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# U.S.-South Korea Nuclear Cooperation in a Complex World

**Kenneth N. Luongo**

**April 7, 2023**

The United States and South Korea will celebrate the 70th anniversary of their strong partnership at a summit in Washington at the end of April. This relationship has endured many tests and always emerged better and more resilient. The nuclear relationship between the U.S. and South Korea has always been a central element of their cooperation. But an increasingly complex and dangerous global environment will present new challenges that will once again test the strength of this essential partnership.

## North Korea

The foremost nuclear challenge is North Korea's nuclear weapons program. The escalating dangers posed by the ever-expanding sophistication and scope of the DPRK program is a central concern in the bilateral nuclear relationship. The DPRK arsenal threatens the population and economic vitality of South Korea and other nations in the region. It further complicates alliance diplomacy and military planning. Recently the advances in the DPRK nuclear program have stimulated vocal support from some Korean leaders for an independent nuclear weapons program. This creates tensions with the U.S. as well as raising nuclear proliferation concerns with a close ally.

The response to the North Korean provocations has been to escalate the intensity of joint US-ROK military exercises which are designed to convey the unmistakable message of U.S. commitment to the defense of the South. But, the Kim regime continues to increase the nuclear ante, recently posting photos of numerous supposed nuclear warheads and delivery systems. A negotiated settlement to the North Korean nuclear weapons program seems unlikely at this moment. So, tensions will continue to simmer and the U.S. and ROK governments will need to stay in synch.

## China

The rising global power of China is a significant and complex challenge in the U.S.-ROK relationship. China increasingly is identified by U.S. leaders as the top competitor to the nation and a chief antagonist of the Western dominated international order. The U.S. strategy is to deny China sophisticated critical technologies and to try to contain and counter its influence. China is actively increasing its nuclear weapons and delivery capabilities and it is viewed as an escalating military and political threat.

However, China is South Korea's top trading partner, encompassing over 25% of its exports. South Korea already has weathered a trade reduction backlash from China over the basing of American missile defenses on its territory. This mismatch of interests will continue to challenge the full alignment of American and South Korean policy on China.

Still, there is likely to be bilateral agreement on the danger of China's nuclear weapons expansion. There also will continue to be agreement on the importance of preventing China from becoming a dominant exporter of civil nuclear technologies in this century, although there is not a cohesive bilateral policy or strategy on this issue.

## Indo-Pacific Strategy

There is a question about the status of South Korea in the evolving American Asia-Pacific military strategy. Intensified bilateral military exercises are occurring, a signal to the DPRK of American commitment to the defense of South Korea as well as a demonstration of military might to a Chinese government contemplating an invasion of Taiwan.

But, South Korea has been excluded from the AUKUS nuclear submarine agreement between the U.S., U.K., and Australia. And U.S. officials have stated that the nuclear submarine arrangement with Australia will not be extended to any other nation. South Korea also is not part of the Quadrilateral Security Dialogue between the U.S., Australia, India, and Japan.

Partly this situation is influenced by South Korea's economic dependence on China and the delicate nuclear balance on the Korean peninsula. But, if the nuclear weapons challenges from the DPRK and China's bellicosity continue to intensify, there may need to be a reconsideration of South Korea's role in both the nuclear submarine and Quad initiatives.

## Civil Nuclear Cooperation

Beyond military nuclear issues, the bilateral relationship on civil nuclear issues is an essential area of joint cooperation. However, it is weathering a stormy period of conflict over intellectual property and export controls related to Korea's APR-1400 reactor, and it is being reshaped by new global challenges.

The relationship on civil nuclear cooperation between the U.S. and South Korea is based on decades of interaction, long-term technical cooperation, and mutual dependence in reactor supply chains and construction. However, it is being tested by the conflicts that have emerged over the expansion of the global nuclear reactor market.

And it is being reshaped by five important global imperatives:

- The need for reliable zero-carbon energy
- The growing importance of energy security
- The influence of nuclear geopolitics
- Advances in next-generation nuclear technologies, and
- The continued importance of high nuclear governance standards

### *KEPCO-Westinghouse Dispute*

A dispute between America's and South Korea's top nuclear companies, Westinghouse and KEPCO, has resulted in an unprecedented multi-year freeze in the bilateral nuclear relationship. The root of this conflict was sparked by the potential sale of reactors to Saudi Arabia. Since South Korea signed its 4-reactor deal with the UAE, it has been hunting for new international reactor buyers. And in 2019, it looked like Saudi Arabia was the most viable option.

To pursue the Saudi opportunity, KEPCO informed the U.S. government that it had completely indigenized all components of the APR-1400 and, therefore, the reactor was no longer subject to American export controls. This lit the fuse for the current conflict as Westinghouse, backed by the U.S. government, did not agree that all U.S. controlled technology had been eliminated from the Korean reactor. Numerous and unproductive negotiations over the issue then ensued with no resolution.

The problem for KEPCO was, and remains, that the U.S. does not have an agreement for nuclear cooperation with Saudi Arabia. This means that if U.S. controlled technology is in the Korean reactor, it will not be able to sell it to KSA until a U.S.-Saudi nuclear cooperation agreement is in place.

This agreement is unlikely for a number of reasons including the intense antipathy toward Saudi Arabia in the U.S. Congress, which has authority over the approval of the agreement. The U.S. government has numerous concerns about Saudi Arabia, but one is the unwillingness of the nation to accept nonproliferation requirements that would increase confidence that the Saudi nuclear program would not be weaponized. Senior Saudi leaders have openly stated that they would pursue nuclear weapons if Iran fielded its own nuclear arsenal.

South Korean President Yoon and his predecessor have agreed with the U.S. to require strong non-proliferation conditions for any deal on which they would collaborate in a third country. This includes the IAEA safeguards agreement's Additional Protocol.

Recently the Yoon government restrained KEPCO's pursuit of the Saudi nuclear business because of these commitments.

Further fueling the commercial conflict is the fact that in the past few years it has become clear that Saudi Arabia is not the only realistic opportunity for large reactor export. The deteriorating relationship with Russia among former Soviet satellite states in Central and Eastern Europe as a result of the war in Ukraine, has pushed several of these countries, including Poland and the Czech Republic, to build and expand nuclear power plants. Westinghouse and KEPCO have been competing for these new business opportunities and that has created new irritants in the relationship. It is this competition over market share that seems to be stalling a Westinghouse-KEPCO resolution.

With pressure mounting to deliver results at the upcoming Biden-Yoon summit in late April, there is an incentive to resolve the conflict. But a positive outcome is not certain by the time of that meeting. One deadline in mid-March already has been missed and time is running short to provide a summit deliverable on the issue.

Irrespective of the summit, the two countries and both companies are too dependent on one another in the civil nuclear field to allow the cooperation freeze to continue much longer. Some accommodation is necessary because there are serious global issues on which their cooperation depends.

### *Zero-Carbon Energy*

In order to meet the goals of the Paris Climate Change Agreement, analysis by the U.N.'s IPPC and other experts indicates the need for a near-zero carbon electricity system soon after mid-century. Both Korea and the U.S. have committed to achieve net-zero emissions no later than 2050.

Both nations consider nuclear power to be an important contributor to global decarbonization. It provides over 10% of global electricity and it is the majority of the carbon-free electricity in both nations.

As a result of Russia's invasion of Ukraine, and the demand for zero-carbon energy, a number of nations are considering nuclear power. This has created export opportunities for large reactors to industrialized nations, particularly in Central and Eastern Europe and the Middle East.

However, small modular and advanced reactors also can contribute to emissions-free energy in developed and developing economy nations. The market looks particularly promising in Africa, the Middle East, and South Asia. The U.S. and South Korea have issued joint statements asserting that they will work together on next-generation, smaller nuclear technologies and cooperate on exports to third countries.

This cooperation is important if the global net-zero carbon goal is to be met by mid-century. A roadmap for achieving market development and partnership does not exist, but certainly is needed.

### *Energy Security*

In the wake of Russia's invasion of Ukraine, energy security has burst back onto the global agenda as nations flee from dependency on Russian fossil fuels. The connection between energy security and national security had fallen out of favor for decades after the Cold War. Nations walled off energy from security and sought to use it as a commercial means of maintaining peace, particularly with Russia. That policy now has failed.

Nuclear power provides carbon free and baseload power advantages that can decrease reliance on fossil fuels and support the globe's zero-carbon goals. The challenge is that Russia, despite the Ukraine war, remains the world's top exporter of nuclear reactors and fuels. And China has ambitions to rival Russia's position. It, therefore, is essential that the U.S. and Korea cooperate on large and small nuclear reactor exports and seek to reestablish some control over the international market.

### *Nuclear Geopolitics*

The increasing demand for nuclear power is occurring in an environment where the U.S. and its allies are seeking to recover from a period of significantly decreased nuclear export power and political influence in the international nuclear market.

Russia's and China's nuclear industries are state-owned and financed. This provides significant funding for reactor R&D, customer outreach, construction, export, operation, and financing. These companies are also instrumental in supporting the technical and geopolitical objectives of their political leadership.

Despite the Ukraine war, and Russia's unprecedented and dangerous actions at Ukrainian nuclear facilities, a number of Western countries remain dependent on Russian nuclear fuel supplies, including in North America and Europe. This has dampened efforts to impose nuclear sanctions on Russia. With the exception of a reactor deal Finland cancelled, most of Russia's nuclear order book remains intact.

China is assessing its opportunities in this environment. It is aggressively constructing nuclear power plants (NPPs) at home, with 22 currently under construction, 55 already in operation, and a plan to build 150 more by 2035.

China's flagship indigenized pressurized water reactor, the Hualong One (HPR-1000), recently became operational in China and Pakistan. There are plans for the construction of additional HPR-1000's in other nations, including Argentina.

But China has struggled to enter the wider global nuclear export market as its aggressive actions have caused opportunities with which it was engaged to dry up. For example, it has been removed as a potential nuclear supplier in the U.K. and Romania.

Recognizing its weakened nuclear export position, the U.S. has taken actions over the past several years that have laid the foundation for an international nuclear export revival. Poland is an example where U.S. persistence paid off, although it intensified the rift with Korea.

But a key element of this new strategy is to focus on the development and deployment of small modular and advanced reactors. The U.S. is spending billions of dollars on the development of these technologies. And it has identified very aggressive demonstration deadlines.

Korean companies have made investments in U.S. advanced technologies and will serve as suppliers for several U.S. small reactors. South Korea seems to be lagging the U.S. in advanced reactor development, but it is collaborating with at least one potential purchaser of its technology, Saudi Arabia.

As in the case of the large reactors, Russia and China are offering competition in this area. In 2020, Russia and China began operation of moderately-sized nuclear plants, and both see them as an important export technology and an opportunity to project their power in the global environment. These nations offer state money, hot production lines, government-to-government relationships, and hard to beat package deals that no Western nation has yet been able to match.

### *Advanced Nuclear Technologies*

The race for next-generation reactors and markets and the integration of advanced technologies into these plants is the new frontier. Emerging economy nations will be one of the primary drivers in this energy market.

By mid-century, the global population is projected to increase to 9.9 billion, with an additional 2 billion people added by 2050. Of this increase, African nations are projected to account for more than half of the growth, and Central and South Asia will account for another 25 percent.

Additionally, the 47 least developed nations are projected to be the fastest growing economies, many of which are projected to double in population by 2050. With a rapidly growing population, access to clean and reliable energy will be essential to achieving sustainable and equitable growth.

Advanced reactors are smaller and potentially more deployable in developing economy nations that may have smaller or disaggregated electrical grids or need power in extreme (arid and remote) locations. These new operationally flexible and multipurpose

technologies have the potential to meet the new market demands in underserved, small- to medium-sized or off-grid communities.

As these technologies develop, there could be a backlash in South Korea resulting from the Westinghouse-KEPCO dispute that generates a degree of disengagement between the U.S. and South Korea. The corporate fight is over U.S. export control of the reactor because of the content from Westinghouse. If South Korea develops smaller, next-generation nuclear reactors that exclude U.S.-controlled technology then they could be exported without approval by, or consultation with, the U.S. That could intensify commercial competition between the two countries in regions where smaller reactors are an option.

South Korea already has taken steps to engage with the United Arab Emirates and Saudi Arabia on nuclear technology development. The Saudi's are partners with South Korea on the SMART small modular reactor. And a recent visit by President Yoon to the UAE resulted in a commitment by the Emirates to invest in the South Korean nuclear enterprise. This relationship could provide South Korea with a regional partner that can open markets for their small reactors. That could disadvantage American technologies if there is not a level of cooperation between the countries.

### *Nuclear Governance*

Global nuclear security and governance are areas where the U.S. and South Korea have a very significant advantage. They are strong supporters of nuclear safeguards to prevent proliferation, nuclear security to protect against nuclear terrorism, and nuclear safety regulations. They also have expanded their attention to new and emerging disruptive technologies, like cyber and artificial intelligence, that will impact civil nuclear operations.

A critical issue will be the development of the nuclear governance system that will be applied to smaller and exotic advanced reactors. Many of these reactors will use novel or exotic fuel cycles for which the current international nuclear governance system is not prepared. Developing the new nuclear guardrails for advanced technologies is an area where the U.S. and South Korea need to cooperate.

Also, much of the emerging nuclear market for smaller reactors includes nations with little preparation for nuclear operations and insufficient infrastructure to produce a qualified and stable work force. Deeper support is required in these nations for the development of the institutional, regulatory, non-proliferation, and security infrastructure that is necessary.

Although the IAEA provides considerable support in preparing nations for new nuclear programs, it has not yet produced specific guidance required to safely and securely operate next-generation reactors for peaceful purposes. Guiding the development of that policy so that it is effective and supports global safety and security will be an important challenge on which the U.S. and South Korea must cooperate.

Further, recent developments have raised the question of how nuclear power technologies will be treated and protected in war zones. The most acute example of this is Russia's serious abuse of Ukraine's nuclear facilities, particularly the Zaporizhzhia Nuclear Power Plant, which is the largest in Europe. Significant dangers have arisen from the Russian occupation of the plant.

This danger may extend beyond Ukraine if more Middle Eastern nations decide to build nuclear power infrastructure. There already have been attacks against reactors in Iraq and Syria. And there was a 2019 drone swarm attack against energy infrastructure - the Saudi oil processing facilities at Abqaiq - that was related to the war in Yemen.

Also, the U.S. Department of Defense is engaged in a process of evaluating small nuclear reactors that could be deployed at or near the battlefield. The rules for protecting these types of plants are unclear and the danger that they could be targeted is real. If the U.S. decides to deploy small reactors in war zones then other countries very likely will follow.

In all of these cases it is clear that new rules of nuclear governance are required. There cannot be a race to the bottom on this process with Russia and China. The continued effectiveness of the nuclear governance system requires that the U.S. and South Korea strengthen their cooperation as global nuclear suppliers and leaders on high governance standards.

## Strengthening the Civil Nuclear Partnership

The U.S.-South Korea nuclear relationship is multifaceted and complex. It includes numerous regional and international concerns and challenges, including from North Korea, China, and the rising importance of the Indo-Pacific region.

These issues will be central to the discussion between Presidents Biden and Yoon at their upcoming summit in Washington. While it is unclear how much concrete progress can be made on these headline matters, the other core element of the bilateral nuclear relationship needs to be repaired and girded for the future - the current corrosion in the civil nuclear relationship needs to be reversed.

Reestablishing the strength of this alliance is essential for addressing climate change, advancing technology, building energy security, upholding high nuclear governance standards, and preventing authoritarian nations from dominating global nuclear trade in this century.

There are several steps that can be taken at the summit or afterwards.

### *Lower the Temperature on Market Competition*

It is absolutely essential that the conflict between Westinghouse and KEPCO be resolved at the earliest possible date. The summit is placing political pressure on both parties, but a resolution seems elusive. Without one, the overall civil nuclear partnership

cannot be unfrozen. At the heart of the conflict is the competition for international nuclear markets for large Gigawatt-sized reactors but on the horizon is a rivalry for small reactor export opportunities.

At the moment, the U.S. has the upper hand because the Korean APR-1400 contains Westinghouse technology and is subject to U.S. export controls. However, there are other large reactor markets and both companies are highly reliant on the other for supply chains. While the two companies may be discussing this issue, there may be room for a quiet and impartial discussion hosted by a third party to focus on export opportunities, assess supply chain issues, and identify the strengths, weaknesses, and political needs of each country.

Any back-channel discussion should also focus on how the U.S. and South Korea can or should cooperate on small reactor technologies. This includes addressing the international markets for these technologies, the dangers posed and how to manage those concerns, and preparation of inexperienced countries to operate reactors safely and securely.

### *Define the Additional Protocol Parameters*

Saudi Arabia will remain a problematic nuclear supply case for both the U.S. and South Korea until it accepts international non-proliferation conditions, including the IAEA safeguards Additional Protocol. The features of the AP are both functional and prescriptive. It provides the IAEA with the ability to gather additional information, use advanced technologies to assess undeclared nuclear activities, and enhanced inspection authority.

The U.S. and South Korea should build a clear understanding of their joint commitment to require the Additional Protocol as a condition of supply in third countries and also identify where there is flexibility in how the safeguards enhancements are applied. Defining the parameters and implementation mechanisms of this nuclear security commitment can ameliorate commercial conflicts. For example, the AP may be less applicable for the first eight to ten years of any nuclear project when the facility is under construction. This discussion could offer flexibility in addition to strength and prevent Russia or China from being awarded reactor contracts by default.

### *Refocus the HLBC*

The U.S. and South Korea should revive and reshape the High-Level Bilateral Commission (HLBC), which was created by the 2015 U.S.-Korea nuclear cooperation agreement extension. It was created to primarily manage sensitive technical issues that arose during the negotiation of the agreement. But its mandate needs to be extended to several additional critical issues.

One is the development of a strategy to ensure Russia is replaced as the dominant global nuclear reactor and fuel exporter and that prevents China from replacing it. This needs to be a techno-diplomatic-commercial plan.

Another is to ramp up cooperation on advanced reactor technologies and create alternatives to test facilities that now only exist in Russia. This is a long-term process that will support the advanced reactor industry in both countries as it develops.

Further, the two nations should join forces on the development of the nuclear security and safeguards guidelines that will be required for small and advanced reactors that use exotic fuel cycles. It already is clear that some advanced reactor designs, including those using molten salt and TRISO fuel, will not fit well within the current safeguards and security parameters of the IAEA. And they should discuss how to address the emerging issues of nuclear reactors in war zones.

Additionally, both countries should consider how to better structure their engagement on nuclear technologies that are not electricity-production specific. The continuation of the spent fuel processing project created under the 2015 nuclear agreement extension could be discussed as well as naval nuclear propulsion using non-weapons grade fuel. Engaging on these issues, rather than walling them off, could be viewed in Korea as a sign of a more mature, trusting relationship and could ameliorate some of the political pressure that has built in support of an independent nuclear weapons capability.

### *Collaborate on the Nuclear-Climate Nexus*

Finally, the two nations need to determine how they will jointly advocate for nuclear energy as a climate change and energy security response. Both are dependent on nuclear power for over 50% of their zero-carbon emissions and that output is a benefit for energy security. A joint collaboration could ultimately include a subset of EU nations, Canada, U.K., Japan, and India in a global nuclear alliance supporting zero-carbon power, energy security, and strong nuclear governance.

Kenneth N. Luongo is the president and founder of the Partnership for Global Security and the Center for a Secure Nuclear Future. He a recognized innovator, entrepreneur, and leader in global nuclear and transnational security policy. Mr. Luongo's policy analyses and commentary have been featured in the *New York Times*, *Washington Post*, *Wall Street Journal*, *Foreign Affairs*, Reuters, CNN and numerous other international media, publications, and journals. He has been a TEDx presenter, engaged extensively with global media, and briefed numerous governments. He is a member of the Atlantic Council's Nuclear Energy and National Security Coalition (NENSC) and the Advocacy Council of Nuclear Matters. He served as the Senior Advisor to the Secretary of Energy for Nonproliferation Policy.