

Risk-based denuclearization framework

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DPRK nuclear weapon program

Governs size of
arsenal

Governs sophistication
of arsenal

Governs threat
arsenal poses

**Bomb-grade
Pu or HEU**

Weaponization

Delivery system

- 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 Capability	September 2019 (Rough estimates)
Plutonium	25 - 48 kg
HEU (highly uncertain)	~450 - 700 kg
Tritium	Very limited
Nuclear devices (sufficient material)	~37 (20 to 60)
Nuclear device deliverable by SCUD & Nodong missiles Progress on solid-fueled missiles (KN-23, KN-24 and PK-3)	Yes
Nuclear device deliverable by IRBMs & ICBMs	Hwasong-12, 14, 15 Not yet military useful. Need more tests

North Korea Nuclear Program through five U.S. presidents

3 shades of green (dark best), 3 shades of red (dark worst)

Year	US Diplomacy	DPRK Diplomacy	Yongbyong Presence	Plutonium	Uranium enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992 Bush I	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993 Clinton	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 Bush II	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 Obama	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 Trump	R3	R3	R3	R3	R3	R3	R3	R3 	R3

What will it take to denuclearize?

Nuclear assets	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

View of denuclearization by many in Washington – Libya Model

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

	Specific facilities or activities	ELIMINATE CVID
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	

Eliminate everything now (CVID)

- Requires declaration and verification

- Equivalent to surrender

- Highly unlikely

- Instead, take steps to reduce capabilities & threat

Full declaration up front is unlikely and not doable

A risk management framework to denuclearization

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 risk management framework to denuclearization

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 risk management framework – steps already taken by Kim Jong-un (blue)

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 risk management framework – cooperate on civilian use (green)






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	No nuclear capable
	Space Launch Vehicles	Short term suspension	TBD – establish protocol	Joint ROK space program
Plutonium	Inventory	Cap	Cap, declare & monitor	Eliminate
	5MWe reactor	Halt	Dismantle	Decommission
	ELWR	Halt or don't start	Inspect & future TBD	LWR prototype
	IRT-2000	Halt	Dismantle	Replace for isotope production
	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	Technical, economic, political ?
	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

Backup







North Korea Nuclear Program)

3 shades of green (dark best), 3 shades of red (dark worst)

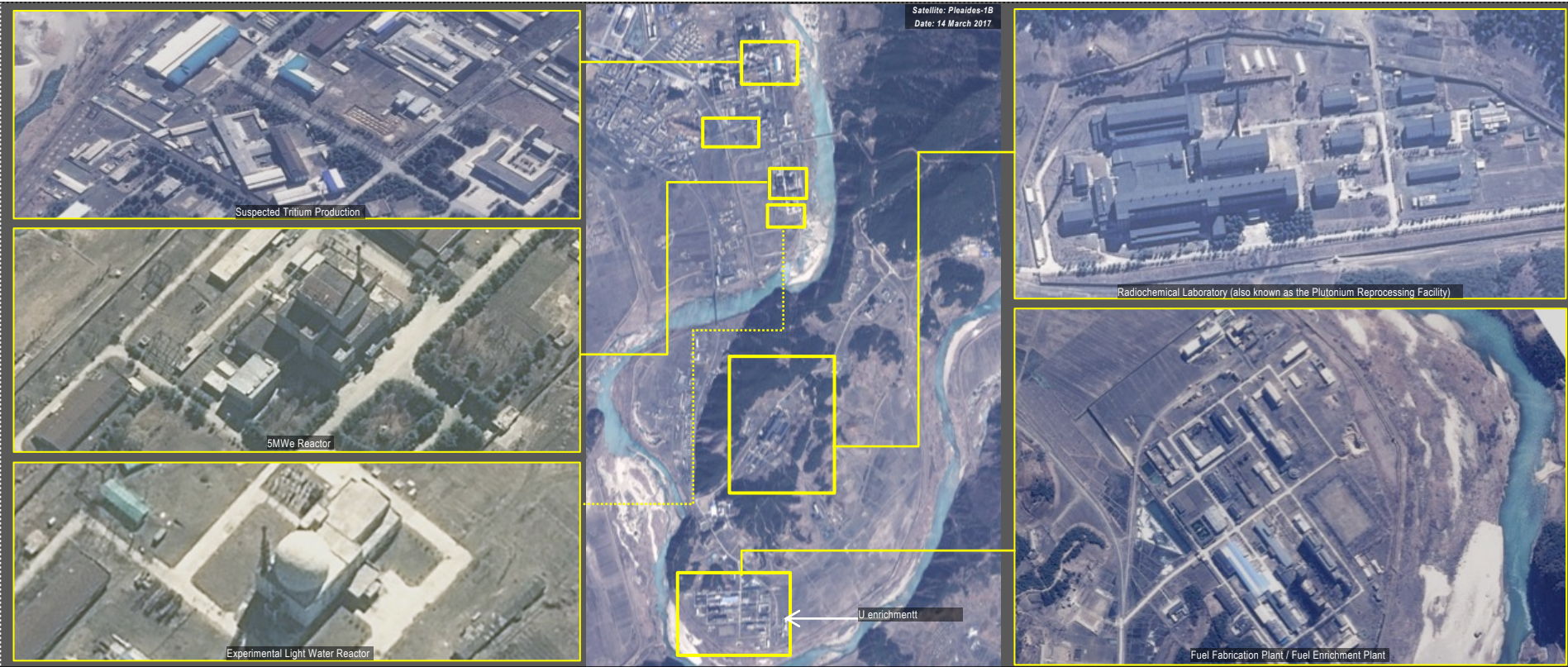
Year	US Diplomacy	DPRK Diplomacy	Yongbyong Presence	Plutonium	Uranium enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles
1992 Bush I	G1	G1	G1	G2	G1	G1	R1	R1	R1
1993 Clinton	G2	G2	U.S. decisions resulted in hinge points				R1	R1	R1
1994	G3	G3					R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	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 Bush II	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 Obama	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 Trump	R3	R3	R3	R3	R3	R3	R3	R3 	R3

North Korea Nuclear Program)

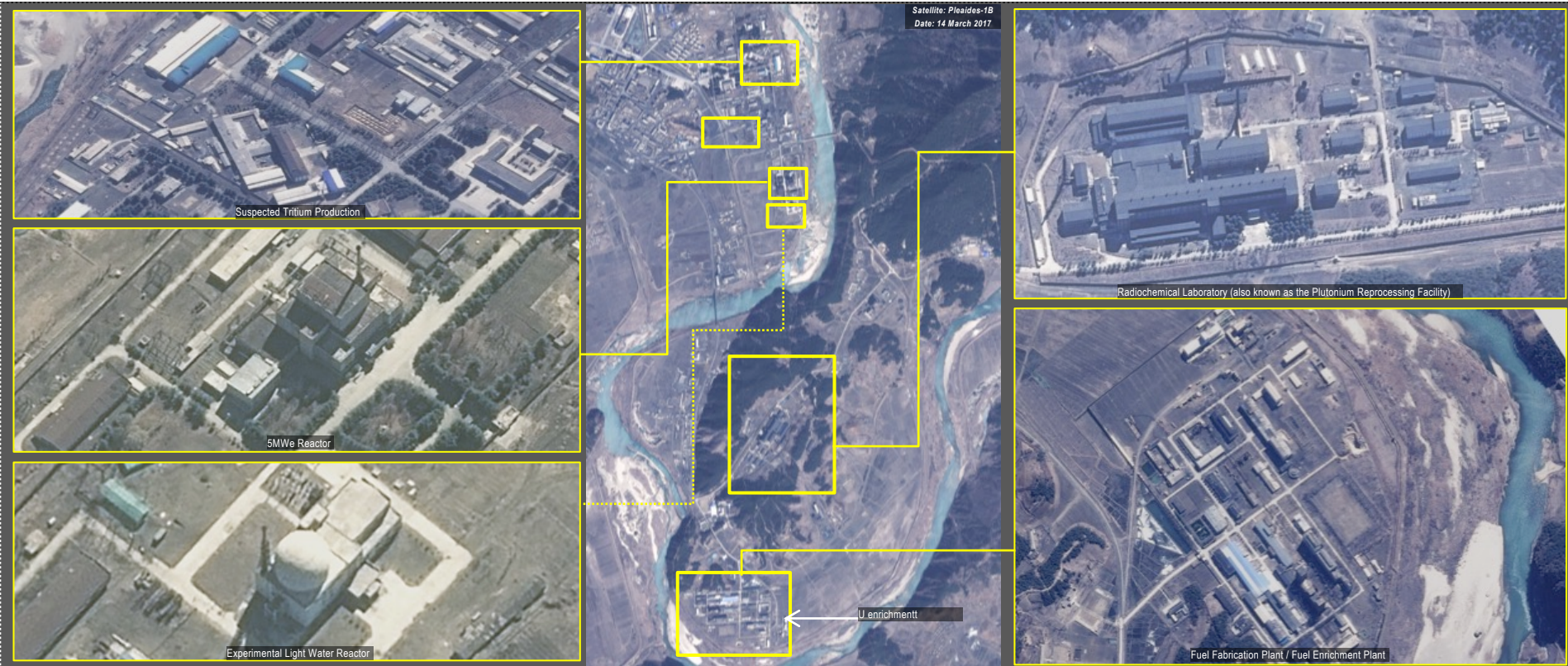
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Year	US Diplomacy	DPRK Diplomacy	Yongbyong Presence	Plutonium	Uranium enrichment	Tritium/Li6	Weaponize Design/build/test	Nukes (Summary)	Missiles	
1992 Bush I	G1	G1	G1	G2	1991-1992		G1	R1	R1	R1
1993 Clinton	G2	G2	G1	G2	G1	G1	R1	R1	R1	R1
1994	G3	G3	G1	G2	1994		G1	R1	R1	R1
1995	G3	G3	G3	G3	G1	G1	R1	G3	R1	R1
1996	G3	G3	G3	G3	G1	G1	R1	G3	R1	R1
1997	G2	G2	G3	G3	1997		G1	R1	G3	R1
1998	G2	G2	G3	G3	R1	G1	R1	G3	R1	R1
1999	G3	G3	G3	G3	R1	G1	R1	G3	G1	G1
2000	G3	G3	G3	G3	R1	G1	R1	G3	G1	G1
2001 Bush II	R2	G2	G3	G3	R1	G1	R1	G3	G1	G1
2002	R3	G2	G3	G3	2002-3		G1	R1	G3	G1
2003	R2	R2	R3	R3	R1	R1	R2	R2	R2	G1
2004	R2	R1	R3	R3	R1	R1	R2	R2	R2	G1
2005	R1	R1	R3	R3	2005		R1	R2	R2	R1
2006	R1	R2	R3	R3	R1	R1	R2	R2 	R1	R1
2007	G2	G1	G3	G1	R1	R1	R1	R1	R1	R1
2008	G2	G1	G3	G1	2008		R1	R1	R1	R1
2009 Obama	R1	R1	R2	R1	R2	R2	R2	R2 	R1	R1
2010	G1	R1	R3	R1	R2	R2	R2	R2	R1	R1
2011	G1	G1	R3	R1	R2	R2	R2	R2	R1	R1
2012	R1	R1	R3	R1	2012		R2	R2	R2	R1
2013	R2	R1	R3	R2	R2	R2	R2	R2 	R1	R1
2014	R2	R1	R3	R2	R3	R3	R2	R2	R1	R1
2015	R1	G1	R3	R3	2015		R3	R2	R2	R2
2016	R1	R3	R3	R3	R3	R3	R3	R3 	R2	R2
2017 Trump	R3	R3	R3	R3	2018		R3	R3 	R3 	R3

How important is the Yongbyon Nuclear Research Center?



How important is the Yongbyon Nuclear Research Center?



**Continued and consistent development.
It is not an old, inactive facility.**

Nuclear Capability	Role of Yongbyon
Plutonium	<p>Reactors: 5MWe Pu production ELWR – electricity + Pu and tritium possible IRT-2000 – Pu and tritium possible</p> <p>Fuel fabrication (metal and oxide) Pu reprocessing Pu metal production Reactor waste storage</p>
HEU	<p>Uranium processing – conversion to oxide and UF6 Centrifuge facility ~ 4000 centrifuges HEU metal production – likely at YB</p>
Tritium	<p>Reactors – primarily 5 MWe Tritium extraction hot cells</p>

Nuclear Capability	2019 Status
Plutonium	<p>Reactors: 5MWe Pu production – prepared to operate ELWR – very close to operation IRT-2000 – not operating Fuel fabrication (metal and oxide) – likely operating Pu reprocessing – in standby Pu metal production – likely operational Reactor waste storage - utilized</p>
HEU	<p>Uranium processing – conversion to oxide and UF6 Operational Centrifuge facility ~ 4000 centrifuges Operating Likely HEU metal production Likely operating</p>
Tritium	<p>Reactors Not operating Tritium hot cell – extraction Ready to operate</p>

Nuclear Capability	October 2019
Plutonium	5MWe – new cooling system ELWR – close to start up operations
HEU (highly uncertain)	YB – centrifuges spinning Covert – likely also spinning
Tritium	No new production
Nuclear devices (sufficient material)	Continued to produce HEU and possibly more HEU weapons
Nuclear device deliverable by SCUD & Nodong missiles Progress on solid-fueled missiles (KN-23 and PK-3)	10 sets of SRBM & MRL launches since May PK-3 solid rocket motor undersea launch
Nuclear device deliverable by IRBMs & ICBMs	No long-range test launches

Nuclear Capability	Outside of Yongbyon
Plutonium	<p>No plutonium production</p> <p>Plutonium fabrication for warheads - yes</p>
HEU	<p>Uranium processing – conversion to oxide and UF6 Yes – but uncertain of capacity</p> <p>Centrifuge manufacture and testing – yes (Kangson??)</p> <p>Covert centrifuge facility – yes (in tunnels??) Uncertain capacity</p> <p>Possible HEU metal production and warhead fabrication</p>
Tritium	<p>No tritium production or extraction</p> <p>Likely deuterium and Li6 production</p> <p>Likely Li6D production</p>
Warhead manufacture, storage	<p>Yes – outside of Yongbyon</p>
Missile manufacture, launch sites	<p>Yes – outside of Yongbyon</p>

What's next for North Korea's nuclear program?

Roll back

- Stop Pu/tritium production
 - Kill 5MWe reactor
 - Don't start ELWR – allow visit
 - Allow IRT-2000 visit
 - Freeze tritium separation – visit
- Halt YB centrifuge facility – visit
 - Halt U conversion and fluorination
 - Allow visits to all YB facilities
- Allow visit to Kangson suspect site
- Punggye-ri test site – allow visit
- Sohae launch site – allow visit
- Written ICBM no-launch agreement
- Agree to no solid-motor rocket tests
- Destroy 5 or so ICBMs
- Destroy 5 or so large TELs
- Agree to discuss declaration

Speed up

- Resume Pu/tritium production
 - Restart 5MWe reactor
 - Start ELWR
 - Perhaps build new 50MWe G-G reactor
 - Restart IRT-2000 with own fuel
- Complete tritium extraction facility
- Continue operating all centrifuge facilities
- Reopen two P-ri nuclear test tunnels
 - Prepare for more nuclear tests
- Continue solid-motor missile launches
- Deploy KN-23 and KN-24 nuclear missiles
- Continue Pk-3 tests, including sub-launch
- Conduct full trajectory ICBM launches

What's next for North Korea's nuclear program?

North's political strategies?

Roll back

- Time to make a deal
- Make economic gains while Trump in office

Speed up

- Speed up now, deal later
- Gain future negotiating advantage during DC turmoil

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North's political strategies?

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How should U.S. respond?