

China's nuclear energy going out and global nuclear safety and security

Lynn Lee, Princeton University

Introduction

As China seeks to build civilian nuclear energy reactors in foreign countries, potentially including new comer states, it is natural to question the future of global nuclear safety and security. In this paper, I make three arguments. First, the global nuclear safety and security landscape will only change dramatically in a highly optimistic scenario of China's nuclear BRI (or nuclear energy going out). Although this scenario is not likely to be realized in the near future (if ever), it is necessary to discuss potential implications on nuclear safety and security early on in order to prevent nuclear accidents, sabotage and/or proliferation. Second, China has made a tremendous progress in improving domestic nuclear safety institutions and culture, but little has been done in the context of the nuclear BRI. Third, the pro-development and status-laden narrative of nuclear energy may preclude some difficult but necessary debates on nuclear safety and security.

State of the nuclear BRI

Table 1 lists all the states that have partnered with China on civilian nuclear energy. Bilateral cooperation is considered inactive in the absence of publicly known updates (ex. MOUs, mid/high-level meetings) in a year since the previous one. In the table, the top two quadrants (white and gray) represent partnerships in which China is on the receiving end of technology and resources for its domestic nuclear power plants. Conversely, the bottom two quadrants (blue and purple) represent partnerships in which China (with or without a third country) is the technology provider to a nuclear energy program in partnering states. Partnerships in these two quadrants constitute the nuclear BRI. The left side of the table (white and blue quadrants) concern nuclear power plant projects, while the other side (gray and purple quadrants) concern supplementary nuclear energy projects (ex. Uranium supply, specific type of technology). Therefore, the blue quadrant (nuclear power plant projects in which China is the technology provider) is the primary interest in this paper and the core of the nuclear BRI.

The blue quadrant is divided into four groups based on the level of progress. First, China has negotiated with the top four countries in this quadrant (Pakistan, Argentina, Romania and the United Kingdom) to build one or more Hualong One reactors. However, projects in these countries except Pakistan have been repeatedly halted due to domestic

opposition and/or the US blacklisting of Chinese nuclear energy related entities.¹ Second, China has signed multiple MOUs with the six countries in the middle group. While the specific terms of the agreements are not known, it is reported that these agreements could lay the groundwork for power plant construction in the future.² However, China's cooperation with these countries have not been active for nearly five years. Third, China has signed MOUs concerning research reactors with two Southeast Asian countries, Cambodia and Indonesia which is commonly understood as a precursor to a larger reactor project.³ Lastly, China, has signed at least one MOU on nuclear energy cooperation with Egypt, Brazil and Sudan.

As the "year" category suggests, the current state of China's nuclear BRI do not hint a robust future. In the most pessimistic scenario, China will build Hualong One and potentially other Chinese designed reactors only in Pakistan and perhaps in the UK. Repeated halts and renegotiations in the British and the Argentinian projects due to national security concerns, domestic opposition, and financing difficulties in client states suggest a tumultuous and weary process.

Nevertheless, there are reasons to not anticipate a total failure. First, recall the BRI (or then OBOR) originally made little progress in the first five years (2012-2017). Few Western analysts predicted the vast and robust expansion of the BRI that we witness today.⁴ Considering that the Nuclear Power Mid- and Long-Term Development Plan passed by the State Council signal a strong support from the government, the nuclear BRI may follow the general BRI trajectory and take off in the near future. Second, climate change and recent energy crises may increase the demand for nuclear energy, yet traditional nuclear energy powerhouses such as the U.S. are retrenching from the market, thus creating opportunities for China to expand in the global market. Regardless of the probability for the

¹ For more information, please refer to: John Collingridge and Jillian Ambrose, "Ministers close to deal that could end China's role in UK nuclear power station," The Guardian, September 25, 2021, <https://www.theguardian.com/environment/2021/sep/25/ministers-close-to-deal-that-could-end-chinas-role-in-uk-nuclear-power-station>; "Romania and USA agree to nuclear cooperation," World Nuclear New, September 26, 2019, <https://www.world-nuclear-news.org/Articles/Romania-and-USA-agree-to-nuclear-cooperation>; "China inks \$8 bn nuclear power plant deal in Argentina," Reuters, February 2, 2022, <https://www.reuters.com/business/energy/china-inks-nuclear-power-plant-deal-with-argentina-2022-02-02/>; "World's Fourth Hualong One unit attains full power," World Nuclear New, April 4, 2022, <https://www.world-nuclear-news.org/Articles/Worlds-fourth-Hualong-One-unit-attains-full-power>.

² For example: "China, Saudi Arabia begin HTGR feasibility study," World Nuclear News, May 17, 2017, <https://www.world-nuclear-news.org/Articles/China,-Saudi-Arabia-begin-HTGR-feasibility-study>; "China discusses nuclear with Belarus, Pakistan" World Nuclear News, March 31, 2010, <https://www.world-nuclear-news.org/Articles/China-discusses-nuclear-with-Belarus,-Pakistan>

³ For example: "China, Cambodia agree to nuclear energy cooperation," World Nuclear News, September 13, 2017, <https://www.world-nuclear-news.org/Articles/China,-Cambodia-agree-to-nuclear-energy-cooperation>; "Indonesia extends nuclear cooperation with China," World Nuclear News, August 31, 2018, <https://www.world-nuclear-news.org/Articles/Indonesia-extends-nuclear-cooperation-with-China>

⁴ For example: Scott Kennedy, "Building China's One Belt, One Road," CSIS, April 3, 2015, <https://www.csis.org/analysis/building-china%E2%80%99s-%E2%80%9Cone-belt-one-road%E2%80%9D>; "China's new sim route: the long and winding road," PWC, February 2016, <https://www.pwc.com/gx/en/growth-markets-center/assets/pdf/china-new-silk-route.pdf>.

optimistic scenario, the possibility of such scenario necessitates a long-term, strategic thinking on nuclear safety and security in order to prevent potential accidents, attacks and/or proliferation. Therefore, in this paper I discuss the implications of the nuclear BRI on global nuclear safety and security predicated on a wild assumption that the Chinese nuclear energy SOEs succeed in winning contracts to build commercial nuclear energy reactors in foreign countries including several new-comer states listed in the blue quadrants of the table.

Table 1. Summary of China's foreign partnerships on nuclear energy**

	Cooperation in nuclear reactor design and construction			Cooperation in other related activities		
	Country	Year	Notes***	Country	Year	Notes
For projects in China	US	1985-	Construction of nuclear reactors in	UK*	1983-	Assistance on supporting technology such as the instrumentation and control system, material support or uranium fuel supply
	Canada*	1998-		Japan*	2007-2009	
	France*	1983-	Construction of nuclear reactors in China and in third countries	South Korea*	2009-2015	
	Russia*	1989-		Australia	2006-2008	
				Belgium*	2010	
				Italy*	2014	
For projects abroad	Pakistan	1990s-	Completed or ongoing construction of Chinese reactors	Hungary*	2015	MOUs signed on cooperating in third countries
	Argentina*	2007, 2012-2017		Czech*	2016	
	Romania	2011-		Slovakia*	2015	
	UK*	2013-		Vietnam*	2009	MOU signed on general cooperation
	Belarus	2008-2010	MOUs signed on potential construction of Chinese reactors	Uganda	2017-2018	
	Ukraine*	2010-2016		Uzbekistan	2010	Cooperation in activities related to uranium mining and fuel development
	Saudi Arabia	2012 - 2017		Niger	2011	
	Thailand	2007-2017		Jordan	2008	
	South Africa*	2014-2015		Namibia	2012, 2019	
	Kenya	2012-2017		Kazakhstan*	2007-2016	
	Cambodia	2017	MOUs signed on potential construction of	Nigeria	2018	Conversion projects as a result of the Nuclear Security Summit or the JCPOA
	Indonesia*	2016-2018		Ghana	2017	
	Egypt*	2015	MOUs on cooperation signed w/ or follow up actions	Iran	2015 -	
	Brazil*	2013 - 2017				
	Sudan	2016				

* This an existence of an 123 Agreement on civil nuclear cooperation with the U.S.

** A detailed account of China's foreign partnerships in nuclear energy is provided in the appendix.

*** Almost every information is aggregated from the World Nuclear News between 2000 and January, 2022.

State of China's nuclear safety and security laws and culture

In order to understand the state of China's nuclear safety and security policy, laws and culture, I analyzed policy and legal documents, and surveyed Chinese publications on this subject from 2012 and present. Year 2012 was chosen as the starting point because the policy document for mid- and long-term planning for nuclear energy was announced as part of the twelfth five year plan, which signals Beijing's strengthened interest in nuclear energy. Another reason is that the first discussion of the nuclear BRI appeared in 2013. In my survey, I prioritized publications written by public officials (ex. SASTIND, Department of Nuclear and Radiation Safety and Regulation), employees of the nuclear energy SOEs (CNNC, CGN, etc) and authoritative academics as well as interview records with high-ranking officials in order to understand Beijing's official line of thinking as accurate as possible. The discourse analysis in this paper is based on my reading of around 200 selected articles on this topic.⁵ On China's nuclear security and safety laws and culture especially between 2012 and 2016,⁶ publications in my search mostly converged onto the same set of issues. First, most authors saw the need for a comprehensive, authoritative nuclear safety law that will control sensitive material from birth to cradle and coordinate regulations under different ministries such as the National Development and Reform Commission and the Ministry of Industry and Information Technology. Some experts recommended a creation of more specific procedural laws to ensure an effective implementation of existing and future regulations. Second, having learned lessons the Fukushima accident, most authors called for an authoritative and independent institution directly under the control of the State Council to inspect and oversee the operation of nuclear power plants. They were unsatisfied with the National Nuclear Safety Administration (NNSA) that has no independent authority over its spending, human resources or external relations. Third, many authors recognized the need to have a concrete compensation, insurance and accountability laws in case of emergency. Fourth, China needed a comprehensive policy on waste management and reactor retirement. Fifth, many experts noted the importance of creating a nuclear safety culture that promotes public participation and education.

⁵ On CNKI, I searched for Chinese-language journal articles published between 2012 and 2022 that contain the keyword "nuclear energy" (核能 henneng) which returned 2866 results. I read around 20 articles from each year in the same period of time on nuclear energy that was written by government officials, industry experts, authoritative academics on China's nuclear energy strategy, the nuclear BRI and international cooperation. Then, I narrowed down the search by specifying the second keyword as "nuclear safety" (核安全 heanquan), which returned 64 results. More specifically, there were 8 articles from 2012, 5 from 2013, 9 from 2014, 6 from 2015, 11 from 2016, 3 from 2017, 2 from 2018, 1 from 2019, 3 from 2020, 6 from 2021 and 2 from 2022.

⁶ Publications on nuclear safety decreased from 2016. Also, the content of these publications began to focus more on international cooperation, which is addressed later in the paper.

Around the same time as these articles were published, Beijing passed and revised a series of laws and administrative regulations to ensure nuclear safety (Table 2). In the aftermath of the Fukushima accident, China halted all ongoing power plant construction and conducted comprehensive safety inspections before resuming operation. Since 2012, China passed the Defense Industry Nuclear Safety Plan, Nuclear Energy Safety Plan 2011-2020 and Nuclear Emergency Preparedness Plan as part of the twelfth five-year plan. Most important, China passed the Regulation on the Safety Management of Radioactive Waste (2012) and the Nuclear Safety Law (2018), which was first time of its kind and more authoritative and comprehensive than administrative regulations. To further signal the importance of a comprehensive, well- coordinated govern policy and action, the State Council published two white papers, one on nuclear emergency preparedness (2016) and another on nuclear safety (2019).

“China has become a more active participant in international cooperation on nuclear safety and security. China has been a responsible member in this area by maintaining a good safety record in domestic commercial reactors and fulfilling inspection requirement.”

In addition to domestic activities, China has become a more active participant in international cooperation on nuclear safety and security. China has been a responsible member in this area by maintaining a good safety record in domestic commercial reactors and fulfilling inspection requirements. Some of the examples are China's request to conduct two long-term safety operation reviews (SALTO) at one of its oldest power plants in Qinshan in 2017 and 2019.⁷ To earn credibility of its reactor design, China is also undergoing the General Design Assessment of the Hualong One reactor in the UK, which is one of the most rigorous of its kind.

Name	Type	Effective since
Regulation on the Supervision and Administration of Civil Nuclear Facilities	Administrative regulation	1986

⁷ “IAEA Concludes Long Term Operational Safety Review at China's Qinshan 1 Nuclear Power Plant,” IAEA, May 16, 2019, <https://www.iaea.org/newscenter/pressreleases/iaea-concludes-long-term-operational-safety-review-at-chinas-qinshan-1-nuclear-power-plant>

Regulations on Nuclear Material Control	Administrative regulation	1987
Regulations on Emergency Management of Nuclear Accidents at Nuclear Power Plants	Administrative regulation	1993, revised in 2011
Law on the Prevention and Control of Radioactive Pollution	Administrative regulation	2003
Regulation on the Safety and Protection of Radioisotopes and Radiation Devices	Administrative regulation	2005, revised in 2019
Regulations on the Supervision and Administration of Civil Nuclear Safety Equipment	Administrative regulation	2007, revised in 2016 and 2019
Regulation on the Administration of Transport Safety of Radioactive Articles	Administrative regulation	2010
Regulation on the Safety Management of Radioactive Waste	Law	2012
Nuclear Safety Law	Law	2018

SOURCE: Sun Ye-cong, Li jingyun et al, "Suggestions on the Property and Field of Nuclear Safety Standards and Establishment of Nuclear Safety Standards System," *Xueshu Yantao* 596, no. 12, 2021.

In recent years, China has moved beyond its status as a responsible participant to a contributor. Since 2000, nuclear experts from China and South Korea held biennial Track 1.5 nuclear energy meetings to exchange information and know-hows in several areas including nuclear safety.⁸ In the first decade of these meetings, South Korea acted as an information provider and China as a taker in the nuclear safety area. Subjects of discussion on this panel were often highly technical to ensure safe operation of the reactors. Since 2014, the nuclear safety session at these meetings have addressed bilateral and trilateral (with Japan) cooperation on education and training for nuclear safety and security. In the meeting memoranda, both China and South Korea expressed interests in not only ensuring safe operation of their domestic reactors and minimizing cross-border damage in case of an accident, but also serving a greater role as regional leaders in nuclear safety for the greater

⁸ I was able to access hard copies of all the meetings notes through the Korean Nuclear International Cooperation Foundation (KONICOF) located in Daejeon, South Korea.

good.

Most notably, during the six active years of the Nuclear Security Summit China took pride in cooperating with the U.S. on multiple projects including constructing the largest regional Center of Excellence. Amidst the great power competition and the trade war in 2017 and 2018, the U.S. and China successfully conducted joint operations to remove HEU from miniature neutron source reactors in Ghana and Niger and covering these reactors to use LEU, which reduced proliferation and terrorism threats in these countries.⁹ For China, these types of cooperation help elevate its status from a member to a leader. Therefore, more positive contribution to global nuclear safety and security from China through bilateral and multilateral cooperation can be expected in the future.

Safety and security concerns for the nuclear BRI

While China's domestic nuclear safety and security records have been commendable, there are still some major concerns such as the absence of an independent and authoritative oversight institution and the lack of a waste management and reactor retirement policy. This section discusses two concerns relevant to the nuclear BRI.

...existing laws and regulations do not address issues with constructing Chinese nuclear energy reactors in another country... This concern becomes significant if China's going out projects follow an optimistic path involving multiple new-comer states because nuclear safety rules and norms will predominantly be transmitted through Chinese technology, training and practices.

First, the existing laws and regulations do not address issues with constructing Chinese nuclear energy reactors in another country. If China's nuclear export projects remain limited to existing nuclear energy states such as Pakistan, the United Kingdom and Argentina, this may be a minor concern since these countries have their own laws and regulations. However, this concern becomes significant if China's going out projects follows an optimistic path involving multiple new-comer states because nuclear safety rules and norms will predominantly be transmitted through Chinese technology, training and practices.

⁹ "The Little Known Success Story of U.S.-China Nuclear Security Cooperation," NTI, June 10, 2020, <https://www.nti.org/analysis/articles/little-known-success-story-us-china-nuclear-security-cooperation/>

Also, domestic governance conditions widely differ by states. Table 3 shows domestic conditions related to nuclear energy in China's partnering states. The first few criteria (the existence of nuclear weapons, power plants and 123 agreements) indicate a state's familiarity with nuclear technology and embeddedness in the nuclear network. The remaining criteria indicate a state's average score and global ranking in voice and accountability, political stability and non-violence, government effectiveness, regulatory quality, rule of law and control of corruption between 2012 and 2020. This data comes from the Worldwide Governance Indicators by the World Bank.¹⁰ This data shows that the majority of China's likely clients have less accountable, less stable, less effective, less rule based and more corrupt government institutions. Some of these states (ex. Sudan, Egypt, Ukraine) have recently experienced or are experiencing violence and war, and some of these states are more prone to terrorism, neither of which China has experienced in the past three decades. It is unknown whether Chinese policymakers and industry professionals are familiar with these conditions and have considered ways to establish safety and security institutions and rules that fit local conditions.

Second, the narrative on nuclear energy associated with economic development and national pride may preclude important but uncomfortable conversations on security and safety. In my survey of Chinese publications on nuclear energy, a vast majority of publications sang high praises of nuclear energy as a national technological achievement and defended the necessity of expanding nuclear power plants for continued economic development responding to climate change.¹¹ For example, the first nuclear power plant in China is praised as "national glory" (*guozhi guangrong*). In the official discourse, industry professionals often reaffirm their commitment to the spirit of "two bombs and one star" (*liangdan yixing*) which refers to China's initial development of nuclear weapons, ICBM and satellite.¹² This narrative not only celebrates China's indigenous nuclear development in the 60s, it also

¹⁰ The purpose of including this data is to demonstrate a wide range of domestic governance conditions, often worse than in China. Because they are not used for statistic analysis, there is no need to scrutinize the methodology and the accuracy of measuring the data. Daniel Kaufmann and Aart Kraay "The Worldwide Governance Indicators," World Bank, last accessed on April 15, 2022; Daniel Kaufmann, Aart Kraay and Massimo Mastruzzi "The Worldwide Governance Indicators : A Summary of Methodology, Data and Analytical Issues" World Bank Policy Research Working Paper No. 5430, 2010, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682130

¹¹ For example: Zhu Yehua, "Guiding China's nuclear industry development with technical innovation" [用科技创新引领我国核事业发展] *Keji daobao* 39, no. 10, 2021; Zhang Jianhua, "Promoting the Sustainable Development of Nuclear Power in China, and Creating a Better Future for the World Nuclear Energy Development," *China Nuclear Power* 12, no. 5, September 2019; "Du Xiangwan: present and future of nuclear energy" [杜祥琬：核能的今天和明天] *China Nuclear Power* 12, no. 6, December 2019

¹² "Strong Nuclear Technology Contributes to the Country in May" [强核报国正当时创出别样五月天] *CNNC*, June 6, 2022, <https://www.cnncc.com.cn/cnncc/xwzx65/mtjj91/1224796/index.html>.

invokes Chinese technonationalism, which notes the strategic importance of science and technology and the necessity of self-reliance on advanced technology.¹³

Table 3. Nuclear familiarity and governance conditions in partnering states

Project type	Country	Nuclear weapon state?	Existing civilian nuclear power plants?	123 agreement?	Voice and accountability score	Voice and accountability rank percentile	Political stability and non violence score	stability and non violence rank percentile	Government Effectiveness score	Government Effectiveness rank percentile	Regulatory Quality score	Regulatory Quality rank percentile	Rule of Law score	Rule of Law rank percentile	Control of Corruption score	Control of Corruption rank percentile
Control	China	Yes	Yes	yes	-1.59	6	-0.41	32	0.35	66	-0.22	45	-0.34	43	-0.29	46
Power plant construction	Argentina	No	Yes	yes	0.45	62	0.06	48	-0.08	51	-0.66	28	-0.54	34	-0.31	45
	Pakistan	Yes	Yes	no	-0.78	26	-2.38	2	-0.68	27	-0.66	27	-0.76	24	-0.87	20
	Romania	No	Yes	yes	0.48	63	0.23	54	-0.05	51	0.52	70	0.29	63	-0.15	52
	United Kingdom	Yes	Yes	yes	1.31	92	0.41	60	1.54	92	1.72	95	1.69	93	1.79	94
Power plant related cooperation	Brazil	No	Yes	yes	0.40	60	-0.34	34	-0.23	45	-0.13	49	-0.15	50	-0.31	46
	Egypt	No	No	no	-1.21	14	-1.40	9	-0.68	27	-0.76	23	-0.51	35	-0.64	31
	Sudan	No	No	no	-1.74	4	-2.06	4	-1.51	6	-1.54	5	-1.17	10	-1.45	4
	Cambodia	No	No	no	-1.14	17	-0.01	47	-0.67	27	-0.48	34	-1.00	15	-1.20	11
	Indonesia	No	No	yes	0.13	52	-0.51	28	0.00	54	-0.13	49	-0.40	40	-0.44	39
	Belarus	No	Yes	no	-1.44	9	0.04	48	-0.53	33	-0.85	21	-0.85	21	-0.28	47
	Kenya	No	No	no	-0.24	39	-1.20	11	-0.38	40	-0.30	42	-0.52	34	-0.93	17
	Saudi Arabia	No	No	no	-1.76	4	-0.54	28	0.20	62	0.05	55	0.17	60	0.18	62
	South Africa	No	Yes	yes	0.64	68	-0.18	40	0.33	65	0.26	62	0.04	56	0.00	57
	Thailand	No	No	no	-0.82	25	-0.90	18	0.32	65	0.19	60	-0.04	53	-0.41	41
Cooperation in a third country	Ukraine	No	Yes	yes	-0.08	45	-1.45	13	-0.47	36	-0.45	35	-0.75	25	-0.91	18
	Czech Republic	No	Yes	yes	0.95	78	1.00	84	1.00	80	1.14	84	1.07	83	0.49	69
	Hungary	No	Yes	yes	0.53	64	0.75	71	0.56	71	0.70	74	0.53	69	0.16	61
	Slovakia	No	Yes	yes	0.92	76	0.87	77	0.71	74	0.89	78	0.54	70	0.18	62

¹³ Evan Feigenbaum, China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age (Palo Alto, CA: Stanford University Press, 2003).

Uranium mining related cooperation	Jordan	No	No	no	-0.74	27	-0.47	30	0.08	57	0.10	57	0.32	63	0.15	62
	Kazakhstan	No	No	yes	-1.21	15	-0.14	42	-0.09	51	-0.06	52	-0.50	35	-0.71	27
	Namibia	No	No	no	0.51	64	0.72	70	0.14	59	-0.07	51	0.26	62	0.33	66
	Niger	No	No	no	-0.39	35	-1.29	10	-0.70	26	-0.67	27	-0.61	31	-0.63	30
	Uzbekistan	No	No	no	-1.82	4	-0.36	34	-0.65	29	-1.38	7	-1.13	11	-1.16	11
Unspecified cooperation	Uganda	No	No	no	-0.61	30	-0.77	21	-0.56	32	-0.27	43	-0.33	43	-1.06	14
	Vietnam	No	No	yes	-1.40	10	0.12	51	-0.03	53	-0.44	36	-0.20	48	-0.47	38

Note:

1. The governance scores range from -2.5 to 2.5.
2. The scores and rankings are the average between 2012 and 2020.

The connection between technology and national pride is not uncommon. In her famous book *The Radiance of France*, Gabrielle Hecht analyzes a sense of national salvation, redemption and liberation associated with the nuclear industry in a Gaullist France after a period of humiliation during the World War II.¹⁴ Similarly, Sanghyun Kim discusses the image of nuclear energy as an example of South Korea's miraculous economic development and modernization under President Park Chunghee.¹⁵ In these cases, these collective, fabricated images, or what Jasanoff and Kim call "sociotechnical imaginaries" are institutionalized and shared by the public.¹⁶ One common problem with the nuclear industry is that these images are often created by a coherent group consist of government officials, elite bureaucrats and scientists.¹⁷ Kim demonstrates that the connection between nuclear technology and national development was so strong in South Korea before democratization, there was little criticism toward nuclear technology because it was regarded as backward and unpatriotic. While there has been critical voices against nuclear energy and alternative sociotechnical imaginaries after democratization, Kim argues that the initial positive and proud imaginary remains largely unchallenged even today.¹⁸ Indeed, only after the

¹⁴ Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II*, (Cambridge, MA: MIT Press, 1998)

¹⁵ Sanghyun Kim, "Social Movements and Contested Sociotechnical Imaginaries in South Korea," in Sheila Jasanoff and Sanghyun Kim ed, *Dreamscapes of Modernity: Sociotechnical Imaginaries and Fabrication of Power*, (Chicago, IL: Chicago University Press, 2015).

¹⁶ Jasanoff, "Future Imperfect" in Jasanoff and Kim, 2015.

¹⁷ For example, in South Korea, the phrase "nuclear mafia" is used to criticize the elite culture in nuclear industry because scientists and government officials, all graduates of a few top-tier universities personally know each other and often use personal connections and less formal channels in decision-making processes. In Japan, the phrase "atomic village" contains the same connotation.

¹⁸ Kim 2015

Fukushima accident did the South Korean government heeded to the anti-nuclear energy movements and temporarily stopped all new nuclear plant construction. Similarly, in Taiwan anti-nuclear energy movements only emerged in the 90s after democratization and gained momentum after the Fukushima accident.

In an authoritarian China, the official narrative on nuclear energy remains unchallenged. In the past decade, there was only one publication opposing nuclear energy and not a single article questioning the rationale of the expanding the domestic market and into the global one.¹⁹ Even after the Fukushima accident, while the government halted all new power plant construction to undergo additional safety inspections, there was never a question about nuclear phase out. Since the accident, only six academic journal articles addressed lessons from the accident on China.²⁰ While all of these articles proposed legal and technical measures to improve safety measures in the power plant to prevent accidents, five fervently supported continuation of the nuclear energy projects mainly for economic and energy supply concerns. Only one published in a second-tier university journal raised the possibility of a nuclear accident happening in China and expressed a critical opinion toward China's overconfidence in its nuclear safety technology and culture.²¹

Compared to South Korea and France, China espouses similar, if not stronger top-down, singular sociotechnical imaginary concerning nuclear energy. Not only is the image strongly associated with national development and pride, in China it is also associated with the country's strategic and military power due to the technonationalistic legacy. This makes any criticism toward nuclear energy seen as even more backward and unpatriotic. While the rigid, top-down narrative weakened and anti-nuclear movements emerged during the democratization process in other countries, this scenario is not likely in an authoritarian China. Under these circumstances, intellectual debates on nuclear energy becomes limited to improving technical, legal and institutional standards. It is difficult to ask fundamental questions such as the desirability of nuclear energy and the possibility of a nuclear accident due to human-induced or policy errors.

The issue of limited discussion nuclear safety is relevant in the context of the nuclear BRI because China is attempting to influence the global narrative on nuclear energy. At the Nuclear Security Summit in 2014, President

¹⁹ Wang Yinan, "Why I oppose re-operation of inland nuclear power plants" [我为什么不赞成重启内陆核电] China Economic Weekly, August 4, 2014.

²⁰ This is based on my search on CNKI.

²¹ Li Zhangyin, "Deep Reflection on Nuclear Power" [沉思核电] Journal of Shandong University of Science and Technology 13, no. 3, 2011, 8-16.

Xi delivered a speech in which he presented a concept of “four emphases” (*sige bingzhong*) which was later included in the nuclear safety white paper. He argued that the international community should place equal emphasis “on development and security,” “on rights and obligations,” “on independent and collaborative efforts,” and “on treating symptoms and addressing causes.”²² On the surface, Xi’s speech is in line with the spirit of the global nuclear regime that allows states’ peaceful use of nuclear technology but is committed to safety, security and safeguards risks. Yet, subsequent publications by Chinese academics and industry professionals demonstrate China’s general discontent with the current global nuclear regime that is skewed toward the Western preference of nuclear security and nonproliferation at the expense of peaceful nuclear use.²³ Furthermore, since 2014, multiple commentators have called for China’s greater leadership and discourse power in international organizations such as IAEA on behalf of developing states in order to correct the skewness and imbalance.²⁴ While this type of Chinese narrative (ex. Win-win cooperation, the community of shared destination) has often led to debates on hegemonic competition and order contestation,²⁵ such concern is not warranted in the context of nuclear safety and security because there is not much willingness or opportunity for China to engage in such competition.²⁶ Instead, the real concern is that driven by the quest for global status, China is spreading the simplistic narrative that associates nuclear energy with national development. This may fuel the expansion of the nuclear BRI while suppressing dissenting voices against nuclear energy and robust discussion on safety and security issues in partnering states and especially in China. In other words, China may make haste moves to build Hualong One or Chinese designed reactors abroad before policymakers and industry experts can devise ways to

²² “Statement by H.E. Xi Jinping President of the People’s Republic of China at the Nuclear Security Summit,” Ministry of Foreign Affairs of the PRC, March 24, 2014. https://www.fmprc.gov.cn/mfa_eng/wjdt_665385/zyjh_665391/201403/t20140325_678144.html

²³ Wu Chunsi, “Nuclear Security Summit, Global Nuclear Order, and the Role of China,” *Journal of International Security Studies*, no. 2, 2016; Zhang Tingke, “Nuclear energy: from developing nuclear weapons to rising as a nuclear power state” [核能：从研发原子弹到跻身核电大国] *China Economic Weekly*, June 30, 2021.

²⁴ *Ibid.*

²⁵ For example, Rosemary Foot, “China’s Rise and US Hegemony: Renegotiating hegemonic order in East Asia,” *International Politics* 57, no. 2, 2020.

²⁶ I argue that China is unwilling to compete against the U.S. in the nuclear safety and security realm because China has been socialized into the existing nuclear safety standards and norms set by the U.S.. China has been an active member in IAEA and has voluntarily asked for multiple inspections since the Fukushima accident. Through bilateral and mini lateral cooperation such as the 123 Agreement with the U.S. and the Trilateral Cooperation Secretariat with South Korea and Japan, China has firmly embedded itself in the global nuclear regime. Numerous Chinese publications have only shown deference not contempt towards American, European, Canadian, Japanese and South Korea nuclear safety systems and culture. Second, as mentioned earlier in the paper China earns prestige and status through great power cooperation such as the removal of HEU in Ghana and Nigeria, and the going construction of the largest regional Center of Excellence. Even if China is discontent in the current nuclear regime and wishes to compete against the U.S., it will be extremely difficult if not impossible for China to create an alternative nuclear safety institutions that competes against the IAEA. Combining Philip Lipsky’s network theory and Dan Deudney’s nuclear one worldism, an effective global nuclear regime requires universal membership, thus limiting members’ exit or outside options. Unlike the AIIB, China will not be able to create an alternative IAEA and recruit member states.

establish nuclear safety and security institutions and culture in partnering states.

Conclusion

In this paper, I reviewed the current state of China's nuclear BRI and of the nuclear safety and security institutions and discourse. While China has made tremendous improvements in safety related domestic laws, I argue that the nuclear BRI raises some concerning safety implications because: 1) Beijing has yet to consider its role in establishing nuclear safety and security rules and norms in partnering states, and 2) the pro-development, status-laden narrative of nuclear energy preclude safety and security related debates that slow down the expansion of the nuclear BRI. As mentioned in the beginning of this paper, my argument is predicated on an untested assumption that the nuclear BRI will follow an optimistic, expansionist projection.

Furthermore, I made arguments based on circumstantial evidence such journal publications (albeit carefully selected). More concrete evidence such as surveys of and interviews with relevant policymakers and industry professionals in both China and partnering states is necessary to support my argument. Despite numerous flaws of this paper, I hope I can contribute to this workshop by highlighting the importance of early discussion on the implications of the nuclear BRI on global nuclear safety and security.

Lynn Lee is a PhD candidate in Security Studies in the School of Public and International Affairs at Princeton University. Her academic interests lies in nuclear issues in Northeast Asia, such as China's nuclear strategy and military modernization, and North Korea's nuclear weapons development. In her dissertation, she examines China's influence strategy through critical infrastructure construction projects (ex. nuclear energy exports) and dual use technology transfer, and intends to contribute to the development of a counter-hegemonic theory. At Princeton, she is student director of the Center for International Security Studies. She holds a MA in China Studies from the Yenching Academy at Peking University and a BS in Foreign Service from Georgetown University. She is fluent in Korean and Mandarin, and proficient in French.