



Technical Note on Reaching a Denuclearization Agreement with North Korea

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As President Donald Trump meets with Kim Jong-un in Hanoi, Vietnam this week, it will be important for the administration to consider, as a whole, whether various offers to shutter and open up for inspection North Korea's nuclear or missile facilities would constitute a technically meaningful deal that would significantly constrain North Korea's nuclear weapons program. It is worth considering the various facilities that could be involved in one of North Korean offers, namely the shutting down of the Yongbyon nuclear complex. However, this offer by itself appears to offer a minimal step toward denuclearization. In this case, there would be a high probability of ending up with a legitimized, nuclear-armed North Korea and no denuclearization for the foreseeable future.

Yongbyon Nuclear Complex: At best, a shutdown of the two main reactors at the Yongbyon nuclear complex would be a first, positive step, but one that is not worth sanctions relief. If significant sanctions relief is given for such a limited initial step, based on earlier negotiation efforts, it carries significant risk of being the only step that North Korea takes toward denuclearization, pocketing sanctions concessions while retaining its nuclear weapons, enrichment facilities, and ballistic missile capabilities. The shutdown of Yongbyon and its facilities would be positive, but it certainly cannot be an American end goal for rendering the nuclear weapons program fundamentally constrained. In fact, given how many nuclear weapons North Korea already has, the shuttering of Yongbyon should be viewed as a minor step. Yongbyon hardly represents North Korea's "crown jewels," as some have called it.

5 Megawatt-Electric (MWe) Reactor: North Korea appears to have tried to salvage the aged 5 MWe reactor at Yongbyon, but recently something must have gone wrong because the reactor seems to be having problems. Thus, it may well be at the end of its lifetime in any case, making a shutdown of negligible impact.

Experimental Light Water Reactor (ELWR): The ELWR's startup date has been delayed for years, and it has not operated or only operated in a minimal test manner. There appears to be a problem that North Korea is struggling with in bringing this reactor into operation. Governments have stated that North Korea may be having issues with

obtaining and installing adequate reactor control equipment. Alternatively, the reactor may be at a point where it needs outside safety review and assistance before going critical. However, once opened to inspections, North Korea could try to seek aid to justify the ELWR's startup and operation as a civilian reactor producing electricity. Toward that end, it also needs to keep the Yongbyon centrifuge enrichment plant open so as to make 3-5 percent enriched uranium reactor fuel under safeguards for the ELWR. The fuel fabrication facilities would also be required to remain open under this eventuality. Thus, the proposed shutdown at Yongbyon may entail far less than publicly proposed by those promoting this idea.

Suspected Tritium Separation Plant: It would be positive to inspect and close the suspected tritium separation plant at Yongbyon. The facility is suspected to be dedicated to the extraction of tritium from irradiated lithium 6 targets from the 5 MWe reactor. The shutdown of this reactor would remove a source of tritium for nuclear weapons, unless the ELWR operated, which could also irradiate lithium 6 to make tritium. However, tritium is not as important as North Korea's lithium 6 enrichment plant, which is not at Yongbyon. That enriched lithium, when combined with deuterium, is the critical material in making thermonuclear weapons. The separated tritium from Yongbyon could be critical for boosting, but it is still uncertain whether North Korea boosts its nuclear weapons. It certainly does not need separated tritium to manufacture thermonuclear weapons, where it requires lithium 6-deuteride and highly enriched uranium. It also does not require separated tritium to miniaturize fission weapons made from plutonium or weapon-grade uranium. Thus, shuttering a tritium separation plant, while of value, would have a limited impact in the larger scheme of North Korea's thermonuclear weapons capabilities.

Reprocessing Plant: The closure of the Reprocessing Plant at Yongbyon would be a positive step, but without a well-functioning 5 MWe reactor, this facility is not very useful in any case. Moreover, ELWR spent fuel is unlikely to be processed there because of its different design. However, its closure would eliminate the threat of North Korea processing uranium targets irradiated in the ELWR and separating weapon-grade plutonium at the facility. However, North Korea could relatively easily and covertly build a plant to reprocess uranium targets irradiated in the ELWR and separate weapon-grade plutonium at a site outside Yongbyon, especially if the verification arrangements are limited to Yongbyon, or are limited in their ability to access military sites outside Yongbyon. The technical challenges and requirements of processing relatively lightly irradiated targets are far less than processing irradiated fuel. Thus, if North Korea operates the ELWR and the deal fails, it could in relatively straightforward manner reconstitute a facility elsewhere to separate significant amounts of weapon-grade plutonium; in fact four to five times the amount produced in the 5 MWe reactor each year.

Punggye-ri nuclear test site: Shuttering the Yongbyon reactors would be reminiscent of North Korea's "dismantlement" of the Punggye-ri nuclear test site tunnels in May 2018. North Korea conducted six tests there, four of which were successful and achieved the results it sought – the successful detonation of what was likely a boosted fission weapon. North Korea could easily "concede" to halting activities at the nuclear test site for economic concessions, and simply later reopen undamaged parts of this test site or build another one at a time of its choosing.

Moreover, this step failed to lead to sampling the test site for radioactive debris from the underground tests, an additional step that could answer the basic question of whether North Korea uses both plutonium and highly enriched uranium in its nuclear weapons. It is assumed that North Korea uses both nuclear explosive materials but if North Korea depends heavily on weapon-grade uranium for its nuclear weapons, and estimates of tens of North Korean nuclear weapons reflect that, then the lack of an answer to this question means that estimates of the number of nuclear weapons in its possession would remain highly uncertain. In fact, before discussing the relative value of shutting down Yongbyon, which is principally a source of plutonium for nuclear weapons, one should know the answer to the above question. Perhaps, North Korea has only a dozen nuclear weapons, all based on plutonium and has simply not built large numbers of nuclear weapons from weapon-grade uranium. But few believe that currently. Thus, our lack of knowledge of such a basic question about how North Korea builds nuclear weapons is again an example of how there is little value in focusing on Yongbyon only, instead of program-wide declarations and shutdowns.

Enrichment Plants: A benefit to inspectors would be viewing the Yongbyon enrichment plant and being able to characterize it first hand, but even with such an offer, it is unclear what could be gained. North Korea obtained its enrichment plant plans from Pakistan, whose designs are well understood, and much is known about the plant already because of North Korea's many known overseas illicit procurements. But what about the other enrichment plants, such as possibly at Kangsong and potentially a still-covert, third plant? They are assessed as existing outside Yongbyon, but little is known about them. The likelihood of at least two enrichment plants existing outside Yongbyon is feared, so any obfuscation regarding nuclear plants outside of Yongbyon should immediately constitute a red flag. These plants would also need to be declared and rendered inoperable to truly matter in any deal aimed at constraining fissile material production.

In conclusion, U.S. negotiators should not agree to a deal that focuses on inspections and closure of Yongbyon facilities, which would leave North Korea in possession of other fissile material production capabilities, an unknown number of nuclear weapons, and an ability to make more nuclear weapons at unknown locations for the indefinite future. This would be an ideal deal for North Korea, but a horrible one for the United States and its allies. While other incentives could be offered, North Korea should be granted near zero sanctions relief until a complete nuclear and long-range ballistic missile facility accounting, inspection verification arrangement, and initial deconstruction effort is first underway.