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Editors' Note

The Democratic People's Republic of Korea (DPRK) withdrew from the Treaty on the Nonproliferation of Nuclear Weapons (NPT) in 2003 and conducted its first nuclear weapon explosion in 2006. There has been great interest in understanding the possible size and composition of the North Korean nuclear arsenal. The North Korean stockpile of nuclear warheads or explosive devices is constrained by the availability of fissile materials, which in turn requires a good understanding of North Korea's nuclear fuel cycle and fuel cycle facility operations.

This journal has published articles since 1994 seeking to improve the understanding of the North Korean nuclear fuel cycle and fissile material stockpiles [David Albright, "North Korean Plutonium Production," *Science & Global Security,* 5(1994): 63–87]. This issue of *Science & Global Security* adds to this body of work with articles looking into North Korea's processing of uranium ore and its plutonium production capabilities.

In "Assessing Uranium Ore Processing Activities Using Satellite Imagery at Pyongsan in the Democratic People's Republic of Korea," Sulgiye Park, Terry McNulty, Allison Puccioni, and Rodney C. Ewing assess the uranium ore processing capacity of the Pyongsan uranium mill in North Korea. This builds on earlier work published in the journal by some of these authors assessing uranium resources in North Korea [Sulgiye Park, Allison Puccioni, Cameron L. Tracy, Elliot Serbin, and Rodney C. Ewing, "Geologic Analysis of the Democratic People's Republic of Korea's Uranium Resources and Mines," *Science & Global Security*, 28(2020): 89–118].

The new article uses satellite imagery analysis to infer that the Pyongsan uranium mill at maximum capacity can process about 360,000 tons of ore per year, yielding about 90 tons per year of natural uranium in yellowcake. This production would be enough to fuel one reload of the 5 MWe graphite-moderated plutonium production reactor in Yongbyon in addition to supporting annual production of about 3000 kg of low enriched uranium (3.5% enrichment) or about 100 kg of highly enriched uranium (90% enrichment). North Korea appears to have been operating the mill at a much lower capacity, however, indicating a possible capability to ramp up yellow cake production if necessary, assuming enough additional uranium ore is available. This finding also suggests North Korea may be able to sustain its nuclear weapon program at current levels without a second uranium mill and may explain why North Korea's Pakchon Uranium Concentrate Pilot Plant appears from satellite imagery to be inactive.

In "Verifying North Korea's Plutonium Production with Nuclear Archaeology" Julien de Troullioud de Lanversin and Moritz Kütt offer methods and computational tools to reconstruct and verify total past plutonium production at the Yongbyon reactor. The authors reconstruct the operating history of the reactor from 1986 to 2020 and use the open-source reactor physics code ONIX to estimate total plutonium production over this period as 77 kg ± 9 kg, and a remaining stock after reprocessing, plutonium component fabrication and weapon testing of about 40 kg ± 8 kg (as of 2020).

ONIX is designed for simulating nuclear reactor performance for nonproliferation and arms control applications, including methods that aim to verify the past production of plutonium. The authors use the nuclear archaeology module of ONIX to assess ways to minimize uncertainties in plutonium production estimation in two different verification scenarios: one in which international inspectors are allowed to return to North Korea to verify past plutonium production declarations based on samples taken from the Yongbyon reactor's graphite, and another in which there is agreement on neutron fluence monitor tags being installed in the reactor to monitor future operations. The analysis provides a way to select the optimum isotope ratios to measure for nuclear archaeology purposes that minimize the propagation of uncertainties in inferring the plutonium production estimates based on such isotope ratio measurements. This work shows that computational tools like ONIX have a potentially important role in advancing existing safeguards under the NPT as well as other instances of verification involving fissile materials such as the Treaty on the Prohibition of Nuclear Weapons and a possible future Fissile Material Cutoff Treaty.