

Nuclear Risk in an Era of Strategic Competition

Prof. Andrew W. Reddie; areddie@berkeley.edu

Associate Research Professor; Goldman School of Public Policy

Founder; Berkeley Risk and Security Lab

University of California, Berkeley





Brief Introduction

I am a scholar of international relations working at the intersection of technology, politics, and international security issues.

Research: Nuclear weapons, AI governance, cybersecurity, civ-mil relations, political methodology and wargaming

Teaching: War? Emerging Tech and National Security Policy; Nuclear Security; Intro to Technology and Public Policy; Quantitative Methods

Affiliations (selected):

- Founder, Berkeley Risk and Security Lab
- Director, Center for Security in Politics
- Director, Bridging the Gap



COUNCIL *on*
FOREIGN
RELATIONS

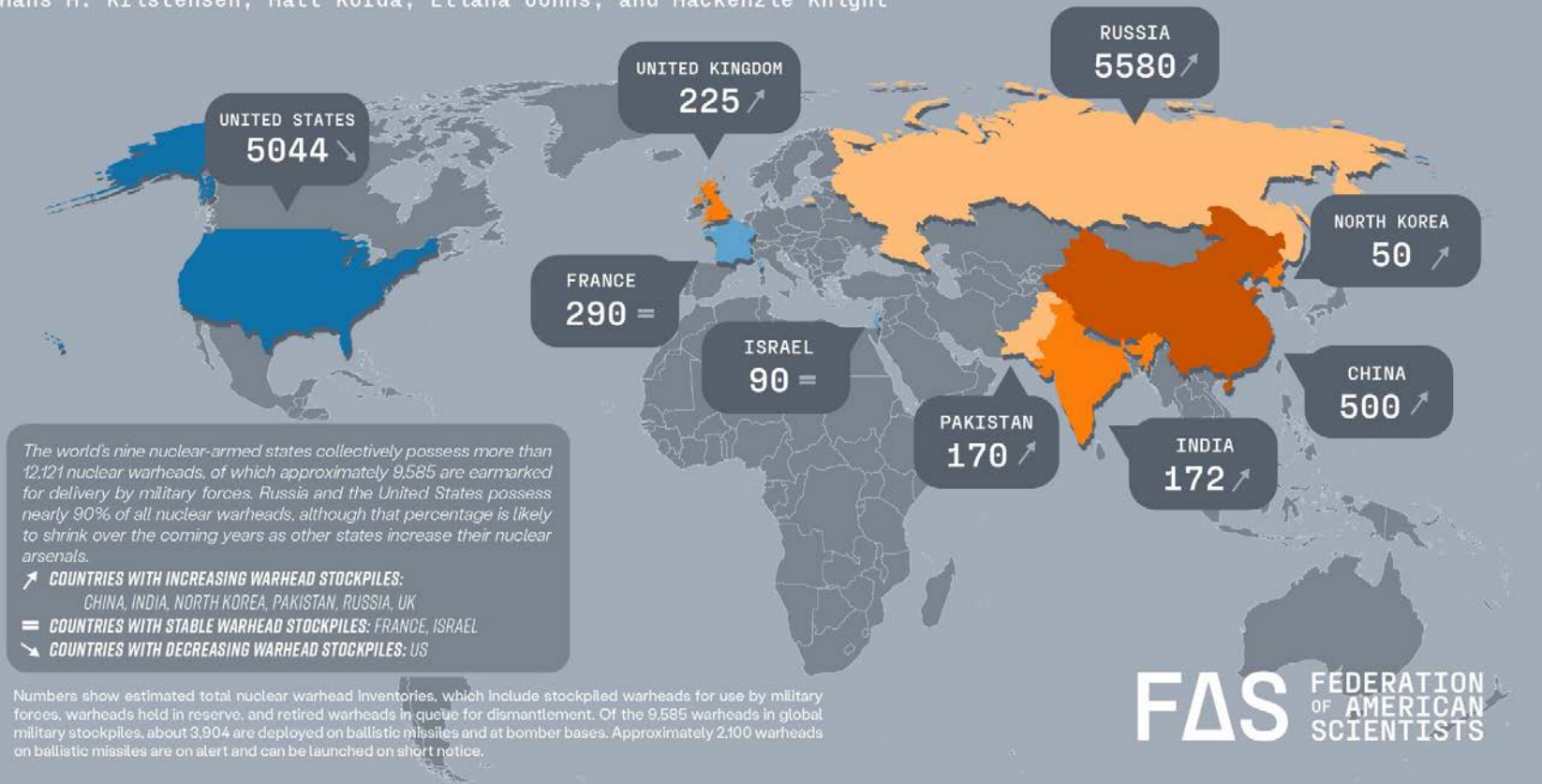


Agenda

1. Context: The Three Body Problem
2. Nuclear Force Postures
 - a. Today
 - b. And Tomorrow (Nuclear Modernization)
3. *Contemporary **Debates**
 - a. Nuclear Numbers
 - b. Targeting
 - c. Non-strategic Weapons
 - d. MD/Hypersonics
 - e. AI
 - f. The Future of Arms Control

Estimated Global Nuclear Warhead Inventories, 2024

Hans M. Kristensen, Matt Korda, Eliana Johns, and Mackenzie Knight



The “Three Body Problem”

 **Atlantic Council**
SCOWCROFT CENTER
FOR STRATEGY AND SECURITY

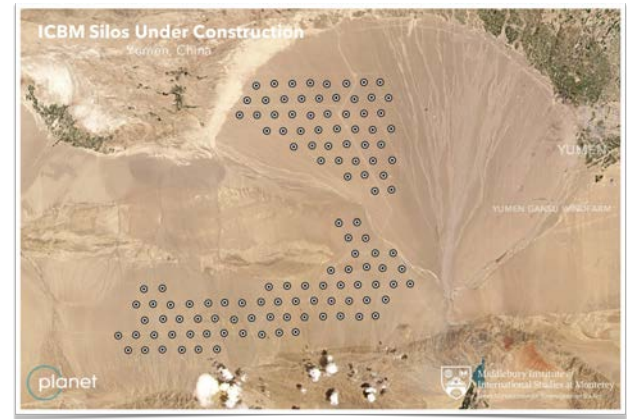
 **GLOBAL
CHINA
HUB**

**US-CHINA LESSONS FROM
UKRAINE: FUELING MORE
DANGEROUS TAIWAN TENSIONS**

Friday, June 16 | 9:00 a.m. (ET)

*Presented by the Atlantic Council's Global China Hub
and the Transatlantic Security Initiative*

#ACGlobalChina #StrongerWithAllies



Nuclear Modernization in Russia

Approx. 1,500 deployed nuclear warheads (per the “old” New START limits)

+ Approx. 2,000 non-strategic nuclear weapons

Developing **new capabilities**:

- Sarmat Heavy ICBM (MIRV-ed)
- 9M730 Burevestnik (nuclear-armed/powering)
- Avangard HGV
 - Breaking the INF Treaty
- Poseidon (Status-6) Torpedo



Nuclear Modernization: China

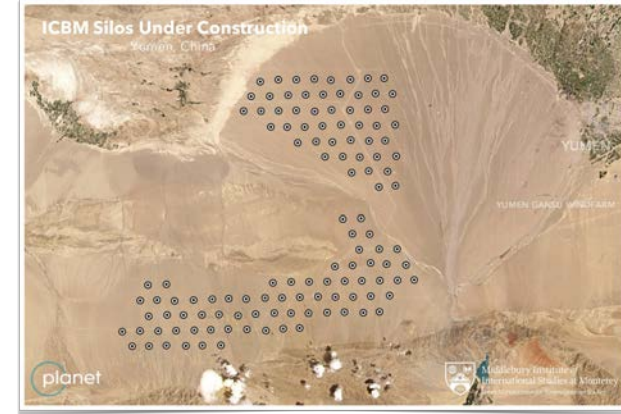
Quantitative increase (“Breakout”)

- The rate of this increase is subject to debate
- 300 → 1,000 warheads (est. by 2030 by U.S. Dept. of Defense)

Qualitative change in force posture

- The rise of the PLA-N
- Siloes in Hami, Yumen, and Ordos

Failed attempts to engage Beijing in nuclear arms control talks



Developments in the DPRK



And Proliferation Risks in the Middle East



World Business Markets Sustainability Legal Breakingviews More

Iran undoes slowdown in enrichment of uranium to near weapons-grade -IAEA

By Francois Murphy

December 26, 2023 4:44 AM PST - Updated a month ago



The Iranian flag flutters in front of the International Atomic Energy Agency (IAEA) organisation's headquarters in Vienna, Austria, June 5, 2011. REUTERS/Markus Schloesser/Anadolu Agency



The Saudi Request for U.S. Nuclear Cooperation and Its Geopolitical Quandaries



A grayscale image of a document with several punch holes. The text "EVERYTHING EVERYWHERE ALL AT ONCE" is printed in a large, bold, black, sans-serif font, centered on the page. The background is a light gray with some minor smudges and shadows from the punch holes.

**EVERYTHING
EVERYWHERE
ALL AT ONCE**

Two U.S. Nuclear Posture Documents

2022 Nuclear Posture Review

1. Identifies **Russia, China, North Korea, and Iran** as potential nuclear challenges, focuses on China as a pacing threat;
2. Reasserts U.S. commitments to **nuclear arms control**;
3. Cancels SLCM-N, retires B83-1 Gravity Bomb, and prioritizes plutonium **pit production**;
4. Provides country specific strategies and heavily focuses on collaboration with **allies**.
5. **Nuclear risk reduction and nonproliferation at the margins**

2023 Strategic Posture Commission Report

1. Focused on Russia and China, including Russo-Chinese nuclear collaboration;
2. Recommends increasing delivery systems numbers across the triad and deploying **more non-strategic nuclear forces**;
3. Calls for active deployment of some active hedge warheads and full funding of NNSA recapitalization efforts (including **pit production**);
4. Recommends **increasing** and **modernizing** conventional forces.

What are Nuclear Weapons For?

The Strategic Posture Commission Report suggests that U.S. nuclear strategy be based upon:

- Assured **second strike**
- **Flexible response** to achieve national objectives
- **Tailored** deterrence to hold at risk what an adversary values most
- **Extended deterrence** and assurance
- **Calculated ambiguity** in declaratory policy
- **Hedge** against risk (geopolitical, technical, operational, programmatic)

U.S. “Nuclear Triad”

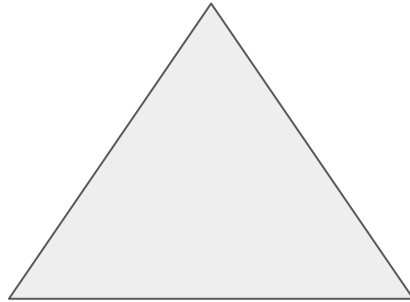
Air Based

46 B-52 Stratofortress (carrying up to 20 GM-86B cruise missiles) and 20 B-2A Spirit bombers (carrying up to 16 B61-7 or B61-11 gravity bombs)

**F-15E, F-16C/D, and F-35 carry non-strategic B61 gravity bomb*

Land Based

400 Minuteman III ICBMs in hardened silos, each carrying a W87/Mk21 or W78/Mk12A warhead



Sea Based

14 Ohio Class submarines, each with up to 20 Trident II D5 SLBMs carrying 4-5 W-76-1, W76-2, or W-88 warheads

**Table 1. First deployment of nuclear delivery systems
and the end of original design lives²⁰⁸**

Current System	Year First Deployed	End of Original Design Life
MMIII ICBM	1970	1980
B-2A Bomber	1997	None
B-52H Bomber	1961	1981
AGM-86B ALCM	1982	1992
Ohio-class SSBN	1981	2011
Trident II D5	1990	2015
Trident D5LE	2017	2042
F-15E DCA	1988	None

*From Triad to Dyad?

There has been a long-standing debate as to whether the ICBM leg of the triad is redundant

While others suggest that the bomber leg should be abandoned

Either way, the Air Force isn't happy...

3 REASONS WHY THE U.S. DOESN'T NEED ICBMs

1. They're **technologically redundant**

Sea-based nuclear weapons are essentially undetectable, & are as accurate as ICBMs.



2. They cost **a lot**

The cost of modernization is estimated to be as high as \$264 billion.

3. They make nuclear war **more likely**

A constant state of high alert creates extreme psychological pressure to launch on warning.



The Role of the Triad

Survivability. Ensuring second-strike stability (SSBN via difficulty of detection and ICBM via intercontinental range)

Responsiveness. ICBMs can be launched within minutes and reach target in approx. 30 minutes

Flexibility. Signaling applications (e.g., FONOPs using the air leg)

Coupling. DCAs

Positive Control. NC3 and “Always, Never”

Nuclear Modernization in the United States

Modernizing the “triad”

- Staying within **New START** limits
 - 1,550 warheads
 - 700 deployed missiles and bombers
 - 800 total (incl. non-deployed)

As well as modernizing **C4ISR** and **NC3** capabilities

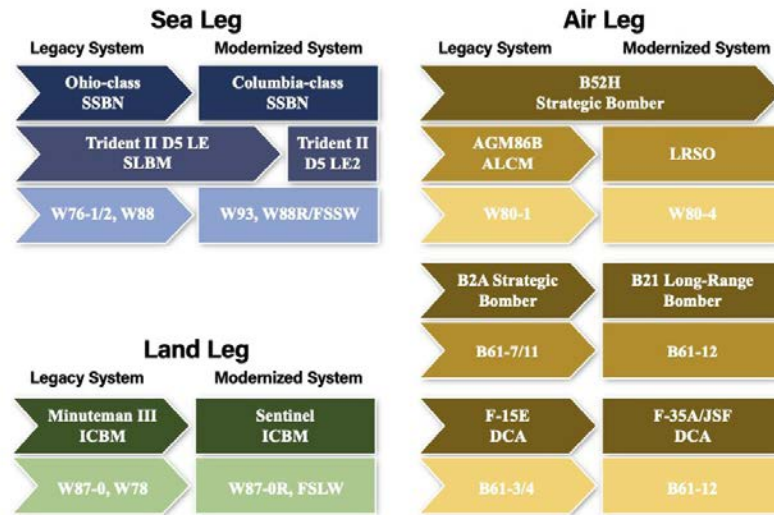


Figure 1. Illustration of the like-for-like transition from legacy to modernized systems.²¹²

Progress Report: Nuclear Modernization

Modernization of **all three** legs have run into problems—with subsequent calls to:

- “Extend” the life of *Ohio*-class
- “Uploading” ICBM and SLBM warheads
- “Re-convert” SLBM launchers and B-52 bombers

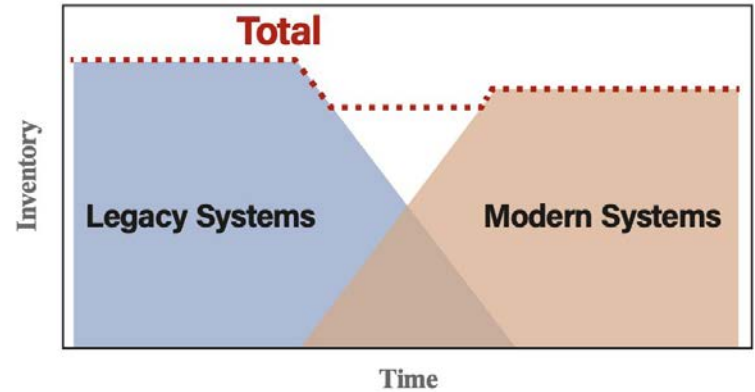
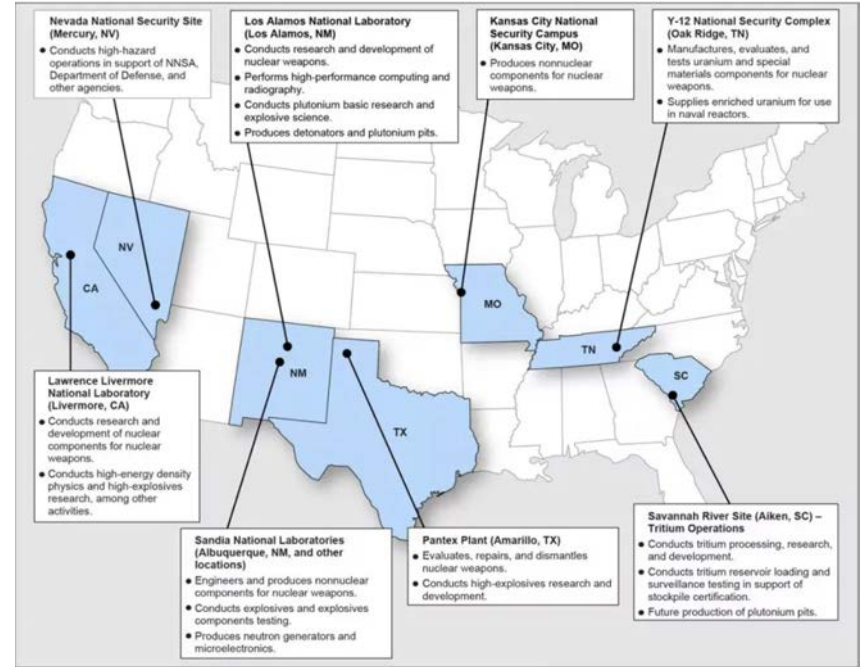


Figure 3: Notional depiction of the transition from a nuclear triad based on legacy systems to triad based on modern systems in the event of a POR delay (or combination of delays). In this case, the total inventory, illustrated by the red dashed line, would experience a shortfall in the late 2020s through early 2030s.

*The U.S. Nuclear Enterprise

The U.S. Department of Defense is not responsible for the production of nuclear weapons, that falls to the the U.S. Department of Energy and the National Nuclear Security Administration (DOE/NNSA).

How is it going?



Sources: GAO presentation of National Nuclear Security Administration information; Map Resources (map). | GAO-23-104422

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How is it going?

Asset Condition by Replacement Plant Value %
Building Condition Index for operating buildings and trailers and Laboratory Operating Board scores for other structures and facilities

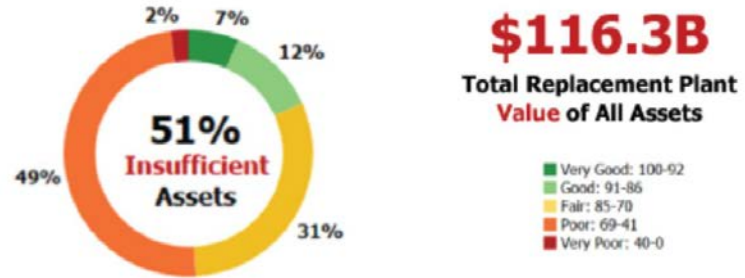
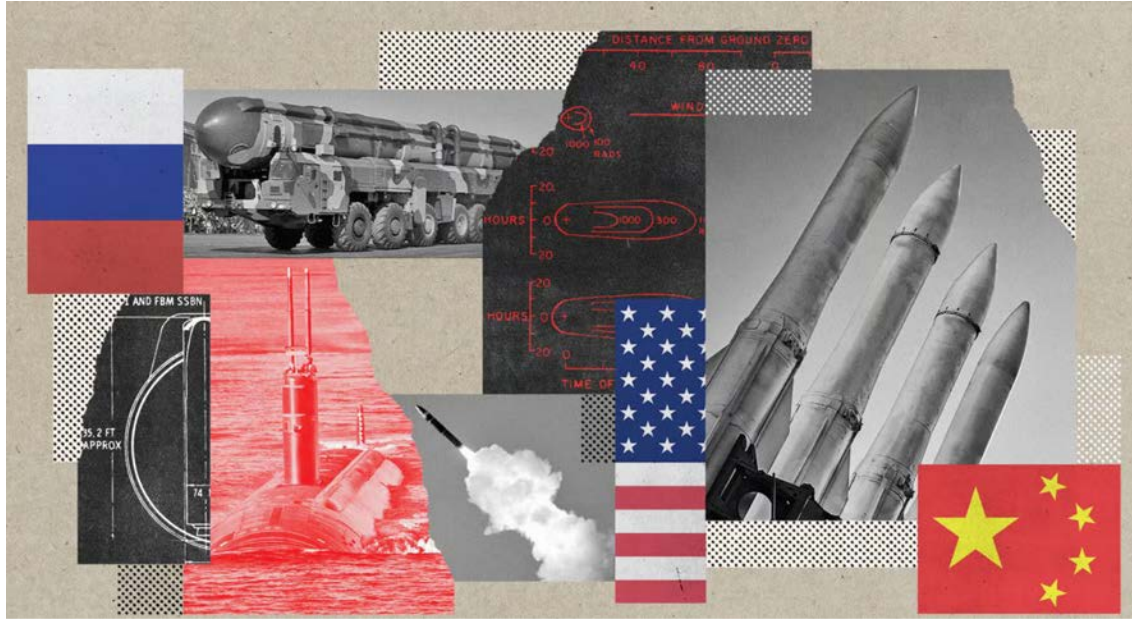


Figure 4. NNSA Asset condition by replacement plant value percentage²⁴⁰

*Is More Better?

While official doctrine has remained **unchanged**, there are increasing calls among some for a quantitative and qualitative **increase** in the number and type of nuclear forces...



*Is More Better?

While official doctrine has remained unchanged, there are increasing calls among conservatives for a quantitative and qualitative increase in the number and type of nuclear forces...

The U.S. Nuclear Arsenal Can Deter Both China and Russia

Why America Doesn't Need More Missiles

By [Charles L. Glaser](#), [James M. Acton](#), and [Steve Fetter](#)
October 5, 2023



Posing with nuclear missiles in Beijing, October 2022
Florence Lo / Reuters

*Nuclear “Uses”

Under what conditions would states use nuclear weapons?

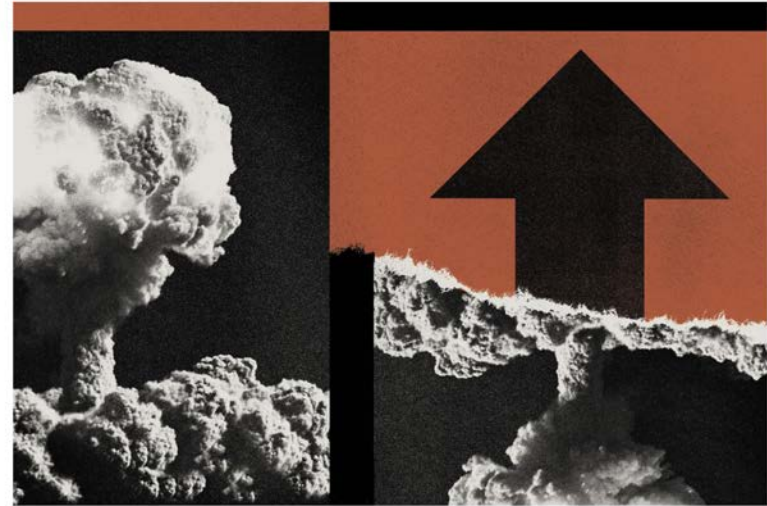
- In response to adversary nuclear use?
- In response to adversary attack with “strategic effects”
- For warfighting?

The Return of Nuclear Escalation

How America’s Adversaries Have Hijacked Its Old Deterrence Strategy

By [Keir A. Lieber](#) and [Daryl G. Press](#) November/December 2023

Published on October 24, 2023



Joan Wong

*Nuclear Targeting

Should the US maintain its current nuclear targeting policy of holding at risk China's and Russia's **leaders, nuclear command-and-control capabilities, military forces, and war supporting industry** (WSI), or should it shift to an approach that focuses on **conventional forces** and **WSI**?



The screenshot shows the CSIS (Center for Strategic & International Studies) website. The navigation bar includes a menu icon, 'Programs', and 'Experts'. The main content area is titled 'Events' and features a blue 'UPCOMING' badge, a location pin icon for 'In Person', and a cloud icon for 'Webcast'. The event title is 'PONI Live Debate: U.S. Nuclear Targeting' in large white text. Below the title, the date and time are listed as 'January 25, 2024 • 10:00 - 11:00 am EST'.

<https://www.csis.org/events/poni-live-debate-us-nuclear-targeting>

Vocab:
Counterforce vs. Countervalue targeting

*Whither SLCM-N?

SLCM-N and non-strategic weapons

- Cancelled in the 2022 Nuclear Posture Review.
- Included in the 2023 NDAA

SPC report encourages “increased deployment” of non-strategic nuclear weapons (particularly in Europe and the Indo-Pacific).

THE DISCRIMINATION PROBLEM: WHY PUTTING LOW-YIELD NUCLEAR WEAPONS ON SUBMARINES IS SO DANGEROUS

9:43

VIPIN NARANG
FEBRUARY 8, 2018
COMMENTARY



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WAR ON ROCKS



DISCRIMINATION DETAILS MATTER: CLARIFYING AN ARGUMENT ABOUT LOW-YIELD NUCLEAR WARHEADS

AUSTIN LONG
FEBRUARY 16, 2018
COMMENTARY



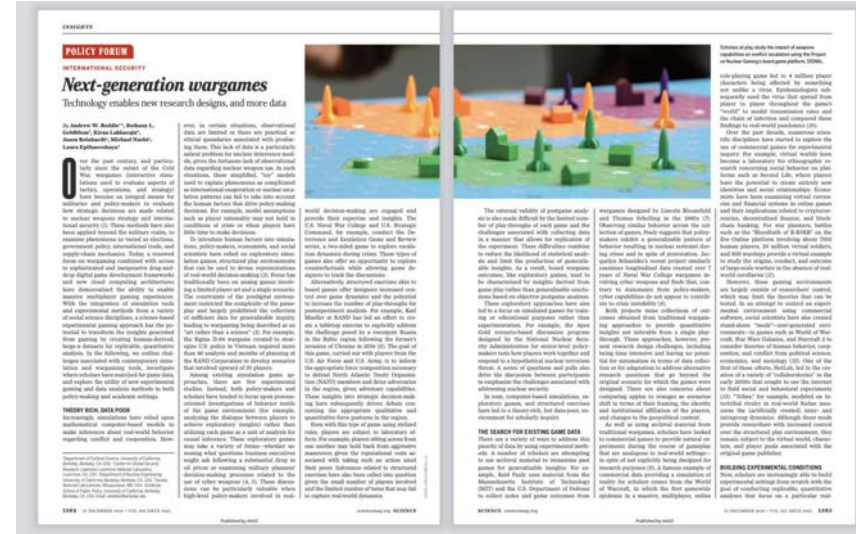
*Whither SLCM-N?

A note on wargaming...

SLCM-N and non-strategic weapons

- Cancelled in the 2022 Nuclear Posture Review.
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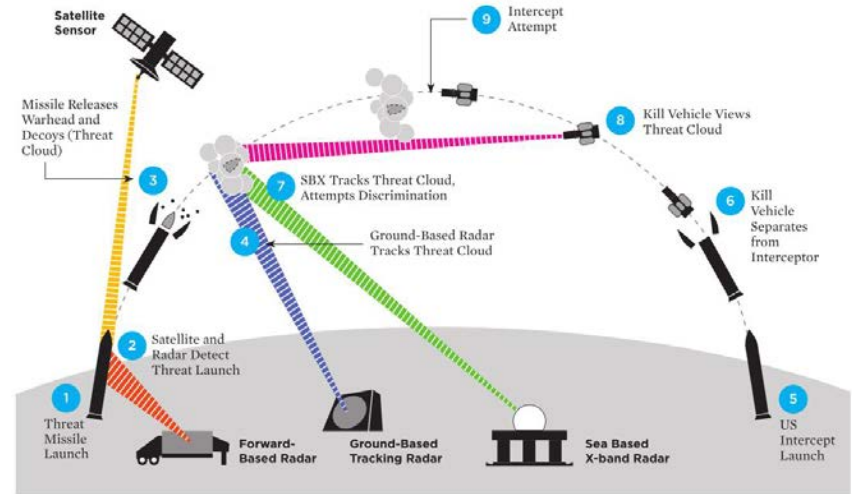
SPC report encourages “increased deployment” of non-strategic nuclear weapons (particularly in Europe and the Indo-Pacific).



*Whither Missile Defense?



Anatomy of an Intercept



The GMD system involves a complex, global network of components. The launch of the threat missile (1) is detected by forward-based radars, if present, and satellite-based infrared sensors (2). The threat missile releases its warhead and decoys (in this example the decoys are balloons, and a balloon contains the warhead; together they are referred to as the "threat cloud") (3), and the ground-based radar begins tracking the threat cloud (4). Based on information from this radar, the GMD system launches one or more interceptors (5), each of which releases a kill vehicle (6). If a discrimination radar, such as the Sea Based X-band Radar, is in place it will observe the threat cloud to try to determine which object is the warhead (7) and pass this information to the kill vehicle. The kill vehicle also observes the threat cloud to attempt to determine which object is the warhead (8). It then steers itself into the path of the chosen object and attempts to destroy it with the force of impact (9).

© Union of Concerned Scientists

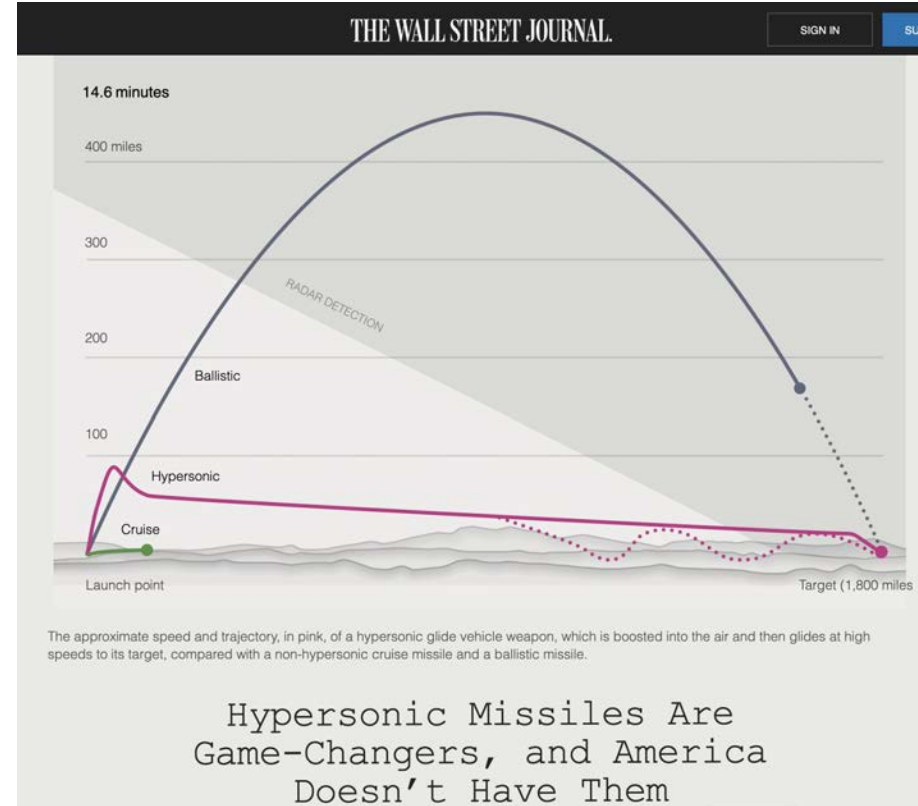
*Hypersonic Weapons

Hypersonic denotes a speed of greater than Mach 5

- Glide vehicles
- Scramjet vehicles

What are the key characteristics of a hypersonic weapon?

What are the missions for the weapon?



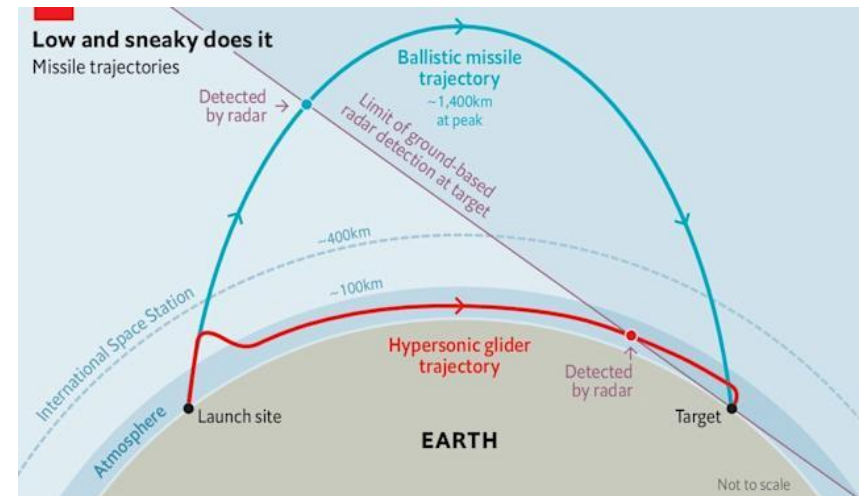
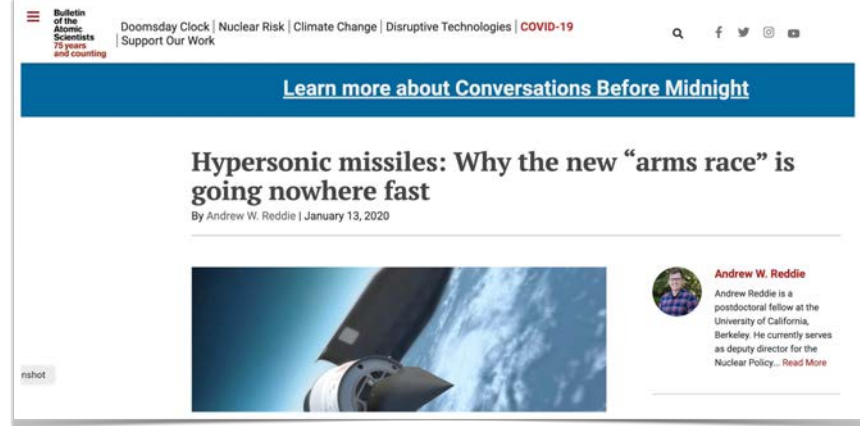
*Hypersonic Weapons

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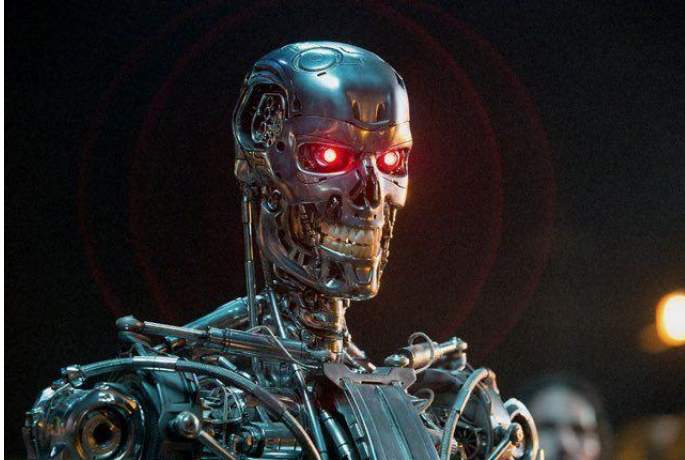
- Glide vehicles
- Scramjet vehicles

What are the key characteristics of a hypersonic weapon?

What are the missions for the weapon?



*“The AI”



Vs.

AI applications that are worthy of our attention tend to be the more mundane...

Machine Learning &
Pattern Recognition



ALGORITHMS FOR
DECISION MAKING



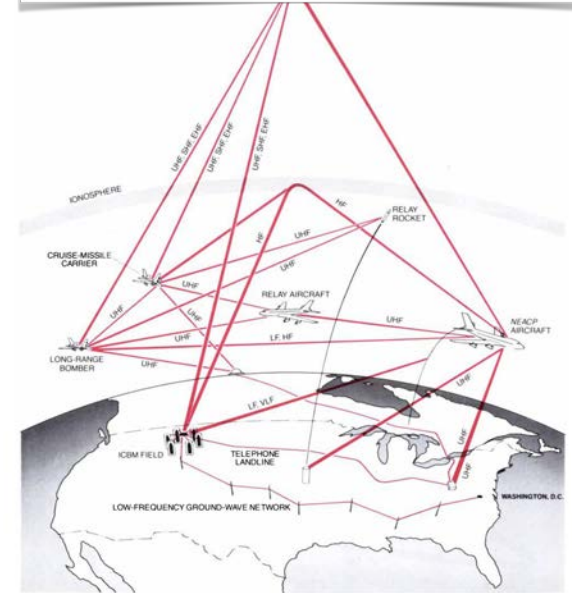
*Machine Learning and AI-NC₃ Integration

There are three clear intersections between ML capabilities and nuclear weapons:

- Signal/Anomaly detection (early warning)
- Dynamic (Re-)Targeting
- Decision support
 - “Left of launch” operations (prediction)

With consequences for...

- Conflict timelines; Uncertainty (particularly in cases of **data poisoning**)





Thanks!

areddie@berkeley.edu; brsl.berkeley.edu

The End of Arms Control?

Linton F. Brooks

For almost half a century, the United States and the Soviet Union/Russian Federation have used arms control treaties to help regulate their nuclear relationship. The current such agreement, the 2011 New START treaty, expires in 2021, although the signatories can extend it until 2026. Because of mutual mistrust and incompatible positions on what to include in a follow-on agreement, New START will probably expire without a replacement. This essay examines the reasons for the demise of treaty-based arms control, reviews what will actually be lost by such a demise, and suggests some mitigation measures. It argues for a broader conception of arms control to include all forms of cooperative risk reduction and proposes new measures to prevent inadvertent escalation in crises.

Not so fast...

*The Future of Arms Control

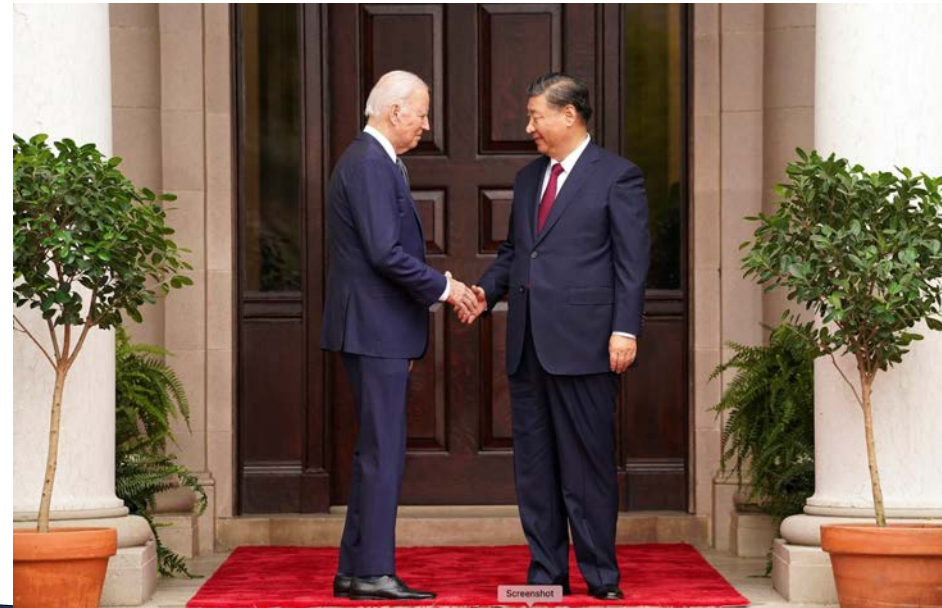
It is unlikely that the **strategic imperatives** behind arms control will disappear, though it may look different moving forward...

- Nuclear limits *sans* verification
- Nuclear risk reduction and nonproliferation at the margins
- AI governance and confidence building measures

Authored by Shannon Bugos and Heather Foye on September 8, 2022

The United States and Russia committed to a statement expressing the need for the world's two largest nuclear-weapon states to negotiate a follow-on arms control arrangement to the 2010 New Strategic Arms Reduction Treaty ([New START](#)), which expires in under four years. This commitment came during the monthlong 10th review conference for the 1968 nuclear Nonproliferation Treaty (NPT) held in August, at which U.S. President Joe Biden stated that his administration stands prepared to begin such arms control talks.

"The Russian Federation and the United States commit to the full implementation of the New START Treaty and



National Security in an Uncertain World

Dr. Kimberly S. Budil

Director, Lawrence Livermore
National Laboratory

13

February

4:00 - 6:00 pm

**Banatao Auditorium
Sutardja Dai Hall**



BRSL



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Cybersecurity

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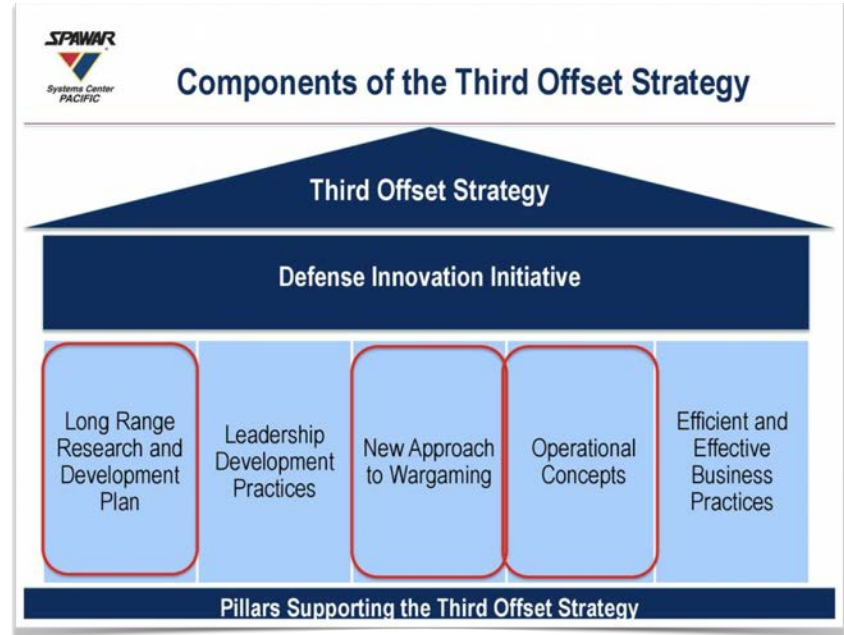
Berkeley

Center for Law
& Technology

“Offset Strategies”

For the United States, nuclear weapons represent a key way in which technological development allows for substitution of capability and “**offset strategies**”

- First Offset (1950s)
- Second Offset (1970s and 1980s)
- Third Offset (2010s)
 - Robotics, artificial intelligence, miniaturization



Notes

- What are the drivers of US nuclear policy, and what has changed / is changing?
- How do developments in Russia, China, and DPRK affect things?
- What are some misconceptions about US policy and the policies of other countries?
- In what ways will technological change affect nuclear risk?
- What can we learn from wargames and simulations? Can they help us prepare better? Improve decision making in a crisis? Under what circumstances might we think of wargames as experiments that have broader validity? How does this field intersect with forecasting?
- How concerned should we be about the intersection of AI and nuclear, both in the US and other countries?
- For people interested in careers in this field, what skills, competencies, experiences, and networks should they seek to build?
- What role do academic organizations and NGOs play? (He can talk here about the Berkeley risk lab he founded)

The Future of Arms Control

The Arms Control Puzzle

Why do states that compete with one another—arming proxies, stealing IP, and engaging in gray zone warfare—create agreements that curtail their ability to proliferate weapons that might help them prevail in a conflict?

Secondarily, why develop and then limit military technologies?



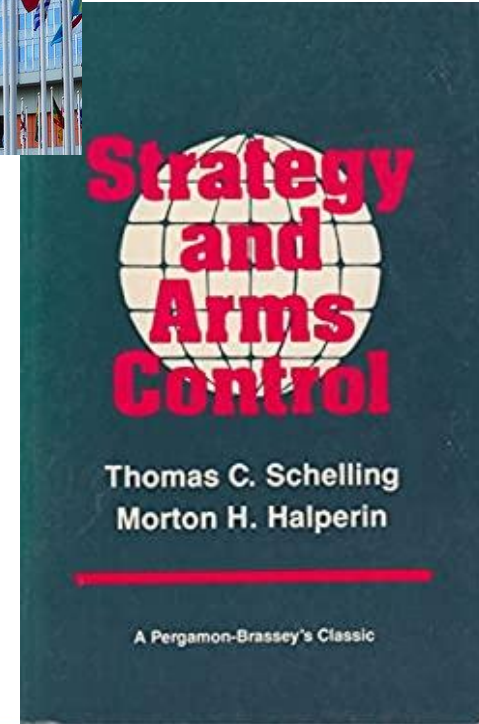
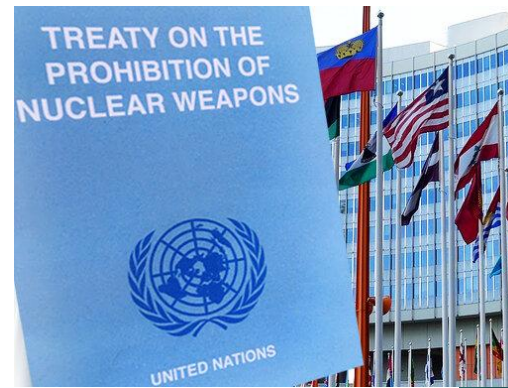
My Answer

It has less to do with the normative or **moral** concerns...

... and more to do with **strategic benefits**

- Cooperative arms control
- Competitive arms control

And this is good news...



A Working Definition

“...all the forms of military cooperation between potential enemies in the interest of reducing the likelihood of war, its scope and violence if it occurs, and the political and economic costs of being prepared for it.” (Schelling and Halperin)

More specifically, agreements at the **international** level to limit or control the **development, production, stockpiling, proliferation** and **usage** of specific **technologies** with **military applications**.

- Importantly, this definition is expansive—beyond the nuclear, treaty-based arms control examples that come to mind (e.g., SALT, START, etc.)
- **Note: Does not require that the regime be subject to monitoring and verification

A (Very) Brief History of Arms Control (1)

Arms control regimes focused on the **disarmament** of those defeated in war

- From the Rome-Carthage Treaty of 201BC to the 1919 Treaty of Versailles

And also on the “**rules of war**”

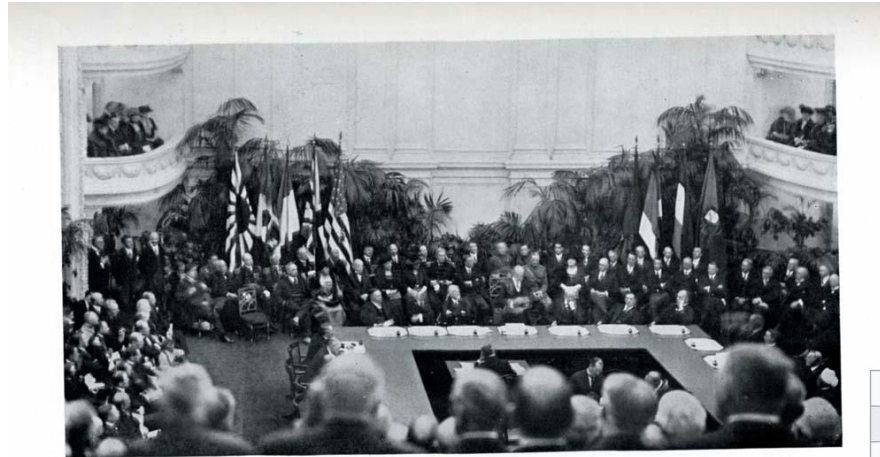
- In the 1000s: Poitiers, Limoge, and other towns where the Catholic church proscribed violence temporarily—and one specific classes of people
- 1139: Canon 29 of the Second Lateran Council prohibits the use of crossbows on Christians
- Canon 71 of the Fourth Lateran Council prohibits the sale of weapons to the non-Christian Saracens (yes, this is export control)



A (Very) Brief History of Arms Control (2)

And to “**control**”
strategic competition
among states

- Washington Naval Treaty of 1922 limits naval construction, asymmetrically



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PHOTOGRAPH MADE IN THE AUDITORIUM OF MEMORIAL CONTINENTAL HALL, ON NOVEMBER 12, 1921, AT THE OPENING SESSION OF THE CONFERENCE ON THE LIMITATION OF ARMAMENT, SHOWING SECRETARY OF STATE HUGHES JUST BEFORE READING HIS MESSAGE TO THE WORLD'S LEADERS SEATED ABOUT THE SQUARE TABLE. IN THE FOREGROUND ARE M. VIVIANI AND M. BRIAND. FACING THE CAMERA ARE LEFT TO RIGHT, SENATOR OSCAR UNDERWOOD, HON. ELIHU ROOT, SENATOR LODGE, SECRETARY HUGHES, MR. BALFOUR, LORD LEE OF FAREHAM AND SIR AUKLAND GEDDES. IN THE BACKGROUND CAN BE DISTINGUISHED SAMUEL GOMPERS, GENERAL PERSHING, THEODORE ROOSEVELT AND HERBERT HOOVER.

Tonnage limitations		
Country	Capital ships	Aircraft carriers
British Empire	525,000 tons (533,000 tonnes)	135,000 tons (137,000 tonnes)
United States	525,000 tons (533,000 tonnes)	135,000 tons (137,000 tonnes)
Empire of Japan	315,000 tons (320,000 tonnes)	81,000 tons (82,000 tonnes)
France	175,000 tons (178,000 tonnes)	60,000 tons (61,000 tonnes)
Italy	175,000 tons (178,000 tonnes)	60,000 tons (61,000 tonnes)

A (Very) Brief History of Arms Control (3)

Unique fears associated with the advent of the nuclear age led to multilateral efforts to “control” the proliferation of weapons of mass destruction:

- Baruch Plan of 1946
- Limited Test Ban Treaty of 1963
- Nuclear Nonproliferation Treaty of 1968 (entered into force in 1970)
 - Formation of the IAEA
 - Made permanent in 1995
- Biological Weapons Convention of 1972 (entered into force in 1975)
- Chemical Weapons Convention of 1993 (entered into force in 1997)



A (Very) Brief History of Arms Control (3)

And associated efforts to prevent the sharing of technologies across borders, referred to as **export control**:

- Coordinating Committee for Multilateral Export Controls, CoCom (1949)
- Zangger Committee/Nuclear Suppliers Group (founded in 1971; NSG in 1974)
- Missile Technology Control Regime of 1987
- Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies of 1996

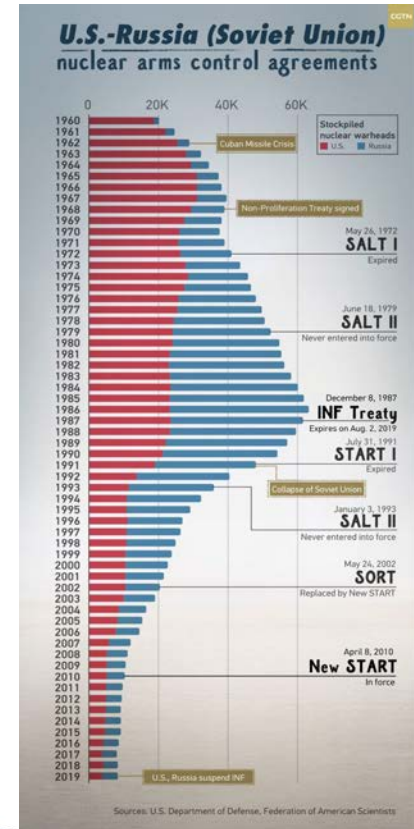
**In the United States over the past five years, CFIUS/FIRRMA and sanctions policy as tools of economic statecraft particularly pronounced.

A (Very) Brief History of Arms Control (4)

Alongside these multilateral regimes, the United States and USSR (and then Russia) negotiated a series of bilateral, nuclear arms control agreements (*some of which became multilateral following the fall of the USSR)

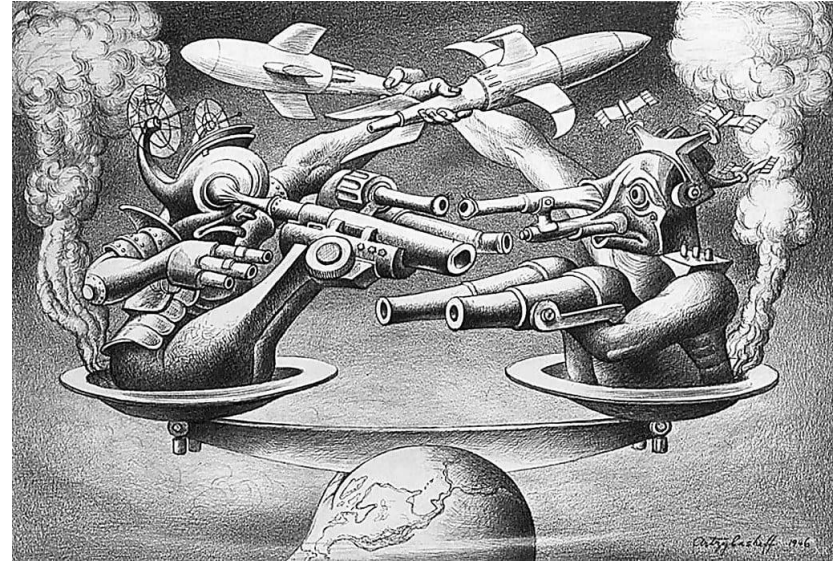
- These agreements varied in terms of their design—most notably in terms of their monitoring and verification arrangements

There were also nuclear-adjacent agreements, most notably the Anti-Ballistic Missile (ABM) Treaty 1972–2002 and CFE.



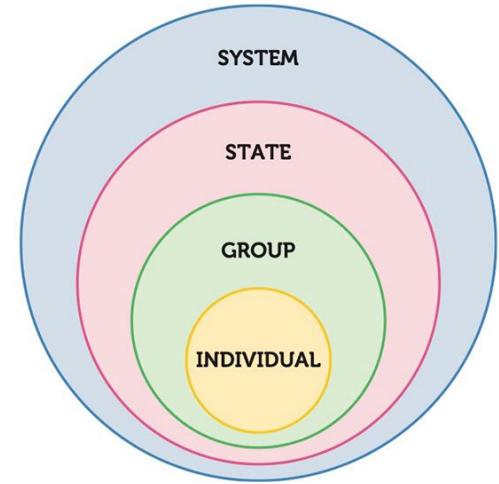
Arms Control in Theory

- Take the basic question, **how do you maximize your security?**
- Do you want **more** quantitative or qualitative capability at your fingertips or **less**?



Arms Control in Theory

- But, your adversary feels exactly the same way...
- This is where we get concerned about a **security dilemma** and associated “arms racing” behavior.
 - Arguably, increasing the likelihood of conflict...
- Thus, a state pursuing its national security imperatives is reducing stability at the level of the international system (e.g., BMD)



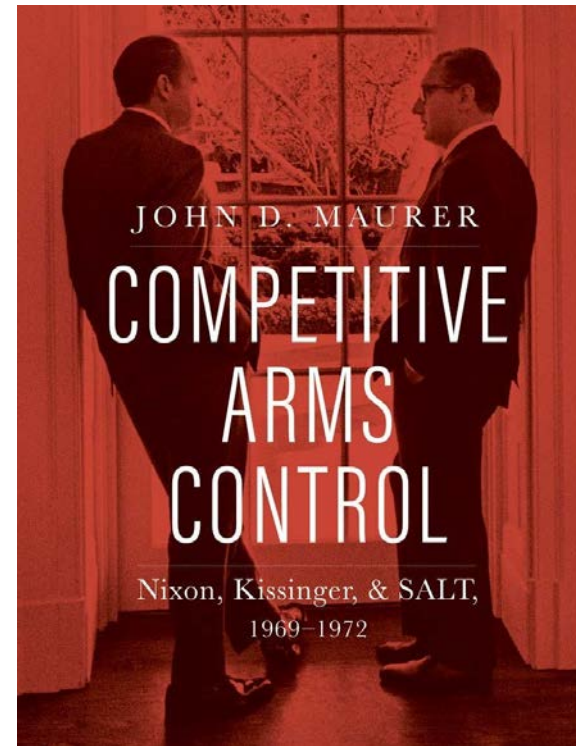
Arms Control in Theory

- Thus, it might make sense for adversaries to cooperate to seek **mutual stability**
 - Seeking arrangements that allow for the “avoidance of war that neither side wants” (Schelling)
 - In practice, reducing the advantage of a state going first (“first strike stability”) and creating the conditions that allow for punishment (“second strike stability”)
- This becomes particularly important given classes of weapons with existential consequences—where inadvertent escalation would have devastating consequences
- Arms control sought to solve this problem
 - NTM, data exchanges, inspections, verification regimes

Arms Control in Theory

Arms control also offered ancillary benefits

- Reduction in military spending that might have otherwise occurred
- Opportunities to pursue “competitive arms control” (Maurer)
 - Where states negotiate to benefit themselves
 - This might explain why states **pursue technologies that it may not use** as a bargaining chip (SLCM-N; hypersonics)



3 Phases of Arms Control:
Negotiation; Agreement;
Practice

The End of Arms Control?

Linton F. Brooks

For almost half a century, the United States and the Soviet Union/Russian Federation have used arms control treaties to help regulate their nuclear relationship. The current such agreement, the 2011 New START treaty, expires in 2021, although the signatories can extend it until 2026. Because of mutual mistrust and incompatible positions on what to include in a follow-on agreement, New START will probably expire without a replacement. This essay examines the reasons for the demise of treaty-based arms control, reviews what will actually be lost by such a demise, and suggests some mitigation measures. It argues for a broader conception of arms control to include all forms of cooperative risk reduction and proposes new measures to prevent inadvertent escalation in crises.

Not so fast...

The Future of Arms Control

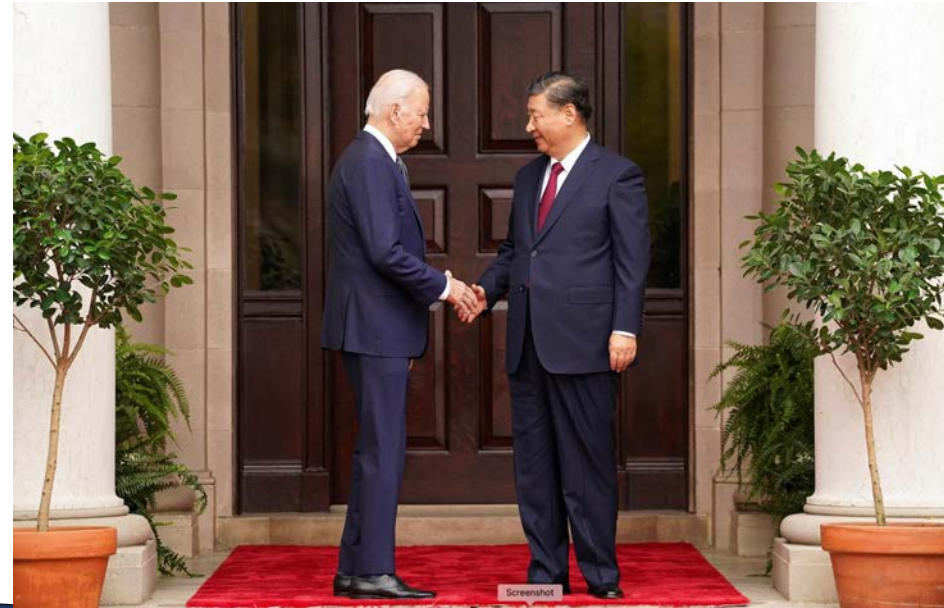
It is unlikely that the strategic imperatives behind arms control will disappear, though it may look different moving forward...

- Nuclear limits *sans* verification
- Nuclear risk reduction
- AI governance and confidence building measures

Authored by Shannon Bugos and Heather Foye on September 8, 2022

The United States and Russia committed to a statement expressing the need for the world's two largest nuclear-weapon states to negotiate a follow-on arms control arrangement to the 2010 New Strategic Arms Reduction Treaty (New START), which expires in under four years. This commitment came during the monthlong 10th review conference for the 1968 nuclear Nonproliferation Treaty (NPT) held in August, at which U.S. President Joe Biden stated that his administration stands prepared to begin such arms control talks.

"The Russian Federation and the United States commit to the full implementation of the New START Treaty and



The Future of Arms Control

What comes after 2026?

- Qualitative and quantitative shifts in nuclear force postures
- Long-term disagreements
 - Missile Defense
 - Non-Strategic Nuclear Weapons

U.S., Russia Agree to Call for Negotiating New START Successor

ARMS CONTROL NOW

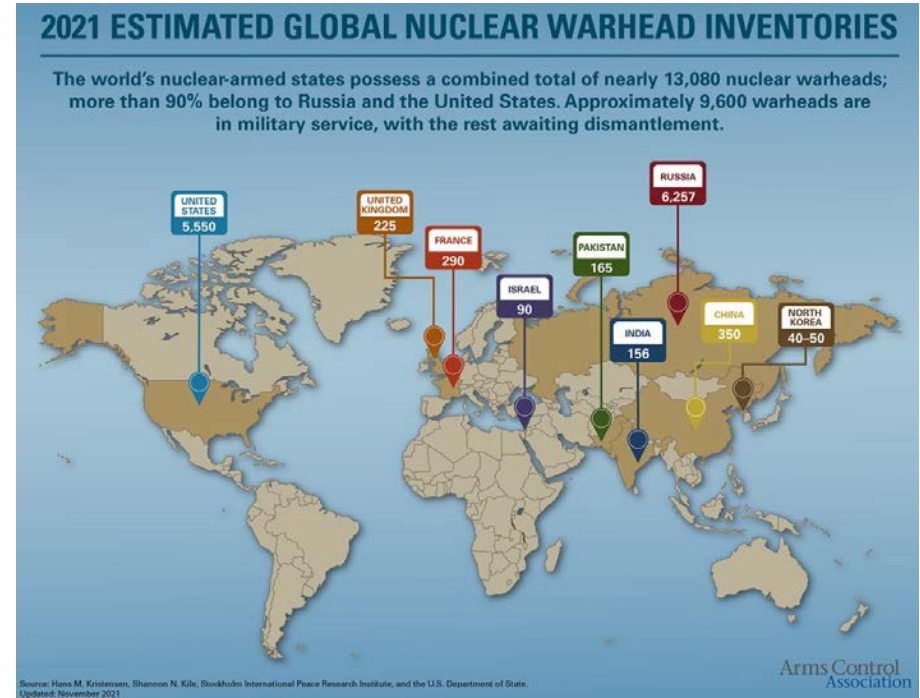
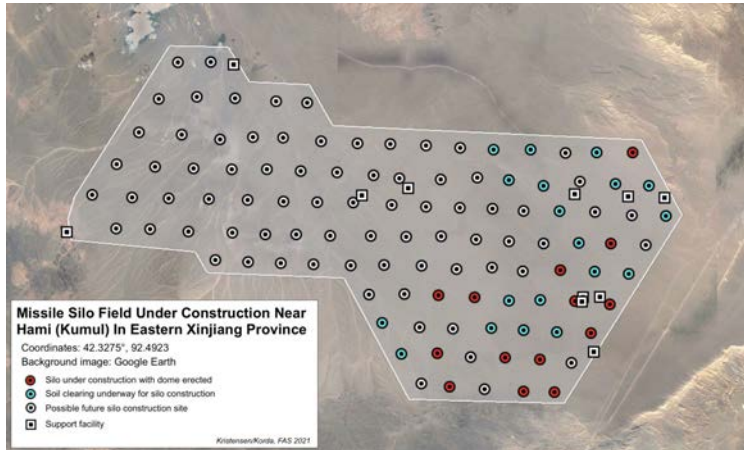
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"The Russian Federation and the United States commit to the full implementation of the New START Treaty and to pursue negotiations in good faith on a successor framework to New START before its expiration in 2026, in order to achieve deeper, irreversible, and verifiable reductions in their nuclear arsenals," states the final draft document of the NPT conference.

Why We Care About Arms Control Today...

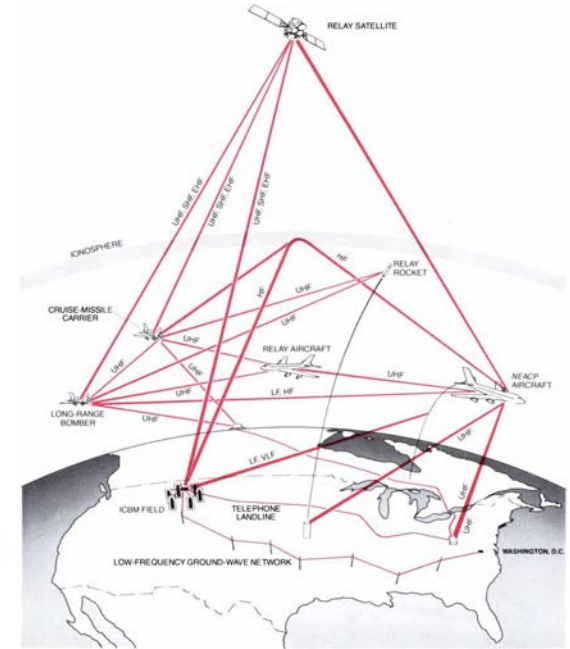
And **who** is going to be involved in the negotiations?



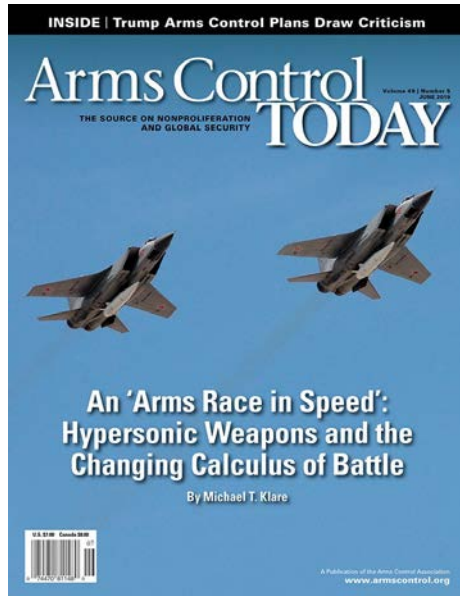
*AI-NC₃ Integration

Under what conditions (and with what emergent properties) do AI technologies yield stability risks?

- Signal detection
 - Data poisoning
- Decision support
 - Left-of-launch preemption



Beyond “Nuclear” Arms Control



Today's Arms Control Pitfalls

Strained Relationships

Increasing distrust between the U.S. and Russia, as well as between stakeholders in the U.S. in China. Lack of operational communication between the US military and the PLA alongside waning U.S. - Russia operational communication.

Rhetorical and Doctrinal Opacity

Including political divisions over doctrine in the U.S. (such as the SLCM-N debate, and highlighted be the different NPRs), unexpected Russian nuclear rhetoric, and lack of clarity about the continuance of long-standing PRC doctrine (including No First Use and warhead demating)

Talent Erosion and Scarcity

Lack of recent arms control agreements has meant less prioritization of arms control talent, and a loss of opportunities to train future arms control experts

Key U.S. Nuclear Posture Challenges

- 1. Timely Modernization:** challenges within the defense industrial base threaten the U.S.'s modernization timelines, with submarine industrial base of particular concern
- 2. Warhead production:** in particular, the U.S. government is concerned about its capability to ramp up plutonium pit production, with a goal of producing 80 pits a year.
- 3. Three Body Problem:** The U.S. faces two near peer nuclear competitors at the same time, in different theatres, holding different interests, and with different nuclear and conventional capabilities.

Opportunities for Arms Control

Russia

1. Long-standing arms control relationship with the United States, some of which remains intact
2. Budget deficits and focus on rebuilding conventional forces post Ukraine
3. Not all of the “doomsday suite” has worked (ex. Burevestnik), allowing for so

China

1. Seeking greater influence in international institutions
2. Previously rejected participating in arms control on the bases of a capabilities imbalance, which is now narrowing
3. Concerned about U.S. capabilities, and might be interested in negotiating them away

Autonomous Systems

Surveillance vs. “kinetic” mission sets

Human-machine integration:

- HITL
- HOTL
- HOOTL

The “Race to the bottom” and AI governance



Nuclear Modernization

- Proposition: Nuclear weapons remain central to the future of war—particularly among great powers...

One of our great fears is that emerging technologies make the practice of deterrence more difficult

- Effects on **survivability**... and thus **mutual vulnerability** that underpins deterrence

