Open Nuclear Network's

BACKGROUNDER: PREVIOUS DPRK NUCLEAR TESTS

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I. INTRODUCTION

The DPRK has conducted six nuclear tests, each of which took place within months of long-range rocket or satellite launches. In anticipation of a possible seventh nuclear test, information on the first six tests has been compiled, including in the table below.

#	Date	Announced Yield Estimates			Reported Design Characteristics	Long-Range Rocket or Satellite Launches
		(ROK)	(China)	(Japan)		
1.	9 Oct. 2006	1 kiloton[1]	-	0.5-1 kiloton[2]	Designed yield said to be approximately 4 kilotons.[3]	Long-range rocket launch, 5 July 2006, failed
2.	25 May 2009	2-6 kilotons[4]	7.0±1.9 kilotons[5]	2-3 kilotons[6]	"New higher level in terms of its explosive power and technology"[7]	Satellite launch, 24 February 2009, failed
3.	12 Feb. 2013	6-7 kilotons[8]	12.2±3.8 kilotons[9]	6-7 kilotons[10]	"Smaller and light A-bomb; yet with great explosive power"[11]	Satellite launch, 5 April 2012, failed Satellite launch, 12 December 2012
4.	6 Jan. 2016	6 kilotons[12]	11.3±4.2 kilotons[13]	6-7 kilotons[14]	"Scientifically verified the power of smaller H-bomb"[15]	7 February 2016, satellite launch 4 July 2017, ICBM test 28 July 2017, ICBM test 28 November 2017, ICBM test
5.	9 Sep. 2016	10 kilotons[16]	17.8±5.9 kilotons[17]	11-12 kilotons[18]	"Variety of smaller, lighter and diversified nuclear warheads of higher strike power [...] and using various fissile materials"[19]	
6.	3 Sep. 2017	50-60 kilotons[20]	108.3±48.1 kilotons[21]	160 kilotons[22]	"Hydrogen bomb for ICBM[,] fission detonation and high-temperature nuclear fusion ignition, and the ensuing rapidly boosting fission-fusion reactions"[23]	

Table 1. Previous nuclear tests of the DPRK

II. SUMMARY OF PREVIOUS NUCLEAR TESTS

A. Test #1

The DPRK conducted its first nuclear test in 2006. Initially, the test was widely interpreted as a failure[24] because the estimated yield (~1 kiloton)[25] was very low in comparison with the yield of the first nuclear weapon tests of nuclear-weapon States (over 20 kilotons).[26] However, further information indicated that the designed yield was only 4 kilotons;[27] a yield of ~1 kiloton, reaching roughly 25% of the target yield, would suggest that the test was instead a partial success.[28]

This alleged small target yield indicates that the DPRK may have detonated a relatively compact device, which would be easier for ballistic missiles to accommodate (Figure 1).[29]

B. Test #2

The second DPRK nuclear test, in 2009, was estimated to have a yield of a few kilotons,[31] roughly reaching the alleged target yield of the 2006 test.[32] The DPRK claimed that the test "helped satisfactorily settle the scientific and technological problems arising in further increasing the power of nuclear weapons."[33]

C. Test #3

In the third nuclear test, carried out in 2013, the DPRK claimed that it had detonated a smaller, lighter device with greater explosive power.[34] Some experts speculated that the third test may have involved uranium,[35] but this was not confirmed by DPRK claims and international atmospheric monitoring findings were inconclusive as to the type of fissile material involved.[36]

Figure 1. Kim Jong Il purportedly inspecting an implosion device on an unknown date.[30] The video frame was taken on 12 December 2017 during a meeting to celebrate the "completion of the state nuclear force." Image: KCTV

D. Test #4

The DPRK claimed to have detonated an "H-bomb" in January 2016.[37] As this test did not demonstrate a typical thermonuclear yield, the possibility of the tested device being a successful two-stage thermonuclear device (commonly referred to as a hydrogen bomb or H-bomb) was met with skepticism and some assessed that a boosted-fission device may have actually been tested.[38] A boosted weapon typically has a hollow core of fission material to accommodate fusion fuel (hydrogen isotopes) in its cavity[39] and is more efficient than pure fission weapons. In its 2017 statement following the sixth nuclear test, the DPRK made the specific claim that it had tested a two-stage thermonuclear device. This much more defined and explicit description, as compared with the more vague comment on the 2016 test (see Table 1) , further points to the possibility that a boosted-fission device was tested in January 2016.[40] Other possibilities, such as the tested device being a pure fission device, could also not be ruled out.

E. Test #5

In the fifth nuclear test, carried out in September 2016, the DPRK claimed to have tested a nuclear warhead for ballistic missile delivery (Figure 2). KCNA claimed that "the standardization of the nuclear warhead will enable the DPRK to produce as many as it requires a variety of smaller, lighter and diversified nuclear warheads of higher strike power with a firm hold on the technology for producing and using various fissile materials."[41] This is the first time the DPRK claimed the use of various fissile materials, indicating that the test device might have utilized uranium or both plutonium and uranium.

Figure 2. Kim Jong Un inspecting a purported fission device for a ballistic missile, image released in March 2016. During this visit, Kim reportedly said that "it was gratifying to see the nuclear warheads with the Korean-style structure of mixed charge adequate for prompt thermo-nuclear reaction."[42] The "mixed charge adequate for prompt thermo-nuclear reaction" indicates that the device being inspected may be a boosted-fission bomb. Image: KCTV

F. Test #6

In the sixth nuclear test, carried out in 2017, a device of considerably higher yield was detonated. The DPRK claimed that a two-stage thermonuclear device, an "H-bomb for ICBM,"[43] had been tested (Figure 3).

Figure 3. The purported DPRK two-stage thermonuclear device (it is not clear whether the tested device was the device shown here). In a hydrogen bomb design, the energy from the primary (a fission device) triggers the fusion of hydrogen fuel in the secondary.
Images: KCNA, KCTV

III. OBSERVATIONS

Considering official DPRK statements, yield estimates, images of the purported nuclear devices and relevant open source literature regarding the DPRK's nuclear devices and nuclear weapon designs, it is assessed that the DPRK's nuclear weapon programme has thus far achieved:

(1) testing of a relatively compact device (tests 1 and 2);

(2) increasing the yield-to-weight ratio of its nuclear device (tests 3, 4 and 5); and

(3) detonating a two-stage thermonuclear device (test 6).

This assessment is largely in accordance with the following 2018 DPRK statement: "we solemnly declare that we have realized nuclear weaponization with credit by carrying out subcritical and underground nuclear tests, making nuclear weapons smaller and lighter [the first five tests] and developing super-large nuclear weapons [test six] and delivery means in order in the course of the campaign for implementing the Party's simultaneous-push line."[44]

APPENDIX: DPRK CLASSIFICATION OF NUCLEAR WEAPONS

In May 2013, Rodong Sinmun, the daily newspaper of the Workers' Party of Korea, published an article titled "Making Nuclear Weapons Smaller, Lighter, Diversified and Precise." 45 This article, while not as authoritative as official statements from DPRK Party and State organs or its leaders, was carried by the most authoritative newspaper in the country, and therefore likely reflects the thinking of some within the relevant nuclear authorities of the DPRK. It should be noted that this classification is not necessarily consistent with the terms used by DPRK state media to report on nuclear and ballistic missile tests.

According to this article, the DPRK classification of nuclear weapon miniaturisation only depends on the yield, as follows:

- Super minituarized: nuclear bombs with a yield of under 1 kiloton;
- Minituarized: nuclear bombs with a yield from 1 to 15 kilotons;
- Mid-sized: nuclear bombs with a yield from 15 to 100 kilotons;
- Large-size: nuclear bombs with a yield from 100 kilotons to 1 megaton (million tons);
- Super-large size: nuclear bombs with a yield of above 1 megaton.

According to the above-referenced article, the DPRK has also classified nuclear weapons into three types: atomic bombs, hydrogen bombs and neutron bombs (neutron bombs are hydrogen bombs tailored to enhance radiation effect).

Finally, the DPRK has further divided nuclear weapons into tactical weapons, battlefield weapons and strategic weapons, as follows:

- Tactical nuclear weapons: to destroy personnel and equipment on the frontline or operational tactical depth zone, delivery means include tactical ballistic missiles and artillery shells.
- Battlefield nuclear weapons: to strike regional targets, launched by medium-range missiles.
- Strategic nuclear weapons: to strike large cities, industrial centres and other strategic targets, carried by strategic delivery means such as ICBMs and submarine-launched ballistic missiles.

ENDNOTES

1. Ministry of National Defense, ROK, see: "North Korea News Letter No. 249," Yonhap News Agency, 14 February 2013, available at: https://en.yna.co.kr/view/AEN20130213010300325

2. "Recent Missile & Nuclear Development of North Korea," Japan Ministry of Defence, January 2022, available at: https://www.mod.go.jp/en/d_act/sec_env/pdf/dprk_d-act_e_220104.pdf

3. New York Times reported that "a senior Bush administration official said he had learned through Asian contacts that the North Koreans had expected the detonation to have a force of about four kilotons." See: William J. Broad and Mark Mazzetti, "Blast May Be Only a Partial Success, Experts Say," New York Times, 10 October 2006, available at: https://www.nytimes.com/2006/10/10/world/asia/blast-may-be-only-a-partial-success-experts-say.html

4. Ministry of National Defense, ROK, see: "North Korea News Letter No. 249," Yonhap News Agency, 14 February 2013, available at: https://en.yna.co.kr/view/AEN20130213010300325

5. "中科大：朝鲜此次核爆威力是长崎原子弹3至7.8倍" [USTC: DPRK nucleartest yield is 3 to 7.8 times of the Nagasaki bomb], University of Science and Technology of China, 4 September 2017, available at: http://www.ce.cn/xwzx/gnsz/gdxw/201709/04/t20170904_25713510.shtml

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11. "KCNA report on successful 3rd underground nuclear test," KCNA, 12 February 2013

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14. “Recent Missile & Nuclear Development of North Korea,” Japan Ministry of Defence, January 2022, available at: https://www.mod.go.jp/en/d_act/sec_env/pdf/dprk_d-act_e_220104.pdf

15. “DPRK proves successful in H-bomb test,” KCNA, 6 January 2016

16. Joint Chiefs of Staff, ROK, see: “N. Korea conducts 5th nuclear test,” Yonhap News Agency, 9 September 2016, available at: https://en.yna.co.kr/view/AEN20160909002556315

17. “中科大：朝鲜此次核爆威力是长崎原子弹3至7.8倍” [USTC: DPRK nucleartest yield is 3 to 7.8 times of the Nagasaki bomb], University of Science and Technology of China, 4 September 2017, available at: http://www.ce.cn/xwzx/gnsz/gdxw/201709/04/t20170904_25713510.shtml

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21. “中科大：朝鲜此次核爆威力是长崎原子弹3至7.8倍” [USTC: DPRK nuclear test yield is 3 to 7.8 times of the Nagasaki bomb], University of Science and Technology of China, 4 September 2017, available at: http://www.ce.cn/xwzx/gnsz/gdxw/201709/04/t20170904_25713510.shtml

22. “Recent Missile & Nuclear Development of North Korea,” Japan Ministry of Defence, January 2022, available at: https://www.mod.go.jp/en/d_act/sec_env/pdf/dprk_d-act_e_220104.pdf

23. “DPRK Nuclear Weapons Institute on Successful Test of H-bomb for ICBM,” KCNA, 3 September 2022

24. A Bush administration official was quoted as saying "the betting is that this was an attempt at a nuclear test that failed … We don't think they were trying to fake a nuclear test, but it may have been a nuclear fizzle." See: “U.S. official: N. Korea test likely ‘nuclear fizzle,’” NBC, 13 October 2006, available at: https://www.nbcnews.com/id/wbna15249383

25. “Statement by the Office of the Director of National Intelligence on the North Korea Nuclear Test,” Office of the Director of National Intelligence, 16 October 2006, available at: https://nuke.fas.org/guide/dprk/odni101606.pdf; “Success, failure or bluff? Scientists pore over data,” AFP, 9 October 2006, available at: https://web.archive.org/web/20061031071948/http://www.khaleejtimes.com/DisplayArticleNew.asp?xfile=data%2Ftheworld%2F2006%2FOctober%2Ftheworld_October303.xml&section=theworld

26. "The first atomic bombs", Britannica, available at: https://www.britannica.com/technology/nuclear-weapon/Residual-radiation-and-fallout#ref275639

27. Zhang Hui, "Revisiting North Korea's Nuclear Test," China Security, Vol.3 No.3, Summer 2007, available at: https://www.belfercenter.org/publication/revisiting-north-koreas-nuclear-test. In this article, Zhang stated that he had confirmed with Christopher Hill, the chief US negotiator of the Six-Party Talks, that Pyongyang had informed Chinese officials in advance of the test that the yield would be 4 kilotons; the New York Times reported that "a senior Bush administration official said he had learned through Asian contacts that the North Koreans had expected the detonation to have a force of about four kilotons." See: William J. Broad and Mark Mazzetti, "Blast May Be Only a Partial Success, Experts Say," New York Times, 10 October 2006, available at: https://www.nytimes.com/2006/10/10/world/asia/blast-may-be-only-a-partial-success-experts-say.html

28. Chinese experts stated that "if [the DPRK] aimed for 4 kilotons and got 1 kiloton that is not bad for a first test … we call it successful, but not perfect." See: Siegfried Hecker, "Report on North Korean Nuclear Program," Policy Forum Online 06-97A, Nautilus Institute, San Francisco, 2006; Hecker, R.L. Carlin and E.A. Serbin, "A technical and political history of North Korea's nuclear program over the past 26 years," Center for International Security and Cooperation, Stanford University, 24 May 2018, available at: https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/narrativescombinedfinv2.pdf. The test was also judged as a partial failure by the US intelligence, see: "Annual Threat Assessment of the U.S. Intelligence Community," US Government Printing Office, 2010

29. Richard L. Garwin and Frank N. von Hippel, "A Technical Analysis: Deconstructing North Korea's October 9 Nuclear Test," Arms Control Association, 7 March 2018, available at: https://www.armscontrol.org/act/2006-11/features/technical-analysis-deconstructing-north-korea%E2%8 0%99s-october-9-nuclear-test; Siegfried Hecker reportedly stated that the DPRK had most likely tested a more advanced design [than a Nagasaki-type design] at the risk of partial failure; see: Jonathan Medalia, "Comprehensive Nuclear-Test-Ban Treaty: Background and Current Developments," Congressional Research Service, 18 September 2008, available at: https://www.ctbto.org/fileadmin/user_upload/pdf/External_Reports/RL33548.pdf. Other circumstantial evidence is that, in 2005, a high level defector claimed that the DPRK was trying to reduce the mass of its atomic bomb from 1 ton to 500 kg. "[특종] 北韓 최고인민회의 대의원 韓國에 망명, 核개발에 대한 중대 증언" [[Scoop] A member of the Supreme People's Congress of North Korea defected to South Korea and gave a serious testimony about the development of the country], Monthly Chosun, August 2005, available at: http://monthly.chosun.com/client/news/viw.asp?ctcd=&nNewsNumb=200508100019

30. Alistair Coleman, "North Korean TV appears to show early 'A-bomb photo'", BBC, 13 December 2017, available at: https://www.bbc.com/news/world-asia-42339666

31. Deborah Charles and Tabassum Zakaria, "North Korea's May nuclear test few kilotons: U.S.," Reuters, 15 June 2009, available at: https://web.archive.org/web/20090618030531/https://www.reuters.com/article/worldNews/idUSTRE55E 5BA20090615; Except the yield estimate included in the table above, there are also other estimates such as 2 to 7 kilotons and approximately 4 kilotons; see: S.S. Hecker, R.L. Carlin and E.A. Serbin, "A technical and political history of North Korea's nuclear program over the past 26 years," Center for International Security and Cooperation, Stanford University, 24 May 2018, available at: https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/narrativescombinedfinv2.pdf

32. Dennis Blair, then director of National Intelligence, stated that the yield of the second nuclear test "supports its claim that it has been seeking to develop weapons, and with a yield of roughly a few kilotons TNT equivalent, was apparently more successful than the 2006 test." See: "Annual Threat Assessment of the U.S. Intelligence Community," US Government Printing Office, 2010

33. "KCNA report on new successful underground nuclear test," KCNA, 25 May 2009

34. "KCNA report on successful 3rd underground nuclear test," KCNA, 12 February 2013

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36. Claire Mills, "Nuclear weapons at a glance: North Korea," House of Commons Library, 7 December 2020, available at: https://researchbriefings.files.parliament.uk/documents/CBP-9071/CBP-9071.pdf; Tong Zhao, "Understanding the Small Yield of North Korea's Claimed H-Bomb Test," Carnegie Endowment for International Peace, 7 January 2016, available at: https://carnegieendowment.org/2016/01/07/understanding-small-yield-of-north-korea-s-claimed-h-bombtest-pub-62430

37. "DPRK proves successful in H-bomb test," KCNA, 6 January 2016

38. For example, Greg Thielmann, "North Korea's Nuclear Threat: How to Halt Its Slow But Steady Advance," February 2016, available at: https://www.armscontrol.org/policy-white-papers/2016-02/north-korea%E2%80%99s-nuclear-threat-halt -its-slow-steady-advance; "Understanding the Small Yield of North Korea's Claimed H-Bomb Test," Carnegie Endowment for International Peace, 7 January 2016, available at: https://carnegieendowment.org/2016/01/07/understanding-small-yield-of-north-korea-s-claimed-h-bombtest-pub-62430; Charles D. Ferguson, "North Korea's Fourth Nuclear Test: What Does it Mean?" Federation of American Scientists, 8 January 2016, available at: https://fas.org/blogs/security/2016/01/north-korea-nuclear/; S.S. Hecker, R.L. Carlin and E.A. Serbin, "A technical and political history of North Korea's nuclear program over the past 26 years," Center for International Security and Cooperation, Stanford University, 24 May 2018, available at: https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/narrativescombinedfinv2.pdf

39. John J. Vandenkieboom, "Nuclear weapon fundamentals", Los Alamos National Library; Matthew Bunn, "'Pit-Stuffing': How to Disable Thousands of Warheads and Easily Verify Their Dismantlement," Federation of American Scientists, 28 February 1998, available at: https://scholar.harvard.edu/files/matthew_bunn/files/bunn_pit_stuffing.pdf

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