US and North Korea: On the road to denuclearization?

Siegfried S. Hecker Center for International Security and Cooperation Stanford University

Los Alamos National Laboratory 75th Anniversary Past, Present and Future August 6, 2018



2017 was a very bad year for U.S. and North Korea



"...we will have no choice but to totally

UN General Assembly September 19, 2017

"...we will have no choice but to totally destroy North Korea. Rocket man is on a suicide mission"

Kim's Reply Sept. 22, 2017



KCNA claim of hydrogen bomb a few hours before test



September 3, 2017 nuclear test

Nov. 29, 2017 Hwasong-15 ICBM-capable



Launch date and time—Nov 29, at 2:47a.m. (North Korean) local time Range and altitude---950km and nearly 4,500km, (actually 4,475km) on a 'lofted' trajectory On a standard trajectory it could cover the entire US, (over 13,000km) Launch site---Pyongsong Flight time---53min 49sec





"The entire United States is within range of our nuclear weapons, a nuclear button is always on my desk. This is reality, not a threat" – Kim Jong-un 2018 New Year's speech



Kim's nuclear button



@realDonaldTrump



North Korean Leader Kim Jong Un just stated that the "Nuclear Button is on his desk at all times." Will someone from his depleted and food starved regime please inform him that I too have a Nuclear Button, but it is a much bigger & more powerful one than his, and my Button works! 5:49 PM - Jan 2, 2018



He also stated that the State nuclear force was now complete and will turn his attention to economy. Also North Korea would participate in the PyeongChang Winter Olympics.

PyeongChang 2018 Winter Olympics

Kim, Moon Pledge Denuclearization Of Peninsula And End To Korean War

April 27, 2018 · 12:39 AM ET



(Korea Summit Press Pool/AP)

June 12, 2018 Singapore Summit



Wall Street Journal

June 12, 2018 Singapore Summit



Singapore Summit Joint Statement – June 12, 2018

- Commit to establish new U.S.-DPRK relations in accordance with the desire of the peoples of the two countries for peace and prosperity
- Join their efforts to build a lasting and stable peace regime on the Korean Peninsula.
- Reaffirming the April 27, 2018 Panmunjom Declaration, the DPRK commits to work toward complete denuclearization of the Korean Peninsula.
- Commit to recovering POW/MIA remains, including the immediate repatriation of those already identified.

North Korea's "nuclearization"



Most difficult part
Reactors (Pu) or enrichment (HEU)

Hydrogen bombs

- Tritium
- Deuterium
- Li-6D

- •Physics, computers
- •High explosives
- Detonators
- Initiators
- Machining
- Assembly
- Explosives tests
- •Arming, fuzing, firing
- Nuclear testing

- •Plane
- •Boat
- •Van
- •Missile

Nuclear materials production



Estimates – how do we know? What is confidence level?

Open Source Analysis

26 SEP 2010

Commercial overhead imagery

Source: DigitalGlobe



24 JUN 2012 Source: GeoEye













Source: DigitalGlobe/ Google Earth

IHS Jane's Satellite Imagery Analysis

Yongbyon, North Korea 39.770027 N 125.750307 E Image Date: 3 February 2014 / Pleiades Satellite

Feb. 3, 2014ç

Rail spur

New steam plant.



Fuel fabrication facility

lew centrifuge buildings

Former fuel rod final assembly

Uranium trioxide to uranium dioxide conversion

Uranium clickide to uranium tetrafluoride to uranium metal conversion

Uranium metallurgy

Hydrogen fluoride production

The fuel fabrication facility is the largest of the functional areas in the southern half of the Centre. Visible is a new centrifuge building with an expected capacity of 2,000 centrifuges.

Looking from the inside

Hecker

Site visits and technical discussions provide valuable information



Jan. 2004 Yongbyon



Aug. 2005 Pyongyang



Nov. 2006 Pyongyang



August 9, 2007, Yongbyon Feb. 14, 2008, Yongbyon Feb. 27, 2009, Pyongyang

The seventh visit brought a big surprise

Purely illustrative - this is not Yongbyon, but close to what we saw (Nov. 12, 2010).

Piketon, Ohio Centrifuge plant, 1984 (Department of Energy)



No outsiders have been in Yongbyon since Nov. 2010

KCNA Publicity – what they show us

Another Kim Jong-un site visit on KCNA in March 2016

Karear Contra TV

Plutonium production in North Korea

- Uranium ore, mining, milling
- Fuel fabrication (U metal fuel)
- Reactor operation (5 MWe)
 Gas Graphite natural U fuel
- Reprocessing (extract Pu)
- Plutonium fabrication/machining

- Capacity < 6 kg/yr (1 bomb)
- Inventory ~ 30 40 kg by 12/2017
- Estimated confidence: High
- Observability: High





HEU production

- Uranium ore, mining, milling
- Conversion to UF6
- Centrifuges for enrichment
 - LEU for LW Reactor
 - HEU for bombs
- Uranium metal fabrication/ machining
- Capacity ~ 150 kg/yr (6 bombs)
- Inventory ~ 250-500 kg by 12/2017
- Estimated confidence: Low
- Observability: Very low





Tritium

• Li-6

- Have capability
- Marketing for sale

Tritium production

- IRT-2000 Reactor (unlikely)
- 5 MWe Reactor (likely)
- ELWR (future?)
- Tritium extraction
 - Hot cells at IRT-2000 site
 - New construction (likely)

Li-6D (lithium deuteride)

- Capacity ~ Likely small for now
- Inventory ~ Not known
- Estimated confidence: Very low
- Observability: Very low



ELWR for future?



New hot cells?

Weaponization



We have few details, but – Bottom line is they conducted 6 nuclear tests

Nuclear tests critical to sophistication

- Oct. 9, 2006: Close to1 kiloton
 Likely Pu
- May 25, 2009: ~ 2 to 7 kilotons
 Likely Pu
- Feb. 12, 2013: ~ 7 to 14 kilotons
 - Either Pu or HEU
- Jan. 6, 2016 deeper than others, ~ 7 to 14 kilotons
 - Claim of H bomb not likely. Possible proof of principle H-bomb?
- Sept. 9, 2016 ~ 15 to 25 kilotons
 - Likely made progress in miniaturization
- Sept. 3, 2017 > 100 kilotons, possibly 250 kilotons
 - Hydrogen bomb possible

NORTH KOREA'S BALLISTIC MISSILES



North Korea's ballistic missile program is one of the most rapidly developing threats to global security. In recent years, an unprecedented pace of missile testing has included new and longer range missiles, sea-launches, and the orbiting of satellites. The most notable of these advances has been North Korea's development of two new intercontinental ballistic missiles, the Hwasong-14 and -15, which can likely reach the continental United States.

CSIS | trades for tradition a | websit devise



North Korea (DPRK) Nuclear Program– Technical Focus 3 shades of green (dark best), 3 shades of red (dark worst)

Year	US Diplomacy	DPRK Diplomacy	US/IAEA YB Presence	Plutonium	U enrichment	Tritium/Li-6 H-bomb fuel	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992									
1993									
1994									
1995									
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2014									
2015									
2016									
2017									

North Korea Nuclear Program– Technical Focus (Stanford University CISAC) 3 shades of green (dark best), 3 shades of red (dark worst) –Hecker/Carlin/Serbin

Year	US Diplomacy	DPRK Diplomacy	Yongbyon Presence	Plutonium	U enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1

1994 Crisis and the Agreed Framework



- Replace graphite-moderated reactors with light water reactors for 2000 MWe
- DPRK will freeze its GMR and related facilities, allow IAEA inspection and dismantle as progress is made on LWRs. Two sides move toward full normalization of economic and political relations
- Both sides will work toward peace and security of a nuclear-free peninsula
- DPRK will consistently take steps to implement the 1992 N/S Declaration
- And other conditions

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1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1

Almost there with diplomacy in Oct. 2000?





Vice Marshal Jo Myong-rok and President Bill Clinton at the White House

2000 US-DPRK Joint

Communiqué pledges fundamental improvement in bilateral relations.

- to "fundamentally improve their bilateral relations" and "build a relationship free from past enmity."
- Reference to missile issue and Kumchang-ri access important



Kim Jong-il and Secretary of State Madeleine Albright in Pyongyang.

Late 1990s - Uranium enrichment



- Covert global procurement network centrifuge technologies, materials and equipment.
- Centrifuge starter kit from A.Q. Khan comprised of twenty P-1 centrifuges and four P-2 centrifuges and possibly an implosion nuclear device design.
- North Korean engineers visit Khan Research Laboratories and receive hands-on training in centrifuge facilities.
- Likely scale-up of equipment for production of UF6 the feed material for centrifuges later exported to Libya.

Plutonium production scaled back dramatically during AF



5 MWe reactor

Operations halted.

- ~6 kg/yr Pu potential.
- Did not operate 1995 through 2003.

50 MWe reactor Construction halted – never completed. (Pu forfeit ~ 56 kg/yr)



200 MWe reactor Taechon Construction never completed. (Pu forfeit ~ 220 kg/yr)

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1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
Progress stops abruptly in 2001

President Bush enters office with a contingent of hardline officials highly critical of the Agreed Framework and intent on ending it.

President George Bush and President Kim Dae-jung





Bolton: "It's what we needed to drive a stake through the Agreed Framework"





WORLD

BUSH TELLS SEOUL TALKS WITH NORTH WON'T RESUME NOW

The Agreed Framework falls apart in 2002



The US-DPRK relationship continues to deteriorate, culminating in a decisive October meeting in Pyongyang.

WORLD

U.S. TO WITHDRAW FROM ARMS ACCORD WITH NORTH KOREA

By DAVID E. SANGER OCT. 20, 2002



U.S. Assistant Secretary of State James Kelly arrives at a Beijing hotel on October 17 after visiting North Korea.

Year	US Diplomacy	DPRK Diplomacy	YB Presence	Plutonium	U enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1

Year	US Diplomacy	DPRK Diplomacy	YB Presence	Plutonium	U enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1

John Lewis Stanford delegation Track II visit to Yongbyon, Jan. 2004



Upon return to the US, Hecker concludes North Korea can build the bomb

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1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1

Missed opportunities in 2005?

The US and North Korea agree to the September 19 Joint Statement, but unilateral US actions hinder positive momentum.



The fourth round of the Six Party Talks in Beijing.





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1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1

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1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
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2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1
2008	G2	G1	G3	G1	R1	R1	R1	R1	R1

Disablement efforts in 2007-2008: Serious, but reversible.

IAEA inspectors and US technical team allowed back into Yongbyon. Hecker visits in 2007 and 2008.

- 5 MWe reactor is not operating. No plutonium being produced.

- Disablement efforts are verified but are reversible.

- Likely increase in clandestine effort to build uranium enrichment facility.







Pyongyang heads into 2009 determined to enhance nuclear program



August 2008



Time runs out for Amb. Chris Hill - 2008

- In Feb./March visit to North Korea, we are told about upcoming space launch. We asks Amb. Ri why welcome the Obama administration so harshly, he tells us that is the way it is and you have no idea of how bad it is going to get.
- Internal events may have dramatically changed North Korea's direction. Kim Jong II suffered a severe stroke in mid-August 2008, opening the need for succession planning. Concern that outsiders would try to take advantage of the North at such a vulnerable period apparently triggered a decision that the moment for reconciliation had passed and that the North must now proceed with its nuclear program.
- The April 5 space launch (which failed) is followed by May 25 nuclear test, which is deemed successful with yield of 4 to 7 kt.

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2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1
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2010	G1	R1	R3	R1	R2	R2	R2	R2	R1

Yongbyon visit by Stanford team on Nov. 12, 2010

"We will convert our center to an LWR and pilot enrichment facility"



"No one believed us when we announced this in 2009 including you, Dr. Hecker," Ri Yong-ho (VM MFA) **Pyongyang reveals modern uranium centrifuge facility to Lewis/Hecker/Carlin in Nov. 2010** North Korea demonstrates second path to the bomb – makes assessment difficult

Piketon, Ohio Centrifuge plant, 1984 (Department of Energy) Purely illustrative - this is not Yongbyon, but close to what we saw

(U.S. Department of Energy)

No outsiders have been in Yongbyon since Nov. 2010

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2012	R1	R1	R3	R1	R2	R2	R2	R2	R1

2012 Leap Day Agreement – classic case of different views and opportunity missed



US Special Representative for North Korean Affairs Glyn Davies briefs reporters after a meeting with Kim Kye Gwan in February.

Opportunity for:

- Missile and nuclear test moratorium
- Resolving uranium enrichment issue
- Freezing nuclear work and allowing inspectors back in Yongbyon

- No joint statement or agreement each side makes its own announcement
- US claims moratorium for long-range missiles
- North Korea only ban long-range missiles, not space launches (claims priority of Space Treaty over UNSC resolutions)

As a result of April 13 satellite launch, US walks away from deal and North Korea nuclear buildup continues unabated

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1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1
2008	G2	G1	G3	G1	R1	R1	R1	R1	R1
2009	R1	R1	R2	R1	R2	R2	R2	R2 🌪	R1
2010	G1	R1	R3	R1	R2	R2	R2	R2	R1
2011	G1	G1	R3	R1	R2	R2	R2	R2	R1
2012	R1	R1	R3	R1	R2	R2	R2	R2	R1
2013	R2	R1	R3	R2	R2	R2	R2	R2 🍸	R1
2014	R2	R1	R3	R2	R3	R3	R2	R2	R1
2015	R1	G1	R3	R3	R3	R3	R2	R2	R2

North Korean diplomatic overtures in 2015

January: North Korea announces formal suspension for suspension proposal.

Later in the year, engages in private talks with Washington on DPRK proposal for a peace agreement.





ASIA PACIFIC

North Korea Offers U.S. Deal to Halt Nuclear Test

By CHOE SANG-HUN JAN. 10, 2015

Year	US Diplomacy	DPRK Diplomacy	YB Presence	Plutonium	U enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1
2008	G2	G1	G3	G1	R1	R1	R1	R1	R1
2009	R1	R1	R2	R1	R2	R2	R2	R2 🍸	R1
2010	G1	R1	R3	R1	R2	R2	R2	R2	R1
2011	G1	G1	R3	R1	R2	R2	R2	R2	R1
2012	R1	R1	R3	R1	R2	R2	R2	R2	R1
2013	R2	R1	R3	R2	R2	R2	R2	R2 🍸	R1
2014	R2	R1	R3	R2	R3	R3	R2	R2	R1
2015	R1	G1	R3	R3	R3	R3	R2	R2	R2
2016	R1	R3	R3	R3	R3	R3	R3	R3 7 7	R2

Year	US Diplomacy	DPRK Diplomacy	Yongbyong Presence	Plutonium	U enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993	G2	G2	G1	G2	G1	G1	R1	R1	R1
1994	G3	G3	G1	G2	G1	G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1
1997	G2	G2	G3	G3	R1	G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1
2001	R2	G2	G3	G3	R1	G1	R1	G3	G1
2002	R3	G2	G3	G3	R1	G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	G1
2005	R1	R1	R3	R3	R1	R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 🌪	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1
2008	G2	G1	G3	G1	R1	R1	R1	R1	R1
2009	R1	R1	R2	R1	R2	R2	R2	R2 🌪	R1
2010	G1	R1	R3	R1	R2	R2	R2	R2	R1
2011	G1	G1	R3	R1	R2	R2	R2	R2	R1
2012	R1	R1	R3	R1	R2	R2	R2	R2	R1
2013	R2	R1	R3	R2	R2	R2	R2	R2 🍸	R1
2014	R2	R1	R3	R2	R3	R3	R2	R2	R1
2015	R1	G1	R3	R3	R3	R3	R2	R2	R2
2016	R1	R3	R3	R3	R3	R3	R3	R3 🍸 🍸	R2
2017	R3	R3	R3	R3	R3	R3	R3	R3 🖤	R3

Nuclear Capability	December 2017 (Rough estimates)
Plutonium	30 – 40 kg
HEU (highly uncertain)	250 - 500 kg
Tritium	Very limited (Multi grams)
Nuclear devices (sufficient material)	~25-30
Fit and robust for: SCUD & Nodong	Yes
IRBM & ICBM	Hwasong-12 Hwasong-14 Hwasong-15
Fit on missiles	Need more tests

Year	US Dipl.	DPRK Dipl.	YB Presence	Nukes	Missiles	N/S Relation	N/Sino Rel.	Sanctions	NK Economy	US Fin. Aid
1992	G1	G1	G1	R1	R1	G3	R2	R1	R2	\$0
1993	G2	G2	G1	R1	R1	G2	R1	R1	R2	\$0
1994	G3	G3	G1	R1	R1	R2	R1	R1	R3	\$0
1995	G3	G3	G3	G3	R1	R1	R1	R1	R3	\$9.7M
1996	G3	G3	G3	G3	R1	R1	R1	R1	R3	\$30.3M
1997	G2	G2	G3	G3	R1	G1	R1	R1	R3	\$82.4M
1998	G2	G2	G3	G3	R1	G1	R1	R1	R3	\$122.9M
1999	G3	G3	G3	G3	G1	G3	G1	R1	R3	\$287.2M
2000	G3	G3	G3	G3	G1	G3	G2	R1	R2	\$138.7M
2001	R2	G2	G3	G3	G1	G1	G2	R1	R2	\$132.97M
2002	R3	G2	G3	G3	G1	G2	G2	R1	R2	\$140.9M
2003	R2	R2	R3	R2	G1	G1	G2	R1	R1	\$27.78M
2004	R2	R1	R3	R2	G1	R1	G1	R1	R1	\$36.4M
2005	R1	R1	R3	R2	R1	G1	G1	R1	R1	\$5.7M
2006	R1	R2	R3	R2	R1	G1	R1	R1	R1	\$0
2007	G2	G1	G3	R1	R1	G3	R1	R1	R1	\$45.1M
2008	G2	G1	G3	R1	R1	R1	G1	R1	R1	\$224.7M
2009	R1	R1	R2	R2	R1	R2	G1	R1	R2	\$24.6M
2010	G1	R1	R3	R2	R1	R3	G2	R1	R1	\$3.5M
2011	G1	G1	R3	R2	R1	R3	G2	R1	R1	\$0.9M
2012	R1	R1	R3	R2	R1	R3	G2	R1	G1	\$0
2013	R2	R1	R3	R2	R1	R2	R2	R2	G1	\$0
2014	R2	R1	R3	R2	R2	R2	R2	R2	G1	\$0
2015	R1	G1	R3	R2	R2	R2	R2	R2	G2	\$0
2016	R1	R3	R3	R3	R3	R3	R2	R2	G2	\$0
2017	R3	R3	R3	R3	R3	R2	R2	R3	G2	\$0.9M

Year	Nukes	Missiles	Sanctions
1992	R1	R1	R1
1993	R1	R1	R1
1994	R1	R1	R1
1995	G3	R1	R1
1996	G3	R1	R1
1997	G3	R1	R1
1998	G3	R1	R1
1999	G3	G1	R1
2000	G3	G1	R1
2001	G3	G1	R1
2002	G3	G1	R1
2003	R2	G1	R1
2004	R2	G1	R1
2005	R2	R1	R1
2006	R2	R1	R1
2007	R1	R1	R1
2008	R1	R1	R1
2009	R2	R1	R1
2010	R2	R1	R1
2011	R2	R1	R1
2012	R2	R1	R1
2013	R2	R1	R2
2014	R2	R2	R2
2015	R2	R2	R2
2016	R3	R3	R2
2017	R3	R3	R3

Year	Nukes	Missiles	Sanctions	NK Economy	US Fin. Aid
1992	R1	R1	R1	R2	\$0
1993	R1	R1	R1	R2	\$0
1994	R1	R1	R1	R3	\$0
1995	G3	R1	R1	R3	\$9.7M
1996	G3	R1	R1	R3	\$30.3M
1997	G3	R1	R1	R3	\$82.4M
1998	G3	R1	R1	R3	\$122.9M
1999	G3	G1	R1	R3	\$287.2M
2000	G3	G1	R1	R2	\$138.7M
2001	G3	G1	R1	R2	\$132.97M
2002	G3	G1	R1	R2	\$140.9M
2003	R2	G1	R1	R1	\$27.78M
2004	R2	G1	R1	R1	\$36.4M
2005	R2	R1	R1	R1	\$5.7M
2006	R2	R1	R1	R1	\$0
2007	R1	R1	R1	R1	\$45.1M
2008	R1	R1	R1	R1	\$224.7M
2009	R2	R1	R1	R2	\$24.6M
2010	R2	R1	R1	R1	\$3.5M
2011	R2	R1	R1	R1	\$0.9M
2012	R2	R1	R1	G1	\$0
2013	R2	R1	R2	G1	\$0
2014	R2	R2	R2	G1	\$0
2015	R2	R2	R2	G2	\$0
2016	R3	R3	R2	G2	\$0
2017	R3	R3	R3	G2	\$0.9M

Year	US Diplomacy	N/S Relations	DPRK Diplomacy	Nukes	Missiles
1992	G1	G3	G1	R1	R1
1993	G2	G2	G2	R1	R1
1994	G3	R2	G3	R1	R1
1995	G3	R1	G3	G3	R1
1996	G3	R1	G3	G3	R1
1997	G2	G1	G2	G3	R1
1998	G2	G1	G2	G3	R1
1999	G3	G3	G3	G3	G1
2000	G3	G3	G3	G3	G1
2001	R2	G1	G2	G3	G1
2002	R3	G2	G2	G3	G1
2003	R2	G1	R2	R2	G1
2004	R2	R1	R1	R2	G1
2005	R1	G1	R1	R2	R1
2006	R1	G1	R2	R2	R1
2007	G2	G3	G1	R1	R1
2008	G2	R1	G1	R1	R1
2009	R1	R2	R1	R2	R1
2010	G1	R3	R1	R2	R1
2011	G1	R3	G1	R2	R1
2012	R1	R3	R1	R2	R1
2013	R2	R2	R1	R2	R1
2014	R2	R2	R1	R2	R2
2015	R1	R2	G1	R2	R2
2016	R1	R3	R3	R3	R3
2017	R3	R2	R3	R3	R3

Lessons learned from the comprehensive history

- Pursuit of weapons was deliberate and determined slowed by diplomacy, sometimes reversed, but never abandoned.
- Most important element was a US/IAEA presence in Yongbyon boots on ground.
- US diplomacy since 2000 has been sporadic and reactive. Tired to avoid risk instead of managing risk don't walk away without weighing the risks.
- Nuclearization was a massive enterprise took 25 years to go to dark red, going to dark green (denuclearization) will take time.
- As bad as it was in 2017, stop it from getting worse. Several opportunities missed in the past by not managing the incremental risks.
- The narrative that North Korea "has cheated on every agreement" is neither accurate nor useful. U.S. has never held up its end to "normalize" relations. Must understand history better so as not to repeat mistakes.

Singapore Summit Joint Statement – June 12, 2018

- Commit to establish new U.S.-DPRK relations in accordance with the desire of the peoples of the two countries for peace and prosperity
- Join their efforts to build a lasting and stable peace regime on the Korean Peninsula.
- Reaffirming the April 27, 2018 Panmunjom Declaration, the DPRK commits to work toward complete denuclearization of the Korean Peninsula.
- Commit to recovering POW/MIA remains, including the immediate repatriation of those already identified.

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 & medrange 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	

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 arsenal			
Scientists, engineers			
Nuclear tests			
Tunnels			
Test infrastructure			
IRBM &ICBM			
SLBM & Solid rocket motors			
New engine tests			
SR & MR Missiles			
Space Launch Vehicles			
Inventory			
5MWe reactor			
ELWR			
IRT-2000			
Reprocessing Facility			
Metal fuel fab facilities			
Tritium			
Lithium-6			
HEU inventory			
YB centrifuge facility			
Covert centrifuge facilities			
Nuclear & missile technology			
	Specific facilities or activitiesNuclear arsenalScientists, engineersNuclear testsTunnelsTest infrastructureIRBM &ICBMSLBM & Solid rocket motorsSR & MR MissilesSpace Launch VehiclesInventorySMWe reactorELWRIRT-2000Reprocessing FacilityMetal fuel fab facilitiesTritiumLithium-6HEU inventoryScovert centrifuge facilitiesNuclear & missile technology	Specific facilities or activitiesShort term < 1 yearNuclear arsenalScientists, engineersNuclear testsNuclear testsTunnelsTest infrastructureIRBM &ICBMSLBM & Solid rocket motorsSpace Launch VehiclesSpace Launch VehiclesInventorySMW reactorIRT-2000Reprocessing FacilityMetal fuel fab facilitiesItitium-6HEU inventoryYB centrifuge facilityKutore facilitiesKutore facilitiesKutore facilitiesSpace facilitySupport facilitiesSupport fa	Specific facilities or activitiesShort term < 1 yearMedium term 2 to 5 yearsNuclear arsenalScientists, engineersNuclear testsTunnelsTunnelsTest infrastructureIRBM &ICBMSke Solid rocket motorsSpace Launch VehiclesSpace Launch VehiclesInventoryStaff facilitiesIRT-2000Reprocessing FacilityIthium-6Ith

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			
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			

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	Сар	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	Сар	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

North Korean leader Kim Jong Un visits textile plants, chastens workers for not working hard



July 2, 2018 KCNA

Roadmap to North Korea's Denuclearization: Key Takeaways

- Phased approach to denuclearization <u>and</u> normalization
- Libya denuclearization model is not feasible
- Pyongyang is encouraged to front-end load concrete denuclearization actions
- Offer to have U.S. and South Korea assist the North in cooperative conversion from military to civilian nuclear and space programs.
- Verification is best achieved by cooperative measures.
- Détente between North and South Korea is the game changer.

BACKUP CHARTS





George W. Bush 2001/200

NoneNoneBut laid foundationNorth Korean nukes

None But got prepared

> Likely none Freeze, but hedged

Rough estimates of number of bombs in North Korea



Likely 6 at start Possibly 20 to 25 at end


The North Korea Challenge for U.S. Presidents

Don't build the bomb Succeeded – but NK built a hedge



Don't build the bomb Failed. ~ 6 nukes by end of term. No successful missile tests



Don't build a nuclear arsenal. Denuclearize Failed. ~ 20 – 25 bombs by Dec. 2016 Successful missile tests



Trump Challenge: Prevent use of nuclear weapon on Korean peninsula. Denuclearization will take time North Korea "has cheated on every agreement" narrative is neither accurate nor helpful. Need to better understand history so as not to repeat mistakes.

- 1992 North/South Joint Denuclearization Declaration – North did not comply, but superseded by Agreed Framework.

- 1994 Agreed Framework – "cheating" is technically not correct because it was not an agreement. Certainly covert uranium enrichment activities were not in the spirit of the AF as well as contrary to 1992 N/S Joint Declaration.

- 2000 Joint US-DPRK Communiqué – voided by the Bush administration

- Sept. 19, 2005 Joint Statement – never really got off the ground because of US back peddling on LWR and applying BDA sanctions. Not a matter of cheating, but rather North Korea terminated its participation.

- Feb. and Oct. 2007 agreements on disablement followed by dismantlement. North claimed US was moving goal posts on verification. However, the North appeared to be determined to terminate –not really an issue of cheating, rather one of Pyongyang walking away from the agreements.

- Leap Day 2012 deal – very poorly consummated deal with actions not clearly spelled out. Two sides had different interpretations of what was permitted.