



HARVARD Kennedy School
BELFER CENTER
FOR SCIENCE AND INTERNATIONAL AFFAIRS
Managing the Atom Project

Reducing the Risk of Nuclear War

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1

Effect of a single nuclear weapon

2



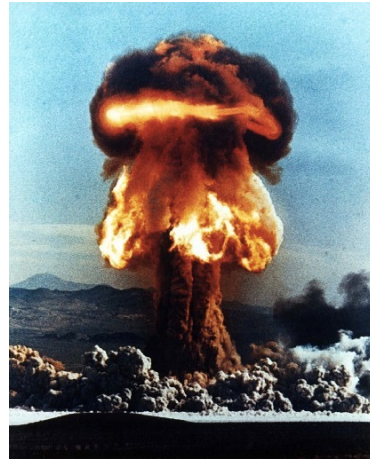
Source: Time-Life

2

How might a nuclear war start?

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- ❑ Nuclear deterrence makes a rational decision to begin a nuclear war hard to imagine...
- ❑ But Cold War crises, and pre-nuclear wars, highlight the dangers of unintended escalation, miscalculation in the heat of the moment, accidents, unauthorized use, decisions based on wrong information...
- ❑ Leaders might believe a limited use of nuclear weapons could avoid devastating defeat – and they could deter further response



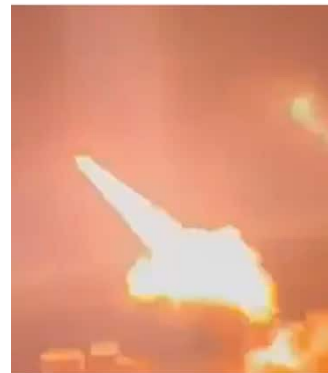
Source: Department of Energy

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Edging toward the brink?

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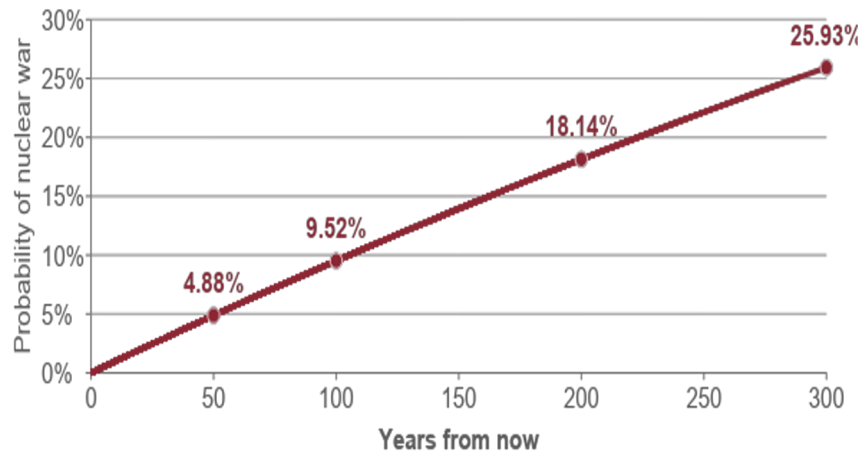
- ❑ Cuban Missile Crisis, 1962
 - Kennedy's guess: 1/3 chance of nuclear war
- ❑ Berlin Crisis, 1961
 - President briefed on option for nuclear 1st strike
 - President directs option that would “visibly increase the risk of nuclear war”
- ❑ Russia's war on Ukraine, 2022
 - U.S. agencies estimated 50% chance Putin would use nuclear weapons if Ukraine's counteroffensive threatened Crimea
- ❑ India-Pakistan, 2025
 - Firstt-ever large-scale aerial combat, missile and drone strikes, between nuclear-armed states



Fateh-2 missile launched against India. Source: X@DeepikaBhardwaj

4

Even a 1/1000 annual chance adds up over the long term...



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We need risk-reduction action on each step on the pathway to nuclear war



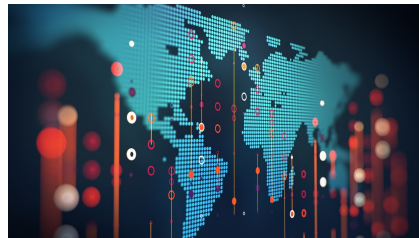
- ❑ Key step: preventing crises. Any militarized crisis between nuclear-armed states is dangerous – “fog of crisis” raises risks
 - Avoiding crises is partly deterrence – but mainly foreign policy
 - A more prudent foreign policy for a dangerous nuclear era?
- ❑ Preventing escalation from crisis to conflict
 - Partly deterrence – partly negotiation, de-escalation, reassurance
- ❑ Preventing escalation to nuclear use
 - Similar issues – but heavier emphasis on deterrence
- ❑ How to reassure, reach resolutions, in the midst of hatred, fear, disinformation, in crisis or conflict?

6

All such conflicts likely to be complex, multi-domain affairs – possibly multi-player

7

- ❑ Future conflicts likely to involve many domains – land, air, sea, space, cyber
 - “Integrated,” “multi-domain” deterrence still poorly understood
 - Will asymmetric responses – e.g., conventional strikes in response to devastating cyber attacks – increase escalation risks?
 - A lesson of past crises: fog of crisis, misperception, events no leader intended...
- ❑ In multi-polar nuclear world, will others join in, or stay out?



Source: CSIS

7

How might deliberate leadership decisions to use nuclear weapons happen?

8

- ❑ Leaders might reach for the nuclear button when they believed they or their country would be better off after nuclear use
 - Use against a non-nuclear state without a nuclear ally
 - Use against a state whose forces were so vulnerable the leader believed a damage-limiting strike was possible
 - Limited use to achieve particular political or military objectives, believing that the adversary would be deterred from a devastating response (e.g., “escalate to deescalate”)



Source: USAF

8

Categories of incentives for leaders to use nuclear weapons first

9

- ❑ Preemptive – leader believes an attack is coming, strikes first
 - ❑ Preventive – leader believes adversary is getting dangerous capabilities, strikes to prevent that
 - ❑ Defensive – leader believes nuclear use is needed to protect the survival of the state/regime, or another vital interest (such as an important ally)
 - ❑ Offensive – leader believes nuclear use will help secure a very important offensive victory
 - ❑ Coercive – leader believes nuclear use will force an adversary to take a a desired action
 - ❑ Force protective – leader faces “use them or lose them” pressure
- Actions in each category have been planned or considered in the nuclear age...*

9

Beyond deliberate leadership decisions...

10

- ❑ Unauthorized use
 - Field commanders might believe use was essential
 - Authority or capability might be pre-delegated to them
- ❑ False alarm
 - Deliberate decision, but mistake
- ❑ Escalation from accident
 - E.g., accidental detonation, accidental launch
 - More likely to lead to escalation if occurs in a major crisis or conflict – and more likely to occur then (Sagan, “Limits of Safety”)



Damage from accidental explosion in Beirut, 2020

Source: Mehr News Agency

10

How are changing geopolitics changing the risk of nuclear war?

11

- ❑ Dramatic increase in U.S.-Russian hostility
 - Russia more aggrieved, willing to use violence, than was understood
 - Russian conventional forces weakened – greater nuclear reliance
 - Almost all dialogue cut off
 - Last accord limiting U.S. and Russian forces expired
- ❑ Dramatic increase in Chinese power, U.S.-Chinese hostility
 - Far more powerful conventional forces, >3x increase in nuclear force
 - No strategic dialogue, no arms control restraints
- ❑ Multipolar deterrence
 - Does the U.S. need to be prepared to fight both Russia and China?
 - Now 9 nuclear-armed states
 - Multipolar orders tend to be more war-prone...

11

How are evolving technologies changing the risk of nuclear war?

12

- ❑ Artificial intelligence, drones, autonomy
 - > 1st-strike threats to nuclear forces?
 - Changed decision environment, affects risk of escalation
- ❑ Cyber – blurring lines between peace and war, no defined escalation thresholds
- ❑ Counter-space – could lead to escalation
- ❑ Precision conventional – sometimes both forces and C3 “entangled” with nuclear, so attacks in conventional conflict could be seen as nuclear threat...
- ❑ Missile defense – could increase chance of unrestrained arms race



12

How will AI change the picture?

13

- ❑ Already deeply integrated into military operations
 - All nuclear-armed states committed to keeping humans in control of nuclear launch decisions – but how will their decision environment change?
- ❑ AI could affect (in ways we mostly do not understand):
 - Probability of militarized crises between nuclear-armed states
 - Incorrect AI advice could lead to crisis – as could social, economic, political disruptions from dramatic change
 - AI could also help negotiators find new ideas, avoid crises
 - Probability of crises escalating to armed conflict
 - AI increases the pace of battle (worse human decisions) – all decisions will be AI-influenced
 - Autonomous weapons easier, or harder, to avoid escalation?
 - Probability of armed conflict escalating to nuclear use

13

What about AIs out of human control?

14

- ❑ Intelligent agents outside of human control are likely to change many aspects of human life – we'll be living with a new species
 - They may be more “capable” than we are – but think differently
 - Nuclear weapons command systems are “air-gapped” – is that enough?
 - Iranian Natanz enrichment plant was air-gapped – but attacked by Stuxnet hack
 - Could agents influence humans to give them access to relevant systems, codes? Or influence humans to carry out the decisions AIs preferred?
- ❑ Of course, nuclear is only one of many tools by which AIs could cause catastrophic harm
- ❑ BUT, AI may also open new opportunities for negotiation, mediation, that reduce overall international risks...

14

Dateline: Iran

15

- ❑ 2025 war greatly reduced Iran's nuclear capabilities – not so of current war
 - U enrichment not operational, still has HEU for several bombs, centrifuges
 - Many uncertainties – where is the HEU, are there more centrifuges, other deeply buried sites, few inspections underway
- ❑ But wars likely increased Iran's incentives to get the bomb – needs a deterrent against further attack
 - My guess: probability Iran has nuclear weapons in 10 years higher now



Source: khamenei.ir

15

The Iran nuclear archive



- ❑ 6 key conclusions:
 - Iran had focused program to produce, test nuclear weapons
 - Made more technical progress than had previously been known
 - Has ability to reconstitute
 - Much more foreign assistance than previously understood
 - Some facilities, activities went undetected
 - Issues will have to be addressed in future deals
- ❑ Many mysteries remain...

16

Dateline: North Korea

17

- ❑ Unpredictable dictator armed with dozens of nuclear weapons, ballistic missiles that can reach United States
 - Testing wide range of missiles, testing, nuclear test possible, HEU, Pu production unabated
 - Has threatened to rain “nuclear fire” on ROK, Japan, United States
 - History of provocations
- ❑ Agreements, sanctions, threats have all failed
- ❑ No clear prospects for “denuclearization”



Source: KCNA

17

Dateline: South Asia

18

- ❑ Clash in 2025 included the deepest strikes in 50 years
- ❑ Ongoing nuclear arms race
- ❑ Disputed territory; terrorists who might provoke conflict; could blunder into war
 - But have ended recent crises
- ❑ Both have growing nuclear arsenals, some of the world’s most capable terrorists
- ❑ Some modeling suggests even Indo-Pakistani nuclear war could cause “nuclear fall”



Source: Wikimedia Commons

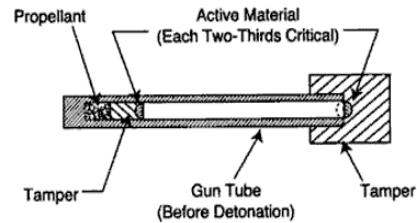
18

Dateline: Unknown

Nuclear and radiological terrorism

19

- ❑ Numerous gov't studies: terrorist group *could* plausibly make a crude bomb if it got material
- ❑ ~20 cases of seizure of stolen HEU or plutonium
- ❑ Aum Shinrikyo, al Qaeda both pursued nuclear weapons
- ❑ ISIS intent unclear, but had more money, people, territory under control, ability to recruit globally than al Qaeda ever had



Source: NATO

19

Will the nuclear order hold?

20

- ❑ Last treaty limiting U.S. and Russian nuclear weapons expired 2/26 – will some follow-on arrangement be found? Will China's buildup be constrained somehow?
- ❑ Ukraine, Iran, Iraq, Libya all attacked after giving up nuclear weapons on their soil or nuclear weapon programs – may increase demand for nuclear weapons
- ❑ U.S. allies no longer feel they can rest their security on U.S. guarantees – may also increase demand for nuclear weapons
- ❑ Evolving technologies are complicating nuclear balances, potentially easing proliferation – but could also strengthen verification and monitoring....

20

Some good news about nuclear weapons

21

- ❑ 80 years with no nuclear attacks – amazing success
- ❑ >80% of the world's nuclear weapons have been dismantled
- ❑ <5% of world's states have nuclear weapons – same as 35 years ago
 - No net increase in 3.5 turbulent decades – remarkable achievement
- ❑ >50% of the states that started nuclear weapons programs gave them up
 - Efforts to prevent proliferation succeed more often than they fail
- ❑ >50% of the states that once had potential nuclear bomb material on their soil have eliminated it
- ❑ Nuclear material around the world is far more secure than it was 25 years ago – much harder for terrorists to get
 - Most egregious weaknesses fixed – but more to be done

21

What can you do?

22

- ❑ Get informed
 - Multiple sources of news, analysis
- ❑ Get involved
 - Many organizations (from left to right) working on these issues
- ❑ Help fund efforts to reduce the danger
 - Non-government funding for work on nuclear policy has declined ~80% over last 20 years – insane, given the circumstances
 - Wide range of work to analyze, develop new proposals, bring them to policymakers is funding-constrained
 - Wide range of institutes, organizations deserve support

22

A thought experiment on cost-effectiveness

23

- ❑ If 1/1000 chance of nuclear war that kills 1B people each year, the “expected value” is 1M deaths every year
- ❑ If “value of a statistical life” is \$12M (typical US regulatory figure), expected losses \$12B/yr
 - BUT, actual deaths only a fraction of total consequences
- ❑ If \$20M/yr could reduce the chance of nuclear war by 1%, that’s expected value of \$120M/yr – factor of six return on life-saving investment
- ❑ But can NGOs actually reduce the risk? Past record suggests yes – long history of NGOs suggesting, advocating for ideas that make the world safer, getting them adopted (source of significant part of the “good news”)
 - Few things more satisfying!

23

The importance of presidential judgment

24

- ❑ Cuban Missile Crisis:
 - Initially, Kennedy’s advisors called for air strikes followed by an invasion
 - Kennedy pushed back, asking for another option
 - The recommended course might well have led to nuclear war
- ❑ Kennedy: Key lesson was always to give the adversary a choice between humiliating defeat and nuclear war
- ❑ The world relies on sober judgment by the leaders of nuclear states



Source: JFK Library

24

Further reading...

25

- ❑ Full text of Managing the Atom publications:
<http://belfercenter.org/mta>
- ❑ Full text of Bunn publications and presentations, by topic:
<https://matthewbunn.scholars.harvard.edu>
- ❑ Matthew Bunn, "Preventing Nuclear War in a Multipolar Era of Great-Power Hostility and Evolving Technology," presentation, Norwegian Intelligence School, October 26, 2023, <https://tinyurl.com/2ysmu7gc>
- ❑ *The Iran Nuclear Archive: Impressions and Implications*, 2019
<https://tinyurl.com/2o7gqcm3>
- ❑ *Revitalizing Nuclear Security in an Era of Uncertainty*, 2019
<https://www.belfercenter.org/NuclearSecurity2019>

25

Back-up slides

26

26

Nuclear-related clashes of 2025

27

- ❑ India-Pakistan: First-ever large-scale aerial combat, missile and drone strikes, between nuclear-armed states
- ❑ Ukraine-Russia: First-ever major attack on the strategic forces of a nuclear state by a non-nuclear state
 - And relentless Russian attacks, nuclear saber-rattling, air intrusions/sabotage/murder in NATO countries...
- ❑ Israel-US-Iran: Largest ever air and missile strikes on nuclear program of a non-nuclear state by nuclear-armed states



Fateh-2 missile launched against India. *Source:* X@DeepikaBhardwaj

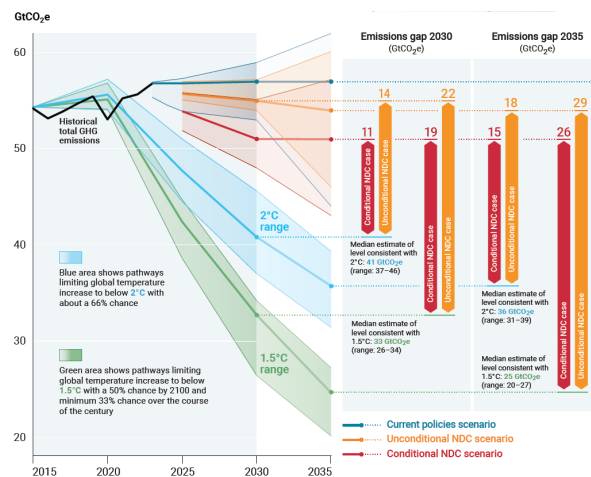
Nuclear weapons on world center stage

27

Huge low-carbon energy growth needed to mitigate climate change

28

Figure ES.3 Global GHG emissions under different scenarios and the emissions gap in 2030 and 2035



Source: UNEP
Emissions Gap
Report, 2024

28

Key constraints on nuclear energy growth to the terawatt scale

29

- ❑ Cost – and financing
- ❑ Safety risks – real and perceived
- ❑ Security risks – real and perceived
- ❑ Nuclear waste management – mostly politics
- ❑ Siting and public acceptance
- ❑ Limited government and industry capacity
- ❑ Stringent regulation
- ❑ Proliferation risks – mainly from the nuclear fuel cycle
- ❑ U supply: Not likely to be a constraint this century

29

The nuclear horizon has darkened in the last 10 years

30

- ❑ Radically increased U.S.-Russian and U.S.-Chinese hostility
 - Dramatic worsening from the war in Ukraine
 - Repeated Russian nuclear threats
- ❑ Large expansion of Chinese nuclear forces underway
 - U.S. considering nuclear buildup to cope with “two nuclear peer” threat
- ❑ Major advances in evolving technologies that complicate nuclear balances – missile defenses, AI, cyber, counter-space, more...
- ❑ Substantially increased doubts over U.S. leadership
 - Increased anxieties among U.S. allies
- ❑ Arms control + risk reduction measures greatly weakened
 - INF Treaty, U.S. + Russian participation in Open Skies treaty gone
 - Almost all U.S.-Russian gov-gov communication was cut off until recent weeks
 - New START suspended, expires 2/26

30

The nuclear horizon has darkened in the last 10 years (II)

31

- ❑ Major expansion in North Korean nuclear + missile arsenal
- ❑ Dramatic increase in Iranian nuclear capabilities – which led to war (major uncertainties about current status)
- ❑ New clashes and ongoing arms competition in South Asia
- ❑ Ongoing nuclear terrorist threats
 - Global terrorist groups reduced but rebuilding (al Qaeda, Islamic State)
 - Expanded insider threats from violent domestic extremists in many countries
 - Reduced global focus on the danger – nuclear security summits long over
- ❑ Increased tensions between nuclear haves and have-nots
 - Symbolized by the nuclear weapons ban treaty, now in force
 - Tensions make nonproliferation progress more difficult
- ❑ Ongoing (expanding?) obstacles to progress toward disarmament

31

Evolving technologies may be reducing deterrent stability

32

- ❑ BMD, cyber, counter-space, precision conventional, autonomy create new complexities → greater escalation risks
 - Cyber blurs lines between peace and conflict, difficult to control
 - Counter-space and cyber may both create incentives to hit first, early
 - Missile defenses complicate strategic planning
 - “Entanglement” of nuclear and conventional forces, command and control create incentives to escalate
 - AI-enabled decisions may shorten decision time, change decision environment



Hypersonic weapon concept. *Source: space.com*

32

Russia's war on Ukraine has upended much of the international order

33

- ❑ A founding member of the United Nations – charged with ensuring international peace and security – is waging large-scale aggressive war
 - Using nuclear threats as shield to protect its offensive war
- ❑ A state that gave up the nuclear weapons on its soil for security assurances is being torn apart
- ❑ Impacts on security, food, energy are reverberating around the world
- ❑ U.S.-Russian talks were cut off



Source: Reuters

33

Pres. Trump's dramatic shifts in U.S. foreign policy create nuclear risks and opportunities

34

- ❑ President Trump has seemed to side with Russia, then rhetoric shifted toward Ukraine -- publicly questioned U.S. alliances
- ❑ Risks:
 - Ukraine more likely to be forced to compromise its sovereignty – sends message to others
 - U.S. adversaries more likely to think U.S. commitments are a bluff, attack U.S. allies or partners
 - U.S. allies feel less protected, more likely to pursue nuclear weapons



Source: AFP/Getty Images

34

Pres. Trump's shifts in U.S. foreign policy create nuclear risks and opportunities (II)

35

❑ Opportunities:

- If an end to Russia's war on Ukraine can be achieved, the risk of nuclear use in that conflict would be ended
- Improved U.S.-Russian relations could make it possible to discuss nuclear restraints, risk reduction



Source: Sputnik/AFP/Getty Images

❑ How the Ukraine war ends matters for future nuclear risks

- If Ukraine ends up with its sovereignty crushed after giving up nuclear arms, sends one signal
- If Ukraine ends up as a thriving, secure democracy, sends another

35

President Trump wants nuclear deals

36

❑ Trump has worried about nuclear war – and sought to be the one to cut a nuclear deal – for decades

- 1980s: wanted President Reagan to appoint him to reach a nuclear arms deal with the Russians
- Has come back to it many times



Source: Department of Defense

❑ In 2nd term:

- Has warned of the danger of nuclear war
- Has called for deals with Russia and China on “denuclearization”
- Launched nuclear talks with Iran before strikes
- Is also seeking deal with N. Korea

36

Cuban Missile Crisis: The tale of sub B-59

37

- ❑ Diesel sub, designed for northern waters, not the Caribbean
 - >110° on board – carbon dioxide high, sailors passing out
- ❑ Sub armed with a nuclear torpedo – physical capability to fire
 - U.S. Navy did not know it was nuclear-armed
- ❑ U.S. Navy using “practice depth charges” to force it to the surface
 - Those on sub believed war had begun, they were under attack
- ❑ Captain reportedly ordered nuclear torpedo prepared for firing
- ❑ Differing accounts of details – but agreement that Capt. Vasily Arkhipov – also on the sub by sheer chance – prevented use

The fog of crisis can lead to disaster

37

The war in Ukraine requires rethinking most aspects of nuclear policy

38

- ❑ With a more aggrieved Russia, more willing to use military force, and more willing to rattle the nuclear saber, nuclear deterrence needs new thinking
 - With weakened conventional forces, Russia will be more dependent on nuclear weapons than before
 - U.S. allies seeking still stronger assurances
- ❑ The future of nuclear arms control is in doubt
 - Intense U.S.-Russian hostility means more nuclear danger, fewer chances to take steps to reduce it
- ❑ The future of nuclear nonproliferation is uncertain
 - Ukraine's fate may lead other countries to reconsider nuclear options
- ❑ Requires rethinking nuclear energy, nuclear safety, and nuclear security with the possibilities of wars, political unrest, state collapse in mind

38

Dateline: Russia

39

- ❑ Aggressive war in Ukraine; nuclear threats, modernization, novel weapons, exercises; cyberattacks; election interference...
- ❑ Intense U.S.-Russian tensions
 - Almost all communication cut off – risk of escalation to direct conflict
- ❑ Russian forces, command and control vulnerable; arms control in crisis; potential for launch on false alarm or unintended crisis escalation



Source: ITAR-TASS

39

Will Russia use nuclear weapons during the Ukraine war?

40

- ❑ Russian leaders might think could break “hurting stalemate,” stop a Ukrainian breakthrough, or end NATO support with nuclear use
 - Destroy military targets
 - Threaten cities and demand surrender (Putin has referred to “precedent” of Hiroshima and Nagasaki)
 - Use against NATO countries
- ❑ US has threatened “catastrophic” response
 - Might Russia conclude it could deter substantial retaliation?



Loading an Iskander missile, 2015 Source: Reuters

40

Dateline: China

41

- ❑ Much smaller nuclear force, but major modernization underway
 - >500 weapons, increasing rapidly
 - 100s of new nuclear missile silos – possibly a goal of parity with the United States
- ❑ Heightened U.S.-China tensions
 - Taiwan, South and East China seas, trade, cyber, other issues
- ❑ No arms control, verification, or dialogue on strategic issues in place
 - China (and Russia) concerned over U.S. missile defenses, conventional strike capabilities, nuclear forces



Source: AP, Li Gang

41

Is nuclear arms control coming to an end?

42

- ❑ Most U.S.-Russian nuclear arms control accords are gone – expired, or one or both sides withdrew...
- ❑ New START – last remaining limit on U.S. and Russian force numbers expires 2/26 – no talks on replacement
 - Russia has “suspended” participation, refusing inspections
- ❑ With China’s growing nuclear arsenal, U.S. faces a more multipolar nuclear world
 - Serious discussion of further buildup of U.S. nuclear forces to meet “two nuclear peer” threat
 - US buildup would likely lead to further Chinese, Russian responses
- ❑ Potential for nuclear arms competition with no agreed restraints – but all sides have incentives to avoid those dangers and costs

42

From Putin's perspective: next steps in arms control

43

- ❑ Imagine: it's 2026, talks on a new arms control agreement are beginning
- ❑ The U.S. wants
 - Lower numbers
 - An accord that limits all warheads – including Russian tactical weapons
 - On-site inspections at warhead sites
 - Inclusion of new Russian weapon types in the treaty's limits
 - But the U.S. refuses any serious limits on missile defenses (including space-based ones) or precision conventional strike capabilities, Ukraine-NATO a problem
- ❑ Should Russia agree?



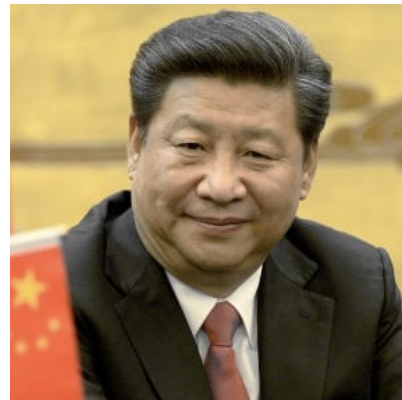
Source: kremlin.ru

43

From Xi's perspective: participate in arms control?

44

- ❑ Imagine: it's 2026
- ❑ The U.S., concerned about China's growing (but still small) arsenal, wants China to agree to limits
 - China doesn't want to be formally locked into an inferior position
 - But China wants to be seen as an advocate of disarmament
 - U.S. is unwilling to constrain missile defenses that China sees as threatening its deterrent
- ❑ What limits, if any, should China agree to?
 - Formal, informal possibilities



Source: Muneyoshi Someya/Getty Images

44

From Kim's perspective: A potential conflict scenario

45

- ❑ Imagine:
 - A major North Korean provocation
 - e.g., shelling an island again
 - South Korea insists on striking back harder, to reestablish deterrence
 - North Korea uses ~6 conventional missiles against a U.S. airbase
 - ROK, U.S., begin an air campaign to destroy the DPRK's missiles
- ❑ DPRK faces “use them or lose them” pressures
- ❑ Can they tell the air campaign is not intended as a prelude to an all-out regime-change attack?



Source: Reuters

45

The surprising success of nonproliferation

46

- ❑ No net increase in nuclear-armed states in 35 years
- ❑ All but 5 states are parties to the nuclear Nonproliferation Treaty (NPT)
 - Obligated not to get nuclear weapons, and to accept inspections
 - Many other accords, initiatives, support the overall regime
 - Never in human history has the most powerful weapon available to our species been so widely forsworn
- ❑ What explains success?
 - Most states realize they are better off if they and their neighbors don't have nuclear weapons
 - Treaty changes states' decision-making: Foreign Minister, Finance Minister now more likely to be at the table, and nuclear weapons advocates need to reverse a decision already made
 - NPT creates norms – easier to build coalitions against programs

46

But growing challenges to the global regime

47

- ❑ Russia's war on Ukraine (which disarmed for security assurances), and doubts about U.S. support are increasing nuclear interest
- ❑ Many states unhappy with the NPT – believe nuclear powers not seriously pursuing disarmament
 - Ban Treaty manifests frictions
- ❑ Ongoing challenges controlling sensitive technologies – new tech. such as additive manufacturing makes more difficult
- ❑ Possible spread of sensitive tech. as nuclear energy spreads



Source: AFP

47

Some key takeaways

48

- ❑ Nuclear weapons continue to pose real risks to U.S. and global security, requiring constant attention to minimize
- ❑ Evolving technologies may reduce deterrent stability – but there is likely to be more continuity than change
- ❑ Nuclear arms control has had real benefits for U.S. and global security, and is worth trying to continue
- ❑ The global effort to stem the spread of nuclear weapons has been surprisingly successful, and serves almost everyone's interests
 - But requires constant effort for continued success
- ❑ Nuclear and radiological terrorism remain real dangers
- ❑ Good policy has managed to reduce nuclear dangers in multiple areas – and can do so again in the future

48

Dateline: Unknown

Nuclear and radiological terrorism (II)

49

- ❑ Terrorists could also sabotage nuclear facilities (potentially cause Fukushima-scale accident), or use radioactive material in “dirty bomb”
- ❑ Policy options
 - Improve security for nuclear and radiological materials, facilities (How to sustain momentum with the summit process years in the past?)
 - Block nuclear smuggling (How to find the needles in the haystacks?)
 - Counter high-capability terrorist groups (How can we do better?)
 - Prepare to respond (How much can this mitigate the harm?)

49

One U.S.-Russian nuclear arms control agreement left – what’s next?

50

- ❑ ABM Treaty, INF Treaty, both terminated
- ❑ Presidents Biden and Putin extended New START for 5 years – but what comes then?
- ❑ New START is working
 - Both sides have met key limits
 - Inspections on hold as a result of pandemic
 - Expires 2/2026
- ❑ Intense U.S.-Russian hostility, Russian treaty violations, make it very difficult to reach, ratify new treaty
- ❑ What about China? What about non-strategic nuclear weapons? What about missile defenses, counter-space weaponry, other factors affecting strategic stability?

50

Why should we care?

Benefits of nuclear arms control

51

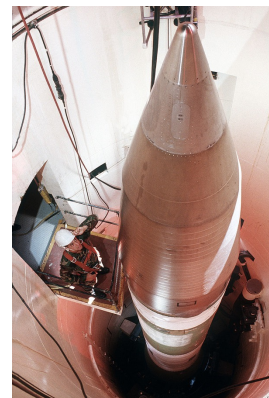
- ❑ Benefits of the agreements themselves:
 - Reduced mutual perceptions of threat
 - Force structure stability
 - Predictability (important for planning)
 - Transparency
 - Reduced cost of maintaining forces
- ❑ Benefits of the arms control process:
 - Discussions allow greater mutual understanding of nuclear policies, plans, perceived dangers
 - Build relationships, habits of cooperation that spill over to other areas
 - Offers arena in which Russia is treated as an equal – helps assuage prestige, humiliation concerns

51

Dateline: United States Strategic modernization

52

- ❑ U.S. strategic weapons are aging
- ❑ Obama administration laid out a plan for new ICBMs, SLBMs, submarines, bombers, and cruise missiles, with “life extended” (upgraded) warheads
- ❑ Trump endorsed, expanded with new low-yield SLBM, nuclear SLCM, new warhead – Biden budget continues
- ❑ >>\$1 trillion cost over 30 years
- ❑ Bipartisan support – especially with Ukraine war
 - But we need a broader debate over deterrence needs, costs, risks, arms control
 - Some say further weapons needed



Source: DOD

52

The rest of the Middle East – and East Asia

53

- ❑ Iran's program has given other countries in the region incentives to explore nuclear options
 - Saudi Arabia – statements threatening to get nuclear weapons if Iran does; possible deal with US for both reactors and enrichment
 - Egypt – past safeguards violation never fully resolved; expanded civilian nuclear energy plans
 - Turkey – new statements calling NPT commitment into question, expanded civilian nuclear energy plans
- ❑ North Korea's program gives its neighbors incentives to worry – especially if extended deterrence weakened
 - Japan (full fuel cycle in place), ROK (majority support for nuclear weapons), Taiwan (faces growing threats, weaker U.S. commitment)
- ❑ Few apparent risks in other regions

53

Dateline: Global Chemical and biological threats

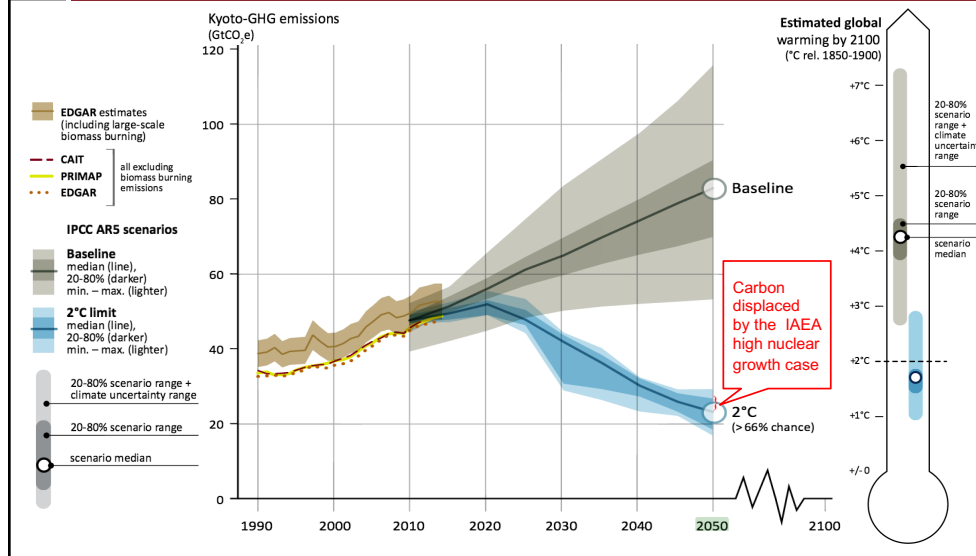
54

- ❑ Current pandemic shows the impact contagious disease can have
 - Imagine if more contagious, more deadly
- ❑ Widespread chemical use by Syria – even after alleged disarmament
- ❑ North Korea and Russia apparently used chemical weapons for assassinations—may indicate other stocks
- ❑ Terrorists have pursued chemical, biological weapons
 - Islamic State produced, used its own mustard gas
 - Aum Shinrikyo conducted nerve gas attacks in Tokyo subways
 - Aum Shinrikyo, al Qaeda pursued anthrax, other biological agents
 - New gene editing technology (e.g., CRISPR) could increase risks
- ❑ Some state biological weapons programs persist
- ❑ Deep dual-use dilemmas, verification challenges

54

Huge, transformational nuclear growth needed for substantial climate role

55



55

Key constraints on large-scale nuclear energy growth – can they be loosened?

56

- ☐ Economics
- ☐ Safety risks – real and perceived
- ☐ Security risks – real and perceived
- ☐ Nuclear waste management – mostly politics
- ☐ Siting and public acceptance
- ☐ Limited government and industry capacity
- ☐ Stringent regulation
- ☐ Proliferation risks – mainly from the nuclear fuel cycle
- ☐ U supply: Not likely to be a constraint this century

In each area, both new policies and new technologies have the potential to loosen past constraints on growth

56

Maintaining U.S. nuclear influence

57

- ❑ U.S. role in the nuclear market is now greatly reduced
- ❑ But the United States offers world-leading innovation, and approaches to safety, security, and nonproliferation
- ❑ Both economic and security benefits to maintaining a significant U.S. position in nuclear markets
 - Important to U.S. influence over other countries' nuclear choices
- ❑ President Biden has to grapple with:
 - How to avoid losing nuclear's domestic low-carbon contribution
 - How to ease the path to commercializing new technologies
 - How to help U.S. firms compete against state-owned (or assisted) firms from other countries
 - How best to advance U.S. nuclear safety, security, nonproliferation objectives

57