely-spaced basing (CSB) or "dense pack," using the MX in existing Minuteman silos, and finally, a rail-based system.

The tension between verifiability and concealment and the shaping of U.S. mobile missile plans

At the outset of the MX missile program, the design of the system was shaped by perceived warfighting requirements together with concerns about the duality between the strategic needs of concealment and the arms control needs of verification. Defense planners wanted a large, MIRV-ed missile to counter similar Soviet systems.[709] Such a large system would not easily be made mobile and stealthy. Next to this were considerations related to arms control and verification. On

[707] "Report of the President's Commission on Strategic Forces." Massachusetts Institute of Technology, April 1983. http://web.mit.edu/chemistry/deutch/policy/1983-ReportPresCommStrategic.pdf.
[708] Steven L. Rearden & Kenneth R. Foulks, "JCS and National Policy, Vol. XII, 1977-1980," Joint History Office, 2015, p. 212. https://www.jcs.mil/About/Joint-Staff-History/.
[709] See Scowcroft Report for more details on this argument.

the one hand, verification called for the ability to ascertain details such as the number of launchers, missiles, or warheads, and on the other hand, concealment was seen as necessary for the survivability of the missiles during its operational phase. The ultimate inability to reconcile this set of conflicting requirements contributed to the gradual diminishing of the scale of the U.S. mobile missile programs.

Early designs for the MX mobile system in the late 1970s were sweeping and ambitious. One design concept that came to the fore early in the life of the MX program was Multiple Aimpoint System (MAP). This set of designs relied on the maintenance of location uncertainty and concealment together with hardness and mobility. There were roughly half a dozen types of MAP systems deemed technically feasible. These were grouped into three major alternatives for sheltering that were seen to best limit environmental impacts. The alternatives included "vertical shelters" or concrete shelters in which missiles would be placed vertically and transported over roads, "horizontal shelters" which was the same concept but with a horizontally-oriented missile, and the "hybrid trench" concept of a shallow, buried, reinforced concrete connector joining a large number of protective shelters among which a missile, on a transporter vehicle, is moved randomly.[710] The vertical shelter approach was favored by the Air Force for "cost" and "hardness" reasons. However, the hybrid trench was considered to have significant advantages from a verification and monitoring standpoint. Because the task of introducing missiles into the trench system would take time and be highly visible, it was argued that the Soviets, either

[710] "A Paper on Protective Strategic Missile Basing: Its Relationship to Strategic Arms Limitations," October 1978, p. 2-6. William E. Colby Papers (MC #113) Box 15, Folder 8, SALT, 1978.

through in-person observation or via satellites, would be able to count the total number of missiles entering and exiting the system.[711]

These lofty design concepts would eventually become tempered by real cost and political considerations. By 1979, there were 4,600 MX missile shelters programed.[712] By 1982, this number had been brought down to 100. In November that year, four options had made to Reagan's desk. The leading option going into the meeting was known as closely spaced basing (CSB) also known as "dense pack." These were "super hard" silos placed close together, which relied on the untested notion of fratricide, or of Soviet warheads taking one another out due to their proximity.[713] Dense pack was estimated to cost $26 billion, not including possible additions like deception measures or limited ballistic missile defense. The other alternatives offered to Reagan were to abandon the land-based leg of the triad (no cost), to deploy 100 M-X in existing Minuteman silos ($17 billion), or to proceed with multiple protective shelters in a vein similar to MAP ($40-$50 billion).[714] Shortly afterward, Reagan announced his decision to deploy 100 MX missiles in an array of 100 closely spaced, super-hardened silos in a dense pack configuration at or near Francis E. Warren Air Force Base in Wyoming.[715]

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[711] "A Paper on Protective Strategic Missile Basing: Its Relationship to Strategic Arms Limitations," October 1978, p. 3-9, 3-16. William E. Colby Papers (MC #113) Box 15, Folder 8, SALT, 1978.
[712] NIE-11/38-79, p. 12.
[713] Letter to William J. Casey from the Deputy Secretary of Defense, 12 November 1982, Central Intelligence Agency, https://www.cia.gov/readingroom/docs/CIA-RDP84B00049R000400670009-1.pdf
[714] "NSC 66: M-X Basing Decision." The Reagan Files, compiled by Jason Saltoun-Ebin, 2014., November 18, 1982, p. 208.
[715] "NSC 66: M-X Basing Decision." The Reagan Files, compiled by Jason Saltoun-Ebin, 2014., November 18, 1982, p. 209.

Despite this more modest manifestation of the MX deployment, the program would continue to struggle to get off the ground. Despite a White House telephone blitz, the House voted in December 1982 to strip funding for the MX from the Defense Appropriations bill. Representative Joseph P. Addabbo, Democrat of Queens, led the opposition, contending that the program would cost too much while providing little security. "This is too expensive a bargaining chip," he asserted. Opponents also argued that Reagan's proposal for dense pack either was untested or would not work. Representative John Burton, Democrat of California, noted that Mr. Reagan had recalled that today was the anniversary of the Japanese bombing of Pearl Harbor, called that the "initial dense pack." He referred to the battleships moored stem to stern and aircraft lined up wingtip to wingtip that were blasted by Japanese torpedo planes and bombers. Several opponents also asserted that the MX was not necessary to provide a deterrent against the Soviet Union, arguing that the current force of Minutemen missiles, bombers, submarine-launched missiles and cruise drone missiles, plus those being developed, was sufficient. Representative Edward Markey, Democrat of Massachusetts, derided the President's plan as "Reagantomics." Critics noted the environmental objections that were forming in the West, where the MX array was to be constructed near Cheyenne, Wyo. They referred to the general antinuclear sentiment seen in various nuclear freeze resolutions in the November elections.[716]

The Reagan administration responded with a two-pronged argument about the nature of Soviet threats and the need for the MX as a bargaining chip in the arms control process. The Reagan administration responded with a statement declaring the House's decision a "grave mistake." It

[716] Halloran, Richard, "House, 245-176, Votes Down $988 Million for MX Missile; Setback for Reagan Policy," The New York Times, 8 December 1982, https://www.nytimes.com/1982/12/08/us/house-245-176-votes-down-988-million-for-mx-missile-setback-for-reagan-policy.html

asserted that the United States hasn't built a new land-based missile system in 15 years, while the Soviets were in their "fifth generation" of new missiles. Invoking the needs of arms control, the administration further underlined that "of great importance, we should know from experience that the Soviets will not negotiate with us when we disarm ourselves. Why should they negotiate seriously when we give up weapon systems voluntarily, asking nothing of them in return?"[717]

The Reagan administration managed to salvage U.S. mobile missile initiatives through tasking the bipartisan Scowcroft Commission to come up with solutions and recommendations. In addition to advocating for the Midgetman small road-mobile ICBM, the Commission also recommended the immediate deployment of 100 MX missiles in existing Minuteman silos to demonstrate national will and to compensate for the retirement of Titan II ICBMs. The Scowcroft Commission also encouraged a vigorous examination of all basing alternatives, including mobile concepts for the MX. The Scowcroft report resulted in bipartisan support in Congress, and on 10 August 1983 the Secretary of Defense instructed the Air Force to deploy 100 MX in Minuteman silos at F.E. Warren AFB, Wyoming. At the same time, the Defense Secretary directed the Air Force to initiate design of a small, single-warhead ICBM for the Midgetman program.

This moment of renewed support did not last, however, and the MX program – by this time also known as "Peacekeeper" – would continue to be paired down due to political opposition. MX deployment was scheduled to begin in January 1986, but these plans were interrupted in July

[717] "The MX missile," 7 December 1982, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, pp. 214-215.

1985. Congress limited MX deployment to 50 missiles until the administration could produce a more survivable basing plan. Reagan's solution for basing the remaining 50 missiles, announced 19 December 1986, was called the "Peacekeeper Rail Garrison." Under the rail garrison concept, the remaining MX missiles would be placed on trains stationed at various U.S. Air Force installations. The 25 trains, each carrying two missiles, would deploy off-base and onto the national railroad network during periods of international tension to improve survivability.[718]

By this time, verification was still at times treated as a design consideration for the MX, but it was largely dismissed as an American problem rather than a Soviet one, indicating that verification concerns should not dictate American mobile deployment designs. In the words of ACDA Director Kenneth Adelman at a National Security Council meeting in 1987, "Verification is our problem; the Soviets can read about it in the Congressional Record."[719] During this meeting, Director of Central Intelligence Bob Gates, stated that "the hardest thing you can ask us to monitor would be a limit on mobiles…" He proposed, however, that the United States could "offer suggestions on things that could help us quite a bit. For example, it would be interesting to know how they would distinguish the SS–24's that are rail mobile missiles rather than those being produced with silos. In general, there are some good things that could be done, and we need to explore this." [720]

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[718] "ICBM Modernization" The Reagan Files, compiled by Jason Saltoun-Ebin, 2014., December 16, 1986, pp. 458-459; https://fas.org/nuke/guide/usa/icbm/lgm-118.htm

[719] "Minutes of a National Security Planning Group Meeting, Subject: Arms Control Preparations for the Summit." Foreign Relations of the United States, December 4, 1987. Reagan Library, Executive Secretariat: National Security Planning Group (NSPG) Records, NSPG 171 12/24/1987. https://history.state.gov/historicaldocuments/frus1981-88v11/d239.

[720] Ibid.

The Reagan administration's push for a mobile ICBM ban using arguments about blind spots and uncertainty

As budget constraints and public unpopularity were diminishing the U.S. mobile missile program, the Reagan administration would attempt to use KENNEN's blind spots and verifiability to push for a mobile missile ban. In October 1985, the Reagan administration momentarily solidified its position on a ban. As part of a National Security Council Decision Directive, the administration stated as part of the U.S. position going into talks with the Soviets: "Given the increasing difficulty posed in verifying the number and status of mobile ICBMs, and in determining with certainty that any type of mobile ICBM carries only one warhead, the U.S. also proposes a ban on all mobile ICBMs."[721]

The decision provoked an outcry from Congressional critics. The Administration had earlier expressed its support for road-mobile Midgetman systems in exchange for Congressional support of deploying a limited number of silo-based MX missiles. James Schlesinger, then a former Defense Secretary and an adviser to the Scowcroft Commission, said: "This proposal represents a reversal of the primary concern for heavy, fixed site missiles and a repudiation of the Scowcroft Commission." Senator Daniel Patrick Moynihan, Democrat of New York, and a ranking member of the Senate Intelligence Committee, said the administration's proposal "puts the consensus in jeopardy - it's a mindless loss."

[721] National Security Decision Directive Number 195, The U.S. Position: Nuclear and Space Talks, October 30, 1985, https://fas.org/irp/offdocs/nsdd/nsdd-195.htm.

Defense officials at times admitted that the changed position and proposal for a mobile ICBM ban reflected new considerations: for one, the feeling that the Scowcroft arrangement had collapsed because Congress, under intense budget pressures, had cut plans for the MX from 100 deployed missiles to 50. For another, Administration officials were also said to doubt that Congress would ultimately be willing to approve spending for a substantial Midgetman program.[722]

The Reagan administration was internally divided on the issue. While defense leadership supported the ban, the change in position was adamantly opposed, by the State Department and by Paul Nitze in particular. Nitze believed that a recent Congressional decision to move forward with the MX and Midgetman both in mobile modes should not be jeopardized by what he perceived as a futile attempt to ban mobile missiles.[723] In a letter to Reagan on January 10, 1987, Nitze argued that the programs were crucial to a survivable land-based ICBM component "with or without an arms control agreement." He urged that the United States should have an arms control position "consistent with our modernization plans" and that "continuing to propose a ban would put our arms control position in conflict with our efforts to ensure a survivable deterrent."[724]

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[722] Gordon, Michael R., "Reagan's offer on mobile missile ban is assailed," The New York Times, November 3, 1985, https://www.nytimes.com/1985/11/03/world/reagan-s-offer-on-mobile-missile-ban-is-assailed.html.

[723] "Memorandum From the President's Assistant for National Security Affairs (Carlucci) to President Reagan," Foreign Relations of the United States, January 14, 1987, National Security Council, National Security Council Institutional Files, SR Box 094, NSDD 256. https://history.state.gov/historicaldocuments/frus1981-88v11/d181

[724] "Memorandum From the Special Advisor to the President and Secretary of State on Arms Control Matters (Nitze) to President Reagan," Foreign Relations of the United States, January 10, 1987, National Security Council, National Security Council Institutional Files, SR Box 094, NSDD 256, https://history.state.gov/historicaldocuments/frus1981-88v11/d178.

Nitze's concerted opposition to a mobile missile ban compelled Defense Secretary Caspar Weinberger to lean into arguments invoking uncertainty and blind spots. In a letter, he asserted that the Soviet Union had a proven capability to hide mobile ICBMs, making a ban essential because it would ease such verification concerns and allow for easier detection.[725] He recounted:

> *"They [hid deployments] in the case of the mobile SS–16, where after 8 years we were still only able to determine "probable" deployment. Our alleged ability to count SS–25s is based on the unfounded assumption that there will be a garage for each launcher. We have not yet even identified the mobile launcher for the Soviet 10-warhead SS–X–24."*

Weinberger argued further that Soviet cheating through covert production of mobile ICBM launchers and additional missiles for refire could largely negate the warhead reduction the United States was seeking to achieve through START. He noted,

> *"Mobile ICBMs are simply incompatible with a 50% reduction agreement, for cheating by the Soviets could give them a highly destabilizing advantage. Without an ability to verify a clear-cut treaty violation, the U.S. would find it impossible as a political matter to terminate its obligations under the treaty."*

Caught between the two positions, Reagan ultimately accepted the arguments about the possibility of Soviet cheating on mobile ICBMs, but instead of landing in support of ban, he interpreted possible cheating to mean that the United States should likely continue to pursue its own mobile missile program. The following conversation during a National Security Council

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[725] "Memorandum From Secretary of Defense Weinberger to the President's Assistant for National Security Affairs (Carlucci)," Foreign Relations of the United States, January 13, 1987, National Security Council, National Security Council Institutional Files, SR Box 094, NSDD 256. https://history.state.gov/historicaldocuments/frus1981-88v11/d180

meeting on 8 September 1987 demonstrates Reagan's sentiment and response to Weinberger's argument about how blind spots necessitated a ban:

> ***Weinberger (Deputy Secretary of Defense)****: The treatment of mobile ICBMs is the most fundamental issue. Our position now is that we should have no mobiles. There is no way we can verify them, and to move now would just mean that we would get nothing for it. I think that we should have a firm position not to allow mobiles.*
> *…*
> ***Gates (DCI)****: Overall, we are able to monitor some aspects of a mobile missile agreement well and others poorly. The policy agencies must make the judgments of military risk associated with our monitoring capabilities and our uncertainties. The singular question becomes, "how much risk are we willing to take?"*
> ***Adelman (ACDA)****: Mr. President, I would note that the problems that we face in START are similar to the problems we will face in INF verifying SS-20s.*
> *…*
> ***Carlucci (Secretary of Defense)****: We all agree that no one is proposing that we just put mobiles on the table. Isn't that clear?*
> ***Weinberger****: That's good, and I agree, but you've got to remember that sub-limits are not verifiable if mobiles can be produced. A ban is needed, not anything else. If we don't have a ban, nothing is verifiable. We should not give a thing to get a treaty that is not verifiable.*
> ***Reagan****: Well, Cap, I think we have to figure that they're going to have mobiles whether we ban them or not. We will have to have them, too.*
> ***Weinberger****: It's a little harder for them to have mobiles if we ban them. If there is no ban, it will be impossible to verify any sub-limits. For example, in the INF area, because there is a ban, if we find any missiles it is a clear, naked violation. If there is no ban, it is easier for them to have violations under the sub-limits to have more missiles that are mobile than those permitted by a treaty.*
> ***Carlucci****: Well, let's concede then that they can or will cheat. The President's point, though, is if they're not banned, we can have some too.*[726]

The conversation is a clear example of the opposing nuclear policy positions that can result from verification uncertainty and blind spots. Uncertainty can be leveraged toward a ban and a measure in line with disarmament, or it can be leveraged for nuclear weapon

[726] "Review of United States Arms Control Positions," September 8, 1987, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 537.

investment, modernization, and competition. This case and others show that there tends to be a greater level of effectiveness in the latter case. JCS historians have noted that U.S. presidents were prudent to recognize that they had to have JCS support for arms control measures in order to clear the Senate. As a result, when faced with a decision about how to interpret and respond to uncertainty and blind spots, they note that the President is likely to lean toward measures that demonstrate to skeptics that they remained committed to preserving a credible, up-to-date strategic deterrent.[727]

Mobile ICBMs maintain a consistent base of support in Congress

Part of the reason the mobile missile ban would fail domestically was also because of the way KENNEN information was leveraged within Congress in support of U.S. mobile missile programs. Despite pressure for defense budget cuts, the Midgetman and MX program would maintain consistent majority support in both the House and the Senate.

Debates in the House over mobile missiles helps illustrate the role of KENNEN information. In June 1985, Representative Ken Kramer, Republican of Colorado, introduced an amendment to the 1986 Defense Authorization Act seeking to cancel the Midgetman program on basis that it would worsen arms competition and further weaken the prospects for successful arms control. He moved to instead use the funding for the

[727] Steven L. Rearden & Kenneth R. Foulks, "JCS and National Policy, Vol. XII, 1977-1980," Joint History Office, 2015, p. 223. https://www.jcs.mil/About/Joint-Staff-History/.

Strategic Defense Initiative's research, development, testing, and evaluation.[728] The opposition to Kramer's move relied on two key arguments in favor of U.S. mobile missile initiatives: their enhancement of stability and deterrence and because the Soviets were building them, too. Senator McCurdy presented a counter amendment carving out $774,500,000 for the Midgetman program and noting it should receive priority development.[729]

The debate is notable because it showcases the significance of information about Soviet mobile missile programs and the information acquired through KENNEN to making the case for Midgetman and MX. Kramer and other analysts could counter the general arguments about the necessity of mobile missiles for stability by pointing to the destabilizing effects of continued arms competition. The argument less easy to counter was Soviet mobile missile modernization. Senators McCurdy, Hillis, Kasich, and Dicks in their support for the McCurdy amendment, referenced the advances of the Soviet SS-23, SS-24, and SS-25 mobile ICBM systems, information that had been acquired through KENNEN imagery. Kramer attempted to defend his position by claiming that the Soviets were so far ahead of the United States in mobile ICBM development that it was senseless for the U.S. to waste resources to catch up. This point worked against him, however, by adding fuel to the arguments of those advocating the importance of U.S. technological superiority and the slippery slope toward being in an irreversibly inferior position. [730]

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[728] H.Amdt.121 to H.R.1872, 99th Congress (1985-1986), https://www.congress.gov/amendment/99th-congress/house-amendment/121?q=%7B%22search%22%3A%5B%22midgetman%22%5D%7D&s=3&r=1

[729] Congressional Record, House, June 20, 1985, pp. 16473-16477.

[730] Congressional Record, House, June 20, 1985, pp. 16473-16477.

The pattern of using KENNEN information about Soviet mobile missile developments to sustain U.S. mobile initiatives extended to the Senate. A debate over the MX missile program as part of the 1986 Defense Appropriations Act illustrates the pattern and points to the impact. Senator Sam Nunn of Georgia proposed an amendment that would limit the MX program to 40 missiles in ways that some felt would negate the intended purpose of the program altogether.

The debate over the amendment was long and extensive, but a pattern among those defending the MX program continued to be to offer detailed information about the Soviet mobile missile program, often presented as pieces that together depicted the Soviets as superior in multiple dimensions. Senator McClure, a defender of the MX program, presented as part of his case against Nunn's amendment eleven charts in rapid succession (**Figure 5.1**).[731] The information was used to support his case that "This Soviet ICBM first strike counterforce capability casts an ever-deepening shadow over the international politics of the entire world."[732] With the exception of a couple of charts devoted to fixed delivery systems, the large majority of the information could only have been acquired through high-resolution satellite imagery information.

Senator Steven Douglas Symms, Republican from Idaho, made a similar case for the MX using high-resolution imagery information that had trickled down to the public level in

[731] Congressional Record, Senate, May 23, 1985, p. 13461.
[732] Congressional Record, Senate, May 23, 1985, p. 13461.

rounded form (**Figure 5.2**). Senator Symms pointed to the comparison that the only difference between the Nazi buildup and the Soviet buildup was that there is "no arsenal of democracy to rescue the United States of America like there was an arsenal of democracy, the United States, to rescue Great Britain from the clutches of the Nazis in 1941."[733]

Chart 1: Soviet violations of SALT II
Chart 2: Illustration of the effect of SALT II on U.S. and Soviet strategic forces, showing that the Soviet Union has built up during the 1978-1985 period of SALT II to a level much higher than the JCS predicted in 1978, and that since 1979, the number of Soviet strategic nuclear delivery vehicles increased by about one-fourth, and Soviet nuclear warhead more than tripled by the end of 1985
Chart 3: Shows the rail mobile SS-24 which may be deployed at any time
Chart 4: Illustrates the Soviet rail network and the existing strategic missile complexes all along this rail network for supporting the rail mobile SS-24
Chart 5: Comparative United States and Soviet ICBM capabilities and other strategic capabilities. The fifth chart shows that the Soviets have well over 1,400 ICBM's compared to only 1,000 for the United States
Chart 6: Shows the Soviets have over 6,300 warheads on their ICBMs compared to 2,100 for the United States for a 3-to-1 Soviet numerical advantage
Chart 7: ICBM production (zero for the United States) and about at least 150 per year for the Soviets over the past decades
Chart 8: A 3-to-1 advantage in Soviet ICBM equivalent megatonnage
Chart 9: the ninth chart deals with Soviet supersonic bombers and reveals a Soviet advantage of over 250 to 1 in that category
Chart 10: Soviet advantage in ballistic missile submarines of better then 62 to 35
Chart 11: Soviet advantage in ballistic missile submarines of over 950 to 520

Figure 5.1. List of charts used by advocates of U.S. mobile missile development and modernization programs in a U.S. Senate debate that came out in favor of maintaining the MX missile program.

The debate also shows a pattern of arguments about uncertainty. In addition to the citation of "violations" of the SALT II agreement, senators made arguments that positioned blind spots as a leading motivation for continued U.S. development of its own mobile missile programs. For example, Senator McClure argued, "the Soviets could have

[733] Congressional Record, Senate, May 23, 1985, p. 13483.

an unlimited number of SS-25, SS-24, and SS- 16 mobile ICBM's and we might never know when they were deployed or how many, because they are completely camouflaged and concealed, which is also a violation of SALT II."[734] In the end, Senator Nunn's measure was ultimately watered down to include a higher number of MX missiles and stipulations for the continued research of mobile basing modes.[735]

The Soviet Union has 820 heavy ICBM launchers while the United States has none. The Soviet Union has 9,300 ready ICBM warheads while the United States has 2,100. The Soviet Union has 2,000 intercontinental range SLBM warheads while the United States has none. The Soviet Union has 575 nuclear armed sea-launched cruise missiles while the United States has approximately 12. The Soviet Union has 650 intercontinental bombers while the United States has 239. The Soviet Union has 3,700 reserve strategic launch systems while the United States has none. The Soviet Union has 13,800 surface- to-air missile launchers for continental air defense while the United States has none. The Soviet Union has 3,600 primary and secondary antiballistic missile launchers while the United States has none. The Soviet Union has 3,200 interceptor aircraft for continental air defense, while the United States has 42.

Figure 5.2. Overview of a line of argument used by advocates of U.S. mobile missile development and modernization programs in U.S. Senate debate.

Specific information drawn from KENNEN's ultra-high-resolution capabilities was also used to strengthen the case for U.S. mobile missile programs. During the late 1970s, the issue of Soviet "hardening" of its missile and control sites would become a severe concern of U.S. officials in addition to old worries about superior Soviet throw-weight

[734] Congressional Record, Senate, May 23, 1985, p. 13461.
[735] Congressional Record, Senate, May 23, 1985, p. 13649.

and warhead numbers. The 1977 National Intelligence Estimate (NIE) claimed that "In the absence of MX deployment, the number of Soviet ICBM warheads surviving a hypothetical attack by US ICBMs will double during this period. This is because the near-term effects of Minuteman III improvements tend to be offset by continued Soviet conversion to harder silos and to ICBMs with MIRVs."[736] The 1979 NIE similarly reported that the Soviets were "hardening silos as they are converted to accommodate MIRVs" and continuing the "expansion and protection of capabilities for command, control, and communications by a combination of hardening, redundancy, and mobility."[737]

NPIC reported modifications of launch control facilities at Soviet ICBM sites related to hardening strategies using KENNEN imagery. An imagery analysis report described a Soviet program to modify old SS-18 launch groups to increase silo hardness, a main component of which included upgrading launch control facilities. **Figure 5.3** illustrates nature of the details extracted from satellite imagery, showing the addition of this "second headworks base" used to increase hardness and survivability of the launch control facility. Overall, the details of the report point to high-resolution imagery information of at least one to two meters:

> *"The IIF silo door, door pocket, headworks, and headworks base are then removed from the silo and dismantled on the service apron…The replacement IIF headwork sections are delivered to the launch site and assembled on the service apron… The launch site hardened antennas (dome and hook or plus antennas) will be replaced by their newer counterparts, the modified hardened dome antenna and the hardened linear antenna."*

[736] NIE 11-3/8-77, p. 36.
[737] NIE 11-3/8-79, p. 6.

> *"Modifications at the LCF [Launch Control Facilities] are designed to technically upgrade facilities and improve survivability. LCF modifications include the replacement of the launch control center (LCC) silo headworks; the probable addition of a second LCC silo headworks base; and the replacement of the silo door pocket, door and LCC capsule… It is probable that the hardened dome and washer antennas at the LCF will be modified or replaced."* [738]

In addition to this information appearing throughout the NIEs, the Soviet philosophy of super hardened silos became of great interest to the Senate Armed Services Committee. Dr. Larry Gershwin, National Intelligence Officer for Strategic Programs, described the Soviet philosophy regarding super hardened silos culminating in a tutorial on cratering and the effects on a super hardened silo against a ground burst attack." Such briefings, where information was already conveyed showing the numerous areas that the Soviets were ahead, the issue of hardening was perceived and imagined as a way of making the Soviet nuclear arsenal invulnerable to attack, even if the issue would be more complicated in practice. [739]

When the factor of hardening was brought together with Soviet missile and warhead numbers and capabilities, the initial picture of the MX program and the envisioned Soviet response was vast and daunting. The 1980 NIE asserted that if the Soviets chose not to observe any SALT II limitations, analysts estimated that the Soviets had the capacity to build to 14,000 ICBM RVs by 1990. In turn, a total of about 10,700 MX shelters would be required to counter this. While the estimate acknowledged that it was unlikely that both sides would deliberately strive for such

[738] "Imagery Analysis Report: Current Programs to Upgrade the Deployed SS-18 Missile System," National Photographic Interpretation Center, Central Intelligence Agency, June 1981, https://www.cia.gov/readingroom/docs/CIA-RDP81T00618R000100670001-5.pdf

[739] Memorandum for the Record: Briefing of Senate Armed Services Committee on Soviet Strategic Developments and Trends, 19 February 1985. https://www.cia.gov/readingroom/docs/CIA-RDP88B00527R000100070008-6.pdf

immense numbers, the calculations indicate, the Soviets will have an incentive to enter into competition to maintain their present relative status and that the United States will have an incentive to respond in some manner. The numbers were deemed to "therefore represent some measure of magnitude of the actions that would have to be considered."[740]

[740] NIE 11-3/8-80 Soviet Capabilities for Strategic Nuclear Conflict Through the Late 1980s, p. A-12, A-14.

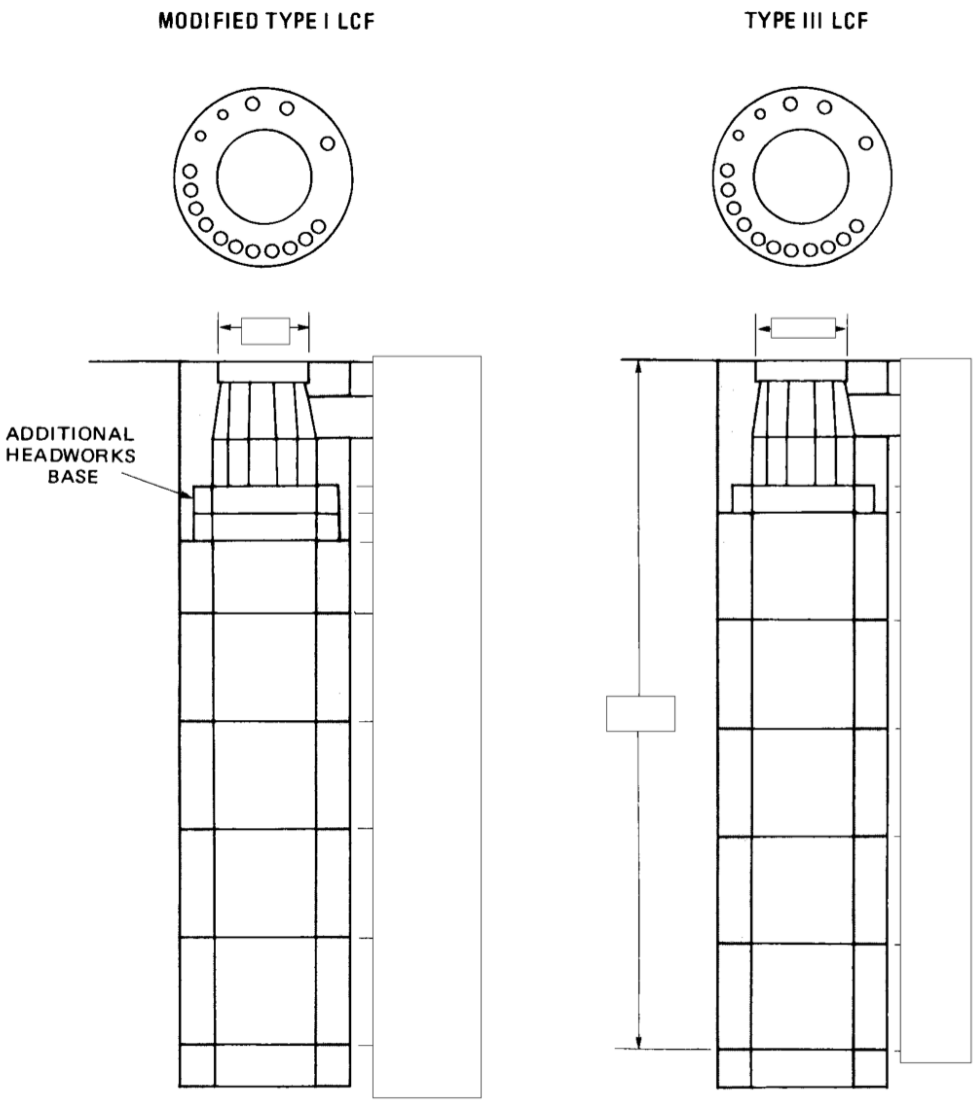

Figure 5.3. Illustration depicting the level of detail extracted from satellite imagery, showing the addition of the "second headworks base" within a silo used to increase hardness and survivability of the launch control facility. [741]

[741] "Imagery Analysis Report: Modification of Launch Control Facilities at Pervomaysk and Derazhnya SSM Complexes, USSR (S)," October 1980, National Photographic Interpretation Center, Central Intelligence Agency, https://www.cia.gov/readingroom/docs/CIA-RDP80T01782R000300050001-9.pdf.

Intermediate-Range Nuclear Forces

The case of intermediate-range ballistic missiles (IRBMs) stands as an exception in this study. This is the only case where blind spots and verification issues were successfully leveraged as part of an effort to codify a ban on a category of weapon within a treaty. Like some other weapon systems, new information and capabilities, methods, and technical infrastructure connected to the deployment of KENNEN were used to characterize the nature of the Soviet SS-20 threat, and there was significant domestic support for developing and deploying the U.S. Pershing II medium-range ballistic missile and cruise missiles in Europe. There was also a similar debate structure to other weapon systems with some defense leadership and the Reagan administration eventually supporting a ban that was opposed by the Joint Chiefs, the State Department, and by some within Congress.

This section argues that the ultimate difference was several factors connected to the issue being based in Europe rather than the United States. These factors, which were not present in the other cases in this study, included European pressure for disarmament, an international propaganda battle specific to the European theater, and lesser U.S. domestic interest in the matter given that the weapons were based in and targeted at sites in Europe rather than the United States. It was these factors that made the difference in a successful ban, and therefore the case does not conflict with the overall findings of this study.

The U.S. debate over a ban or limits

New information and capabilities, methods, and technical infrastructure connected to the deployment of KENNEN was used to characterize the nature of the Soviet SS-20 threat. As detailed earlier in this study, the digitization of intelligence introduced under KENNEN transformed practices from verbal "storytelling" to computer databases, which in turn supported the tracking of mobile nuclear forces that involved large numbers of temporary locations. The development of such practices, over time, allowed NPIC analysts to develop precise counts of deployed SS-20s – numbers that featured in high-level discussions about how to organize the U.S. arms control response.

The Reagan administration was initially determined to proceed with intermediate-range nuclear force modernization and had delayed the resumption of INF negotiation initiatives begun under the Carter administration. A conversation on January 13, 1983, between President Reagan, Defense Secretary Caspar Weinberger, and the JCS shows how the numbers and perceived imbalances mattered to decisions about the U.S. position, including Reagan's initial determination to proceed with weapon deployments. The position of having zero intermediate range-nuclear forces in Europe (the so-called "zero-zero" position) was forming around, but it remained unsolidified as officials continued to judge political circumstances.

> ***Reagan**: The last figure I heard for Soviet SS-20s was 315. Is that still the correct figure?*
> ***Weinberger (Secretary of Defense)**: They now have 333 SS-20s and are finishing nine more sites. They will have 342 by March or April. Moreover, those missiles are mobile and can hit any target in Europe.*
> *…*
> ***Reagan**: Well, if we have a total of 572 missiles and 108 are Pershings then that means 464 are cruise missiles. We must remain at zero-zero [as the U.S. position on INF]. But based on warheads, we allowed ourselves to be inferior. Is that a deterrent force only?*

> ***Gorman (Assistant to the JCS)****: The 572 number came right out of the air.*
> ***Reagan****: We must deploy missiles. We will go along with what is needed for the [Federal Republic of Germany] elections for a starting point, but if we sit there with zero-zero in our negotiating position and they then propose some ridiculous scheme, we have to respond. Why not go along with an interim reduction of the forces while continuing the negotiations for zero-zero? ...*
> ***Weinberger****: The key phrase is "interim leading to zero-zero"* [742]

Defense Department leadership spearheaded by Weinberger became increasingly adamant about the "zero-zero" position. Its arguments interwove verification concerns with strategic ones. In his original memorandum to Weinberger laying out the zero only option, Richard Perle, an advisor to Reagan, wrote that it would have the advantage of "*simplifying verification problems, which at levels higher than zero are probably insurmountable*," and it would "*simplify the problem of refire, which at levels higher than zero will perpetuate.*" An absolute ban would be easier to monitor and enforce, since to discover so much as a single SS-20 rocket or launcher would be to catch the Soviets in a violation of the treaty. In addition, the Soviets would not be able to carry out any tests on a weapon that was prohibited rather than merely limited; and flight tests of ballistic missiles are virtually impossible to conduct clandestinely, so compliance with the ban would be easy to monitor.[743]

The strategic argument for zero intermediate-range forces was deeply dependent on the European defense environment. U.S. hawks supported the zero option largely because NATO had so few bases. With NATO possessing between 250 and 300 military installations deemed worth targeting, it was determined that even moderate levels of SS-20s in Europe posed a threat of

[742] "Arms Control/INF," 13 January 1983, in Saltoun-Ebin, Jason. *The Reagan Files: Inside the National Security Council, 2nd Edition*. Seabec Books, 2014, p. 220.
[743] Talbott, p. 70.

annihilation that would be nearly impossible to counteract. To Perle, any level of SS-20s in Europe higher than 100 and the resulting 300 warheads those missiles would carry posed an unacceptable security risk.[744] He believed that offers between 0 and 500 would invariably become complicated as questions of balance and geography came into play; the only way to avoid this kind of one-upmanship was to preempt it, and the only number the Soviets could not undercut was zero.[745]

This thinking was not shared throughout the defense establishment, however. The Joint Chiefs, under the leadership of General David Jones as Chairman, opposed the comprehensive zero option. They were afraid that, if the United States insisted on treating SS-12s and -22s along with the SS-4s, -5s, and -20s, the Soviets might have a stronger case for including shorter-range Western missiles, notably the Pershing Is already deployed in West Germany, in whatever limits or bans were finally negotiated to cover the Pershing IIs and Tomahawks. This reflected a recurring tension: On the one hand, there was a desire, personified by Perle, to include as many Soviet weapons as possible in whatever restrictions were to be proposes. On the other hand, there was anxiety about what one member of the Joint Staff called "the boomerang effect: if we throw at the Soviets a proposal aimed at limiting a maximum of their stuff, they get all the greedier in trying to limit ours—and by the logic of our own position, it's that much harder for us to resist them."[746] The Chiefs were also worried that a more comprehensive proposal for zero weapons

[744] Ambrose, M.J. The Control Agenda: A History of the Strategic Arms Limitation Talks. Cornell University Press, 2018, p. 182.
[745] Ambrose, p. 183.
[746] Talbott, p. 66.

would make it harder to fend off the inevitable Soviet counterproposal covering American aircraft.[747]

The State Department and the lead arms control negotiator, Alexander Haig, were similarly reluctant toward the zero position. Their concerns centered on it being an excessively rigid negotiating position. Haig further contended that the zero option would not be in the interests of the West even if it were negotiable: "We wouldn't want it even if we could have it." He believed the cancellation of NATO deployments, even in exchange for elimination of the SS-20s, would risk decoupling the American nuclear deterrent from the defense of Europe.[748]

In an acknowledgement of the verification challenges that would come with maintaining even low numbers of intermediate-range nuclear forces, Haig emphasized the necessary willingness to go beyond satellite verification measures. In the October 13th National Security Council meeting, he asserted that along with a low numbers position, "we will insist on stringent verification procedures that will almost certainly go beyond National Technical Means (NTM)." ACDA, which supported the State Department's argument, similarly expressed concern about the zero option, favored low numbers, and stated, "We also want to stress the importance of accurate data and of effective verification."[749]

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[747] Talbott, p. 66.

[748] Talbott, p. 71.

[749] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, October 13, 1981. Reagan Library, Executive Secretariat, NSC: NSC Meeting File: Records, 1981–88, NSC 00022 13 Oct 81. https://history.state.gov/historicaldocuments/frus1981-88v03/d92.

One important shift came with a change in leadership of the Joint Chiefs as General Jones finished his appointment as was replaced by General John Vessey. While Jones finished his term as Chairman, he was never part of "the family," as Reagan's inner circle of advisors was called. Nor did his advice carry much weight at the White House or with Weinberger. Personalities were a factor, but Reagan and Weinberger also diverged with Jones on strategic weapons policy and arms control. In contrast, Vessey and Weinberger formed a "highly effective and productive partnership" almost immediately. In contrast to his intermittent contacts with Jones, Weinberger met with Vessey practically every morning for half an hour or more to go over business.[750] This partnership helps explain the gradual shift in the JCS position on INF. As the INF debate progressed, the Joint Chiefs ended up in favor of the zero-zero deal. Apart from some reluctance from Army and Marine Corps leaders, the consensus among the Joint Chiefs was that the INF Treaty marked a major breakthrough and was "too attractive a proposition to pass up."[751]

Using the temporal blind spot to push for a ban

As this divide – with State and ACDA on the side of limits and Defense and the Joint Chiefs on the side of a ban – persisted, blind spots and verification issues were leveraged throughout the debate as a reason to completely ban intermediate range forces rather than limit them to low

[750] Steven L. Rearden, "Council of War, A History of the Joint Chiefs of Staff, 1942-1991, Joint History Office, 2012, pp. 422-424. https://www.jcs.mil/Portals/36/Documents/History/Institutional/Council_of_War.pdf

[751] William J. Crowe, Jr. with David Chanoff, The *line of fire: from Washington to the Gulf, the politics and battles of the new military*, New York: Simon & Schuster, 1993, p. 264, as cited in Steven L. Rearden, "Council of War, A History of the Joint Chiefs of Staff, 1942-1991, Joint History Office, 2012, p. 461. https://www.jcs.mil/Portals/36/Documents/History/Institutional/Council_of_War.pdf

numbers. Early in the process, Weinberger, backed up by the CIA's Director of Central Intelligence William Casey, argued that the zero position benefited from easier verification, an issue that was coming to be viewed as a major public sticking point among both European parliaments and the U.S. Congress.

> ***The President:*** *How will we verify an agreement?*
> ***Allen (Assistant to the President for National Security Affairs):*** *We will have the national technical means, satellites, and so on. But in addition, we will be looking at on-site inspections and other means. The problem is that because of the Soviet obsession against inspections, our insistence may appear to some Europeans to have the effect of scuttling the negotiations.*
> ***The President:*** *Even if you could have inspections, who could really travel and verify in that vast country?*
> ***Casey (Director of Central Intelligence):*** *With a zero ban, it would be easier.*
> ***The President:*** *Even then, the Soviet Union is a large country. Couldn't they easily hide something in Siberia or somewhere else?*
> ***Meese (Counselor to the President):*** *With a zero ban, we would have an easier indicator of whether or not the Soviets were complying.*
> ***Weinberger (Secretary of Defense)****: The Soviets would have to dismantle their systems. Third countries and international organizations might need to be involved, but nothing is guaranteeable.*
> ***The President:*** *Maybe we should be leasing some of the people from the Third World nations at Cancun6 to help verify the dismantling.* [752]

In later stages of the negotiations, this position on zero as the key to verifiability and the success of INF would be taken further. During a meeting on October 14, 1987, William Webster, the former Director of the Federal Bureau of Investigation and the new Director of Central Intelligence having taken over in May 1987 from Casey, made the case to Reagan and his cabinet that INF needed to include the total elimination of intermediate-range nuclear force infrastructure. He argued:

[752] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, October 13, 1981. Reagan Library, Executive Secretariat, NSC: NSC Meeting File: Records, 1981–88, NSC 00022 13 Oct 81. https://history.state.gov/historicaldocuments/frus1981-88v03/d92.

> ***Webster (Director of Central Intelligence)****: We're concerned about the verifiability of the INF Treaty, and especially the current position, which does not remove the infrastructure of Soviet INF forces. We should have no infrastructure remaining, although I know there is some price on the NATO side. I think we should forbid all operations in training and have the personnel leave the bases that are being eliminated, and we need strong on-site inspection… I want to make sure that we consider verification in light of the ratification problems that we're going to have.* [753]

Going into 1987, the U.S. position entailed a long list of verification provisions that included on-site inspection. These measures included: Identification of areas and facilities where treaty-limited systems could be located and prohibition against having them elsewhere; Reciprocal comprehensive exchanges of specified data on treaty-limited systems, support facilities and equipment; reciprocal updating of this data; Specialized procedures for destruction, dismantlement and conversion of long-range INF missile systems, including on-site inspection; Short notice on-site inspection and continuous monitoring of facilities declared to the other side in the data exchanges, as well as short notice inspections of suspect sites; and provisions for the use of non-interference with National Technical Means (NTM), a requirement for broadcast of engineering measurements on flight tests, a ban on encryption and a ban on concealment measures that impede monitoring by NTM; Separate negotiations would be opened immediately on other operational-tactical missiles (which were not further defined) with a view to their

[753] "Minutes of a National Security Planning Group Meeting, Subject: Upcoming Shultz-Shevardnadze Meetings in Moscow." Foreign Relations of the United States, October 14, 1987. Reagan Library, Executive Secretariat, NSC: National Security Planning Group (NSPG) Records, NSPG 0168 14 Oct 1987 [Shultz-Shevardnadze Meetings in Moscow]. https://history.state.gov/historicaldocuments/frus1981-88v06/d79.

reduction and elimination.[754] Some of these and other on-site measures were ultimately accepted by the Soviet Union due to their parallel concerns about U.S. cruise missile programs – a system they worried gave the United States latitude to cheat and build a hedge.[755]

This elaborate list, consisting of measures which had now come a long way from the verification of SALT I, together with Webster's concerns reflected the widespread and varied trepidations about the verifiability of INF. This included specific concerns such as the status on non-deployed SS-20s that might be stashed out of sight and maintained by testing and maintenance using the SS-25, a still legal missile, launch systems.[756] This also included more general discontent centering on verifiability in the U.S. Senate, personified in chief by Senator Jesse Helms of North Carolina. As soon as the Foreign Relations Committee opened its hearings, Sen. Jesse Helms began to rant and rave about the possibility that the Russians would cheat -- "In fact, they are cheating right now."[757] Helms proposed an amendment to INF that would require that the treaty "be deemed void and terminated in the event of any major violation amounting to a material breach." It was rejected by a vote of 9 yeas and 89 nays.[758] However, another amendment proposed by Helms, demanding that the treaty would not be ratified "until the

[754] "Overview of the INF Negotiations, An ACDA Staff Paper," 3 March 1987, Central Intelligence Agency Archives, https://www.cia.gov/readingroom/docs/CIA-RDP90G01353R000800110002-4.pdf , pp. 33-34.
[755] Talbott, p. 288.
[756] Rowl, Evans and Robert Novak, "What about the hidden SS-20s?" The Washington Post, November 18, 1987, https://www.washingtonpost.com/archive/opinions/1987/11/18/what-about-the-hidden-ss-20s/691db713-bd30-4a8e-b77c-944ef60bec83/
[757] Wicker, Tom, "'Senator No's' Effort to Derail INF Treaty based on Outright Misrepresentation," Sun Sentinel, 29 January 1988, https://www.sun-sentinel.com/news/fl-xpm-1988-01-29-8801060760-story.html
[758] S.Amdt.2295 to Treaty Document 100-11, 100th Congress (1987-1988), https://www.congress.gov/amendment/100th-congress/senate-amendment/2295/actions

President has certified to the Senate that, in his judgement, the number of SS-20 missiles reported by the Soviet Union as being possessed by it on November 1, 1987 pursuant to the initial data exchange under the Memorandum of Understanding is a true accounting of the number of SS-20 missiles possessed by the Soviet Union on that date." This amendment was approved by 81 yeas and 13 nays and set that stage for NPIC's work to certify the numbers described earlier in this chapter.

KENNEN's remaining temporal blind spot, a product of a development trajectory that had prized large, expensive satellites that could only be produced and operated in small numbers, was ultimately leveraged in this case to ban intermediate-range nuclear forces. Importantly, however, the digital infrastructure supporting KENNEN was similarly influential in verifying the baseline counts of missiles that gave the U.S. Senate the assurance it believed was necessary to proceed with INF.

Unique attributes of the INF debate

The question remains as to why KENNEN's information and blind spots could be used to produce a ban in the case of INF, an outcome that did not emerge for any other weapon system. A leading reason was that unlike other cases in this study, the leadership of the Department of Defense and the Joint Chiefs were solidly behind a ban on intermediate-range forces in the region. With corralling from Weinberger and through his partnership with Chairman Vessey, they eventually unified in support of a ban, a factor which did not emerge in any other case. Defense leaders and conservatives largely supported the zero option because NATO had so few bases in the region. It was determined that even low to moderate levels of SS-20s in Europe

posed a threat of annihilation that would be nearly impossible to counteract. They used blind spots to support this argument, pressing the case that a ban was easiest to verify and offered the greatest assurance against even a covert Soviet SS-20 program. Given that defense leaders were leading forces opposed to a ban in other cases, this presents the strongest explanation for why INF resulted in a ban and does not contradict the overall findings of this study.

A second contributing factor that did not exist in other cases was European pressure and the international nature of the decision-making environment. The United States' INF deployments were facing waning support from some of the European allies, many of whom were facing growing pressures from domestic peace movements.[759] Whereas Carter had had to deal with European security anxiety and perceived force disparities in the European theater, by the time Reagan took office, the European political environment had changed. Growing European peace movements had unified against the scheduled deployments, and the Soviet Union sought to capitalize on this sentiment and sow dissent within the NATO alliance with an aggressive propaganda campaign. West German Chancellor Helmut Schmidt, facing a domestic peace movement and a fractious parliament, stated publicly that the United States had to give Europe a binding assurance that negotiations on INF would resume without delay.[760]

A third factor unique to the INF case was lessened domestic pressure. The level of domestic attention to the INF issue was far less than that of the MX and Midgetman programs. Grass-roots arms control lobbies in the United States paid little attention to the INF negotiations until 1987.

[759] Nolan, Janne E., "The INF Treaty," in *The Politics of Arms Control and Treaty Ratification*, Michael Krepon and Dan Caldwell etd., New York: St. Martin's Press, 1991, p. 356.
[760] Nolan, p. 360.

INF was largely seen as a political side show. One observer noted, "Liberal arms control advocates … have concentrated their political energy on other fights – for nuclear weapons freeze and against the MX intercontinental missiles – rather than intermediate range-nuclear forced based and aimed at targets in Europe."[761]

A fourth unique factor connected to the international nature of the debate was a unique opportunity for a propaganda battle between the United States and the Soviet Union, each attempting to win support from international audiences in ways they hoped would enhance their agendas and security.

Weinberger worked to frame the zero proposal in grand terms as a way to elicit public support and appear as the "White Hats." During a National Security Council meeting on October 13, 1981, he made the case to Reagan:

> ***Weinberger (Secretary of Defense):*** *…We need to assess the nature of our tasks brought on by the strength of Soviet programs…The U.S. has no counter… In this light, we might need to consider a bold plan, sweeping in nature, to capture world opinion. If refused by the Soviets, they would take the blame for its rejection. If the Soviets agreed, we would achieve the balance that we've lost. Such a plan would be to propose a "zero option." ... If it were ultimately decided to adopt this option, it should be proposed by the U.S. in a spectacular Presidential announcement…*
> ***The President:*** *Do we really want a "zero option" for the battlefield? Don't we need these nuclear systems? Wouldn't it be bad for us to give them up since we need them to handle Soviet conventional superiority?*
> **…**
> ***Weinberger:*** *The Soviets will certainly reject an American "zero option" proposal. But whether they reject it or they accept it, they would be set back on their heels. We would be left in good shape and would be shown as the White*

[761] Nolan, p. 384.

Hats…Also, we would be insisting on stringent verification criteria and on dismantling.[762]

Such lofty language is also evident both in Reagan's 1981 announcement of INF and the "zero approach," as well as in his 1983 State of the Union address:

November 1981 speech: *"Twice in my lifetime, I have seen the peoples of Europe plunged into the tragedy of war…The United States is prepared to cancel its deployment of Pershing II and ground-launch cruise missiles if the Soviets will dismantle their SS - 20, SS - 4, and SS - 5 missiles. This would be an historic step. With Soviet agreement, we could together substantially reduce the dread threat of nuclear war which hangs over the people of Europe. This, like the first footstep on the Moon, would be a giant step for mankind."*[763]

January 1983 State of the Union Address: *"In the case of intermediate-range nuclear forces, we have proposed the complete elimination of the entire class of land-based missiles… Deep down, the Soviets must know it's in their interest as well as ours to prevent a wasteful arms race. And once they recognize our unshakable resolve to maintain adequate deterrence, they will have every reason to join us in the search for greater security and major arms reductions. When that moment comes -- and I'm confident that it will -- we will have taken an important step toward a more peaceful future for all the world's people."*[764]

The speeches indicate how INF was used by U.S. leaders as a unique opportunity to present itself as a peace-seeking and responsible leader. In some ways, it was low-hanging fruit. The United States could claim an arms control victory but did not have to give up any deployments on its

[762] "Minutes of a National Security Council Meeting." Foreign Relations of the United States, October 13, 1981. Reagan Library, Executive Secretariat, NSC: NSC Meeting File: Records, 1981–88, NSC 00022 13 Oct 81. https://history.state.gov/historicaldocuments/frus1981-88v03/d92.

[763] "Remarks to Members of the National Press Club on Arms Reduction and Nuclear Weapons," Ronald Reagan Presidential Library, November 18, 1981, https://www.reaganlibrary.gov/archives/speech/remarks-members-national-press-club-arms-reduction-and-nuclear-weapons

[764] "Address Before a Joint Session of the Congress on the State of the Union," Ronald Reagan Presidential Library, January 25, 1983, https://www.reaganlibrary.gov/archives/speech/address-joint-session-congress-state-union

own soil. Because of this, it faced much less domestic opposition getting INF negotiated, signed and ratified. KENNEN information and blind spots could be used within this environment which was already ripe for a ban to strengthen the case for it on the basis of verification. Overall, the case of INF shows how information and uncertainty can be used in compatible ways to achieve a ban when political will and strategic motivations align, and particularly when such measures are backed by defense and military leadership.

Conclusion

Developments of the late 1970s and early 1980s were shaped by the advancement of mobile missile technology and the new threats and considerations this brought to bear on existing understandings of arms control, deterrence, and security. Within this space, the advancements of the KENNEN satellite program and the digital infrastructure that came with it allowed imagery analysts to track these changes, with U.S. target lists growing along with Soviet mobile missile forces. While the resolution capabilities of KENNEN advanced, the same temporal blind spot remained. As in past cases, this uncertainty was leveraged next to information about Soviet nuclear forces obtained through KENNEN to make the case for several U.S. nuclear force modernization initiatives against the alternatives of canceling programs or banning them under agreements.

Established systems: ICBMs and MIRVs

START ultimately achieved modest reductions and limits across launchers and warheads. But competition in throw-weight and MIRVs, a dynamic that had been sustained and intensified by satellite information, continued with relatively little restraint, and the United States continued to invest in new missile and warhead programs. Imagery analysts' increasingly successful tracking of Soviet mobile missile programs through KENNEN and new digital methods contributed to the growth of the target list of the U.S. nuclear warfighting plan, known as the Single Integrated Operating Plan (SIOP). This larger target list, together with new information from KENNEN about Soviet ABM developments that fueled the illusion of significant Soviet ABM advances, was used to argue for both U.S. defensive modernization (i.e., the Strategic Defense Initiative) and offensive modernization (i.e., the MX missile program). In Congress, arguments invoking the information from KENNEN arose repeatedly throughout the late 1970s and early 1980s as part of arguments to make the case for modernization over the alternatives of cancelling programs and seeking reductions through arms control. This information cycle and process worked to strengthen the case for limits and modernization over bans across a wide range of missile and warhead development initiatives.

Pending systems: Mobile ICBMs and Mobile IRBMs

The outcomes for the two central pending weapon systems for this period, mobile ICBMs and mobile IRBMs differed greatly, despite the only major difference between the systems being a matter of range. For mobile ICBMs, a ban was considered and even submitted as part of the

formal U.S. position. However, information from KENNEN about the Soviet ICBM program would be used to help sustain the case for the United States' own mobile missile initiative: the Midgetman and the MX. Such data – which included a mix of information gleaned through KENNEN related to Soviet throw-weight, warhead numbers, non-deployed missiles, and silo-hardening measures – would be used both at the National Security Council level and Congressional level to resist a ban and keep on life-support U.S. mobile missile programs that were increasingly diminished by budget constraints and public opposition. The result was that despite the domestic resistance toward U.S. mobile missile program, they would both persist until the end of the Cold War.

The case of intermediate-range ballistic missiles (IRBMs) stands as an exception in this study. This is the only case where blind spots and verification issues were successfully leveraged as part of an effort to codify a ban on a category of weapon within a treaty. Like some other weapon systems, new information and capabilities, methods, and technical infrastructure connected to the deployment of KENNEN were used to characterize the nature of the Soviet SS-20 threat, and there was significant domestic support for developing and deploying the U.S. Pershing II medium-range ballistic missile and cruise missiles in Europe. There was also a similar debate structure to other weapon systems with some defense leadership and the Reagan administration eventually supporting a ban that was opposed by the Joint Chiefs, the State Department, and by some within Congress.

This case study argues that the ultimate difference was that the leadership of the Department of Defense and the Joint Chiefs were solidly behind a ban on intermediate-range forces, a factor

which did not emerge in any other case. Defense leaders and conservatives largely supported the zero option because NATO had so few bases in the region. It was determined that even low to moderate levels of SS-20s in Europe posed a threat of annihilation that would be nearly impossible to counteract. They used blind spots to support this argument, pressing the case that a ban was easiest to verify and offered the greatest assurance against even a covert Soviet SS-20 program. Given that defense leaders were leading forces opposed to a ban in other cases, this presents the strongest explanation for why INF resulted in a ban and does not contradict the overall findings of this study.

Overall, this case study shows that as the United States entered the digital age of intelligence, the existing patterns of high-resolution satellite information and uncertainty from remaining blind spots being used to support limits and modernization over bans and restraint persisted, and in some cases, were strengthened. Both information and blind spots were used to sustain U.S. mobile missile programs that saw rapidly waning support over the years. While the new capabilities under KENNEN's digital architecture allowed for the accounting of mobile missiles for the first time, this information was primarily used by military and conservative leaders seeking to retain the U.S. mobile missile force. KENNEN's development along the resolution initiative left the temporal blind spot largely unchanged – it was still a large, expensive system that could only be fielded in small numbers. Therefore, while intelligence capabilities in this digital age advanced to be able to provide better estimates of Soviet mobile missile forces, they could not verify their numbers with an amount of precision that would satisfy skeptics. Blind spots therefore continued to be successfully used a reason to retain and modernize U.S. missile

initiatives. The result was that the possibility of a mobile ICBM ban and closing off this area of concern and competition disintegrated despite the U.S. programs never gaining real traction.

Conclusion

> ***Interviewer**: As you look back at it now are you sorry you went ahead with the MIRV?*
> ***Secretary of State Henry Kissinger**: Well, that's a good question… I would say in retrospect that I wish I had thought through the implications of a MIRVed world more thoughtfully in 1969 and 1970 than I did. What conclusions I would then have come to I don't know."*[765]

This study has followed the fleeting yet distinct opportunities that emerged during the Cold War to ban various types of nuclear weapons. Some of these weapons were seen as deeply destabilizing such as MIRVs and ABMs. Others suffered from severe verification challenges such as cruise missiles and mobile missiles. In each of these cases, a ban stood as a policy option on the table that held considerable support within the U.S. government but that faded under pressure. The study has also traced the persistence of established weapon systems like ICBMs and SLBMs that were long resistant to reductions and were instead limited while being continually built-up and modernized.

The study finds that the use of high-resolution satellite imaging technology information and blind spots, brought to bear by U.S. choices to pursue the resolution initiative, was an instrumental factor in the shape that arms control took: retaining rather than banning weapons through limits intertwined with wide-reaching modernization initiatives. The mechanism for these outcomes were new arguments that changed the shape of domestic debates over nuclear forces by invoking the precise information these satellites provided about Soviet forces together with the substantial uncertainty left by their remaining blind spots.

[765] SALT Handbook, Key Documents and Issues 1972-1979, Edited by Roger P. Labrie, p. 298.

A pattern consisting of four types of arguments within National Security Council debates and Congressional debates were present throughout the case studies, each relating to how satellite information and blind spots were used to make the case for arms control limits over bans and the case for modernization over stagnation or cancellation.

1: High-resolution information and the case for limits

In the argument for arms control limits, high resolution satellite information was professed to enable the verification of limits and to attest that limits directed toward parity were a more desirable path than arms racing and the pursuit of superiority. The argument was used by ACDA after the first CORONA satellites, by the primary architects and supporters of the SALT agreements and START, as well as in Congress and the public media advocating for arms control limits.

With CORONA, imagery resolution increased to allow precise counting of fixed ICBMs and the differentiation of missile types. These developments were successfully leveraged by ACDA and other proponents of limits to pressure the Joint Chiefs to withdraw their insistence for on-site inspections to enact limits on ICBMs. As the treaty solidified, further advances in high resolution satellite imagery would be used to facilitate mixing provisions between weapons of various types and allow both sides more freedom to design their modernization strategies and types of qualitative upgrades. An argument of verifiability, strengthened by resolution advances, also

helped bring submarines onto the negotiating table by allowing for the distinguishing of ballistic missile submarines from other types and the detection of modifications during the retrofit period.

Limits were also able to be tailored due to the precise verification capabilities granted through GAMBIT in particular. SALT I initially contained a provision not to expand the size of ICBM silos. This provision was intercepted by DOD, which asserted that the new MIRVed Minuteman III would require a dimension increase to U.S. silos. This resulted in a changed American position for the agreement text to prohibit any "significant increase," defined as an increase greater than 10-15 percent of the present dimensions of silo launchers. Such a measurement would not have been possible without GAMBIT. Satellite imagery thus came to be used as a way to not only verify limits but also to provide the flexibility tailor limits in ways that supported U.S. modernization initiatives.

Later under HEXAGON, satellite capabilities were used to support the creation of a system to verify MIRV deployments in ways that bolstered limits above existing levels over a freeze. This system was a set of "counting rules" that would better enable imagery analysts to use missile type as a proxy for numbers of warheads, megatonnage, and throw-weight. While this system could have arguably been developed under earlier reconnaissance systems, including CORONA, GAMBIT, or even cooperative aerial reconnaissance, HEXAGON's wide area capture capabilities at high resolution would have made monitoring changes to the large number of targets more feasible. The counting rules system paved the way for the free development of MIRVs and support the choice to continue to modernize the technology.

As the Soviets pushed cruise missiles into the scope of the treaty, HEXAGON's advances that slightly enhanced verifiability were effectively leveraged by proponents of cruise missiles to argue against a ban on the technology under the notion that they could be controlled under SALT II and developed responsibly.

2: Blind spots and the case for limits

The argument for limits based on blind spots was that because satellites could not verify with certainty the absence of a given Soviet weapon system that therefore the United States could not ban the weapon and should instead pursue limits. The argument was used by executive leadership, the military establishment and some members of Congress referring to the uncertainty and threat of Soviet cheating under a potential ban. Its impact was that it often worked as an additional buttress to arguments for weapon retention and modernization.

For MIRVs, which U.S. leaders – apart from ACDA director Gerard Smith – strongly favored to keep developing, an argument using blind spots and uncertainty was used with little grounding to help remove them from the scope of arms control. The issue of verification might have objectively been solved by determining that missiles of a certain type were MIRV-capable through testing data, and then monitoring a ban or limits on those missile types via satellite imagery. The temporal blind spot would hold little relevance under such a scheme. Especially as GAMBIT models emerged with high resolutions, missile-type identification became possible. Opponents of a MIRV ban effectively obscured the issue by simply claiming that overhead imagery could not determine which missiles were MIRV-ed and which were not. The spreading

of this incomplete and flawed perception along with the perceived futility and unacceptability of on-site inspections was instrumental in preventing MIRVs from being included within the scope of SALT proposals. The argument survived from early NSC meetings until the final Congressional hearings that approved the SALT agreements without a MIRV ban.

For ABMs, in the early years of the CORONA program when the technology emerged in the Soviet Union, analysts were unable to confidently characterize construction given the overlap with anti-aircraft systems and the relatively low-resolution of acquired imagery. The resolution blind spot was thus seen as an early barrier to ABM inclusion in arms control discussions in the mid-1960s. By the late 1960s, as GAMBIT matured, the intelligence community determined that capabilities for detecting and monitoring fixed ABM systems were high.

Despite this advance, this same issue that was used to destroy the ABM ban was used to help mount support for ABM limits. Defense leaders continued to raise concerns related to the remaining temporal blind spot about covert SAM site upgrades to illicit ABM systems, arguing that this was a reason the U.S. should pursue ABM research and development regardless of whether the Soviets were interested in a ban. While these concerns later proved unfounded, an ABM ban could not be recovered.

In the case of cruise missiles, arguments invoking blind spots and unverifiability were initially used to strengthen the case to keep cruise missiles out of SALT II. Only after the Soviets pushed the weapon system onto the negotiating table was the verifiability argument (type 1) made in order to win domestic support for limiting cruise missiles rather than banning them.

3: High-resolution imagery and the case for modernization

In terms of modernization, there was the argument that because high-resolution satellite information revealed Soviet development of certain capabilities deemed threatening to the stability of deterrence, the U.S. must develop a corresponding weapon system or modernize to ensure deterrence is maintained. The argument was used by the defense leadership, the Committee on the Present Danger, in Congressional debates, and increasingly implied by National Intelligence Estimate reporting.

The argument appears to have been a strong contributor to the development and retention of MIRVs, ABM research and development, cruise missiles, and mobile-land based ICBMs. It was often positioned as the primary argument at the NSC level and in Congress used to amass support for and overrule those seeking to cut or cancel a U.S. weapon program, resulting in retention and development of the weapon (even if whittled down) over cancellation.

Under CORONA and GAMBIT, this argument was instrumental in the effort to retain and advance MIRVs. Imagery information had been used to depict a detailed picture of Soviet forces, showing that the Soviets were numerically ahead in both missile delivery systems and throw-weight and the MIRVs were the only area where the United States was ahead. This package of information therefore made the retention of MIRVs appear essential, lest the United States relinquish the sole area where it had an advantage. This argument carried through the NSC debates to Congress, painting a MIRV ban as unthinkable despite the strong support for it by the

leader of the SALT negotiations and ACDA, Gerard Smith. In the case of ABMs, imagery information about the Soviet ABM development process was used to feed arguments for modernization. Imagery of Soviet ABM developments was frequently interpreted as evidence of an 'inevitable' technological development that the United States must actively meet.

HEXAGON's new information was also used in the public and Congressional sphere to weaken the case for SALT II and to argue in supportive of new directions for the U.S. ICBM program such as the MX mobile concepts. Groups like the Committee on Present Danger and their allies in Congress were most influential in this process. Within this environment, new information from HEXAGON was used to argue that the Soviets were achieving strategic superiority, particularly by invoking specific figures about superiority in aggregate throw-weight. Such information was derived through HEXAGON's ability to track the details of Soviet missile upgrades and the corresponding changes to cumulative force measures like total warhead numbers and aggregate throw weight.

Under KENNEN and the digital infrastructure that developed in its wake, imagery analysts' increasingly successful tracking of Soviet mobile missile programs through KENNEN contributed to the growth of the target list of the U.S. nuclear warfighting plan, SIOP. This larger target list, together with new information from KENNEN about Soviet ABM developments, fueled concerns about Soviets pulling ahead in mobiles and the illusion of significant Soviet ABM advances. These particular fears became the basis of arguments for both U.S. defensive modernization (the Strategic Defense Initiative) and offensive modernization.

The information from KENNEN about the Soviet mobile ICBM program would be used to help sustain the case for the United States' own mobile missile initiatives: the Midgetman and the MX. Such data would be used both at the National Security Council level and Congressional level to resist a ban and keep on life-support U.S. mobile missile programs that were increasingly diminished by budget constraints and public opposition. In addition, the matter of Soviet "hardening" of its missile and control sites observed in KENNEN imagery would be used together with old worries about superior Soviet throw-weight and warhead numbers to increase durability of the argument for the MX program. The result was that despite the domestic resistance toward U.S. mobile missile program, Midgetman and MX would persist until the end of the Cold War.

4: Blind spots and the case for modernization

The corresponding argument for modernization invoking blind spots was that because satellites could not provide certainty of the quantity or qualities of a given Soviet weapon system, therefore the U.S. must modernize its own respective or balancing capabilities. The argument was used by the Joint Chiefs and military establishment as well as members of Congress. The argument's individual impact is difficult to assess given that it was most often used together with arguments invoking satellite information about Soviet forces, but debate records indicate that this argument worked to enhance the perceived urgency of the arguments for modernization based on threats to deterrence and stability.

One of the most fervent examples of this type of argument was by the Team B experiment in 1976 that occurred under HEXAGON. While it was provided with the same intelligence and imagery as Team A, Team B came to wildly different conclusions about Soviet intentions. The drafters of that report used the uncertainty of blind spots to conclude that the Soviet Union surpassed the United States in overall military strength and was bent on a first-strike policy.

Team B cited the recent development of Soviet MIRV technology, coupled with a rapid modernization of ICBM and SLBM targeting capabilities, to argue that the NIE was underestimating the impact of the sophistication, effectiveness and threat of numerical superiority that missile program was posing.[766] Team B also complained that the NIE did not adequately address the issues surrounding the planned Soviet deployment of the SS-X-16 mobile missile system. Because it was determined from imagery information that it was built off the SS-20 platform (an intermediate range nuclear missile), it was argued that the SS-20 could be quickly and covertly converted into the longer range SS-16 in times of crisis, and would be a backdoor around the SALT I Treaty.[767] The report also used observations of Soviet ABM construction to argue that since the Soviet ABM research and development was continuing at a pace similar in size and scope it was before the ABM Treaty in 1972, it was likely that Soviet ABM technology was greater than the NIE concluded it was.[768] Both primary and secondary analyses show that Team B's arguments would have a lasting impacting on the tendency to produce worst-case estimates of Soviet forces, which were in turn used as further justification of U.S. modernization initiatives, including for the brewing MX program.

[766] Team B Report. p. 21. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf
[767] Team B Report, p. 26. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf
[768] Team B Report, pp. 35-37. https://nsarchive2.gwu.edu/NSAEBB/NSAEBB139/nitze10.pdf

This uncertainty and blind spot argument was also used within the case for U.S. mobile missile initiatives under KENNEN. The satellite had provided the ability to obtain a broader understanding of the burgeoning Soviet mobile ICBM force. However, this understanding was incomplete due to the frequent movements of forces and the limits posed by the temporal blind spot. Defense and Congressional leaders thus used this uncertainty about the scope and scale of the Soviet mobile program to make the case for the Midgetman and the MX, which was particularly instrumental in maintaining mobile missile research and development investments despite the shrinking in scale of the two programs over time.

This study has argued that blind spots were interpreted not as neutral uncertainties, but as spaces where the Soviets "might be" doing something that would harm U.S. national security. The interpretation of satellite images as what "might be" is a legacy not of the military's interest in nuclear superiority, nor its advocacy for additional funding. Instead, this research shows that the practice arose from the analysts who interpreted satellite photos. Without the benefit of computer memories, the analysts held a tradition of telling "stories" within an organizational culture of meritocracy that rewarded the richest and most detailed accounts. As imagery resolution improved and the volume of imagery expanded, this tradition of storytelling would persist and intensify; stories would become increasingly focused on and intertwined with the bigger strategic picture and issues of superiority in ways that contributed to strengthening arguments for modernization. Such tendencies would be further intensified by pressures like the Team B experiment, where analysts took the same imagery information to claim Soviet intentions of

seeking a first-strike capability and comprehensive superiority in ways that would push the entire intelligence institution in the direction of worst-case estimates.

Contributions to the literature

This research adds to the literature on the origins of arms control by showing how the development and use of high-resolution satellites in the early 1960s were instrumental in helping already existing arms control ideas developed by the arms control epistemic community gain traction in the U.S. domestic political environment. In particular, resolution advances allowing for the identification and balancing of qualitative aspects of nuclear weapons gave credence to arms control prescriptions for achieving balance and stability. In practice, the study shows how these resolution advances, together with the uncertainty of blind spots, also contributed to the directing of arms control away from its original vision of maintaining crisis stability: rather than banning destabilizing systems such as MIRVs or ABMs, satellite information and uncertainty were used to argue for their retention and modernization. Such developments shaped the course of nuclear force planning, strategy, and the direction of arms control toward competition rather than restraint and cooperation.

The conventional wisdom about arms control has argued that the improvement in information quality provided by satellites should increase the perceived value of cooperation with an adversary and of arms control characterized by mutual restraint as a policy choice. This

argument has been made broadly within the context of international cooperation.[769] It has also been made specifically in the context of arms control. Kenneth Abbot has argued that among the types of information relevant to cooperation in an arms control context, "information on compliance is particularly important, both for itself and for the light it can shed on other issues." He asserts that states will be reluctant to enter into agreements without "clearly defined mechanisms for the ongoing production of reasonably timely and reliable information on these matters."[770] Others have framed this assumption about the relationship between information and cooperation in terms of the quality of intelligence information, arguing that the more open a government is about the character of its weaponry, the less likely it is that the worst-case scenario will dominate the other state's response.[771] This general understanding is also reflected in historical accounts of satellite technology and arms control. Such accounts of verification technology and of U.S. satellite-imaging programs have frequently credited the emergence of satellites with the realization of arms control.[772]

[769] See Keohane, "The Demand for International Regimes," (1984) p. 345 and pp. 337-338 for discussions about how information sharing supports cooperative outcomes more generally.
[770] Kenneth W. Abbott, "Trust but Verify: The Production of Information in Arms Control Treaties and Other International Agreements," Cornell International Law Journal 26, no. 1 (Winter 1993): 4.
[771] Downs, George, David Rocke, and Randolph Siverson. "Arms Races and Cooperation." *World Politics* 38, no. 1 (October 1985): 138-139.
[772] See, for example, arms control histories such as Stuart Croft, *Strategies of Arms Control: A History and Typology*. Manchester: Manchester University Press, 1996, p. 59, and Patrick Morgan's argument about verification in the context of his chapter on "Elements of a General Theory of Arms Control," in Arms Control: History, Theory, and Policy, Volume 1, etd. Robert E. Williams Jr. and Paul R. Viotti, Santa Barbara: Praeger Security International, 2012, p. 29. Other examples include technological histories such as Burrows, William E., *Deep Black: Space Espionage and National Security.* New York: Random House, 1986, pp. viii-ix. Day, Dwayne A., John M. Logsdon, and Brian Latell. *Eye In the Sky: The Story of the Corona Spy Satellites.* Washington, D.C.: Smithsonian Institution Press, 1998.

This study goes beyond the conventional wisdom that the development of satellites contributed to the realization of arms control. The research shows that the advancement and use of high-resolution satellites contributed to the shaping of arms control to focus on limits over bans and to the strengthening of modernization and qualitative build-ups. It shows how both new information and uncertainty were instrumental to this process. Namely, as the United States acquired more information about Soviet nuclear forces, the information it did not have became more powerful.

The significance of high-resolution imagery information

One contribution of this research to the existing literature centers on clarifying the importance of high-resolution imagery information to the shape that arms control took during this period. The evidence indicates that without high-resolution imagery information during this period, the cases for both arms control limits and for modernization would have been significantly weakened.

Arguments about uncertainty could admittedly have still been made had the United States adopted the temporal initiative in satellite development; uncertainty in this case would have likely just been reframed in terms of the resolution blind spot and the inability to decipher details from images. Therefore, the ultimate significance of the resolution initiative was the combination of uncertainty left by the enduring temporal blind spot together with the presence and proliferation of high-resolution imagery information. Had there not been high-resolution information, the majority of data and details that supported arguments for modernization would not have existed.

Without high-resolution imagery information, attempts to argue for modernization within the framework of warfighting and deterrence would have instead had to rely on information consisting of fixed launcher numbers alone, given that this is all that could have been deciphered from low-resolution imagery. But in the debates over arms control, such arguments for more investment in nuclear weapons based on purely quantitative grounds and "missile matching" were often rejected by the White House, Congress, and in public opinion, all of which were uncomfortable with such outright arms racing. Representative John F. Seiberling gives an example of the averse attitudes toward more obvious forms of arms racing such as missile matching in a 1976 House debate over the future of U.S. nuclear strategy. He argued,

> *"A more sensible approach than 'essential equivalence' is to conclude that nuclear sufficiency and 'assured destruction' doctrines make more sense than an endless matching of Soviet capabilities. Once you can destroy the other society and much of its military force one time over, you need add no further strategic arms. The size of the forces on both sides makes it wildly implausible that the leadership on either side can perceive any useable strategic advantages out of the fact that the two forces are not mirror images of each other."*[773]

The weight of the detriment of being perceived as arguing for missile matching is evidenced by the careful tendency of proponents of new nuclear weapon programs within Congressional appropriations debates to explicitly state that their arguments were rather about strategic stability

[773] Congressional Record, House of Representatives, March 17, 1976, p. 6817.

than arms competition.[774] This points to a core significance of high-resolution information: without such details, arguments for modernization that were grounded by the claim of maintaining strategic stability (rather than overt competition) would have had no supporting data other than fixed launcher numbers. The argument would have been stripped down to asserting that because the Soviets had a certain number of a type of weapon, the United States should have it too. There is little evidence of such arguments being seriously constructed within NSC and Congressional debates, much less arguments of this nature that gained real traction.

By contrast, the arguments about modernization enabled by high-resolution information and a focus on improving capabilities in cohesion with prevailing ideas about nuclear strategy were much more nuanced and compelling to relevant audiences. Such arguments provided greater room for maneuverability and lent greater credence to those making them under the heading that the United States didn't just need to build "more," it needed to build "better" (thought it still ultimately amounted to "more" at the end of the day). These arguments were usually framed in the context of pursuing the most responsible path in the interest of maintaining strategic stability. Beneath this surface, high-resolution imagery that comprehensively captured the detailed capabilities of the Soviet ICBM modernization program was used both to design U.S. forces and procurements, as well as to gain political capital and financial support for such measures.

[774] Example of this type of caveating in: Congressional Record, House of Representatives, June 20, 1985, by Representative Hilis on p. 16475 and Representative McCurdy on p. 16476.

Information and uncertainty in the hands of defense and military leadership

Another contribution of this research is to draw attention to the power of information and uncertainty in the hands of defense and military leadership. Previous work has shown that military influence on foreign policy has grown steadily over the last century.[775] The Joint Chiefs' views were particularly influential given the heightened tensions of the Cold War context, and ignoring their views was seen as going against U.S. security interests. Historical accounts have pointed to U.S. presidents paying heed to this reality and operating carefully when it came to establishing positions on arms control.

This helps to explain in part why when ACDA or the State Department would try to leverage satellite information and blind spots toward a ban, their efforts were less effective. For ACDA and State, the use of such levers was seen as pacifistic, idealist, and often, weak. For the military, the use of high-resolution satellite information and uncertainty allowed them to circumvent being seen as seeking modernization simply to increase the strength and capabilities of their services. They could instead argue using high-resolution information that such measures "balanced" corresponding Soviet advances and could be verified in ways that would allow their continued development under "responsible" limits. Military leadership could argue using blind spots that the uncertainty of covert Soviet programs in new weapon areas justified the continuation of U.S. research and development in these areas.

[775] See for example, Stoler, Mark A. *Allies and Adversaries: The Joint Chiefs of Staff, the Grand Alliance and U. S. Strategy in World War II*. Chapel Hill: University of North Carolina Press, 2000. Accessed September 1, 2021. ProQuest Ebook Central.

The outcomes of the case studies each support this observation. For SALT I, SALT II, and START, defense and military leadership were the primary proponents of modernization and retaining and advancing U.S. nuclear weapon programs under arms control limits instead of bans. Each debate shows arguments constructed with high-resolution satellite information and uncertainty forming the backbone of their case. The exceptional outcome of INF also supports the observation that precise intelligence information and uncertainty can be especially powerful in the hands of the military. In this case, when defense and military leadership presented a united position for a ban on intermediate-range forces, both information and blind spots worked effectively in their favor. High-resolution information was leveraged to argue that the Soviet SS-20 force could be adequately accounted for, and remaining blind spots were used to push the case for a comprehensive ban rather than low numbers of weapons on the basis of easing verifiability. In their hands, the arguments resulting from wielding information and uncertainty was seen as displays of responsibility, restraint, and prudence rather than pacifism and idealism.

An important question is why high-resolution satellite information and uncertainty did not work in favor of military leadership early in the Cold War when they were pushing for superiority over arms control limits. An answer begins with the point that information and uncertainty were particularly effective when they could be used as counters to the perception of the military as warmongering and seeking an arms race. Such levers worked particularly well when they could be used to paint military leadership as working in the interests of U.S. national security rather than in the interests of their own services. This study sees the unique weight and impact of

information and uncertainty depending on the role and image of those using them as one useful path for expanding on these findings in the context of future research.

Contemporary satellite technology and the future of arms control

Today the landscape of satellite-imaging technology has changed with the expansion and advancement of capabilities within the commercial sector. The improvements in affordability and accessibility of the technology have allowed a wide array of commercial developers to move forward in new directions. High-resolution imagery at 30 centimeters is now widely and publicly available.[776] Importantly, for the first time, remaining blind spots are diminishing due to three primary developments. First, commercial companies are deploying large constellations of small satellites.[777] Some are designed to offer frequent revisit rates to sites of high interest and others are designed to cover the entire planet with imagery every 24 hours, creating a complete daily record of activity.

Second, commercial companies are improving synthetic aperture radar (SAR), a technology that the U.S. government tried and failed to deploy during the Cold War in a cost-effective manner. SAR is a type of active data collection where a sensor produces its own energy and then records the amount of that energy reflected after interacting with features on the ground.[778] The technology is relevant to the temporal blind spot because of certain techniques that allow for

[776] See for example: Maxar (https://www.maxar.com/imagery-leadership)
[777] Examples include Planet (https://www.planet.com); BlackSky (https://www.blacksky.com)
[778] "What is Synthetic Aperture Radar?" NASA, Earth Data: Open Access for Open Science, published April 16, 2020, https://earthdata.nasa.gov/learn/backgrounders/what-is-sar.

detection of temporal changes between images that might look otherwise the same.[779] SAR change detection methods can tell, for example, if an aircraft has been removed and then returned to the same spot in between image captures, allowing an imagery analyst to better bridge the gap in monitoring between two successive images.

Third, commercial companies are combining the two capabilities of numerous small-satellite configurations with SAR capabilities.[780] The U.S. government has contracted such companies, meaning that the latest generation of large, ultra-high resolution U.S. reconnaissance satellites are now being combined with more agile commercial capabilities. The implication of all of this is that while the temporal blind spot has not disappeared completely, it is indeed rapidly shrinking.

A question is whether diminishing blind spots in a contemporary context solves or aggravates issues related to nuclear arms control and modernization. The answer is mixed. It is unlikely to mitigate the tendency to choose modernization over cancellation or limits over bans because the combination of resolution advances together with temporal advances may provide even further detail about an adversary's nuclear forces to justify modernization programs and sometimes even a turn away from arms control. Examples include the way imagery was used as evidence to abdicate the INF treaty in 2018, or the use of imagery of Russia's next generation of nuclear

[779] SAR temporal change detection methods include assessing differences in the magnitude of the signal intensity between two dates or assessing estimates of the temporal decorrelation of signal interference, known as speckle. See E. J. M. Rignot and J. J. van Zyl, "Change detection techniques for ERS-1 SAR data," in IEEE Transactions on Geoscience and Remote Sensing, vol. 31, no. 4, pp. 896-906, July 1993, doi: 10.1109/36.239913.
[780] Capella Space (https://www.capellaspace.com)

cruise missiles being used to justify corresponding U.S. modernization efforts. In the latter instance, military leadership "contends modernization is necessary as Russia updates its own stockpile with new types of weapons." In the context of a defense of the new U.S. Long-range Standoff missile, Peter Huessy of AFA's Mitchell Institute for Aerospace Studies underscored that between 1991 and 2020, Russia deployed 21 new types of nuclear bombers, cruise missiles, intercontinental ballistic missiles, submarines, and sea-launched ballistic missiles, while the U.S. did not roll out any new variants.[781]

The diminishing temporal blind spot also causes new problems for deterrence and strategic stability. Some have argued recently that persistent overhead monitoring together with AI and big data analytics has the potential to advance to a state where the tracking of road-mobile ICBMs in something approaching real time after they have left their garrisons could be a possibility. It is acknowledged that even with such advances, such a system might still be imperfect and vulnerable. However, because of the powerful *potential* threat to Russian and Chinese second-strike capabilities that this monitoring capability could pose, such a system would likely be destabilizing from the perspective of the countries that felt themselves targeted. These states might assume that such capabilities are intended to support a first strike, or that they could in the future, in a change of doctrine rapidly become so intended. That conclusion has likely been reinforced by analogy, in the decision by the United States in its 2019 Missile

[781] Zachary Cohen, "Satellite images indicate Russia is preparing to resume testing its nuclear-powered cruise missile," CNN Politics, 20 October 2020, https://www.cnn.com/2020/10/20/politics/russia-nuclear-powered-cruise-missile-test-satellite-images/index.html; Tirpak, John A. "New Nuclear Cruise Missile Ahead of Schedule for Next Development Phase," Air Force Magazine, January 15, 2021, https://www.airforcemag.com/new-nuclear-cruise-missile-ahead-of-schedule-for-next-development-phase/

Defense Review to state explicitly that U.S. missile defense "policy, strategy and capabilities" must also address anticipated advanced Russian and Chinese delivery systems.[782]

Contemporary developments also present new opportunities for arms control and disarmament. One is that arguments about uncertainty to justify nuclear build ups will become increasingly hard to make. The historical record shows that such arguments invoking blind spots and uncertainty were useful supports to the case for modernization beneath arguments that invoked high-resolution information about new Soviet weapon systems. This is because the uncertainty argument allowed policy makers to frame the case for a new weapon system in terms of defense, caution, and prudent hedging rather than it being seen as overt arms racing. The diminishing of the ability to compellingly make an uncertainty-based argument would mean that decisions to build new nuclear weapon systems and modernize would have to be taken as a direct response to identified adversary force developments alone, thus having a higher chance of being seen as overt arms race behavior and stoking the corresponding public and political backlash that has historically tempered such measures.

Another opportunity for arms control and disarmament is that commercial satellite developments will continue to strengthen the case for verifiability across the spectrum of control measures from limits to reductions to bans and disarmament. Improvements to verify arms control limits are perhaps the most unremarkable given that political support existed for such measures even when verification capabilities were weaker. Of greater significance may be the improvements to the ability to verify bans and disarmament, especially with new global measures like the 2017 Treaty

[782] Christopher F. Chyba, "New Technologies & Strategic Stability." *Daedalus* 2020; 149 (2): 161-162.

on the Prohibition of Nuclear Weapons. This study shows that any optimism toward such possibilities must be measured, however. The historical evidence presented here has indicated that information and uncertainty have tended to be most effective in the hands of defense and military leaders pushing for modernization in the context of arms control limits. Any forward movement would therefore likely either require the support of defense and military leadership or a groundswell of public pressure, the likes of which have not yet been seen in U.S. history.

The historical record shows that the U.S. intelligence community had confidence in verifying bans back in the 1960s given that cheating under a ban would involve the extremely difficult endeavor of hiding all aspects of a weapon program, including research and development, deployment, storage, transportation, and maintenance activities. Today, the capability to verify a ban would be significantly enhanced, especially if the measure is based on the elimination of an entire weapon program. During the Cold War, the temporal blind spot might have delayed the discovery of illicit activity, as well as made it harder to build a case for cheating given the spotty coverage that at times resulted from having a small number of satellites. With contemporary optical and SAR commercial small-satellite constellations and their daily archives, even if there is a slightly delayed discovery, there would be a record of daily evidence to investigate and allow for the determination of whether a detected activity was an odd event or part of a bigger pattern indicative of cheating. The interest and participation of civil society in utilizing commercial satellite imagery to participate in monitoring and analysis related to arms control, nonproliferation, and disarmament is also significant. This community greatly expands the resource constrained intelligence departments of governments and enhances the potential for

timely detection of noncompliance. Such emerging capabilities indicate that verifiability will continue to grow as an asset rather than a liability to those making the case for bans.

Overall, with regard to future satellite technology advancement in both resolution and temporal directions, the findings of this research emphasize two possible paths: that such developments could be used to intensify modernization and competition, or it could be used to elevate the opportunity for bans and nuclear disarmament. This research has shown how throughout the Cold War, U.S. leaders have often invoked satellite imagery information and blind spots to depict limits and modernization as an inevitable path and the only policy option that made sense. The findings show that this was not an inescapable path but rather a set of continual choices to treat satellite-imaging technology as an agent of modernization and the micromanagement of nuclear forces through the structuring of qualitative and quantitative limits in arms control. The alternative choices to pursue superiority or to pursue disarmament have been supported by satellite-imaging technology since the first CORONA satellite. Recognizing these decisions as free choices among a wider domestic and international audience may in time allow for the greater democratic participation in nuclear policy and force structuring decisions and the moderating of the high-level U.S. government tendency to choose to build new and often destabilizing weapon types in the face of opportunities to ban them.