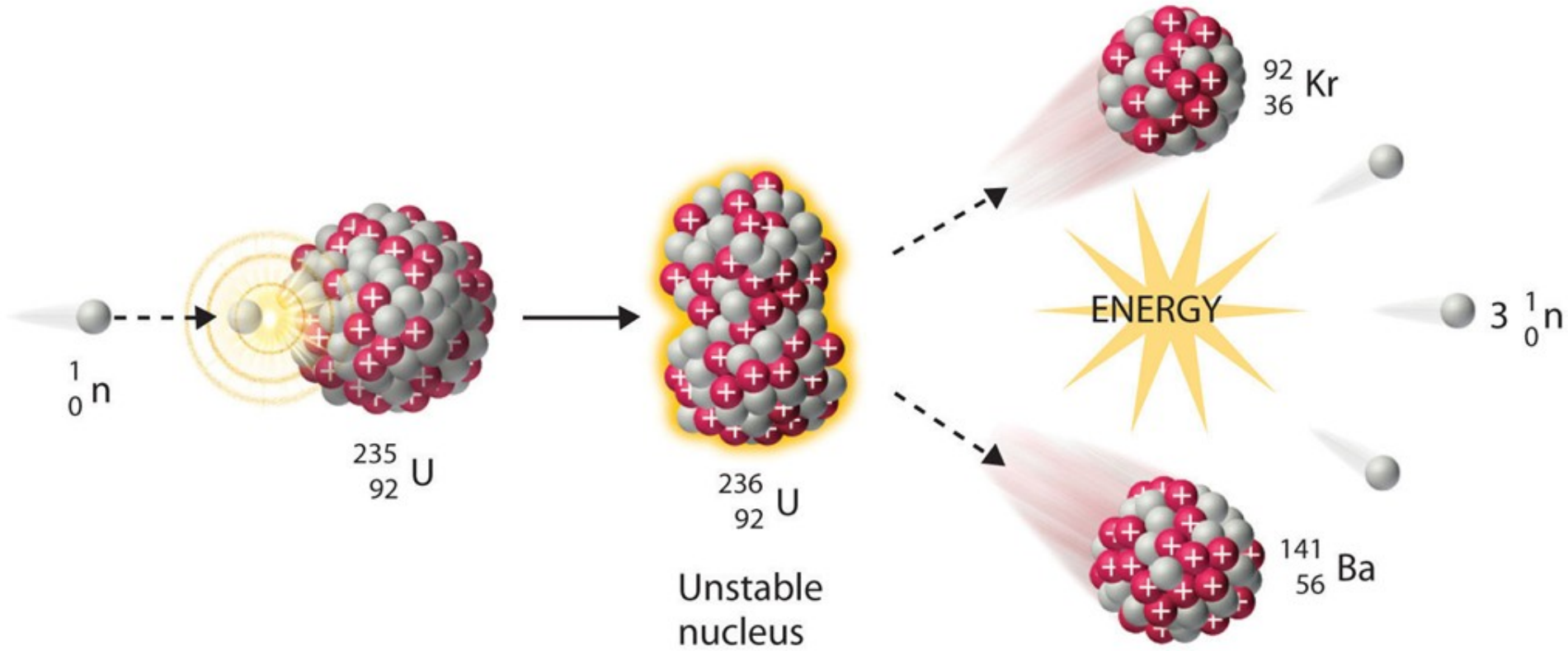


Modern Technologies and Conflicts

Weapons of Mass Destruction



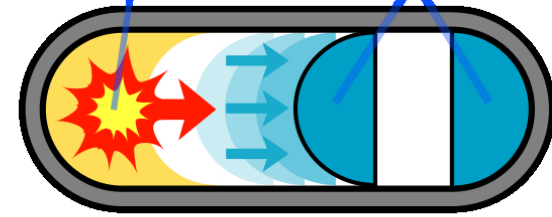
Basic fission



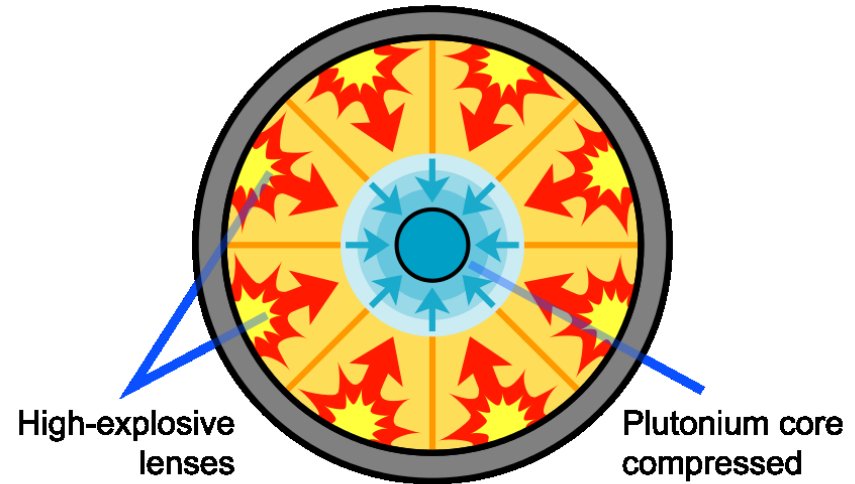
Types

- gun-type
 - first, less efficient and simpler design
 - assembly of 2 subcritical parts
 - Little Boy (Nagasaki, 6.8. 1945)
- implosion
 - newer, more efficient design
 - conventional explosion compresses the core
 - Trinity test (Nevada, 16.7. 1945)
 - Fat Man (Hirošima, 9.8. 1945)

Conventional chemical explosive Sub-critical pieces of uranium-235 combined



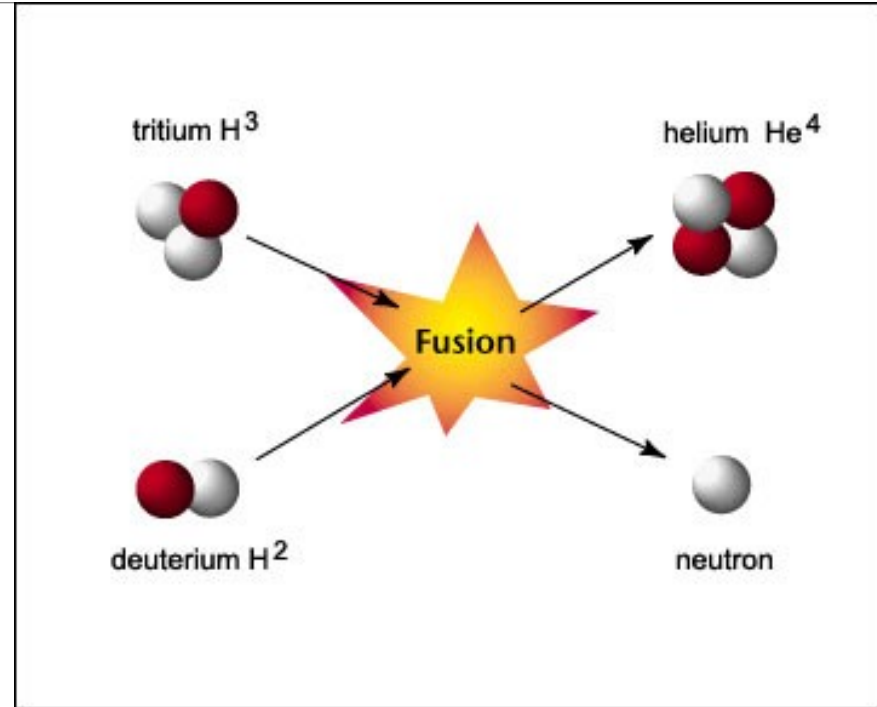
Gun-type assembly method



Implosion assembly method

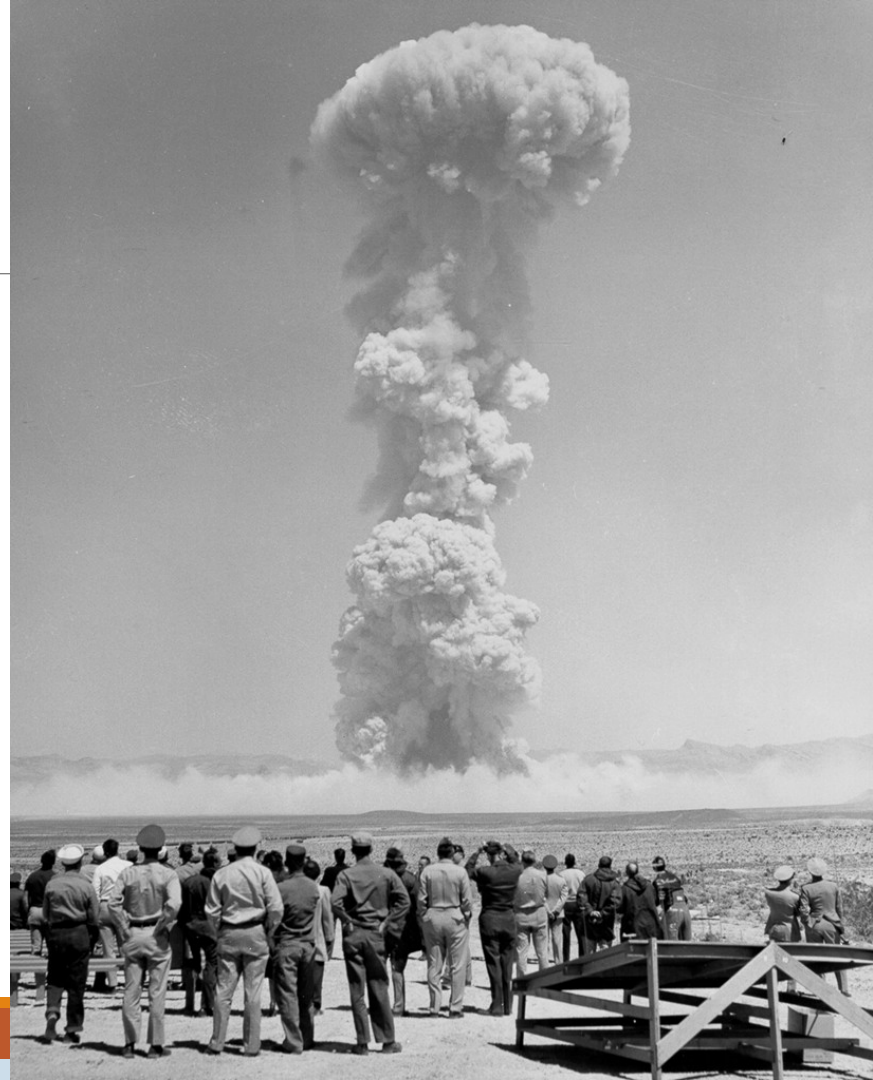
Nuclear fusion

- boosted fission
 - boosting yield of fission bombs by adding helium isotopes (1940s)
- thermonuclear/hydrogen bombs
 - hydrogen core compressed via fission bomb
 - developed in 50s
 - Castle Bravo, 1954, 15 MT
 - Tsar Bomb, 1961, 50 MT
 - roughly 1000x stronger than WW2 bombs
 - commonly used today on ballistic missiles



Other types

- Enhanced Radiation Weapon
 - optimized for neutron radiation
 - minimal physical destruction
 - “kills people, leaves buildings standing”
 - can be used on tactical or ABM missiles
- Electromagnetic Pulse
 - optimized for gamma and x-ray radiation
 - overloads and destroys electronics
 - non-nuclear variant also exist





Radiological weapons

- so called “dirty bomb”
 - spreading radiation through conventional explosion
 - tested as Denial-of-Access weapon
 - possibly attractive for terrorists
 - sounds scary but quite impractical
 - radiation too weak, temporary and can be cleaned up
 - primary threat is panic, not direct deaths
- 2006, Litviněnko assassination

Depleted uranium

- by-product from uranium enrichment
- 50% heavier than lead, similar to tungsten
 - but cheaper and pyrophoric
- used in munitions, armoured, shielding, counterweights...
- lasting controversy regarding its effect on health and environment

- no nuclear reaction taking place
- minimal level of radioactivity (comparable to banana)
- but can be quite toxic (similar to other heavy metals)



History

- nucleus and radioactivity discovered before WW1 (Rutherford, Currie)
- first principles developed in 30s (Leo Szilard, Otto Hahn)
- 1942 project Manhattan started
 - UK lacked the industrial capacity
 - Germany focused on rocketry
- 1945 end of WW2
- USSR (1949), UK (1952), France (1960), China (1964), Israel (196?), India (1974), Pakistan (1998), DPRK (2016?)



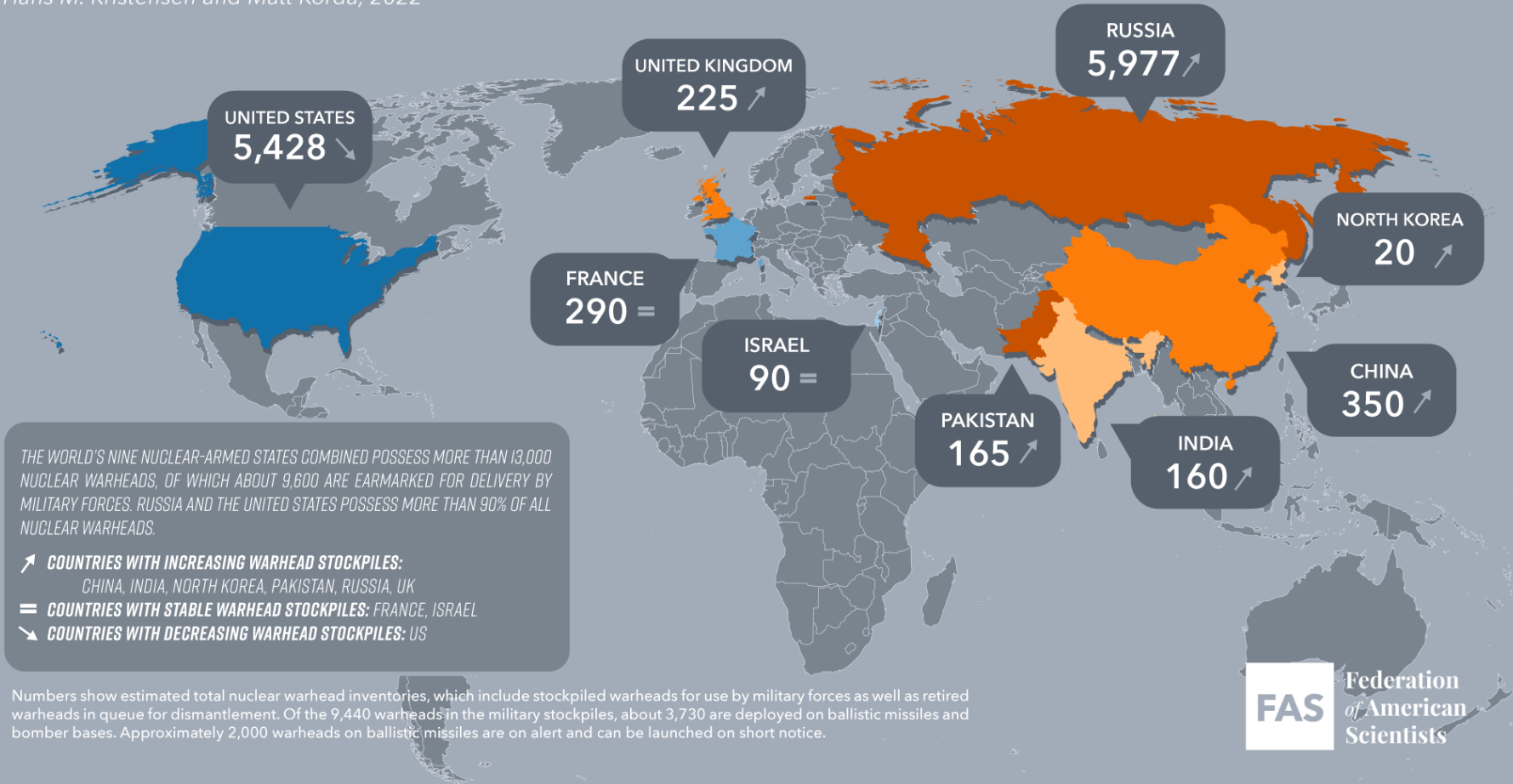


Current arsenals

- permanent members of UN SC
- plus India, Pakistan and Israel
- ongoing efforts by DPRK and Iran
- issue of post-soviet countries
- former programs in Libya, Iraq, Syria, South Africa, Brazil, Taiwan, Sout Korea, Yugoslavia, ...
- <https://www.ctbto.org/nuclear-testing/>

ESTIMATED GLOBAL NUCLEAR WARHEAD INVENTORIES, 2022

Hans M. Kristensen and Matt Korda, 2022



Terrorism

- ongoing speculations
 - esp. after collapse of USSR and 9/11
- regular news about efforts of terrorist groups to procure nuclear weapons or dirty bombs, without confirmation or results
- building a nuclear weapon from scratch impossible
- might steal it, buy it or attack a nuclear facility
- building dirty bomb is trivial, could be used to spread fear

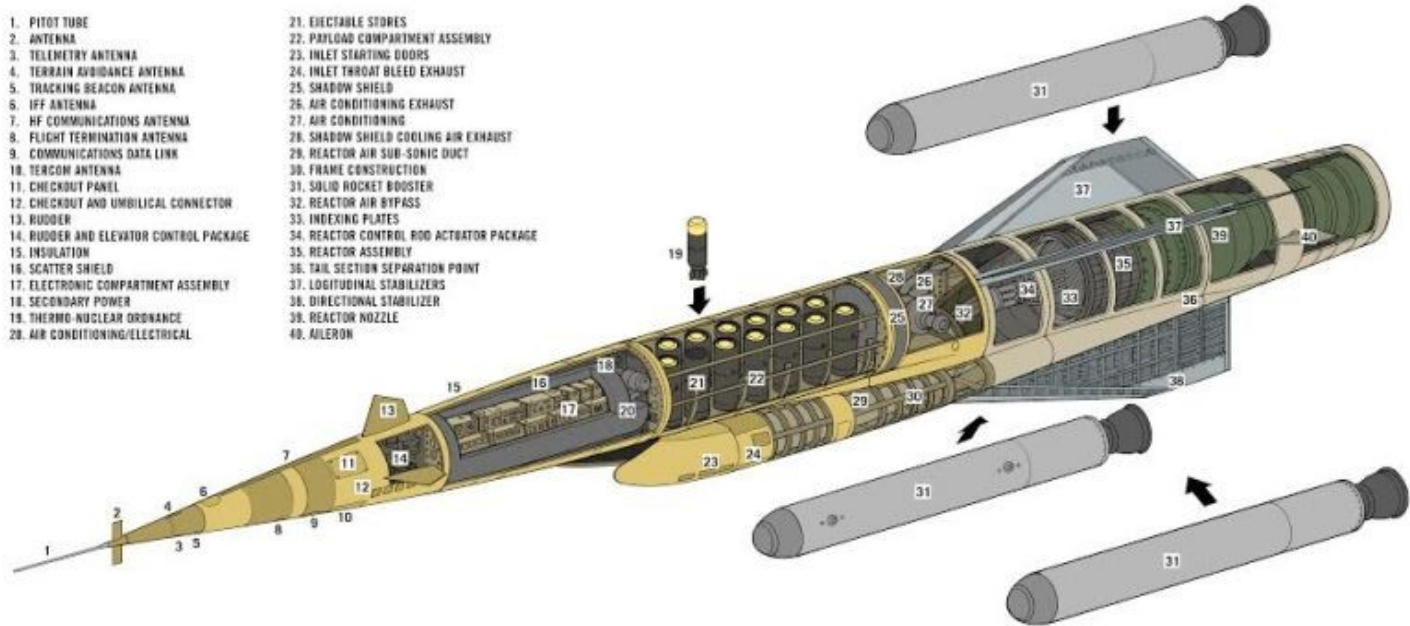


Some notable weapon systems

- SLAM (1955-1964)
doomsday weapon

LING-TEMCO-VOUGHT SLAM (PLUTO)

- | | |
|---|--|
| 1. PITOT TUBE | 21. EJECTABLE STORES |
| 2. ANTENNA | 22. PAYLOAD COMPARTMENT ASSEMBLY |
| 3. TELEMETRY ANTENNA | 23. INLET STARTING DOORS |
| 4. TERRAIN AVOIDANCE ANTENNA | 24. INLET THROAT BLEED EXHAUST |
| 5. TRACKING BEACON ANTENNA | 25. SHADOW SHIELD |
| 6. IFF ANTENNA | 26. AIR CONDITIONING EXHAUST |
| 7. HF COMMUNICATIONS ANTENNA | 27. AIR CONDITIONING |
| 8. FLIGHT TERMINATION ANTENNA | 28. SHADOW SHIELD COOLING AIR EXHAUST |
| 9. COMMUNICATIONS DATA LINK | 29. REACTOR AIR SUB-SONIC DUCT |
| 10. TERCOM ANTENNA | 30. FRAME CONSTRUCTION |
| 11. CHECKOUT PANEL | 31. SOLID ROCKET BOOSTER |
| 12. CHECKOUT AND UMBILICAL CONNECTOR | 32. REACTOR AIR BYPASS |
| 13. RUDDER | 33. INDEXING PLATES |
| 14. RUDDER AND ELEVATOR CONTROL PACKAGE | 34. REACTOR CONTROL ROD ACTUATOR PACKAGE |
| 15. INSULATION | 35. REACTOR ASSEMBLY |
| 16. SCATTER SHIELD | 36. TAIL SECTION SEPARATION POINT |
| 17. ELECTRONIC COMPARTMENT ASSEMBLY | 37. LONGITUDINAL STABILIZERS |
| 18. SECONDARY POWER | 38. DIRECTIONAL STABILIZER |
| 19. THERMO-NUCLEAR ORDNANCE | 39. REACTOR NOZZLE |
| 20. AIR CONDITIONING/ELECTRICAL | 40. AILERON |



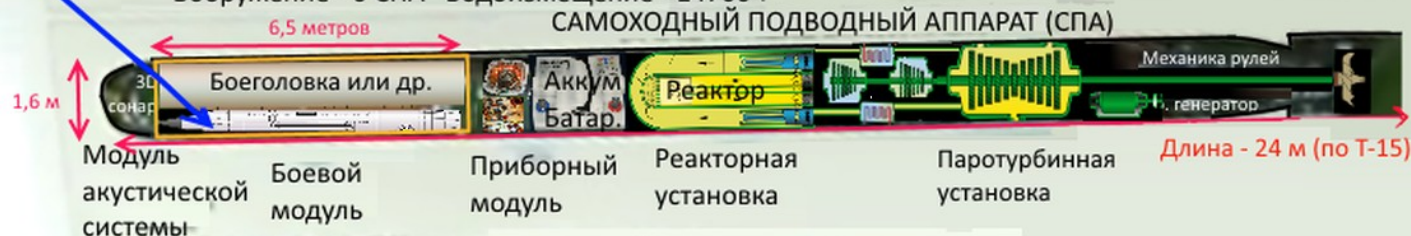
DAMON MORAN
2008

ОКЕАНСКАЯ МНОГОЦЕЛЕВАЯ СИСТЕМА СИСТЕМА "СТАТУС-6"

"Возможные сферы использования таких комплексов различны — работа торпедами по надводным кораблям, смешанная ракетно-торпедная нагрузка, постановка минных заграждений (скрытная в том числе), охота за АПЛ противника"
Алексей Рамм, Дмитрий Корнев, Дмитрий Болтенков

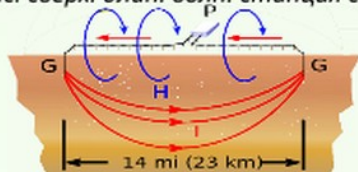
Из "множества целей" публично раскрыто использование боеголовки до 100 Мегатонн с возможной "кобальтовой бомбой"

ПОДВОДНЫЕ НОСИТЕЛИ САМОХОДНЫХ ПОДВОДНЫХ АППАРАТОВ (СПА)



Глубина хода - до 1000 м Скорость хода - до 185 км/ч Дальность хода - до 10000 км

Средства управления и связи с СПА
На рис. сверх. длин. волн. станция связи



Средства обеспечения и эксплуатации



Этапы проведения НИОКР

Создание пилотной системы до 2019 года

Проведение гос. испытаний 2019-2020

Расшифровка слайда Минобороны РФ
- Для изображения реактора и турбины СПА использовано изображение современных компонентов реакторов на свинцово-висмутовой смеси

- Расшифровка скорости дана в варианте Российской Газеты, BBC, АиФ и Global Security



Types of chemical weapons I.

- Nerve agents
 - block nerve signals > convulsions, paralysis of muscles > asphyxiation or heart failure
 - sarin, soman, tabun, VX, novichok
- Blood agents
 - absorbed into blood by inhalation or consumption > block oxygen
 - cyanide, arsenic, oxygen monoxide
- Choking agents
 - stings and destroys cells in lungs and membranes > lungs flood with liquid > asphyxiation
 - phosgene, chlorine

Types of chemical weapons II.

- Blistering agents
 - up to 24 hours after contact, chemical burns for days, extremely painful, necrotic
 - yperite (mustard gas), lewisite
- Psychoactive
 - temporary loss of consciousness, confusion, hallucinations
 - LSD-25, BZ, Kolokol-1
- Incapacitating
 - cause vomiting, burning in eyes, coughing, tears
 - chloracetophenon, CS, CR, adamsite



History I.

- use of smoke since time immemorial
- da Vinci's proposal for chemical grenade
- boom of chemistry since 19th century
- largest use in history during First World War
 - 1914 – tear gas, first use by France, unsuccessful
 - 1915 - chlorine, phosgene
 - 1917 - yperite (mustard gas)
 - over 1 million soldiers impacted, 100 thousand killed (primarily by phosgene)
 - all major powers used chemical weapons
- nerve gases discovered in Germany in 1930s



History II.

- very limited combat use during WW2 – why?
 - Germany did not know nobody else discovered nerve gas, worried about escalation
 - used a lot by Japan
 - planned use for defense of Great Britain
 - Zyklon B in extermination camps
- “gas race” during Cold War
- used in smaller conflicts in Middle East, Africa, etc.





Technology used

- methods of dispersion
 - wind, artillery, air bombs, spraying, binary munitions
- methods of protection
 - detection by sight and smells, damp cloth over face
 - later gas masks, continually improved, full suits
 - neutralizing chemical agents, antidotes, electronic detection

Strategic and tactical aspect

- highly dependent on weather
 - temperature, wind and humidity can limit the effect or even hit friendly forces
- contamination
- quite cheap and simple to produce
- very bad for PR
- not very effective when the armies are protected
- can escalate quickly



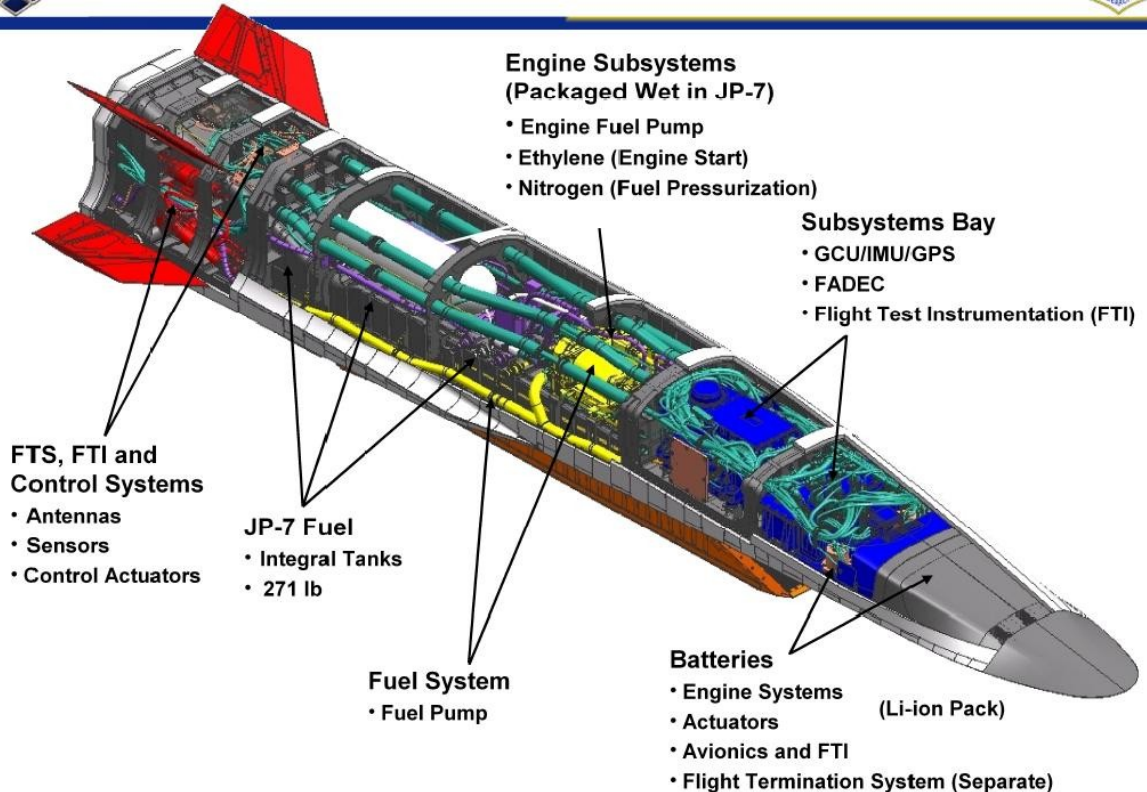
Terrorism etc.

- chemical weapons are relatively easily procurable
- sometimes used to enhance conventional attacks
 - not effective
- Aum Shinrikyo
 - 1990-5: 10 attempts for chemical attack
 - (4x sarin, 4x VX, 1x phosgene and cyanide)
 - 2x successful, 14 killed, 4000 injured
- Moscow theater siege, kolokol-1 used by police, 2002
- attacks on chlorine tanks in Iraq, 2007
- use in Syria since 2012, multiple sides
 - (chlorine, sarin, yperite, tear gas)
- assassination of Kim Jong Nam, 13/2/2017, VX
- Sainsbury attack on Skripals, 04/04/2018, novichok



Some notable weapon systems

- scramjet
- goal is fastest possible reaction when ballistic missiles cannot be used and cruise missiles are too slow
- hypersonic (mach5+)
- flight across pacific in 1-2h
- theoretical basics known since WW2
- mixed success in tests



Some notable weapon systems

- Mach7+, range up to 200 km
- electromagnetic force instead of chemical combustion
- small “cheap” munition, less risky to store
- purely kinetic energy kill
- 11 kilograms @ Mach7 \approx 87t @ 100 km/h (locomotive)
- targets at land, sea and air
- first deployments “soon”

https://www.youtube.com/watch?v=O2QgOvFMG_A&feature=youtu.be&t=8s

- problems:
 - o gun wear and durability
 - o power demands

