Strategic Defense in Depth
The Multilayer Defense

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With thanks to my friend, Dr. John Harvey,
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Elements of layered defence for nuclear security

- Nuclear Weapons and Deterrence
- Early Warning & Missile Defenses
- Nuclear Arms Control
- Non-and Counter Proliferation
- Global Nuclear Threat Reduction
- Countering Nuclear Terrorism
The President of the United States is *the sole authority* who can authorize the employment of nuclear weapons.

DoD takes numerous steps to ensure U.S. nuclear forces are *always* under positive control and responsive to Presidential direction.
Nuclear Command & Control

- Inform POTUS of nature/scope of strike underway
- Provide means for POTUS to engage key advisors
- Seek the President’s decision
- Communicate that decision to forces
- Manage surviving forces

Must be accomplished
under any condition of warning,
alert posture, disturbed environment & POTUS location
- Launch-detection satellites
- Ground-based early warning (EW) radars
- Facilities to interpret early warning information
  - (e.g., Colorado Springs)
- Airborne, ground-mobile, fixed command centers
  - Strategic Command Center, National Military Command Center, etc.
- Survivable communications to POTUS and forces
  - Satellite, other RF links, land-line communications
  - Post-attack survivable communications: EHF, LF/VLF
Logic flow of nuclear strategy: from concepts to hardware

1. **Declaratory policy**
2. **Missions**
3. **Nuclear deployments**
4. **Nuclear Delivery Systems**
5. **Force Size, Capabilities, Alert Posture**
What are U.S. Nuclear Posture Reviews?

- The US sets out its nuclear deployment & employment doctrines in a Presidentially-ordered Nuclear Posture Review

- Elements of the Nuclear Posture
  - Deterrence Strategy: What are nuclear forces intended to deter? How?
  - Extended Deterrence to our Allies (Europe, Asia)
  - Declaratory Policy
  - Planning & Targeting
  - Nuclear Command and Control (NC2)
  - Alert Posture, Operations, Training and Exercises
  - Approach to Hedging
  - Sustainment & Modernization (warheads, delivery systems, NC2 & infrastructure)
Nuclear Posture Reviews (NPR)

Content & Context:

- Four reviews since the end of the Cold War

- All four NPRs concluded that
  - Strategic Triad of nuclear forces, and EU basing of U.S. nuclear bombs carried by NATO dual capable aircraft, are essential to both strategic & extended deterrence.
  - Deterrence cannot be based solely on the existence of nuclear forces
    - It depends on the ability of forces to hold at risk assets most valued by an adversary.
  - Force capabilities may need to be adjusted as adversary target sets & employment strategies evolved.
  - Moratorium on nuclear testing should be continued

- The Biden 2022 NPR is in preparation
Declaratory policy: Official public statements about circumstances in which a state would consider using nuclear weapons

- **Positive:** The U.S. would only consider employing nuclear weapons in extreme circumstances to defend vital interests of U.S., its allies, and partners.

- **Negative:** Official public declarations about under which circumstances a state rules out the use of nuclear weapons
  - U.S. will not use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the NPT & in compliance with their nuclear non-proliferation obligations (2018 NPR)
  - India & China have declared no-first-use policies, i.e., the would use nuclear weapons only in response to a nuclear attack

See: https://www.armscontrol.org/factsheets/declaratorypolicies
Example 1: The U.S. rejects a *no-first-use* policy

- Doubts declarations of such a policy by other countries
  - China & India declare that they would use nuclear weapons only in response to a nuclear attack

- Prefers a calculated ambiguity regarding the precise extreme circumstances that might lead to a U.S. nuclear response

- Hedges against the potential rapid growth of emergence of nuclear & non-nuclear *strategic threats* (2018 NPR)
  - Includes chemical, biological, cyber, & large-scale conventional aggression.
Example 2: U.S. rejects launch-on-warning policies

- The U.S. will not launch its ICBMs based only on one sensor’s data.

- Overlapping system of space & ground based sensors can detect & characterize potential attacks unambiguously
  - Before notifying top leadership, data concerning a potential attack are confirmed by matching data from both ground & space-based sensors
  - DoD also considers broader political-military context in evaluating receives the data concerning a possible missile launch.
Declaratory policy

Missions

Nuclear deployments

Nuclear Delivery Systems

Force Size, Capabilities, Alert Posture
Fundamental pillar of policy: Nuclear Deterrence

- Deterrence rests on a *perceived* ability
  - to deny an adversary the objectives it seeks from an attack
  - the capability to inflict intolerable costs under any circumstances

- *Primary but not sole purpose* of U.S. nuclear forces:
  - Deter nuclear attack against the U.S. & its allies
  - *If deterrence fails*, respond with the prospect of a certain and devastating retaliation

- Nuclear Deterrence requires an effective “second strike” force

- Deter global conventional war with Russia & China, discourage catastrophic non-nuclear strikes on population involving chemical or biological weapons of mass destruction (WMD)
Characteristics of effective deterrence: All actors must perceive/believe its ...

- **Credibility**: second strike force response is credible (works)
  - Scientific Stockpile Stewardship
- **Capability**: second strike would be be certain & devastating
  - Life extension of old (tested) warheads
  - Warhead modernization
- **Survivability**: The second-strike force can survive a first strike
  - Launcher hardening, stealthy operation, mobile missiles, robust C³
- **Flexibility**: Nuclear forces offer flexible, limited, & graduated response options beyond extremes of inaction or large-scale attack
  - No exploitable gap between stated U.S. objectives & perceived capabilities
  - Options must make adversary’s nuclear response less likely, not more likely
- **Stability**: Deterrence persists as force sizes & circumstances change
Strategic stability as understood before the collapse of the USSR

- **First Strike Stability**: Even in peacetime, survivable nuclear forces are sufficient to extract an overwhelming price such that no adversary leader would wake up one morning "out of the blue" and decide to push the button.

- **Crisis stability**: In regional conventional conflict, with nuclear forces on increased alert, survivable forces still provide an extraordinarily compelling incentive not to strike first.

- **Arms race stability**: Incentives dissuade both sides from reprising the massive action-reaction buildup of the 1950's and 60’s
  - Manage their competition via arms control, transparency, etc.
Declaratory policy

Missions

Nuclear deployments

Nuclear Delivery Systems

Force Size, Capabilities, Alert Posture
U.S. nuclear deployments

Total Warheads as of 2017: 3,822

Source: NMHB_2020
Declaratory policy

Missions

Nuclear deployments

Nuclear Delivery Systems

Force Size, Capabilities, Alert Posture
Present configurations of nuclear forces

- **Strategic forces** – intercontinental weapons (>5000 nautical miles)
  - Land ICBM), sea (SLBM), and heavy bomber delivery vehicles
  - Large (>100 kT) thermonuclear weapons
    - > 10 x Hiroshima weapon
- **Intermediate range delivery vehicles** (1000 – 2000 km)
  - Cruise missiles: theater & battlefield
    - Air & sea launched
    - Low altitude, terrain-following, “under the radar”
  - Hypersonic (>Mach-5): theater
    - Under development in US, Russia, & China
    - Stealthy, could penetrate all present defenses
- **Tactical nuclear weapons**: battlefield
  - Low yield (few – tens of kT) bombs, shells, mines, etc.
  - Short-range battlefield use (15 – 150 km)
Nuclear delivery systems: US, Russia, & China

Source: NMHB_2020
The United States Triad
LGM-30G Minuteman III ICBM
The responsive leg of the nuclear triad

- 400 Minuteman III missiles in dispersed, hardened silos
  - Now has single RV
  - Connected to underground launch control center through hardened cables.
  - Two-officer launch crews
  - Silo would have to be in the crater of a nuclear burst
  - On continuous, around-the-clock alert since 1959

- To be replaced by new GBSD (Ground Based Strategic Deterrent)

Ohio-Class Ballistic Missile Submarines
SSBNs - the most survivable leg of the nuclear triad

- Fourteen Ohio-class SSBNs
  - Stealth design, nuclear powered
  - Typically spend 77 days at sea then 35 days in port
    - Have two independent crews
  - Carries 24 Trident II D5 (SLBMs)
  - Tridents carry 8 MIRVs (multiple, independently targeted warheads)

Strategic bomber fleet
Highly flexible leg of the triad

- 46 B-52H Stratofortress
  - Long-range heavy bomber
    - Sub-sonic
    - 5-person crew
  - Delivers a wide array of nuclear & conventional weapons
- 20 B-2A Spirit
  - Multi-role stealth aircraft
    - High sub-sonic
  - Unrefueled range:
    - ~ 6,000 nautical miles
  - 2 pilot crew
U.S. nuclear weapons & delivery systems

U.S. Nuclear Weapons (Warheads and Bombs)
- W78
- W76-0
- W76-1
- W76-2
- W88

U.S. Nuclear Delivery Systems (Platforms and Vehicles)
- MMIII ICBM
- GBSD ICBM
- Ohio SSBN
- Columbia SSBN
- D5 SLBM
- D5 LE SLBM
- D5 LE2 SLBM
- B-2 Bomber
- B-52 Bomber
- B-21 Bomber
- Legacy DCA
- Legacy ALCM
- F-35 DCA
- LRSO ALCM

Legend:
- Land
- Sea
- Air
- Current capability
- Completely fielded within 10 years
- In production within 10 years
- In research & development within 10 years

Source: NMHB_2020
U.S. warhead production timeline
No new warheads since the 1980s

Life Extension Programs
## Old nukes never die

<table>
<thead>
<tr>
<th>Warhead Type</th>
<th>Date of Entry into Stockpile</th>
<th>Planned LEP(^1)</th>
<th>First Prod. LEP</th>
<th>Planned Repl.(^2)</th>
<th>Projected FPU(^5) for Replacement</th>
<th>Nuclear Component Age at Initial Replacement(^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B61-3/4(^*)</td>
<td>1979</td>
<td>B61-12 LEP</td>
<td>2020</td>
<td>FAW(^3)</td>
<td>~2040–2050</td>
<td>~60–70 yrs</td>
</tr>
<tr>
<td>B83-1(**)</td>
<td>1983</td>
<td>Retired by 2025</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Cruise Missile W80-1</td>
<td>1982</td>
<td>W80-4 LEP</td>
<td>2025</td>
<td>FAW</td>
<td>~2040–2055</td>
<td>~60–75 yrs</td>
</tr>
<tr>
<td>SLBM W76</td>
<td>1978</td>
<td>W76-1 LEP</td>
<td>2008</td>
<td>FBW(^4)</td>
<td>~2045–2047</td>
<td>~65–70 yrs</td>
</tr>
<tr>
<td>ICBM W78</td>
<td>1979</td>
<td>n/a</td>
<td>n/a</td>
<td>W87-1</td>
<td>~2030</td>
<td>~50 yrs</td>
</tr>
<tr>
<td>ICBM W87</td>
<td>1986</td>
<td>Partial LEP</td>
<td>1999</td>
<td>FBW</td>
<td>~2035–2040</td>
<td>~50–55 yrs</td>
</tr>
<tr>
<td>SLBM W88</td>
<td>1989</td>
<td>Alt 370 Refresh</td>
<td>2022</td>
<td>FBW</td>
<td>~2035–2040</td>
<td>~45–50 yrs</td>
</tr>
</tbody>
</table>

\( ^* \) Non-strategic bomb  \( ^** \) Strategic Bomb  \( ^1 \) Life extension programs (LEP) reuse nuclear components  
\( ^2 \) Replacement requires nuclear component production  \( ^3 \) Future Air-Delivered Warhead (FAW) timeframe identified; characteristics to be determined  
\( ^4 \) Future Ballistic Missile Warheads (FBW) initial studies planned; diversity and characteristics to be determined  
\( ^5 \) First Production Unit  \( ^6 \) Replacement dates are notional
Stewardship of the active stockpile

- Maintain warheads in an operational status & regularly replace Limited Life Components every few years
  - Tritium components, neutron generators, & power-source batteries
- Evaluate warheads for reliability, every six months, & validate for safety, every year
- Predict, detect, & evaluate potential problems of the aging stockpile
- Refurbish & remanufacture warheads & components, as required by Life Extension Program
Maintaining the warhead stockpile

- Warheads are being maintained well beyond their original design lifetimes.
  - NNSA labs detect anomalies that may ultimately degrade performance of some nuclear weapons to unacceptable levels.
- Life Extension Programs address aging & performance issues, enhancing safety features & improving security, while meeting strategic deterrence requirements.
- LEPs reduce, to the extent possible, undesirable materials:
  - Hazardous, costly to manufacture, degrade prematurely, or react with other materials in a manner that affects performance, safety, or security.
The U. S. has no current capability to mass produce fissile components for nuclear weapons

===> DOE/NNSA must re-establish a limited warhead production capability

- Establish a fissile component production capability with sufficient capacity ===> Pit production of 80 per year

- Maintain the science and engineering institutions needed to support the U.S. nuclear deterrent, now and in the future.
Funding levels for nuclear systems (Obama / Trump programs)

Funding far below historical levels before decision to cut DoD budget. Large bills coming to maintain force even at ~2/3 today’s level.

Investment Average (1962–1993) = 5%
Investment Average (FYDP) = 1%

Fiscal Year
SSBN = ballistic missile submarine; NAOC = National Airborne Operations Center; SLBM = submarine-launched ballistic missile; New ICBM, New NAOC, and New SLBM are unfunded

MIT - Physics
Tasks for DOE/NNSA

- Understand the state of weapons in the U.S. stockpile
- Predict the state of weapons in the future
- Maintain/enhance the personnel, computational, experimental, & test capabilities needed to...
  1. Provide enduring capability & capacity to produce no fewer than 80 Pu pits per year by 2030
  2. Assess annually the safety & reliability of the nuclear weapons stockpile design
  3. Meet schedules for four warhead Life Extension Programs
  4. Develop & produce modern nuclear warheads as needed in the future
Not later than 60 days before the President implements a nuclear employment strategy differing from the strategy then in force, the President shall submit to Congress a report setting forth:

1. Description of the modifications to the strategy, plans, and options of the US made by the new strategy
2. Assessment of effects of such modification for the nuclear posture of the US
3. Implications of such changes on the flexibility & resilience of US strategic forces & their ability of such forces to support US goals with respect to nuclear deterrence, extended deterrence, assurance, & defense.
4. Extent to which the modifications increase reliance on US conventional or non-nuclear strike capabilities or missile defenses.
The largest issue for Biden’s NPR

- Deterring a hostile Russia remains an increasing focus for U.S. nuclear and conventional forces.
  - Based on its rejection of the post-Cold War order
    - Reflected in occupation of Crimea, invasion of Ukraine, & efforts to destabilize other sovereign states

- If Russia believes that it could escalate its way to victory, by reoccupying a Baltic state, then it must be set straight
  - No conceivable advantage & an incalculable downside risk would accrue from any nuclear use against NATO

- The US must retain an analogous posture vis-à-vis China
Other major questions for the Biden NPR

- How many ICBMs should we deploy to meet security needs while maintaining a robust cadre and career path for ICBM operations?
- Can ballistic missile modernization be leveraged to reduce costs via a smart approach to common ICBM & SLBM components?
- What is needed to ensure that U.S. nuclear forces can’t be neutralized by attacks, whether kinetic or cyber, on the Command & Control system?
Other major questions cont’d

- What security assurances are needed for our Asian allies?
  - Should US seek Allied concurrence on plans to demonstrate capability to deploy nuclear weapons to bases in Korea & Japan?
    - Or to field a modern, nuclear, land-attack SLCM on surface ships or attack submarines?

- In a conventional conflict with the U.S., how can an adversary’s initial limited use of nuclear weapons best be deterred?

- Do we need nuclear warheads with new or different military capabilities?
  - Do we need to retain capabilities to develop and produce such warheads, if required?
Topics for discussion:
Provocations toward escalation

- Old model: Step-by-step progression from peacetime to crisis to regional then to global, conventional conflict to nuclear use
- Does limited/regional low yield, nuclear use on ground targets with moderate casualties necessarily imply escalation?
- Is drift of radiation across national borders into NATO the equivalent of a kinetic attack?
- Should a cyber attack with large scale damage be considered the same as a kinetic attack?
- How can we look ahead toward a world without nuclear weapons?
  - Maintaining deterrence/stability with reduced forces