

# The History and Future of Planetary Threats: Nuclear Security Today

*Welcome*

LEE BOLLINGER

*Speaker*

ERNEST J. MONIZ

*Panelists*

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THE WORLD FACES THE HIGHEST RISK of use of a nuclear weapon since the Cuban Missile Crisis, largely due to heightened concern about the potential for blunder or miscalculation. In a virtual event held on 17 November 2020, former Secretary of Energy and Co-Chair and Chief Executive Officer of the [Nuclear Threat Initiative](#) Ernest J. Moniz discussed today's nuclear challenges—and the urgent need to return to diplomacy, diligence, and both technological and policy innovation to reduce these threats. The webinar was co-sponsored by the Institute for Social and Economic Research and Policy (ISERP), Columbia University's Earth Institute, Columbia University's Programs in Global Health at the Vagelos College of Physicians and Surgeons, and The Academy of Political Science.

The webinar was the first inaugural event of The History and Future of Planetary Threats series. In this series, ISERP convenes meetings to examine the history of, as well as contemporary catastrophic risks and hazards, whether natural, accident or deliberate, in the following domains: geological, biological, epidemic infectious disease, environmental, chemical, extreme weather, radiological and nuclear, or combinations of these. By catastrophic we understand to mean classes of events that could lead to sudden, extraordinary, widespread disaster beyond the collective capacity of national and international organizations and the private sector to control, causing severe disruptions in normal social functioning, heavy tolls in terms of morbidity and mortality, and major economic losses; in sum, events that may well cause a change in the direction of history. Nuclear falls into a class of its own, because it can result in the annihilation of life on planet earth and the end of history as we know it.

**LEE BOLLINGER<sup>1</sup>:** Thank you everyone for joining this afternoon as we launch a new series from Columbia's Institute for Social and Economic Research and Policy. The title of the new series is The History and Future of Planetary Threats. Let me begin by recognizing several people. Wilmot James, Senior Research Scholar at ISERP, has taken the lead in organizing this series. Alex Halliday, Director of the Earth Institute and a great scientist, is also helping to lead the establishment of a new school of climate at Columbia. Our guest, Ernest Moniz, is the former United States Secretary of Energy, Co-Chair and Chief Executive Officer of Nuclear Threat Initiative, and of course, a great colleague. Welcome to all of our distinguished panelists.

We are at a time of great reckoning in the world. Extreme and very consequential threats are now materializing and occurring with some regularity. Of course, the major one at the moment is the pandemic. The question is: How to help prevent these threats to the extent we can and how to cope to the extent we cannot?

Universities have a major role to play, and one of increasing importance. Governments sometimes fail to deal with threats in the world and events of great significance. Sometimes they impede. Even when governments are great, there is still a very important role for universities to play. Of course, we do important work in discovering new knowledge and ideas, and we engage with the world in a variety of ways. But there is a great question about whether universities need to become more actively involved given the changes that are occurring and that are now the subjects of this series. The experts and scholars we have across the United States and across the world in the fields of public health, medicine, and science have acquitted themselves with great distinction in this most recent period of pandemic crisis.

I'm very grateful to Wilmot James for the work he's done to bring this series to life, and for the contributions of Alex Halliday and the Earth Institute in assembling this event and those that will follow. I really want to extend a very special thanks to former United States Secretary of Energy Ernest Moniz, as he offers his thoughts on the nuclear challenges of today and what more we can do to address them. Please join me in welcoming Wilmot James and Alex Halliday.

**WILMOT G. JAMES<sup>2</sup>:** Thank you very much to President Bollinger for his introductory remarks and his support for what we are doing. I would like to thank our partners at the Earth Institute, the Programs in Global Health at the Vagelos College of Physicians and Surgeons, as well as The Academy of Political Science.

Alex Halliday is the Director of Columbia University's Earth Institute, and he was previously the Dean of Science and Engineering at Oxford University. Alex has been a pioneer in developing mass spectrometry to measure small isotopic variations, as well as in helping to shed light on the birth and early development of our solar system, the interior workings of the earth, and the processes that affect Earth's surface environment.

We launch today The History and Future of Planetary Threats series with a focus on nuclear risks. There can be no better expert, both from the point of view of the subject matter at hand as well as policymaking, than our guest speaker today, Dr. Ernie Moniz. He is the former U.S. Secretary of Energy and currently the Co-Chair and Chief Executive Officer of the Nuclear Threat Initiative, a global security organization working to reduce nuclear and biological threats. As the 13<sup>th</sup> U.S. Secretary of Energy, he advanced nuclear technology innovation, nuclear security, cutting-edge scientific research, and environmental stewardship. Dr. Moniz previously

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<sup>1</sup> **LEE BOLLINGER** is President of Columbia University, Columbia's first Seth Low Professor of the University, and a member of the Columbia Law School faculty.

<sup>2</sup> **WILMOT G. JAMES** is a Senior Research Scholar at the Institute for Social and Economic Research and Policy (ISERP), College of Arts and Sciences, Columbia University.

served in government as a Department of Energy undersecretary and Associate Director for Science in the Office of Science and Technology Policy. Dr. Moniz served on the Massachusetts Institute of Technology faculty and is the Cecil and Ida Green Professor of Physics and Engineering Systems Emeritus, while also serving as Special Advisor to the President of MIT. He's a non-resident Senior Fellow at Harvard University's Belfer Center, and President and CEO of the Energy Futures Initiative. Dr. Moniz received a Bachelor of Science degree *summa cum laude* in physics from Boston College and a doctorate in theoretical physics from Stanford University.

With Senator Sam Nunn, Dr. Moniz wrote an article in *Foreign Affairs* titled "The Return of Doomsday: The New Nuclear Arms Race—and How Washington and Moscow Can Stop It." I found it to be the most sober assessment of the heightened nuclear security peril that we face today. You make a distinction there between strategic stability and strategic instability. You observe that an accident, a blunder, or a miscalculation can easily set off a cataclysm in this current threat environment which you characterize as one of strategic instability. You highlight a number of risk-related factors. I was struck by the observation that communication channels have closed down between the U.S. and Russia, and that there is no ongoing NATO-Russian crisis management dialogue. Could you please elaborate and spell out the history of having ongoing communication channels? Why is it vital to have these, especially during periods of political tension and conflict?

**ERNEST J. MONIZ<sup>3</sup>:** Thank you, Wilmot. That's a very broad question to start with. Let me thank Lee and Alex, and all three of you for this invitation to launch the planetary threats series.

With regards to the U.S.-Russia relationship, I think you've summarized many of the principal arguments. Let's go back to the Cold War and the Ronald Reagan administration in the 1980s. While we had enormous differences with the Soviet Union—and those played out across the globe—both the United States and the Soviet Union adhered to the idea that we had a joint responsibility to always maintain dialogue because of our overwhelming nuclear arsenals. I don't mean just a dialogue between Reagan and Mikhail Gorbachev. I mean the professional dialogues going on at the diplomatic and military-to-military levels that would always seek stability, seek understanding, and more precisely perhaps, seek to avoid misunderstanding that could lead to a cataclysmic outcome.

Even with that, we were very lucky in dodging the bullet several times with misinformation reaching one or the other president. The decision time for a massive exchange of nuclear warheads is very short. The president has perhaps 10 minutes to respond. The risks were great. There were basically two adversaries taking the responsibility of managing the risks. If you look today, many of those elements are missing.

The level of dialogue has gone down. You mentioned, for example, NATO-Russia crisis management. That mechanism was put in place so that if there were a flashpoint, a hot issue between NATO and Russia, there would be an established dialogue or place of dialogue to walk down those risks. Instead, that channel was cut off as a punishment in the Ukraine incursion in early 2014. That's exactly *when* we needed it and *why* it was put in place—to address those risks.

Instead, we are treating dialogue as a reward, as opposed to a diplomatic tool. With the current level of communication—while the relationship between our countries is very bad and we have our militaries operating in proximity in several cases—the risk of something bad hap-

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<sup>3</sup> ERNEST J. MONIZ was the thirteenth U.S. Secretary of Energy, and is Co-Chair and Chief Executive Officer of the Nuclear Threat Initiative, a global security organization working to reduce nuclear and biological threats.

pening and then escalating has increased. That's why we say that the risks right now are higher than at any time since the Cuban Missile Crisis. We make the distinction that the risk of initiation is far more likely to be a misunderstanding, a blunder, or a miscalculation, as opposed to a willful, planned major nuclear attack. That's the condition. We are sleepwalking towards strategic instability. In both countries, nuclear weapons are being viewed more and more as another battlefield weapon. This is an accident waiting to happen.

**JAMES:** You wrote "The Return of Doomsday" before the recent elections. You make a strong case for developing a new and stronger mutual deterrence architecture at all levels, no matter who is leading and who is in charge. The United States now has a deeply troubled and compromised transition. How do you suggest the world deal with this? What actions can be taken to minimize the peril we face? You mentioned a new diplomacy. What is the new diplomacy that's required to set us on the right path to strategic stability?

**MONIZ:** There are a number of things that the new Biden administration can do. I'm not saying that there's a magic wand. Diplomacy starts at home. If we do not get back to a much more non-partisan approach to these kinds of issues of catastrophic risk, we are exposing ourselves to those risks.

As one example, Sam Nunn and I propose reconstituting a body similar to that which existed in the 1980s. When I mention that period of actively trying to manage these risks, there was an arms control observer group. At that time, it was the Senate with the Reagan administration—with Secretary of State George Shultz in particular. That group was bipartisan. It had regular briefings and discussions with the administration about what was happening, for example, in arms control. That helped pave the way for things like Senate confirmation of agreements, because they were there on the takeoff and not just on the landing. It also gave greater confidence to the negotiations, in that case to the Soviets, because they recognized that the administration and the Congress in the United States worked together on the negotiation.

We advocate forming a similar group today, probably bicameral, including both the House and the Senate, with the administration. Critically, it would provide the political space for negotiations with Russia—space that frankly does not exist today, with both parties being very suspect of any discussions. Creating that political space allows discussions at the diplomatic level and at the military level to be ongoing and to increase stability.

There are other things, which of course, the administration will do. The Biden administration already announced that it will accept Russia's offer to extend the New Strategic Arms Reduction Treaty (New START) for five years, as it is. The New START Treaty is essentially the last remaining pillar of the arms control architecture. It's the last remaining agreement that provides for mutual verification levels, as well as for capping deployed weapons and delivery systems. We suggest that our new administration go a little bit farther. The negotiations will be very tough in those five years, because they need to expand to new kinds of weapons systems—the so-called tactical weapons which have always been an uncomfortable issue for the United States. Missile defense has been a major issue since the United States withdrew from the Anti-Ballistic Missile Treaty early in this century.

I would say, join New START. I'm not the president-elect. This is the Nuclear Threat Initiative speaking. We've discussed making at the same time a unilateral gesture on the United States side to moderately decrease the ceiling from 1,550 to 1,400 and invite Russia to make a reciprocal action.

Trust-building exercises of this type can also condition the negotiations. My colleagues at the Nuclear Threat Initiative and I would advocate that President-elect Biden make a major integrative speech on nuclear policy in his first hundred days or so, similar to what Barack Obama did

in March 2009 in Prague, to lay out an agenda and assert some leadership globally for risk reduction. Clearly, we need a strong recommitment to the Non-Proliferation Treaty or NPT, which has a review conference coming up in the first half of 2021. This treaty includes the commitment to eliminate nuclear weapons eventually, which is a tough task. The year 2045 has a nice ring to it as a goal, since that would be one century of the existence of nuclear weapons.

There are many other things. Let me mention a couple of others. One is that President Biden could voluntarily move towards putting guardrails around the sole authority of the president of the United States to utilize nuclear weapons. We do not think that's a very stable situation. A process that provides more deliberation and increased decision time would be important. We think the president, together with President Vladimir Putin, should direct their militaries and diplomats to work on increasing decision time from 10 minutes to something that's much more rational, in terms of making sure that, for example, data coming in is correct.

We should have negative security assurances without caveats—that we would not use or threaten to use nuclear weapons against non-nuclear weapon states. Maybe that can be expanded to a uniform commitment among the P5, including China, the United Kingdom, and France. There's at least a dozen or so very sensible steps that could be taken through executive action early in the Biden presidency. Of course, just to circle back to the beginning of this answer, executive action would be on much firmer ground if a bipartisan group were established between the Congress and the administration, so that the political space is expanded, including for the president.

**JAMES:** Thank you very much, Dr. Moniz. I invite Dr. Alex Halliday to put some issues to you.

**ALEX N. HALLIDAY<sup>4</sup>:** I want to broaden things a little bit with a discussion about nuclear capability more generally. In particular, how strong is the United States these days in terms of nuclear engineering, given that there are big advances being made in a number of countries around nuclear reactors? How do we advance nuclear energy? The United States doesn't seem to have a well-focused plan of action. That could be of course anecdotal, but I'd be keen to hear what you think. Given the decline of nuclear engineering in many universities as a subject, do you think there's cause for concern in terms of our capability more broadly?

**MONIZ:** Let me first answer a question that you didn't ask, because I want to make sure there's clarity. In terms of stewardship of the nuclear weapons stockpile, I think the performance of the United States enterprise—particularly the so-called weapons labs of Los Alamos, Livermore, and Sandia—has really brought enormous scientific creativity to the task. This is why we are almost 30 years beyond nuclear testing. As I had to do when I was Secretary of Energy, we are able to certify the safety and reliability of the stockpile every year, without testing. The extent of the scientific and technological evolution required to do that is not fully appreciated. I'd be happy to go into that, but let me instead turn to your question!

What you said in terms of the nuclear energy enterprise, which has major implications for our security posture and for the global non-proliferation regime, is correct. But I'll offer some hope. The nuclear technology supply chain in the United States is not in very good shape. We have not built any nuclear reactors in a long time. There was a large drop in university nuclear engineering student interest, in particular domestic student interest. And today we still suffer from that lack of a supply chain. Let me give you an example with security consequences, and

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<sup>4</sup> ALEX N. HALLIDAY is the Director of Columbia University's Earth Institute.

then I'll come back to the good news. Then the good news will be followed by some more not so good news!

Today, the United States has no capability whatsoever with domestically developed technology to enrich uranium. Why is that important? You need a domestic technology for national security applications because of non-proliferation agreements. What would you do with it? You would make uranium fuel, typical low-enriched uranium fuel for nuclear reactors—today for one nuclear reactor, and eventually two nuclear reactors—in order to produce tritium for the nuclear weapons stockpile. We don't have the capacity to do that. We are living off of stockpiles of enriched uranium. Those stockpiles will run out. That's just one example of how a supply chain is not there to support the nuclear security needs.

In terms of nuclear energy, I think it's the reverse. We have today the greatest burst of innovation in new nuclear energy technologies, both fission and fusion, that we have ever had. We are seeing not only the traditional light water reactor technology, but also small modular reactors that generate 50 to 200 megawatts, or the micro-reactors that typically generate one to 10 megawatts. There's a lot more thinking about molten salt, gas reactors, and micro-reactors with new applications. This is generating enormous student interest.

On the fusion side, MIT has a prominent spinout called Commonwealth. There are others. For full disclosure, I'm on the board of one of the privately funded fusion companies, TAE Technologies, which is looking for aneutronic fusion. They're making tremendous progress. If there is a breakthrough in some of these smaller modular fusion plants, that would be a game changer for addressing climate.

On the slightly less positive side, we have not yet reached the kind of public-private partnership that is needed to get one or more of these novel technologies to the serious demonstration phase. The reality is, you get into the nuclear business and you're not talking a hundred million dollars anymore, you're talking billions. We're going to need a dedicated, private-public way of getting over the hump.

The Nuclear Threat Initiative has a major new thrust on global nuclear fuel cycles to avoid proliferation risks, particularly with enrichment and reprocessing plants. If we do not have the technology that everybody else wants, it's very difficult for us to continue to be the leader in establishing strong non-proliferation norms in nuclear commerce. These things are all linked together. The most exciting thing, in the end, is this burst of innovation in terms of new nuclear technologies.

**HALLIDAY:** The final question I was going to ask is: How do you sleep at night? The penultimate question is related to that, and that's cyber threats. How much of a concern are cyber threats? They must be a massive concern, but how resilient do you feel we are in terms of thinking through potential cyber threats inside nuclear facilities? How do you secure the future of our nuclear capability in America in particular?

**MONIZ:** There are so many technology evolutions that challenge the traditional paradigm of how the whole nuclear system is put together, including the policies. The game theoretic deterrence policy put in place around 1960—when you fundamentally had only two real nuclear powers and technology was very different—needs a serious relook with technology being a big driver.

Cyber is one, but the militarization of space is practically completely unregulated. There are many concerns about how artificial intelligence will be put into the command-and-control system for nuclear weapons. Most of us certainly feel very strongly that we cannot go to a so-called “dead hand,” where some machine decides to launch a nuclear weapon. There are things

like the hypersonic technologies that President Putin was pleased to advertise, although Russia is by no means the only country to be developing hypersonic delivery systems.

Cyber is certainly one of the major concerns, specifically the risk that early-warning systems and command-and-control systems could be compromised. I don't think somebody is going to design a cyber intrusion to shoot off an intercontinental ballistic missile. It's much more an issue of the information space that could lead a president to make the wrong decision. The military is very concerned about that.

We at the Nuclear Threat Initiative will soon have a [new report](#) coming out that looks at the question of digitization and cybersecurity in the entire nuclear weapon modernization program. The United States—as well as Russia and China, but I'll focus on the United States—is in the early stages of a controversial roughly \$1.5 trillion modernization of the nuclear weapons system. The argument for that is fairly clear. We're going to have nuclear weapons for decades more, and we haven't modernized in a long time.

When I was Secretary of Energy, one of the reasons I didn't sleep well at night was concern about having nuclear weapons workers, especially at the uranium facility in Oak Ridge, working high-hazard operations in buildings from the 1950s and 1960s. It is known that ceilings fell down internally. You can't keep going on the cheap with these facilities when you're dealing with nuclear weapons. On the other hand, with the United States set to spend \$1.5 trillion, there are questions about whether one needs to do the whole program.

But when you modernize, you don't put back the same old analog devices. There will be massive digitization. The concern is whether one is opening up any back doors to cyber threats in the modernization process. It's a complicated issue, and you're right to put your finger on that as a big issue. Of course, I could also say the same thing for commercial plants.

**JAMES:** Thank you very much. I now invite our panelists to contribute. I will start off by introducing Robert Jervis, who is the Adlai Stevenson Professor of International Affairs at Columbia University, and is a specialist in international politics, security policy decision-making, and theories of conflict and cooperation. His book, *Why Intelligence Fails: Lessons from the Iranian Revolution and the Iraq War*, was published by Cornell University Press in April of 2010.

**ROBERT JERVIS<sup>5</sup>:** Thank you. And thank you, Secretary Moniz, for the very interesting introduction to a complicated subject. I want to come at it in two slightly different ways. The first is the optimistic point that, paradoxically, avoiding nuclear war is a lot easier than avoiding traditional war. Throughout history, why did countries fight? They thought they could win. Often, they did win. To take a contemporary example, the small but rather bloody war between Armenia and Azerbaijan over the Karabakh paid off for Azerbaijan, at least in the short run, just the way it paid off for Armenia 20 years ago.

Sometimes wars in the pre-nuclear era turned out to be mutually disastrous, but often they didn't. That makes avoiding war very hard. Now, with at least bilateral nuclear wars, it's hard to imagine a leader being so blind as to think that we can get away with it without getting our hair mussed. Some of us old enough to remember *Dr. Strangelove* know that line. The understanding is that this is a game of chicken. The worst outcome for both sides is a war. This makes avoiding a war, I won't say easy, but within the realm of feasibility, which really had not been true about avoiding war historically.

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<sup>5</sup> **ROBERT JERVIS** is the Adlai E. Stevenson Professor of International Affairs at Columbia University, specializing in international politics, security policy, decision making, and theories of conflict and cooperation.

This is a coin with three sides. The most obvious other side of the coin is that if there is a war, the consequences are horrible for everyone, just unimaginable. Charles de Gaulle said after a nuclear war the “two sides would have neither powers, nor laws, nor cities, nor cultures, nor cradles, nor tombs.” That residual fear on the one hand produces the peace, but on the other hand, if there wasn’t some probability of this occurring, it wouldn’t have the pacifying effect.

The third hand, and some of Secretary Moniz’s remarks got at that, is that each side can use the possibility of great danger as a competitive lever—even with things getting out of control in the end in a war. In nuclear bargaining, again in *Dr. Strangelove*, each side says to the other: One of us has to be reasonable, and it’s not going to be me. This sets up incentives not to be reasonable in order to get a competitive advantage. In this situation, and in terms of general ways out of the thickets, there are two different, not necessarily conflicting, approaches that countries have followed, and Secretary Moniz hinted at both.

One is the belief that the cause of the danger of war, especially an accidental war, is the weapons and the warning time. The danger with hypersonics is not only that they’re fast, but that they also circumvent part of our warning systems. Weapons configurations can give an offensive advantage in the sense that if you believe war is coming, you want to strike first rather than second—even if you don’t want war. That is what can be terribly dangerous. Classical American arms control policy in the 1960s, and through part of the end of the Cold War, was based on reducing crisis instability by controlling bad characteristics of weapons.

The other view, and not entirely inconsistent with the first, puts politics first. This is the view the Soviets had—and I think the Russians have now—that weapons don’t cause war, people do. We’ve never seen a case where the characteristics of the weapons have led to the wars. A lot of American focus on arms control, and I’ve participated in it, has been fundamentally misleading. The main thrust should be reducing the level of political conflict.

You’re never going to do away with conflict, of course. But I’m fairly optimistic on Russian-American relations. Yes, there are frictions in the Baltic republics and things growing out of Ukraine, but there isn’t anything worth a war. In the Cold War you could argue there was. Now there really isn’t. For all the huffing and puffing on both sides, everyone understands that. In terms of Russian-American relations—between the lack of fundamental, overwhelming political conflict and the fact that everyone knows how disastrous war is—I’m optimistic. In other areas around the world, especially India and Pakistan, there is a lot more pessimism.

**MONIZ:** You started by saying that avoiding nuclear war is easier than avoiding war. I think that I would certainly subscribe to that, and frankly, the data support it—during the Cold War. Part of our problem is that we are not at all certain that those dynamics continue today. That’s because of the miscalculation issues—for example the cyber discussion we just had. This could be initiated not just by Russia but by a third party or by a sub-national group. The potential for terrorism drove the Cold Warriors, like George Shultz, Henry Kissinger, William Perry, and Sam Nunn, toward their controversial recommendation of phasing out nuclear weapons. In fact, the potential for terrorism now is very different than it was in the Cold War.

Your point about hypersonics is absolutely right—it’s not because they’re fast. People forget that intercontinental ballistic missiles are hypersonic, but they do not have the maneuverability and the evasion characteristics. It’s interesting that the Russians have stated specifically that they agree that hypersonic weapons would come under a New START treaty if it were extended.

I continue to maintain that very strong communication channels with the Russian government, as well as civil society, is critically important. I think you’re a little bit on the optimistic side in terms of the U.S.-Russia relationship in general. I agree eventually we’ll get there,

but it's going to take quite a while. However, we have many common interests, and there is no reason why we should not be working together to advance those.

I'll give you an example in which I was personally involved: the Iran negotiation. The Iran deal was signed roughly a year-and-a-half after the Ukraine incursion. Our relationships were not good. The Syria issue was also bubbling up, with Russia initiating military action in September of that year of 2015. However, there was never an issue of us being completely aligned on Iran not having a nuclear weapons program. Of all the other countries in the negotiation, the E3/EU+3 [France, Germany, the United Kingdom, China, Russia, and the United States], Russia was by far the most helpful in getting the deal done and implemented. And that was when we had tough relations. That's what we need to do in all these areas of catastrophic risk. Something that might help is a much more robust scientist-to-scientist collaboration, as we used to have. That's also largely been seriously cut off.

Those are the long-term investments in the relationship. In the meantime, we have plenty of areas in which to work together. Instead, as I said earlier, we treat dialogue as some kind of reward for good behavior. We need to change this around in a dramatic way.

**JAMES:** There's nothing more fundamental than doing so, it is worth emphasizing. I now invite Dr. Keren Yarhi-Milo to comment. She is the Arnold Saltzman Professor of War and Peace Studies in the Department of Political Science and the School of International and Public Affairs at Columbia. She's also the director of the Arnold Saltzman Institute of War and Peace Studies. Her research and teaching focuses on international relations and foreign policy, with a particular specialization in international security.

**KEREN YARHI-MILO<sup>6</sup>:** Thank you so much for having me. Thank you, Secretary Moniz, for your remarks. We talked a little bit about the U.S.-Russia topic. I want to shift gears, delving a little bit deeper into the U.S.-Iran relationship and the future of the Joint Comprehensive Plan of Action (JCPOA). We have the *New York Times* report from yesterday that Trump was asking advisors about a military option. Hopefully we don't get there, and we don't see anything like that. We're talking about a Biden administration hopefully in mid-January going back to diplomacy. Then the big question becomes, what should we expect? Given that you're one of the architects of the JCPOA, I would love to hear your perspective about a couple of issues.

First, it's been almost five years since the JCPOA was implemented. Since then, the different actors learned lessons about what worked and what didn't work with the agreement. What do you think those lessons are for the different actors? At the end of the day, where does it put us when we come back to renegotiate the JCPOA? Is it in the best interest to go back to the same agreement? Or do you think that the accord, or any agreement that does not address Iran's destabilizing policies in the Middle East, is likely to fail—not because of the United States, but because of Israel, the Gulf States, and the response from Republicans and some Democrats? I want to hear your thoughts about where we are and what lessons you think the different actors learned.

The second thing I wanted to ask you about is the issue of credibility. We have this problem right now that we didn't have before. We have not just the Libya model, but now we have the issue of credibility because of how we behaved with regards to Iran. How much do you think it's

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<sup>6</sup> **KEREN YARHI-MILO** is the Arnold A. Saltzman Professor of War and Peace Studies in the Political Science Department and the School of International and Public Affairs. She is also the Director of the Arnold A. Saltzman Institute of War and Peace Studies at Columbia University.

going to affect our ability to negotiate nuclear agreements across the board with North Korea or with Iran in the future? These are the main two questions. Thank you very much.

**MONIZ:** Let me just note that it's not just Libya and Iran. There is Paris, the World Health Organization, and the Asian Trade Agreement. There are many examples, but we'll come back to that.

On the first question, I think there's no doubt that there have been different lessons for different people that affect how the Biden administration will go forward. I want, first of all, to say that everything I say is my own opinion. It's got nothing to do with what the president-elect is thinking, other than he's made the public statement about reentering the JCPOA.

In our sideline discussions during the negotiation, I pointed out that the Iranians were being very optimistic about the economic rewards that they would have from the JCPOA. That's when we were fully in the agreement. Secretary of State John Kerry and Secretary of Treasury Jack Lew were flying to London to try to encourage banks to do business with Iran. The banks were not interested.

This is going to be an optimistic note, and maybe Pollyannish in fact, but I'll make it anyway. The JCPOA did not lift all sanctions by any means. It lifted the nuclear-related sanctions. By the way, at Columbia you have an expert, Richard Nephew, who I would recommend to discuss the sanctions. You still had many sanctions associated with terrorism, human rights, missiles, and other areas. The banking system of Iran was rather rusty in dealing with the international banking system. You have a situation in Iran in which the Revolutionary Guard is known to have an enormous reach into the economic system.

The international banking system continues to have major reservations. They're going to be very cautious. The international corporations were happy to sell things but were not so happy to make big capital investments that could be at risk. One of the lessons through all of this, including with the additional sanctions now being put on, is that I hope the Iranians understand that even if we can get back into some kind of condominium to move forward, they've got a lot of work to do internally before they can reap the benefits of economic investment and the like. I think that's a huge lesson.

Another lesson is that the desire of Iran to have an agreement has been made manifest by the rather carefully calibrated steps in violation of the nuclear parameters. For example, the International Atomic Energy Agency recently said that Iran now has about 12 times the amount of enriched uranium that was capped in the agreement. The first thing to point out is that when the agreement was put in place, they had well over 30 times the amount of material. That's not to say we shouldn't be concerned over the 12. They also have not done 20 percent enrichment. But most important of all, the verification agreement is largely in place. And that is key for international confidence that Iran is not reconstituting a weapons program. However, I think a lesson—not yet one to be concluded—is the extent to which they are prepared to turn down the temperature on regional issues. I don't think we know that. And of course, they have their own presidential election coming up in June, which is going to be a big issue.

There is no guarantee the administration will think in the same way, but I think that there is no option other than to restart a diplomatic thrust by putting back in place the JCPOA with full compliance all around. However, I don't think that it is politically reasonable or practical to go back to that as the end state. In 2015 the decision was made to take the nuclear threat off the table, build in 15 years of nuclear constraint, and build in verification in the hope that over 10 or 15 years some level of trust could be rebuilt by resolving some of those regional issues. If it didn't happen, the deal stood on its own. It accomplished what it wanted. It was not a deal built on trust. It was a deal built on verification and buying some significant time in the politi-

cal life of the countries. However, I think right now we can't go back and just think that we need to have patience and see if it all works out.

Before the JCPOA, there was an interim agreement. The interim agreement laid out the parameters for a succeeding negotiation in a fixed timescale. Perhaps returning to the JCPOA has to be viewed now as the interim agreement for reaching the next agreement in a fixed timescale, where some of these issues have to be addressed. They're going to have to be addressed, but not just by the United States and Iran. The Europeans, Russia, and China are going to have to be on board. Russia is particularly an issue, when you get to regional issues. For this to be successful, our Gulf allies and Israel are going to have to decide to play more of a role in the discussions. If it's going to be a regional solution, we've got to have the regional players engaged. There was some discussion during the JCPOA negotiations. I think it's got to be raised to a whole new level going forward. Not easy, but that's my view of a path forward.

**JAMES:** Our final panelist is Dr. David Brenner, who directs the Center for Radiological Research at Columbia University Medical Center, and is the Higgins Professor of Radiation Biophysics in radiation oncology and of Environmental Health Sciences. He is also the Director of the Radiological Research Accelerator Facility, which was founded by a student of Marie Curie more than a century ago, and is committed to exploiting all forms of radiation to improve human health and medical care.

**DAVID BRENNER<sup>7</sup>:** I'll comment a little bit about the health consequences of some of these scenarios we've been talking about. For a large-scale nuclear event, what is generally agreed as the most likely scenario is not a government-based event, but an improvised nuclear device that comes from some terrorist group. The sorts of events we're talking about are not that dissimilar from the Hiroshima or Nagasaki type events; they're not huge world-ending events. They are completely disastrous events and people will die. However, an awful lot of people are going to be exposed and will not die. We need to think about being able to respond in a useful manner to that type of event. There is a strong program at the National Institutes of Health and the National Institute of Allergy and Infectious Diseases looking at that.

One of the real limitations to the future development of nuclear energy is our lack of understanding of the effects of low levels of radiation. Trying to figure out what are the biological effects of low levels of radiation is a difficult problem. We, and many other people, have been working on that for decades. Until a decade ago, the major source of research and research funding was the Department of Energy Low Dose Radiation Program. For reasons I don't understand, that program died. That's a calamity for the future of nuclear power because if we don't understand well the effects of low levels of radiation, we're going to have to spend far more than we need to on developing nuclear power to levels of safety that perhaps we don't need. What are your views on the future of the low-level radiation program at the Department of Energy?

**MONIZ:** Thank you. I was going to ask you what you think of the linear threshold hypothesis.

**BRENNER:** It's something that needs to be researched more. I think it's the best we have at this moment, but there's a lot of weaknesses involved in it, and we need to probe those weaknesses.

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<sup>7</sup> **DAVID BRENNER** directs the Center for Radiological Research (CRR) at Columbia University Irving Medical Center in New York City, and is the Higgins Professor of Radiation Biophysics (in Radiation Oncology) and of Environmental Health Sciences, and Director of the Radiological Research Accelerator Facility (RARAF).

**MONIZ:** I'm not sure I would personally say it's the best we have available, but it's the only thing we have available in terms of regulatory caution.

Let me first comment on your earlier statement. An improvised device is certainly an issue, but I don't want to take off the table this issue of state use of a nuclear weapon through misunderstandings, blunders, or bad data. We have historical examples where we just barely dodged the bullet. But the terrorist or improvised device is certainly a very important modern phenomenon. I'd also add, and I think you would agree, that it's not just a nuclear explosion, but a so-called dirty bomb set off with conventional explosives and some radioactive sources that would create a real mess.

At the Nuclear Threat Initiative we've had a big program with New York City to eliminate Cesium-137 sources, to be replaced by x-ray technology, because of the dirty bomb risks involved there. The public health part of the Mayor's Office was very helpful. I'm pleased to say that we are making some traction elsewhere as well in terms of alerting the people to the danger as quietly as we can, while pointing out other technology options that would not provide these risks, like the x-ray technology.

On low dose radiation, you're certainly right. The Office of Biological and Environmental Research thought it was time to end that program. There was a lot of frustration over the lack of progress in advancing that, but I completely agree with the importance of it. This conservative regulatory approach is a critical issue throughout the nuclear enterprise—the question is how conservative.

I think—and I'd love to get your reaction—a very promising direction in the low-dose field would be to use the technology that's now being put in place for the Cancer Moonshot, from early 2016. To tie this to contemporary events, the president-elect today was then the vice president put in charge of the Cancer Moonshot program. I went to him almost immediately with two people from the department experienced in the relevant areas, and said that applying very big data analytics and machine learning might be a very interesting new way of approaching cancer issues generally. I think that could be a very interesting way of addressing the low dose radiation issues. It would require an enormous database and going through them with big data techniques and machine learning. Maybe that's a way of trying to pick out that very small signal out of this very noisy background. I don't know if that makes sense in the end, but it was always in the back of my mind that this may be a new tool to apply in the low dose arena.

**BRENNER:** I would completely agree with you. It's a really powerful tool, but it's not the only tool we've got these days with modern molecular biology. There are things that can be done.

**MONIZ:** I think revisiting the program at the Department of Energy in those dimensions could bear fruit. Frankly, Congress is also very receptive to reviving that program.

**JAMES:** That brings us to the end of Dr. Moniz's participation. Let me say, Ernie, you have two qualities that I greatly admire and bring pleasure in my moderating role here today. One quality is your breathtaking mastery of the subject matter. It is quite extraordinary, and I'm sure the audience and panelists would all agree with that. The second quality has to do with your deep experience in policymaking in the arena involving the world's superpowers. That combination of deep experience in policymaking and a mastery of a subject matter was just fabulous. I would like to thank you very much on behalf of Columbia University and all of us for your time, energy, insights, and leadership in this field. We are very grateful to you for your time.

**MONIZ:** Let me thank all of you for the opportunity to discuss here. I want to add my thanks to Wilmot, not just for moderating this, but for being a tremendous partner in another thing we do at the Nuclear Threat Initiative, which is the pandemic problem. In fact, we have some major initiatives which we think can be consequential, and Wilmot has always been at the center of our activities there. Thank you so much for that, Wilmot—and let's solve that problem too.

**JAMES:** Thank you very much. Colleagues, there are some important questions from the audience and I'd like to send some of those in your direction to answer. One participant points out that the discussion focus has been on the United States and Russia. Does that mean that the United States is not concerned about nuclear China?

**JERVIS:** I said that I thought there weren't high conflicts between the United States and Russia. Secretary Moniz thought I was somewhat optimistic, and also worried correctly about accident. When we look at the United States and China, the political conflicts are much greater—focused on the Taiwan Straits, South China Sea, and general rivalries of China as a rising power. Until about five years ago, China's nuclear program had been amazingly restrained. We initially expected China to follow the Soviet and American path of building large and diversified nuclear arsenals. It didn't. It built very small arsenals of only land-based missiles, about 200 or even less, and didn't modernize it after that.

That's changed now. The U.S.-China conflict is focusing on the sea, with pressure of various kinds on Taiwan. We've seen ships bumping in the South China Sea, and a variety of things. If armies are hard to control, navies are impossible. There's tremendous autonomy from every captain. I don't mean that these people on either side are cowboys, reckless, or wanting a war, but the danger of actions taken for self-protection that lead to physical clashes is really quite great at sea.

The United States has tried to bring China into the arms control discussions with the Soviet Union. I think initially this was done largely for propaganda reasons, but there were real reasons to do it. It's very hard because of all the asymmetries. The questioner is absolutely right. I worry much more about a nuclear exchange between China and the United States than I do about Russia and the United States, even though Russia has many more weapons than China does.

**JAMES:** Thank you very much Bob, for that response. Here's a question that goes as follows: With regards to U.S. efforts in the Middle East, is it foreboding to consider Israel's nuclear disarmament as a component in the regional nuclear negotiations?

**YARHI-MILO:** From Israel's point of view, while it is obvious that they never liked the JCPOA and never believed in it, it has become clear that the current situation is not better than what was under the JCPOA. Thinking about Israel's program, nothing that will happen with Iran will change where Israel stands on its own nuclear program. That is not part of the discussion, but it is going to be interesting. That's the big unknown—how Israel will act between now and the time we're going back to diplomacy vis-à-vis Iran. And it is really hard to read from outside what actions Israel will want the United States to take at the moment, or what actions you would want to have the green light from the United States to take unilaterally. Those are important questions, and we don't know.

That goes back to the question that I posed to Secretary Moniz: What are the lessons that Israel learned the first time from the JCPOA? Are we going to see a repeat or a return to this kind of public diplomacy by Israel against another nuclear agreement? Or are we going to see more actions taken? We already see a lot of cyber-attacks that are happening behind the

scenes, and escalation on that front. It's not clear. This is not a great moment for Israel to engage in any military activities against Iran—with the pandemic and the domestic situation in Israel. But you never know, you cannot rule it out. It is going to be complicated and interesting, especially as we transition to the Biden administration. I think Israel will try to gauge what the next president's approach is—how different it's going to be from the first time this administration negotiated the JCPOA, what role will Iran's behavior play, or how they're going to think about sanctions, and so on.

**JAMES:** Thank you very much. Here is another question: What is your opinion regarding a feminist approach to foreign policies, including nuclear armament policy, and what the Centre for Feminist Foreign Policy is recommending? It is part of a broader question around eliminating nuclear weapons and women's involvement in negotiations.

**JERVIS:** There's a thriving field in international politics of feminist approaches. I want to stress approaches, because there isn't *a* feminist theory and it's an enormous range. Most of those theories reject an essentialist approach. This essentialist approach would say: Women, due in a way to biology, are nurturing. They favor negotiations more than violence. They're better negotiators. They're more empathetic. They're more into problem solving. Most feminist theorists reject that, although I actually think there's an argument to be made rooted in evolution for it. But let me put that aside. We of course see that many female leaders behave indistinguishable from men.

Currently with the pandemic, we point to the prime minister of New Zealand, who's handled it in perhaps a distinctive way not unrelated to being a woman and a mother. But when we look at a lot of international issues, women like Margaret Thatcher, Indira Gandhi, and Golda Meir come to mind who were not exactly warm and fuzzy. I think it isn't the difference between men and women, but the basic question of whether a lot of our academic theories—and more importantly the views held by political leaders and public opinion—over-weight for so-called hard power. Partly due to feelings of status, you have to be tough. It's a question of whether most countries, not only Western perhaps, have overlooked possible paths to greater cooperation because they are excessively enamored with views that stress the need to make threats, to fear looking weak, and to look tough.

**YARHI-MILO:** I agree completely with Bob. In terms of the studies, there are mixed results. There's a lot of issues about selection, small sample size, and what you're really capturing with the gender differences over time. The empirical record is mixed. As a woman who studied international security and is now heading an institute in national security, I think that as a field we have failed to incorporate more women. We haven't done enough to incorporate more women into this field.

At the Saltzman Institute, we're launching a program on national security and intelligence that is going to target, mentor, attract, inspire, and train women and minorities in the field of international security. This field needs more diversity and we will all benefit from it. Again, the empirical record on women in decision-making is mixed. But in terms of values, it's in our interest to see greater diversity and the inclusion of more women and minorities into this field. They make a difference and it makes a difference.

**HALLIDAY:** I think it's just a little bit unfair to compare some of the modern women leaders we have with Margaret Thatcher, who is from a different generation. Part of what she had to do to succeed was to behave like a man. Nowadays we're seeing more and more astonishing women leaders, not just as prime ministers or presidents, but also in government more gener-

ally. They are bringing something to the table that I think government desperately needs. There's good statistics on the response to the COVID-19 crisis around the world from where there's a woman leader or very powerful female representation in government, compared with what happens where you don't have that. I just think we shouldn't taint the opportunity there is before us now with comparisons to the way things were back in the 1980s.

**JAMES:** Thank you for that, Alex. There's a great deal to be learnt from women who occupy—and have occupied—leadership positions in terms of the style and approach they bring to tough negotiations. There's a great deal to be learnt, without reducing it to any kind of inherent biology. There's some powerful lessons there. Thanks for those comments.

This brings the seminar to an end. I thought it was absolutely fabulous. Our guest speaker, our panelists, and my co-moderator, Alex, are real experts in the field. The quality of the discussion was just quite outstanding in dealing with a compelling, if not the most compelling, issue of our time. We've arrived at this point in our history where peace is secured through control over the potential to annihilate the entire planet. Keeping a mutually deterring architecture in place is key to how we transition from today into the future. But that architecture has to be modernized, and has to deal with a change in the configuration of who the key players are. That is the task before us, and we all have a role to play in that because it will take a monumental collective effort to get there.

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