

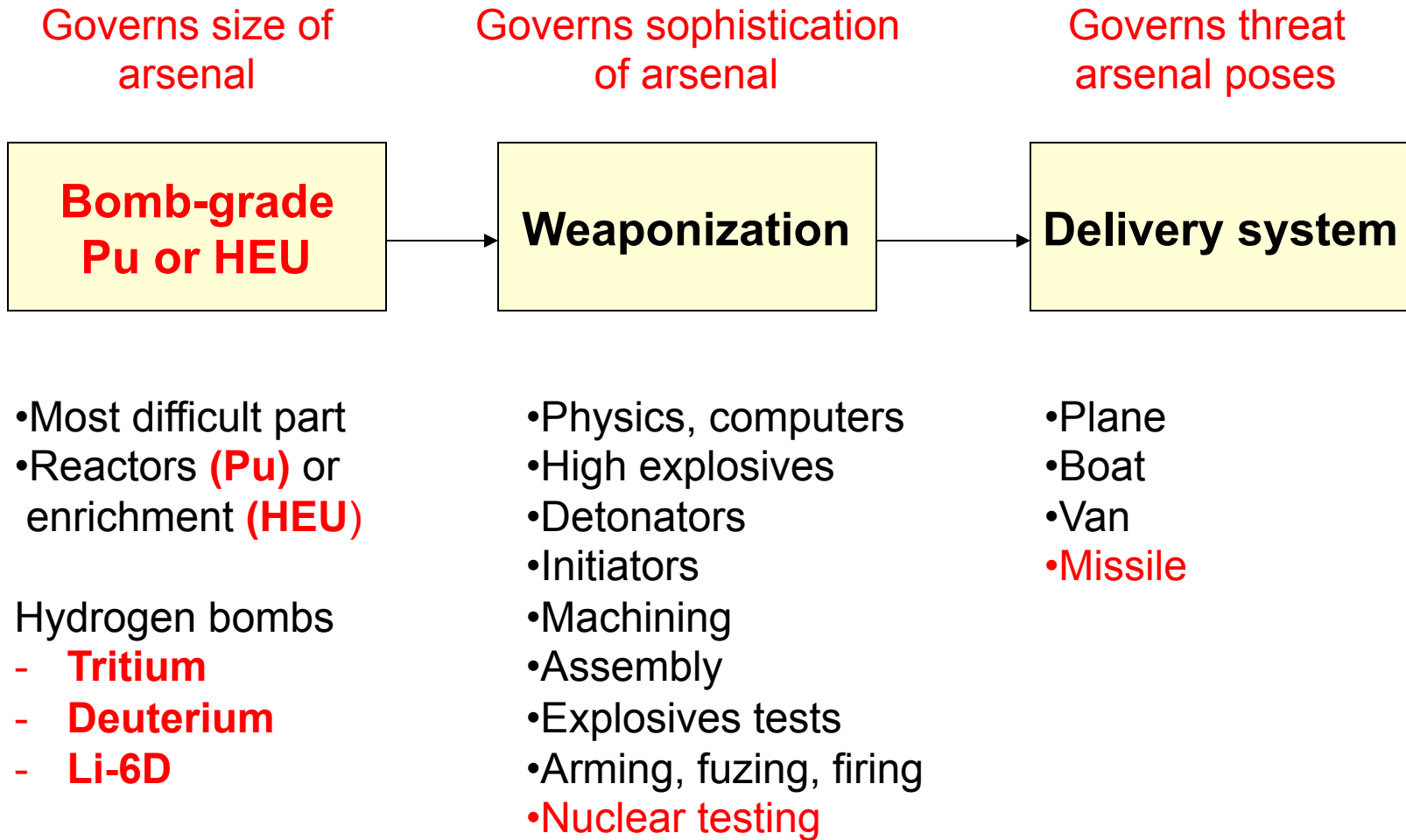
A technically-informed roadmap for North Korea's denuclearization

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North Korea nuclear program



The next chart shows the evolution of “nuclearization” over the past 26 years and its interrelationship to political and diplomatic developments as presented in the history study.
<https://cisac.fsi.stanford.edu/content/cisac-north-korea>

Risk based approach to North Korea denuclearization

Nuclear and missile assets/activities

	Specific facilities or activities
Nuclear weapons	Nuclear arsenal
Personnel	Scientists, engineers
Nuclear tests	Nuclear tests
	Tunnels
	Test infrastructure
Missile Tests	IRBM & ICBM
	SLBM & Solid rocket motors
	New engine tests
	Short & med.-range missiles
	Space Launch Vehicles
Plutonium	Inventory
	5MWe reactor
	ELWR
	IRT-2000
	Reprocessing Facility
	Metal fuel fab facilities
Fusion (H-bomb) fuels	Tritium
	Lithium-6
Uranium Enrichment	HEU inventory
	YB centrifuge facility
	Covert centrifuge facilities
No export	Nuclear & missile technology

Current US view of denuclearization

Risk posed by nuclear assets/activities – red (very high)

	Specific facilities or activities	ELIMINATE
Nuclear weapons	Nuclear arsenal	
Personnel	Scientists, engineers	
Nuclear tests	Nuclear tests	
	Tunnels	
	Test infrastructure	
Missile Tests	IRBM & ICBM	
	SLBM & Solid rocket motors	
	New engine tests	
	SR & MR Missiles	
	Space Launch Vehicles	
Plutonium	Inventory	
	5MWe reactor	
	ELWR	
	IRT-2000	
	Reprocessing Facility	
	Metal fuel fab facilities	
Fusion (H-bomb) fuels	Tritium	
	Lithium-6	
Uranium Enrichment	HEU inventory	
	YB centrifuge facility	
	Covert centrifuge facilities	
No export	Nuclear & missile technology	

- This graphic depicts the current US demand of CVID denuclearization (complete [or permanent], verifiable, irreversible, dismantlement).

- Insisting on immediate CVID along a “Libya model” to eliminate everything up front and virtually all at once is tantamount to a North Korean surrender scenario. It is unimaginable that Kim will agree to a Libya model.

- The scale of the programs is also dramatically different. Libya never got close to nuclear weapons. North Korea has a threatening nuclear arsenal and a huge complex. The suggestion of shipping the North’s nuclear weapons out of the country is naïve and dangerous. The weapons must be disassembled by the people who assembled them.

- Although US should be prepared to accept all concessions Kim is willing to make early on, such as closing the nuclear test site, it must be prepared for a phased approach.

- One option is to still insist on CVID, but space it out over time as in the next chart, but this also unlikely to be acceptable to Pyongyang.

Alternate US view of denuclearization

Risk posed by nuclear assets/activities – red (very high)

	Specific facilities or activities	Short term < 1 year	Medium term 2 to 5 years	Longer term – 6 to 10 years CVID
Nuclear weapons	Nuclear arsenal	Red	Red	Red
Personnel	Scientists, engineers	Red	Red	Red
Nuclear tests	Nuclear tests	Red	Red	Red
	Tunnels	Red	Red	Red
	Test infrastructure	Red	Red	Red
		Red	Red	Red
Missile Tests	IRBM & ICBM	Red	Red	Red
	SLBM & Solid rocket motors	Red	Red	Red
	New engine tests	Red	Red	Red
	SR & MR Missiles	Red	Red	Red
	Space Launch Vehicles	Red	Red	Red
		Red	Red	Red
Plutonium	Inventory	Red	Red	Red
	5MWe reactor	Red	Red	Red
	ELWR	Red	Red	Red
	IRT-2000	Red	Red	Red
	Reprocessing Facility	Red	Red	Red
	Metal fuel fab facilities	Red	Red	Red
Fusion (H-bomb) fuels	Tritium	Red	Red	Red
	Lithium-6	Red	Red	Red
Uranium Enrichment	HEU inventory	Red	Red	Red
	YB centrifuge facility	Red	Red	Red
	Covert centrifuge facilities	Red	Red	Red
No export	Nuclear & missile technology	Red	Red	Red

A technically-informed, risk management roadmap to “denuclearization.”

- Our history study shows that North Korea’s nuclear development has been deliberate and determined, and not primarily predicated on cycles of provocations, appeasement and reversals. Diplomacy has several times slowed or even reversed the program, but never eliminated it. There has been and continues to be a huge trust deficit between the two sides that will almost certainly compel Pyongyang to hedge its bets in any agreed path forward – as it did multiple times over the past 26 years.
- Our experience in dealing with the North has also taught us that retaining a civilian nuclear program and a peaceful space program are of great importance to the North – both for technical and symbolic reasons. Over the past 17 years, the US has considered such civilian activities as covers for military ambitions and has consistently denied these, fearing that such activities would support the North’s military programs. However, this type of risk avoidance instead of risk management has led to several missed opportunities to halt and/or reverse the military programs.
- Today, the risk calculus is quite different from previous years. Unlike in the past, military programs are now so advanced that the civilian programs pose little incremental risk, and their longer-term risks can be managed.
- In the next chart, we propose a phased risk management approach to denuclearization by identifying those assets and activities that pose the greatest risk and must be eliminated (shown in red) and those that can be managed (shown in yellow). The mosaic is meant to provide an overall sense of what’s manageable and what must be eliminated. The phases constitute what might be possible during the first year, the “halt” stage, in years 2 to 5, the “roll back” stage, and in years 6 to 10, the “eliminate” stage. The details are shown in a subsequent chart. Political development will, of course, determine whether or not that time frame can be shortened or lengthened.

A more sensible risk management roadmap to denuclearization (Hecker/Carlin/Serbin)

Risk posed by nuclear assets/activities – red (very high, must be eliminated), yellow (moderate – can be managed)

	Specific facilities or activities	HALT - short term < 1 year	ROLL BACK- medium term 2 to 5 years	ELIMINATE or SET LIMITS - long term – 6 to 10 years
Nuclear weapons	Nuclear arsenal	Red	Red	Red
Personnel	Scientists, engineers	Yellow	Yellow	Yellow
Nuclear tests	Nuclear tests	Red	Red	Red
	Tunnels	Yellow	Red	Red
	Test infrastructure	Yellow	Yellow	Red
Missile Tests	IRBM & ICBM	Red	Red	Red
	SLBM & Solid rocket motors	Red	Red	Red
	New engine tests	Yellow	Red	Red
	SR & MR Missiles	Yellow	Yellow	Yellow
	Space Launch Vehicles	Red	Yellow	Yellow
Plutonium	Inventory	Yellow	Yellow	Red
	5MWe reactor	Red	Red	Red
	ELWR	Red	Yellow	Yellow
	IRT-2000	Yellow	Yellow	Yellow
	Reprocessing Facility	Yellow	Yellow	Red
	Metal fuel fab facilities	Yellow	Yellow	Yellow
Fusion (H-bomb) fuels	Tritium	Red	Red	Red
	Lithium-6	Yellow	Yellow	Red
Uranium Enrichment	HEU inventory	Yellow	Yellow	Red
	YB centrifuge facility	Yellow	Yellow	Yellow
	Covert centrifuge facilities	Yellow	Red	Red
No export	Nuclear & missile technology	Red	Red	Red

A technically-informed, risk management roadmap to “denuclearization.”

- Our detailed study of the North’s nuclear program identifies the most important initial steps to take toward denuclearization to be: no nuclear tests, no intermediate or long-range missile tests, no more production of plutonium and highly enriched uranium, and no export of nuclear weapons, materials or technologies.
- The next chart suggests specific steps that can be phased in over three time horizons. In the short term, North Korea will surely hedge its bets by retaining parts of the program. But the risks in the yellow areas are manageable and will help focusing on the most immediate and pressing risks shown in red. The phased approach will also provide an effective way to build trust and interdependence, which are required for a viable long-term solution – complete demilitarization of North Korea’s nuclear program.
- If the North insists on retaining civilian nuclear programs and peaceful space access, the incremental risk posed by these can be managed if adequate verification measures can be developed. Although an electricity-producing light water reactor can potentially be diverted to plutonium production and a medical isotope research reactor can do the same, the risks are manageable. They are less than those posed by North Korea’s current plutonium production reactor. Likewise for space launch vehicles. These under proper verification protocols will not advance the North’s ICBM program nearly as much as the current missile buildup.
- An agreement to have North Korea retain a civilian nuclear program and peaceful space program also solves the nuclear and missile personnel redirection issue. In addition to transitioning to civilian activities, the technical staff can help to decommission and clean up the facilities dedicated to the weapons program. One can envision a professional staff reorientation along the lines of the Nunn-Lugar program with Russia.
- The future of the uranium centrifuge program will also need to be determined. Currently it is believed to be dedicated primarily to producing weapon-grade HEU. However, under proper verification procedures, it could be restricted to producing LEU for light water reactors and be adequately verified.
- We also suggest that the best verification measures will result from cooperative civilian nuclear programs and space programs. That is, pursuing these ventures cooperatively between North Korea, South Korea and the US (perhaps later with others) will provide a presence of technical personnel at the North’s facilities that will greatly improve attaining adequate verification.

A more sensible risk management roadmap to denuclearization (Hecker/Carlin/Serbin)

Risk posed by nuclear assets/activities – red (very high, must be addressed), yellow (moderate – can be managed)

	Specific facilities or activities	HALT - short term < 1 year	ROLL BACK- medium term 2 to 5 years	ELIMINATE or SET LIMITS - long term – 6 to 10 years
Nuclear weapons	Nuclear arsenal	Cap	Declare & reduce	Eliminate & verify. Join NPT
Nuclear personnel	Scientists, engineers, techs	Assist in halting operations	Assist in roll back	Redirect to civilian programs
Nuclear tests	Nuclear tests	Moratorium/suspend	Ban	Ban (sign CTBT)
	Tunnels	Suspend activity	Close	Destroy
	Test infrastructure	Suspend activity	Dismantle	Dismantle & verify
Missile tests	IRBM & ICBM	Moratorium/suspend	Declare, disable & monitor	Destroy missiles, no developm.
	SLBM & Solid rocket motors	Moratorium/suspend	Declare, disable & monitor	Destroy missiles, no developm.
	New engine tests	Suspend	Halt & monitor	Ban tests and development
	SR & MR Missiles	Short term suspension	TBD – set allowable limits	TBD – set allowable limits
	Space Launch Vehicles	Short term suspension	TBD – establish protocol	TBD – establish acceptable limits
Plutonium	Inventory	Cap	Cap, declare & monitor	Eliminate
	5MWe reactor	Halt	Dismantle	Decommission
	ELWR	Halt or don't start	Inspect & future TBD	TBD
	IRT-2000	Halt	Dismantle	Decommission, possibly replace
	Reprocessing facility	Don't operate	Dismantle front end (no new fuel)	Dismantle & decommission
	Metal fuel fab facilities	Don't operate	Dismantle	Decommission
Fusion (H-bomb) fuels	Tritium	Halt reactors (as above)	Dismantle reactors & hot cells	Eliminate
	Lithium-6	Halt production	Dismantle production facilities	Eliminate
Uranium enrichment	HEU inventory	Limit (halt support facilities)	Cap, declare & monitor	Eliminate
	YB centrifuge facility	Halt & inspect	Inspect & future TBD	TBD
	Covert centrifuge facilities	Limit (halt support facilities)	Declare & inspect	Eliminate
No export	Nuclear & missile technology	No export pledge	No nuclear export. Join MTCR	No nuclear export. Join MTCR

A technically-informed, risk management roadmap to “denuclearization.”

- The approach suggested here is based on our belief that North Korea will not give up its weapons and its weapons program until its security can be assured. Such assurance cannot be achieved simply by an American promise or an agreement on paper, it will require a substantial period of co-existence and interdependence.
- The roadmap is designed to manage risks on the path to denuclearization. We believe it has a chance of being supported by Pyongyang based on our experience in dealing with North Korea’s diplomatic and technical communities. In practice, the path will necessarily be forged during long and complicated negotiations. As shown in the charts, we have left many of the actions as to be determined (TBD) during the negotiations.
- To make it attractive to the Trump administration, which has stated its desire to denuclearize completely and quickly, it will be important for North Korea to front-end load as much of the denuclearization process as possible. The May 24 demolition of the nuclear test site is one such example. It moves the nuclear testing actions from the long term to the immediate term. We believe several similar moves such as disabling the plutonium-production reactor could be achieved during or before a summit (assuming one will occur).
- Uranium enrichment facilities will be problematic. North Korea has covert facilities that it is unlikely to declare and eliminate initially. We believe that early access to the known Yongbyon centrifuge facility and halting operations of the uranium chemical processing facilities that support all enrichment activities are the most important initial steps. These will limit the amount of HEU that could be produced covertly in the mean time and allow managing the risks until the fate of the Yongbyon facility is decided and the covert facilities declared and dismantled.
- In addition to this general roadmap, it will be critical during negotiations to consider steps needed to implement the agreements. In addition, the financial costs of each of the steps must be analyzed and anticipated.
- Finally, this approach has become much more feasible in the past six months during which the North and South have taken remarkable steps toward reconciliation. Together, they can establish a path toward coexistence and interdependence, manage most of the financial burdens, and develop verification protocols that were unimaginable for decades.

CTBT – Nuclear Comprehensive Test Ban Treaty

MTCR – Missile Technology Control Regime

NPT – Nuclear Nonproliferation Treaty