SCIENCE & GLOBAL SECURITY
2019, VOL. 27, NO. 1, 1–2
https://doi.org/10.1080/08929882.2019.1613255

Routledge
Taylor & Francis Group

SGS Editor's Note 27-1

This issue of the journal, the first of 2019, marks the journal's 30th year of publication. Founded in 1989 as an international forum for advancing the technical basis for arms control, the initial focus of the journal was U.S.-Soviet arms control with the expectation that, in time, the scope would become increasingly global. This current issue reflects this broadening of a global perspective and contributors. It includes three articles dealing with the denuclearization of North Korea, the most recent of today's nine nuclear-armed states. The international community has been engaged in active, but so far unsuccessful, diplomacy with North Korea aimed at eliminating its nuclear weapons program. The articles in this issue seek to contribute to this ongoing effort.

The first article in the issue is "A Cryptographic Escrow for Treaty Declarations and Step-by-Step Verification," by Sebastien Philippe, Alexander Glaser, and Edward W. Felten. It provides an answer to the challenging question of how a nuclear-armed state could provide a secure and timely declaration of its weapon and material stockpiles, and their locations, for eventual verification as part of a disarmament agreement without running the risk of providing information that may provide a military advantage to an adversary should the disarmament process break down.

The proposed method applies the ideas of adopting a cryptographic hash and a binary Merkle Tree to provide a technical basis for an information-sharing mechanism that would allow a state (in this case, North Korea) to declare up-front a detailed nuclear weapon program and to commit to the declaration being correct and complete, but to only reveal the contents step by step for sequential verification as the state's leaders gain confidence in the disarmament process. The authors note that with this scheme, "because each site can be revealed without compromising others, the pace of inspections can be adapted to the political process, making this approach well suited for an 'action for action' negotiating process, where both sides would make incremental concessions working towards an ultimate settlement."

The second article also assumes some possible hesitancy on the part of North Korea in opening key sites for intrusive verification by inspectors early in the disarmament process and the need to gradually build confidence and transparency. The article "Neutrino-Based Tools for Nuclear Verification and Diplomacy in North Korea" is coauthored by a group of 20 researchers from seven countries (Britain, China, Germany, Japan, South Korea, Russia, and the United States).

They propose deploying neutrino detectors at or close to North Korea's Yongbyon site to monitor the 20 MWth reactor that has been operating for almost three decades and believed to make weapon plutonium, and the 100 MWth experimental light-water reactor under construction in the same location. Since the neutrino flux depends on reactor power and the fissile-material composition of the fuel, the proposed detectors could verify whether the reactors remain shut down (if that is part of an agreement) and observe if they are being restarted covertly, or they could monitor reactor operation if it is agreed that the reactors can be run for peaceful use. One added benefit of this proposed strategy and solution is the opportunity it offers for creating

collaborations between North Korean scientists and those in South Korea and elsewhere, for instance by setting up similar neutrino detectors at reactors in South Korea and other countries interested in such an effort.

The final article in this issue is "The Scope of Foreign Assistance to North Korea's Missile Program," by Markus Schiller. It provides a detailed technical assessment of the evolution of North Korea's ballistic missile program since the 1980s up to the 2017 test of the *Hwasong*-15 (or *KN*-22) missile that had a possible range of 10,000 km or more, putting it into the class of the intercontinental ballistic missiles. The article examines the 23 different guided ballistic missile systems which have been observed in North Korea since the 1980s to suggest that the apparent relative success of this missile program may have depended on substantial access to former Soviet missiles, missile engines and other components, and expertise, and that North Korea may continue to be reliant on missile technology imports.

The article finds that, compared to other countries, North Korea has conducted many fewer missile flight tests and static engine tests as part of its program but managed to have a high success rate in flights and tests of its diverse array of missiles. A close examination of technical details of missiles from available images, and characteristic design solutions to known missile challenges, liquid propellant systems, and guidance and control systems suggests extensive borrowing, including several missile types that appear to rely on engines closely related to the Soviet-era RD-250 rocket engine family, which dates back to the 1950s. Engines of that family were used in Soviet R-16/SS-7 and the R-36/SS-7 missile, for example. The article suggests several paths for North Korea's external support, including direct knowledge transfer from Soviet and later Russian missile experts, functioning missiles from Soviet (later Russian) production lines, engines and guidance systems from Soviet-era stockpiles, and new airframes from Russia, some of which were assembled in North Korea. A growing number of launch and test failures in the past few years may indicate a shift to greater reliance on indigenous design adaptations and fabrication of missiles and components. This complex history may make it difficult to fully account for any North Korean declaration of its ballistic missile program as part of a denuclearization that includes delivery systems.