[From: “Death’s Twilight Kingdom: The Secret World of U.S. Nuclear Weapon ‘Design Data’ “
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Appendix N: “Critical Nuclear Weapon Design Information”: 273 Individual RD Secrets I've Uncovered

“I was sent on a classified mission.”

“Well, it’s not ‘classified’ anymore, is it?”

-- Col. Kurtz’s answer to Capt. Willard in
“Apocalypse Now” (1979)

Basic A-Bombs

1. The dimensions and configuration of the Fat Man’s Urchin internal (α,n) neutron initiator were:

Outer diameter of the hollow beryllium sphere:	**2.0 cm**
Number of **wedge-shaped** grooves in outer shell:	**15**
Radius of base of grooves:	**0.40 cm**
Radius of apex of grooves:	**0.609 cm**
Outside diameter of internal solid beryllium sphere:	**0.80 cm**

Amount of polonium-210 on surfaces of all grooves: 30 Curies
Amount of polonium-210 on surface of solid sphere: 20 Curies (Total of 50 C = 11 mg). (8)

2. The later developed TOM internal (α,n) neutron initiator was a **Tungsten on Molybdenum** Ball. (2)

3. The 1951 Operation Ranger, Event Able (yield of 1.2 kt) was a **half-crit** Oralloy (Oy) test. Tests Baker-1 and Baker-2 (both 8 kt) were both **half-crit** Pu tests of identical devices. (2)

4. The 1951 Operation Greenhouse, Event Dog was a proof-test of the new Mark 6, 54” dia. HE geometry design, and produced a yield of **81 kt**. It was **a split-levitated version** of the 1948 Operation Sandstone, Event X-ray **37 kt** composite solid core Mk 4, 54” diameter HE geometry, a yield improvement of 2.2x. (3)

5. The 1951 Operation Greenhouse, Event Easy, a proof-test of the 40” diameter Mk 5, was a **split-levitated design,** producing a yield of 47 kt, a 30% increase over the 54” dia. Mk 4 37 kt bomb. The Mk 5 was first tested with a **21 kt** Fat Man **core, producing double (2.2x) the yield (47 kt)** when tested. (3)

6. The 30” dia. Mk 7 had a **6.5” thick HE layer,** with **an 8 kg Oy** split-levitated core **of outside dia. 8.5”**. (3)

7. The 1952 Operation Tumbler-Snapper, Events Easy and How were tests of the new 22” dia. Mk 12, which used split-levitated, composite cores, one with the usual uranium reflector, and the other testing a new beryllium metal reflector:

Test	Yield	Weight (lbs.)	HE	Initiator	Reflector

Easy	11 kt	550	Comp. B/Cyclotol 75/25	TOM	**0.5” U238**
How	14 kt	470	Comp. B/Cyclotol 75/25	TOM	**0.5” Be**

Both devices had an **HE layer thickness of 8”**. (3)

8. The 1.7 kt, 17.4” dia. W-25 warhead used a **solid** composite core. (1)

9. The 67 kt, 22.2” dia., 372 lb. boosted W-30 had an **5” thick** PBX 9010/9404 **HE shell, surrounding a 12” dia. hollow** all-Oy **core.** (2)

10. The 28” dia. boosted W-31 had an **8” thick HE shell surrounding a hollow core 12” in dia.** (2)

11. The W-44 ASROC warhead used the same **pit as the** 17” dia. **W-34**, with a smaller dia./**lower weight of explosives used in the** 81 lb., 13.75” dia., 5 kt **W-44**. (2)

12. The W-48, used in the 155 mm/6” dia. artillery shell, had a **72 ton** yield, dimensions of **5.5” x 21.1”, 110 lbs.** (3)

13. The Mk 54/Davy Crockett was a 10.9” dia., pure fission device, with an approx. **3 kg α-plutonium core**, with a **beryllium** reflector, **2.5” thick PBX HE**, and had an **alpha of 2 every 10 ns** (1 generation every 5 ns). (5)

14. W-55 Subroc warhead was a **12.7” dia.,** 61.5 lb. **gun assembly device, with a 6.4 kg U233 core, with a beryllium reflector, thorium tamper**; **D/T gas boosting, and an 8.4 kt** yield. (8)

15. The generation time (alpha) for early plutonium implosion devices “**varies from 1-6 “as [the] bomb goes from low yield to high yield.**” “[F]or [the 1955 Operation Teapot] Wasp devices **alpha = 4 unboosted, [and] alpha = 6 boosted.**” Boosted fission generation time in 1955 was thus 1.7 ns. (3)

16. A **D-T boosted, fractional crit** A-bomb could use **reactor-grade** (25% Pu240) **plutonium,** instead of the normal 5.5% Pu240 Weapons-Grade Pu, **with no degradation of yield**. (4)

17. A Russian-designed 150 lb., 16” dia. A-bomb could give a yield of 0.25 to 15 kT **(thus an increase in yield of 60x with D/T boosting)**, using basic spherical implosion, boosted A-bomb technology. (1)

18. See Chapter, “Known Weights of Plutonium and U235 in A-Bomb & H-Bomb Primary Weapon Cores”. (99)

19. **Prices** of Oy and Pu and tritium. (3)

The H-Bomb

20. 1) The H-bomb consists of “Primary” and “Secondary” stages, which are physically separate (i.e., separate units a distance apart).

2) The device works by the process of “radiation implosion”. The Primary, which consists of a small diameter (originally 10 – 60 kt), implosion A-bomb, is first detonated.

80% of the Primary’s yield is released as bomb-thermal x-rays, which radiates outwards, and are absorbed by the outer shell of the thermonuclear Secondary, which heats up, and **explosively ablates (vaporizes), implosively compressing the lithium deuteride (LiD) fuel inside it, and**

then compresses, heats, and **ignites the small, centrally-located deuterium-tritium** (D/T) gas "spark-plug", **which then ignites the** fusion of the surrounding **main charge of compressed LiD fuel.**

3) The burning LiD fuel is **finally further compressed and held together longer** by the eventual **timed (by using a long** cylindrical outer **casing) arrival of a shower of neutrons** (from the exploding Primary), **which fissions the Secondary's outer uranium shell** (and also further adds the majority of the weapon's total yield). (9)

21. A **beryllium** metal reflector is essential for the best performance of an H-bomb Primary, due to beryllium's **x-ray transparence**. (1)

22. **Lowest weight**, and **especially smallest dia.** Primary as possible is used **to maximize its x-ray output**. (2)

23. **Dense plastic foam** (they also used cardboard; but now use silica aerogel) holds the Primary in its central position in the case and **absorbs, slows, and reduces its HE's outward explosive force**, allowing a smaller diameter outer casing. Early H-bombs had to have an outer casing of double the diameter of the Primary to avoid casing breech before the fusion reaction had ignited. (1)

24. The first Secondarys (1952 – 1980) were **spherically-shaped**. LLNL later (>1960) developed a **cylindrical** Secondary **with a central hole running along its longitudinal axis**. The modern (W80 and W84 warheads), more efficient Secondary fusion capsule is a **torus** ("doughnut") **shape**. (3)

25. Thermonuclear weapons have a much higher fission than fusion yield. **The fission/fusion ratio of standard H-Bombs is** not the "official" value of 50% fusion and 50% fission, but more like **one-third fusion, and at least two-thirds fission** (except lower yield, lower fission "clean" weapons). (1)

26. The **minimum yield required to initiate the D/T gas** in the H-bomb's boosted Primary or in boosted atomic weapons is only about **20 tons**/0.02 kt. (1)

27. The ratio of D/T boost gas is listed as the unclassified 50/50 value, a rather convenient figure, and one that close examination would reveal is false. **There is a large excess of deuterium in the mixture**, to ensure that the tritium reacts with a maximum amount of deuterium easily and quickly. (1)

28. The use of 40% enriched Li6D **doubled the yield** of the same-sized device over natural 7% Li6D. The use of 96% enriched Li6D **increased the yield by four times** over natural LiD. (2)

29. Using **Oralloy** (U235) instead of natural uranium (U238) in the Seconday **triples** the yield. (1)

30. From the outside going in, **the layers that make up an H-bomb's spherical Secondary** are:

1) a thin beryllium outer layer,

2) a solid 60% mercury – 40% thallium alloy ablation layer,

3) a thin graphite insulating layer,

4) a thick Uranium pusher layer that also fissions in synergy, well after fusion starts in the Li6D,

5) the main Li6D fusion fuel layer, containing most of the make-up of the Secondary sphere,

6) beneath the main Li6D charge, a thin inner shell of Li7D,

7) the metallic thin spherical beryllium external spark-plug container for the D/T gas boost of the spark-plug,

8) the spark-plug: a hollow Be core until filled with a gaseous mixture of tritium and considerably more deuterium. (6)

31. The 1951 Operation Greenhouse, Event George used a cryogenically-liquefied D/T gas mixture. The test produced a yield of 225 kt, probably indicating the fusion of about **150 g of tritium (mixed** with an excess amount of 600 g of deuterium), which then fissioned 11 kg of U238 (natural uranium).

    The George shot probably **used a 15 kt gun assembly** Oralloy fission A-bomb to initiate the fusion of the D/T mixture. (2)

32. The 1952 Operation Ivy Mike H-Bomb prototype's 10.4 MT total yield was **77% fission and 23% fusion.** It used an estimated **250 - 300 g of Tritium** in its D/T **spark-plug** in the center of the main liquid deuterium charge, to initiate ignition of it. Detonation of its 40" dia. Mk 5 Primary compressed the liquid deuterium to **700x its normal density** (0.14 g/cm3 to 98 g/cm3). (4)

33. A Mk 7, **28" dia.** Primary was used in the 1954 Operation Castle (Events Bravo, Romeo, Union, and Yankee) **60" and 54" dia. H-bombs.** (2)

34. 1954 Operation Castle:

Event	Fission Yield	Fusion Yield	Fission % of Total Yield
Bravo	10 MT	5 MT	**67% fission**
Romeo	7 MT	4 MT	**64% fission**
Union	5 MT	1.9 MT	**72.5% fission**
Yankee	7 MT	6.5 MT	**52% fission**
Nectar	1.35 MT	0.35 MT	**80% fission**

10% of Castle Bravo's fission yield (6.7% of its total yield) was produced by 14 MeV neutrons generated by fusion. (6)

35. 1955 Operation Teapot Primary yield from mockup test:

    Apple-2 **29 kt** **29.5" x 75"** 2,300 lbs. (2)

36. 1955 Operation Teapot, Event Turk, held by UCRL, was of a Mk 27 mockup, using an **8 kt, 17" dia.** boosted A-bomb Primary with a **3.5" thick HE shell**:

    Turk 43 kt 30.5" dia. x 61.3" long 2,335 lbs.

    The Mk 27 had a **1" thick** outer casing, and used solid foam blocks to hold its A-bomb Primary **9.5"** from the inside of the hemispherical casing end, **and 5.5"** from the inside of the outer cylindrical casing walls. (6)

37. An estimated **6 g Tritium used on average per boosted Primary shot** and **almost 2 g Tritium per** 40% Li6D **Secondary** spark-plug around 1955/1956**.** (2)

38. A boosted **17" dia.** Primary was used in the 1956 Redwing Cherokee test of the 34.5" dia. Mk 39 which had a yield of 3.9 MT. (1)

39. The 1958 20" dia. Mk 28 uses a boosted **10" dia.** spherical Primary with a core of **1.5 kg Pu + 4.5 kg Oy + 3 g D/T,** with a yield of approximately **14 kt, and a Secondary using 8.5 g D/T.** (6)

40. The Mk 28 had an outer casing **starting with an outer** corrosion-resistant **layer of 0.029" (29 mils) thick** AISI 304 **stainless steel, then a 0.281" thick aluminum layer,** the structural material of the casing. From the outside Al layer going in, was then **a layer of 0.040" (40 mils) thick uranium,** followed by the innermost **layer of 0.082" (82 mils) thick beryllium.** The **U238/Be layers were the "radiation case"**/hohlraum. **The beryllium layer's function is to temporarily inhibit the heated plasma "blow-off" from the uranium layer below it**. (10)

41. The Mk 36 had a yield of **19 MT**. (1)

42. The 1960 Polaris A-1's W-47Y1 warhead had a **400 kt** yield using a **U238 Secondary**; the 1962 Polaris A-2's W-47Y2 had a **1.2 MT** yield using an **Oy Secondary**. (4)

43. The Russian Tsar Bomba, fired in 1961 at a reduced yield of 58 MT with a non-fissile Secondary tamper, had a full fission design yield, using a U238 Secondary tamper, of **150 MT.** It used a **30"** dia. boosted Primary and had an external casing O.D. of **2.1 m/6.9'**. (3)

44. The W-56 Minuteman I & II warheads had a yield of **1.3 MT, dimensions of 17.1" x 38", and weighed 564 lbs.** (3)

45. The Mk 57 bomb had a **10 kt** yield. (1)

46. The W-58 Polaris A-3 MRV warhead had a yield of **200 kt, dimensions of 12.6" x 32", and weighed 220 lbs.; used a 96% Li6D Oy Secondary; and used a 4" thick Primary HE Shell**. (6)

47. The 1962 W-59 initial Minuteman I ICBM warhead had a yield of **870 kt, dimensions of 15.75" x 48", and weighed 553 lbs.** (3)

48. The B61 bomb had a **330 kt** yield. (1)

49. The W-62, the MM III's initial warhead, had a yield of **170 kt**, dimensions of 8" dia x 18", weighed **125 kg**, with a CEP of **0.25 nm**. (3)

50. The W-68 Poseidon SLBM warhead had a yield of **40 kt**, 8" dia. x 24" long, weighing **60 lbs.**, with a CEP of **0.5 nm**. (3)

51. The 1975 Spartan ABM missile's W-71 warhead **used metallic gold** (100% Au197 isotope) **surrounding the Secondary**, that reacts with neutrons to produce 0.4 MeV gamma rays through the reaction Au197 (n,γ) Au198 and makes the warhead "hotter". (1)

52. The 1979 W-78 MM III upgraded warhead has a yield of **500 kt**, is 8" dia. x 18" long, and weighs **275 lbs.** (2)

53. The 18" dia. B83 bomb has a yield of **3.2 MT**. (1)

54. A **15 kt Primary for a 365 kt** Mk 28Y1 (20" dia. x 55" long).
A **25 kt Primary for a 400 kt** W-47Y1 (18" x 34" small size warhead) and **1.2 MT** W-47Y2 (18" x 47").
An **8 – 40 kt Primary for a 1.85 MT** Mk 27 (30.5" dia.) & **3.8 MT** Mk 39 (34.5" x 100").
A **81 kt Primary for 9 MT** W-53Y2 (37" x 103") & **25 MT** Mk 41Y1 (48" x 112"). (10)

55. The more modern W80 and W84 (the latter weighing **24 kg**/53 lbs.) cruise missile H-bomb warheads use **super-grade plutonium** (97 - 98% Pu239) **in the Secondary** instead of Oy. (3)

56. As low as **2 - 3 kg of α-plutonium** is used as the total fissile material **in the modern hollow cylindrical Primary** core. (2)