North Korea Resuming Construction at the Yongbyon 50 MW(e) Reactor

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North Korea is resuming construction at a long-dormant nuclear reactor that, if completed, would increase its production of plutonium for nuclear weapons by a factor of ten.

Satellite images taken by Maxar in April and May 2022 show North Korea laying a pipeline to connect the reactor's secondary cooling loop with a pumphouse on the river to provide access to water for cooling.

Construction on this reactor was frozen in 1994. At that time, the reactor was still several years from completion. Connecting the secondary cooling loop strongly indicates that North Korea now intends to complete construction of the reactor. It is unclear how soon North Korea could do so.

Background

North Korea began constructing this reactor in the late 1980s. North Korean officials claimed the reactor, called "Nyongbyon Nuclear Power Plant No. 2," would have a capacity of 50 MW(e). (The reactor is also known as the "50 MW(e) Reactor" in US and IAEA reports.) This was one of two reactors under construction at the time. The other was the 200 MW(e) reactor located near Taechon.

Screenshots from the video documenting a 1992 IAEA visit to North Korea led by Hans Blix. Left: The 50 MW(e) reactor. Right: the 200 MW(e) reactor at Taechon.

The electric power rating of a reactor is usually one third to one quarter of its *thermal* rating, which indicates how much plutonium the reactor can produce. The United States estimated the

Yongbyon No. 2 reactor to have a thermal power of about 200 MW(th). This is enough to produce 55 kg of weapons grade plutonium a year, or about ten times as much as the existing 5 MW(e) reactor at Yongbyon.

DPRK Reactors in 1994			
	MW(e)	MW(th)	Pu (kg/year)
Yongbyon No. 1	5	20	6
Yongbyon No. 2 (uncompleted)	50	200	55
Taechon (uncompleted)	200	800	220

S*ource: Author reconstruction based on details provided Central Intelligence Agency, Untitled, November 2002. Available at: https://nsarchive2.gwu.edu/NSAEBB/NSAEBB87/nk22.pdf. CIA estimates appear to assume 300 days of operation per year. Note that Yongbyon No. 2 and Taechon were incomplete at the time and have never been operated.*

North Korea froze construction of the Yongbyon No. 2 and Taechon reactors under the 1994 Agreed Framework. After the collapse of the Agreed Framework in 2003, North Korean officials indicated that North Korea was preparing to resume construction at Yongbyon No. 2, although the effort faced bottlenecks. In 2006, Ri Hong Sop, then the director of the Yongbyon Nuclear Science Center, indicated that North Korea intended to complete construction of the 50 MW(e) reactor, but the process had been delayed owing to weaknesses in the North Korean industrial sector.[1]

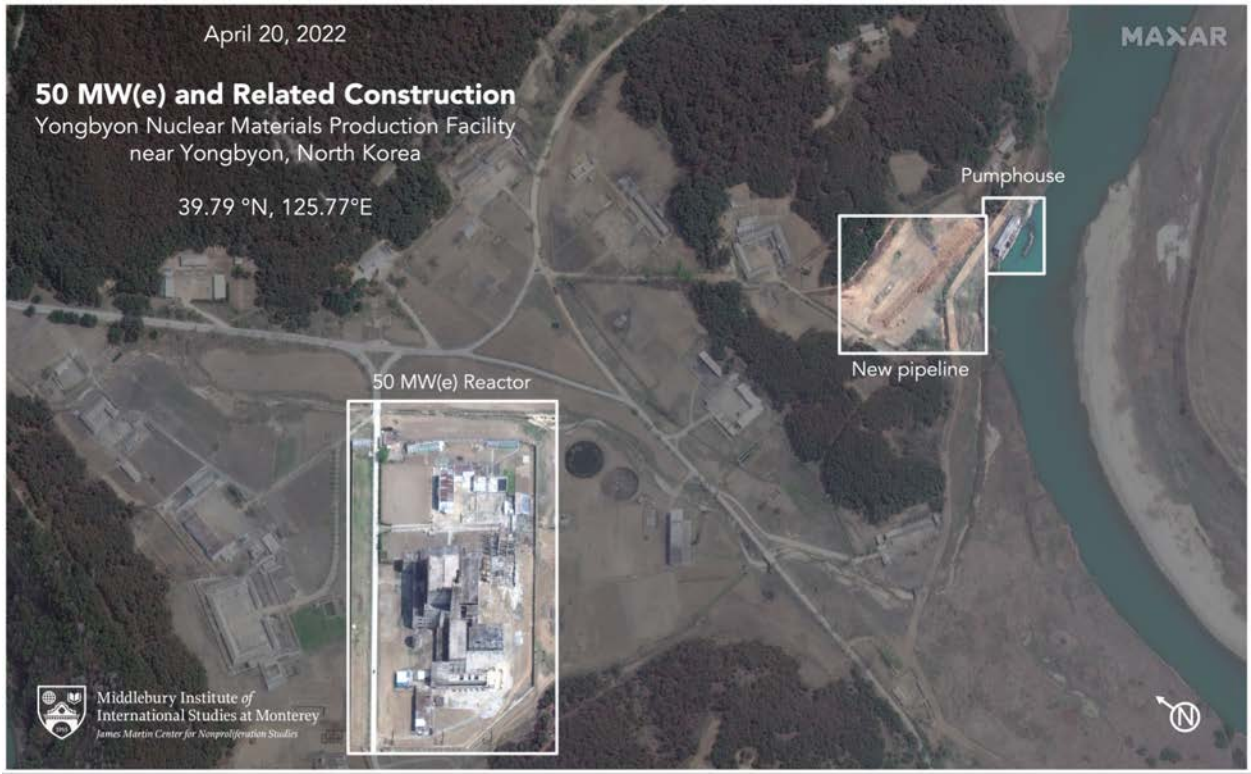
Left: Ri Hong Sop, Director of the Yongbyon Nuclear Science Center and counselor to the General Bureau of Atomic Energy, meeting with Siegfried Hecker in November 2007. Right: Ri, as Director of North Korea's Nuclear Weapons Institute, briefing Kim Jong Un in 2017.

At the time of the Six Party Talks agreement in 2007, which re-froze North Korea's plutonium production infrastructure, IAEA inspectors confirmed that no construction had taken place at the reactor site and that the graphite for the reactor's core remained in storage.[2] The poor condition of the building and the presence of cranes at the site in 2010 led some observers to conclude that North Korea was dismantling the 50 MW(e) reactor.[3]

In April 2013, North Korea announced that it was taking measures "for readjusting and restarting all the nuclear facilities in Nyongbyon."[4] Despite this announcement, only very limited construction activities were seen at the site over the next decade. The 50 MW(e) reactor is assumed to have been part of Kim Jong Un's 2019 offer in Hanoi to close the "nuclear materials production facility" at Yongbyon.

New Satellite Imagery

Satellite images taken by Maxar show that North Korea is connecting the secondary cooling loop of the 50 MW(e) reactor to a pumphouse on the river. In the image dated April 20, construction equipment is visible, as are what appear to be pipe segments. By May 7, North Korea had buried the pipe. This is the first unambiguous indicator that North Korea is moving to complete the reactor.




April 20, 2022
MAXAR
Pipeline Construction and Pumphouse
Yongbyon Nuclear Materials Production Facility
near Yongbyon, North Korea
39.79 °N, 125.77°E
Pumphouse
Construction equipment
Possible pipe segments
Middlebury Institute of
International Studies at Monterey
James Martin Center for Nonproliferation Studies
N


May 7, 2022
MAXAR
Pipeline Construction and Pumphouse
Yongbyon Nuclear Materials Production Facility
near Yongbyon, North Korea
39.79 °N, 125.77°E
Pumphouse
Pipeline now covered
Middlebury Institute of
International Studies at Monterey
James Martin Center for Nonproliferation Studies

The connection of the cooling loop helps explain other activities seen at the 50 MW(e) reactor in recent years.[5] For example, in May 2021, North Korea demolished a building that we believe was intended to house a cooling pond for spent fuel. The demolition work was observed at the time, but its purpose was ambiguous; did North Korea plan to replace it, or simply to dismantle it?[6] Connecting the secondary cooling loop suggests, in hindsight, that the demolition of the apparent spent-fuel building was an early sign that North Korea intends to complete construction of the reactor.

It is difficult to estimate how quickly North Korea could complete construction of the reactor. One major question relates to the overall condition of the reactor building. Although North Korean officials expressed the view in 2006 that it could be repaired, one observer subsequently noted that the building appeared to be in poor condition.[7] Another question relates to North Korea's ability to produce key components for this reactor, which is much larger than the 5 MW(e) reactor that North Korea has operated since the late 1980s.

Implications

Once complete, the 50 MW(e) reactor would produce about 55 kilograms of plutonium per year, a ten-fold addition to the capacity of the 5 MW(e) reactor currently operating at Yongbyon. This corresponds to at least a dozen new nuclear weapons a year, depending on how much plutonium each North Korean weapon uses.

North Korea's interest in more plutonium appears to reflect North Korea's growing emphasis on developing new tactical nuclear weapons. At the 8th Party Congress in January 2021, Kim Jong Un stated that North Korea would increase the types of nuclear weapons available to North Korea. His goals included "developing smaller and lighter "tactical nuclear weapons" while continuing to "push ahead with the production of super large nuclear warhead[s]." Kim also spoke of developing multiple-warhead missiles.[8]

In April 2022, Kim also stated that North Korea requires higher numbers of warheads. During his speech before the April 25, 2022 military parade, Kim remarked that "the nuclear forces, the symbol of our national strength and the core of our military power, *should be strengthened in terms of both quality and scale*, so that they can perform nuclear combat capabilities in any situations of warfare, according to purposes and missions of different operations and by various means."[9]

North Korea seeks tactical nuclear weapons because North Korea plans to use nuclear weapons preemptively in large numbers against US forces in South Korea and Japan in the event of a US invasion.[10] North Korea has two stated purposes for its nuclear arsenal: to "deter" an attack

against North Korea and, should that deterrence fail, to "repel" an invasion that might remove Kim Jong Un from power. North Korea plans and trains to use tactical nuclear weapons to strike ports and airfields where US personnel, equipment and supplies would be located. North Korean leaders probably hope that a nuclear strike against US forces in South Korea and Japan would cause the United States to stop an invasion. And, if it does not, they appear to believe that their best chance to repel an invasion is by interdicting the air- and sealift necessary to sustain a US-led military operation.

Increasing plutonium production by about a factor of ten would allow Kim Jong Un to vastly expand North Korea's stockpile of nuclear weapons in service of both building a large tactical arsenal and equipping long-range missiles with multiple warheads. Along with North Korea's preparations to resume nuclear testing, construction work at the 50 MWe reactor underscores the seriousness of Kim Jong Un's commitment to acquiring a modernized and enlarged nuclear arsenal that would allow North Korea to respond to a US invasion with the preemptive use of large numbers of nuclear weapons.

Endnotes

[1] "In Jan. 2004, we drove by the 50 MWe reactor in Yongbyon. The outside of the reactor building looked in bad repair. Apparently, nothing had been done to the site during the Agreed Framework freeze. In August 2005, Director Ri told us that they had completed a design study that concluded that construction of the reactor could continue on its original site with much of its original equipment. He said that the core of the reactor and other components were not at the Yongbyon site. He said their workers are ready to go back to reactor construction, although he did not give us an expected completion date. During this visit, we were told that virtually nothing had been done at the 50 MWe reactor site and that they have run into some difficulties. Director Ri stated, 'We are now in a partial preparation, not in full swing.' The current effort is directed at recovering the original state of the equipment; for example, removing rust from the steel.' He said, 'The main problem is the preparation by other industries, recovery in other factories, not on site at Yongbyon. This is not a simple job, nor a small job. The problem is in outside industrial facilities.' Responding to our question about having all materials for this construction job available within the DPRK, he answered, 'It is difficult to import, so we must do everything ourselves. It will take longer.' When asked about the timing of resuming full operations, he said, 'I have sent a schedule to the higher level, but have not yet received instructions. I expect to get instructions soon.' Siegfried S. Hecker, Report on North Korean Nuclear Program, Center for International Security and Cooperation, Stanford University, November 15, 2006, p.8.

[2] *Application of Safeguards in the Democratic People's Republic of Korea (DPRK), Report by the Director General,* GOV/2007/45-GC(51)/19, August 17, 2007. https://www.iaea.org/sites/default/files/gc/gc51-19_en.pdf

[3] "The 50 MWe reactor, which was near completion in the mid-1990s but abandoned during the Agreed Framework was being dismantled with large cranes. It looked just like the senior Yongbyon technical official described it: 'a ruined concrete structures and iron scrap.'" Siegfried S. Hecker, *A Return Trip to North Korea's Yongbyon Nuclear Complex*, Center for International Security and Cooperation, Stanford University, November 20, 2010. "During the November 2010 visit to Yongbyon, the Stanford delegation saw that the 50MWe reactor was being torn down." Chaim Braun, Siegfried Hecker, Chris Lawrence, Panos Papadiamantis, *North Korean Nuclear Facilities After the Agreed Framework*, Center for International Security and Cooperation, Stanford University, May 27, 2016.

[4] "DPRK to Adjust Uses of Existing Nuclear Facilities," KCNA, April 2, 2013. https://kcnawatch.org/newstream/1451895823-698999602/dprk-to-adjust-uses-of-existing-nuclear-facilities/?t=1660082270796

[5] See, for example, Frank Pabian, "Minor Modifications at the Abandoned 50 MWe Reactor at Yongbyon," 38North, January 10, 2020. https://www.38north.org/2020/01/yongbyon011020/

[6] Veronika Bedenko, *ONN Monitoring Report: New Activity at Abandoned 50 MWe Reactor at Yongbyon*, July 09, 2021. https://opennuclear.org/publication/onn-monitoring-report-new-activity-abandoned-50-mwe-reactor-yongbyon

[7] "The 50 and 200 MW(electric) reactors do not appear salvageable…" Siegfried S. Hecker, *Report of Visit to the Democratic People's Republic of North Korea (DPRK) Pyongyang and the Nuclear Center at Yongbyon, Feb. 12 - 16, 2008*, March 14, 2008.

[8] "On Report Made by Supreme Leader Kim Jong Un at 8th Congress of WPK," KCNA, January 9, 2021. https://kcnawatch.org/newstream/1610155111-665078257/on-report-made-by-supreme-leader-kim-jong-un-at-8th-congress-of-wpk/

[9] Emphasis added. "Respected Comrade Kim Jong Un Makes Speech at Military Parade Held in Celebration of 90th Founding Anniversary of KPRA," *Rodong Sinmun*, April 26, 2022. https://kcnawatch.org/newstream/1650972015-719114082/respected-comrade-kim-jong-un-makes-speech-at-military-parade-held-in-celebration-of-90th-founding-anniversary-of-kpra/

[10] Jeffrey Lewis, "Has Singapore Led to Real Gains on the North Korean Nuclear Question?" Global Asia, December 2018. https://www.globalasia.org/v13no4/cover/has-singapore-led-to-real-gains-on-the-north-korean-nuclear-question_jeffrey-lewis