

Nuclear weapons modernization and its impact on global security

**Alessandro Pascolini
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outline

- ❖ **aspects of nuclear military systems modernization**
- ❖ **nuclear modernization programs**
 - **country profiles**
- ❖ **nuclear modernization and military doctrines**
- ❖ **impact of nuclear modernization on treaties**
 - **NPT, CTBT, FMT/FMCT, human rights**
- ❖ **nuclear modernization and geopolitical stability**

nuclear modernization

qualitative improvement of the nuclear military systems:

- ❖ warheads/gravity bombs**
- ❖ delivery vehicles**
- ❖ launch platforms**
- ❖ command and control**
(including the space segment)
- ❖ infrastructure (production/maintenance)**
- ❖ science base (research and development)**
- ❖ re-training of personnel**
- ❖ re-structuring of the military forces**

modernization parameters

- ❖ reliability
- ❖ safety
- ❖ security
- ❖ age defects mitigation
- ❖ predictability
- ❖ accuracy/precision
- ❖ survivability
- ❖ stealth
- ❖ use control
- ❖ easy maintenance
- ❖ rapid deployment
- ❖ hardening against stress and radiation
- ❖ ...

nuclear weapons are multi-component devices and each component ages and requires maintenance



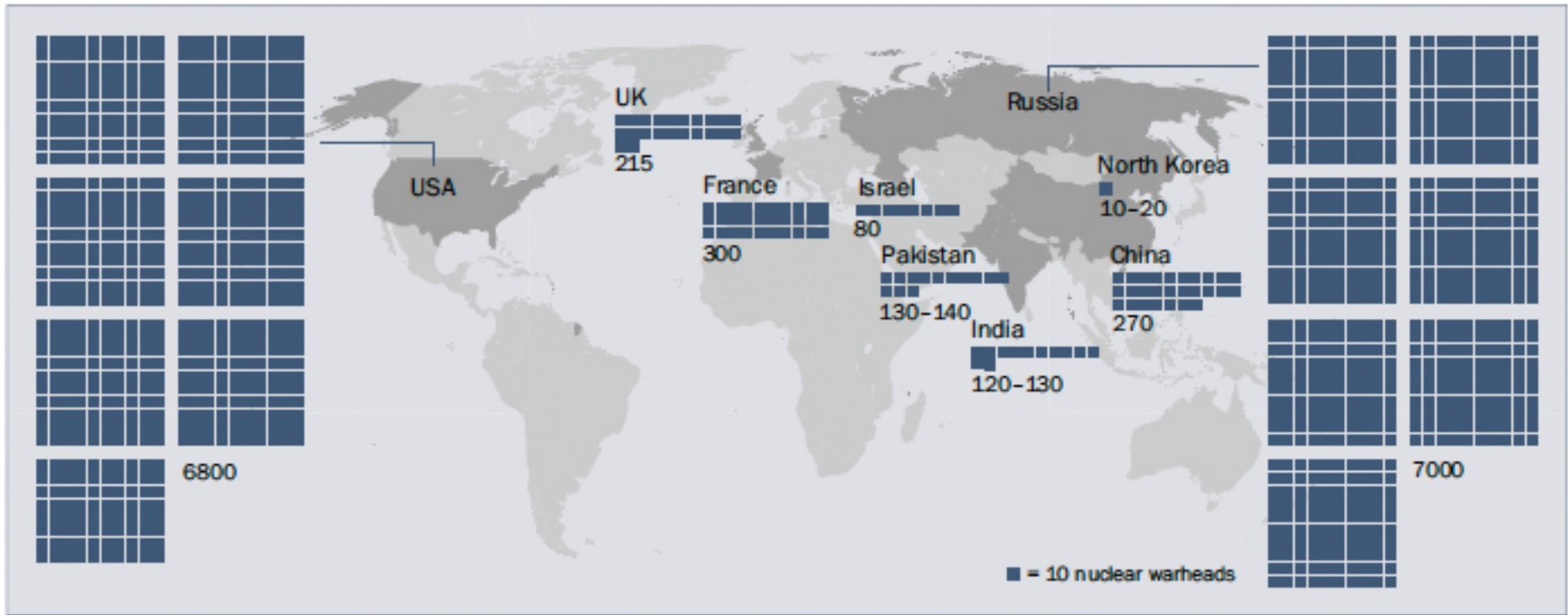
new system/ life extension

The United States *will not develop new nuclear warheads* but consider the “full range” of life-extension program options, including refurbishment of existing warheads, reuse of nuclear components from different warheads, and replacement of nuclear components. Any life extension programs will use only nuclear components based on previously tested designs, and will not support ... new military capabilities (2010 US Nuclear Posture Review Report).

- ❖ *Refurbishment* describes the case in which individual components in the nuclear explosive package are either retained for continued use or replaced with components of nearly identical form, fit, and function.**
- ❖ *Reuse* describes the case in which pits and secondary components from *different*, previously fielded warhead designs are introduced into the warhead. This usually implies that the pits and/or components are taken from existing surplus stocks, but if such parts did not exist in sufficient number, the committee would extend “reuse” to include parts newly manufactured to nearly identical specifications.**
- ❖ *Replacement* describes the case in which pits and/or secondary components introduced into the warhead are based upon previously tested designs but may differ in some respects from such designs.**

motivations for modernization

- ❖ the emergence of new technologies making nuclear arms more efficient and allowing them to be maintained in safer, more secure ways;
- ❖ the development by an adversary of disruptive technologies such as air and missile defenses, antisubmarine warfare, and offensive long-range precision arms;
- ❖ a desire to broaden the functional capabilities of delivery systems originally designed for nuclear missions exclusively;
- ❖ the limited service life of existing systems;
- ❖ competition of different services within each country;
- ❖ desire to make strategic delivery systems more “usable” in a variety of possible operations



total warhead holdings of all nuclear weapon possessing states (SIPRI 2017)

**all nine nuclear powers are hurrying up to the
“hay wagon” of weapon modernization
without realising where it is actually
heading ...**

Chinese nuclear modernization

China *will optimize its nuclear force structure, improve strategic early warning, command and control, missile penetration, rapid reaction, and survivability and protection. Press forward with independent innovations in weaponry and equipment by reliance on science and technology, enhance the safety, reliability and effectiveness of missile systems, and ... strengthen its capabilities for strategic deterrence and nuclear counterattack, and medium- and long-range precision strikes.*

- ❖ new weapons
- ❖ upgrade for MIRV missiles
- ❖ MRBM/ICBM
 - ❖ DF-21 mobile MRBM
 - ❖ DF-31A mobile ICBM
 - ❖ MIRVed mobile DF-41



Chinese nuclear modernization

❖ SSBN/SLBM

- ❖ Jin SSBN

- ❖ **Type-96 SSBN**

- ❖ JL-2 SLBM

- ❖ **JL-3 SLBM**

❖ air force

- ❖ **H-6 bomber**

- ❖ **CJ-20 cruise missile**

❖ GLCM

- ❖ DH-10 dual capable



French nuclear modernization

❖ SSBN/SLBM

- ❖ M51.2 SLBM on SSBN
- ❖ **M51 SLBM replacement**
- ❖ **Triumphant replacement**

❖ air force

- ❖ Rafale F3 aircraft
- ❖ ASPA Cruise missile
- ❖ **ASPA replacement**

❖ infrastructure

- ❖ **CESTA megajoule**
- ❖ **Valduc warhead centre**



Indian nuclear modernization

- ❖ new weapons
 - ❖ upgrade for MIRVed missiles
- ❖ infrastructure
 - ❖ new Chitradurga HEU enrichment plant
 - ❖ BARC plutonium facility
 - ❖ Vishakhapatnam reactors
 - ❖ Kalkam breeder reactor
- ❖ SSBN/SLBM
 - ❖ up to five Arihant SSBN
 - ❖ K-4 SLBM
 - ❖ K-15 Sagarika SLBM



Indian nuclear modernization

❖ air force

❖ **Mirage2000 replacement**

❖ ICBM/MRBM/IRBM

❖ Agni-II MRBM

❖ **Agni-IV IRBM**

❖ **Agni-V IRBM**

❖ **MIRVed Agni-VI ICBM**

❖ cruise missiles

❖ **Nirbhay**



Israeli nuclear modernization

❖ missiles

- ❖ **Jerico III IRBM**

- ❖ **Popeye SBCM**

❖ navy

- ❖ Dolphin submarine

❖ air Force

- ❖ **F-35I (Adir)**

❖ “Nuclear opacity”:

the state’s nuclear capability has not been acknowledged, but is recognized in a way that influences other nation’s perceptions and actions



NATO nuclear modernization

❖ air Force

- ❖ Italy, The Netherlands and Turkey: **F-35A**
- ❖ Germany: **Tornado life-extension**
- ❖ Belgium: **F-16 replacement**
- ❖ **B61-12 weapons**



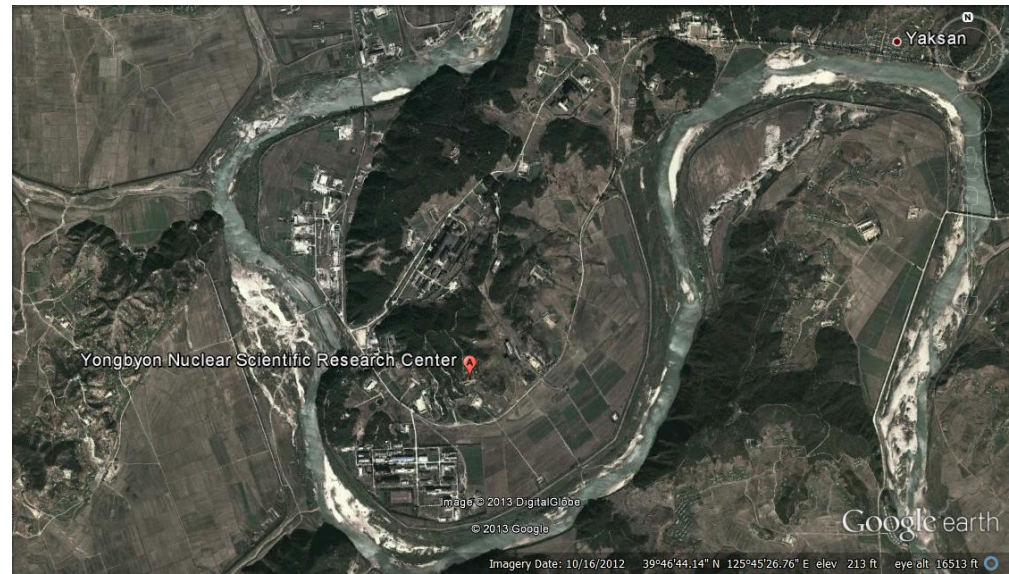
❖ NATO nuclear posture

Allies concerned will ensure that all components of NATO's nuclear deterrent remain safe, secure, and effective for as long as NATO remains a nuclear alliance.



North-Korean nuclear program

- ❖ new weapons
 - ❖ production rate 3-5/year
 - ❖ **thermonuclear weapons**
- ❖ infrastructure
 - ❖ HEU enrichment plant
 - ❖ plutonium producing reactor
- ❖ LBBM
 - ❖ **Hwasong-12 IRBM**
 - ❖ **Bukkeuseong MRBM**
 - ❖ **Taepo Dong 2 ICBM**
 - ❖ **Hwasong-13 ICBM**
 - ❖ **Hwasong-14 ICBM**



Pakistani nuclear modernization

❖ new weapons

- ❖ sustained production 10/year
- ❖ **upgrade for MIRVed missiles**

❖ infrastructure

- ❖ expansion of Kahuta HEU enrichment plant
- ❖ **Gadwal enrichment plant**
- ❖ Khushab IV plutonium producing reactor



Pakistani nuclear modernization

❖ MRBM/SRBM

- ❖ Shaheen 2 (Haft-6) MRBM
- ❖ NASR (Haft-9) SRBM
- ❖ Shaheen 1A (Haft-4)
- ❖ Abdali (Haft-2)SRBM
- ❖ Shaheen 3 (Haft-10)
- ❖ Ababeel MIRV

❖ cruise missiles

- ❖ Babur GLCM (Haft-7)
- ❖ Ra'ad ALCM (Haft-8)
- ❖ Sea-based CM



Russian nuclear strategic modernization

❖ **Putin announced:**
Russia will replace its Soviet-built arsenals with modern weapons

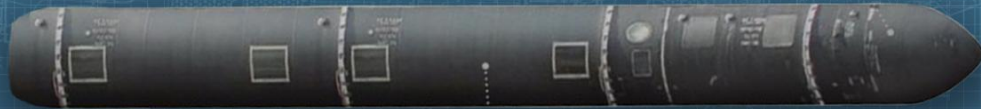


❖ ICBN

- ❖ **RS-24 Yar mobile**
- ❖ **RS-24 Yars in silo**
- ❖ **RS-26 YarsM mobile**
- ❖ **RS-28 Sarmat in silo**

RS-28 (SARMAT) ©KATEHON.COM 2016

WEIGHT OVER	100 TONNES
WARHEAD	UP TO 15 MIRVS
ENGINE	4 RD-274 FIRST STAGE
PROPELLANT	LIQUID

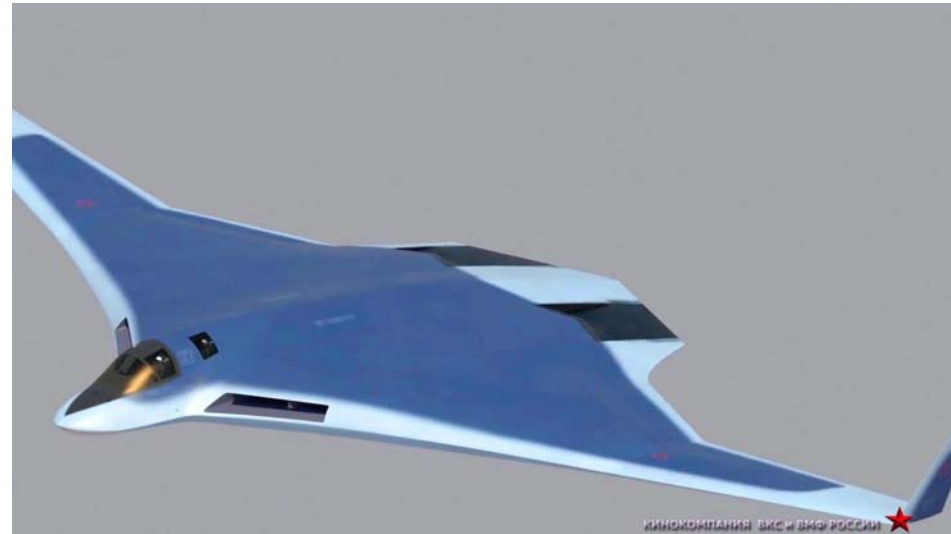


OPERATIONAL RANGE APPROX. 10,000 LOMETRES (6,200 MI)
SPEED OVER MACH 20 (24,500 KM/H; 15,220 MPH; 6.806 KM/S)

Russian nuclear strategic modernization

❖ SSBN/SLBM

- ❖ Borei SSBN
- ❖ RSM-54 SLBN upgrade
- ❖ RSM-56 (Bulava) SLBM



❖ bombers

- ❖ Tu-95 upgrade
- ❖ Tu-160 upgrade
- ❖ new bomber PAK DA



Russian nuclear strategic modernization



Russian nuclear tactical modernization

❖ cruise missile

❖ SS-26 (Iskander-M)

❖ SS-N-19 SLCM

❖ AS-4 ALCM

❖ fighter-bomber

❖ Su-34 (Fullback)

❖ air/missile defence

❖ S-400/ SA-21 interceptors



U K nuclear modernization

❖ SSBN/SLBM

- ❖ **Dreadnought SSBN**
- ❖ **Trident II D5 SLBM**
- ❖ **Mk4A/W76-1 warhead**
- ❖ **Mk4A replacement**

❖ infrastructure

- ❖ **Joint French-UK
warhead centre,
Valduc**



U S nuclear modernization

- ❖ nuclear triad
- ❖ life extension and upgrading of all existing systems
- ❖ infrastructure
 - ❖ Uranium Processing Facility (ORNL)
 - ❖ Plutonium production facility (LANL)
 - ❖ National Ignition Facility (LLNL)
 - ❖ Advanced Extremely High Frequency satellites



U S nuclear modernization

- ❖ new weapons

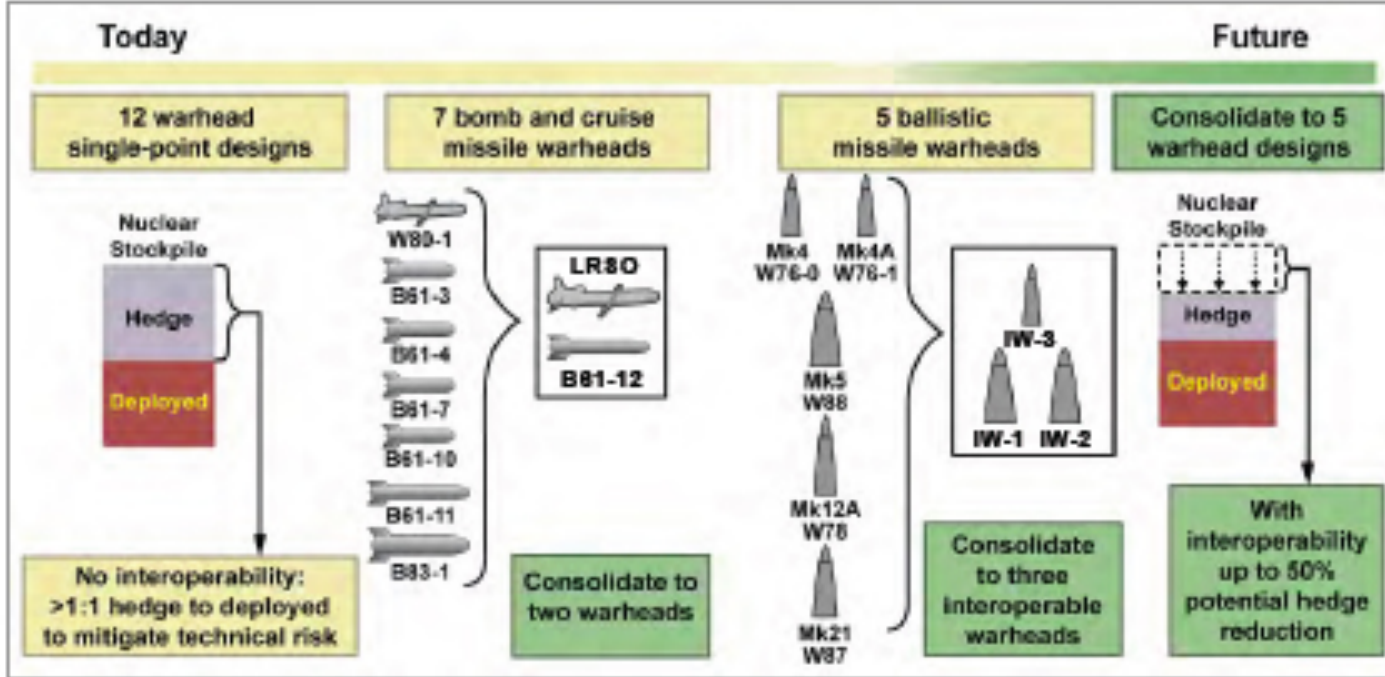
- ❖ upgraded W76-1, W88-1, W78

- ❖ interoperable IW-1, IW-2, IW-3

- ❖ upgraded B61 to **B61-12**



Source: Federation of American Scientists GRAPHICS ADAPTED FROM THE NEW YORK TIMES



U S nuclear modernization

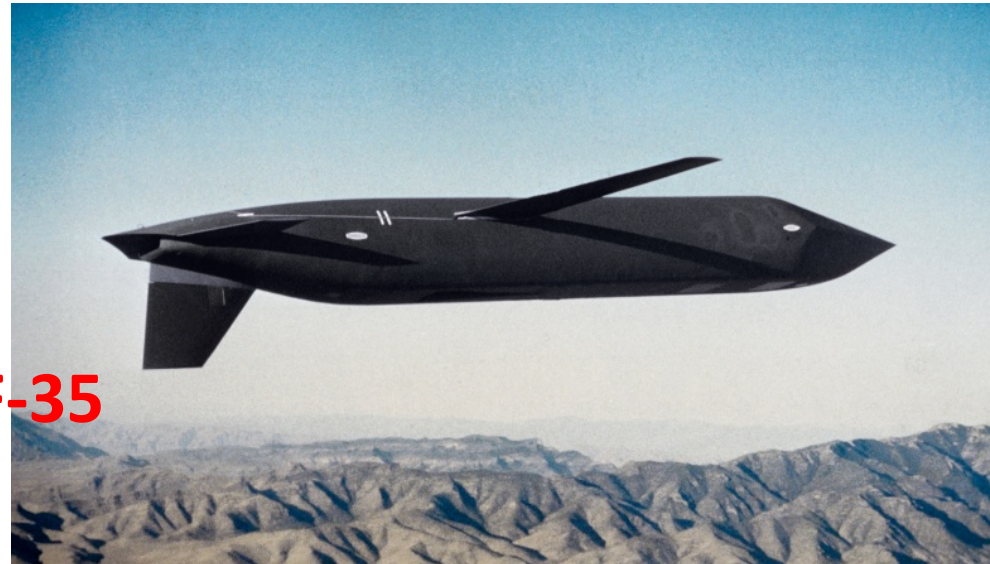
❖ bombers

- ❖ B-2A upgrade
- ❖ B-52H upgrade
- ❖ new bomber B-21 Raider
- ❖ new standoff gravity bomb B61-12
- ❖ new LRSO



❖ tactical

- ❖ nuclear fighter-bomber F-35
- ❖ new standoff gravity bomb B61-12



U S nuclear modernization

❖ SSBN/SLBM

❖ Ohio SSBN life-extension

❖ Trident II SLBM
life-extension

❖ **new generation SSBNX**

❖ **new generation SLBM**



❖ ICBM

❖ Minuteman III life-extension

❖ **new ICBM (Ground Based Strategic Deterrent)**

❖ **W78 warhead upgrade**

❖ **new generation warheads**



nuclear modernization outlook

- ❖ the arsenals of Cina, India, Pakistan and DPRK grow
- ❖ overall reductions, but new qualitative capabilities
- ❖ the new systems will remain operational up to mid 2080s
- ❖ financial or technical limitations can hinder some projects



Key: ALCM - Air-Launched Cruise Missile; GLCM - Ground-Launched Cruise Missile; ICBM - Intercontinental Ballistic Missile; IRBM - Intermediate Range Ballistic Missile; SLBM - Sea-Launched Ballistic Missile; SLCM - Sea-Launched Cruise Missile; SRBM - Short Range Ballistic Missile; SSBN - Nuclear-Powered Ballistic Missile Submarine; WH - warhead

impact of modernization on missions

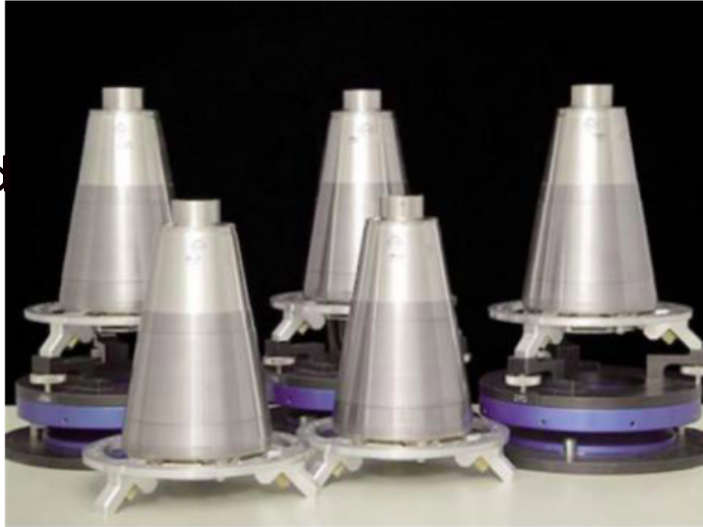
- ❖ the longer-range missiles extend the nuclear threat to extended areas: India can reach Cina, North Korea Alaska and most East Asia, Israel the whole Middle East, ...**
- ❖ the shorter-range missiles are extremely destabilizing and escalation prone**
- ❖ MIRVing reflects a strategy to quickly strike multiple targets and invites adversaries to a war-head race**
- ❖ nuclear-armed cruise missiles increase the risks of miscalculation, misperception, rapid escalation and arms racing, due also to the ambiguity of their conventional/ nuclear role**
- ❖ the higher accuracy of delivery vehicles and the improvement of effectiveness of weapons makes it possible to destroy hardened targets with lower yield and less collateral damage and fallout**
- ❖ deterrence is being replaced by postures aiming to more refined strike plans with multiple options against different combinations of targets, for different objectives at different levels of intensity**

example of modernization

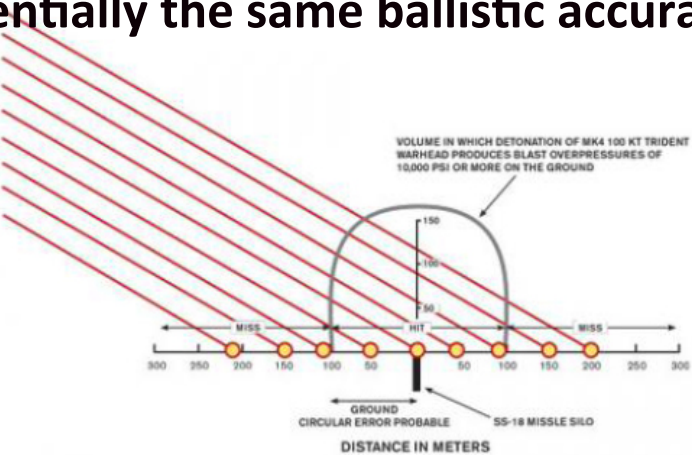
MC4700 fuze on the W76-1/ Mk4A

The old Mk4 re-entry body had three fixed height-of-burst settings, which meant that some warheads would fail to detonate inside the optimal volume above the target to produce the peak pressure needed to destroy the target.

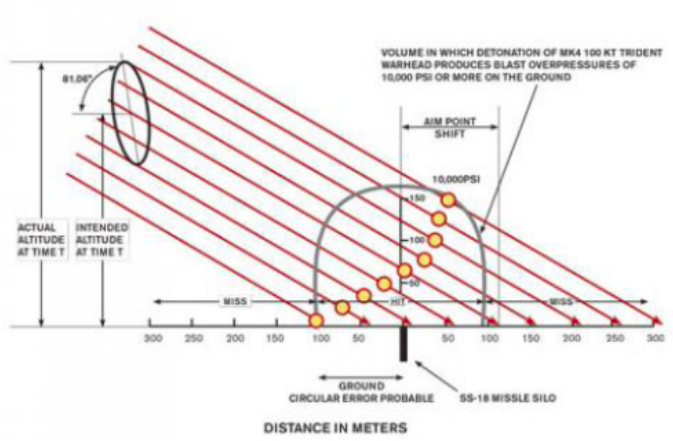
The new super-fuze has a flexible height-of-burst capability that enables it to detonate at any height within the lethal volume over a target. The new fuze vastly increases the chances that the target will be destroyed, even though the arriving warheads have essentially the same ballistic accuracy.



DETONATION SPREAD: CONVENTIONAL BALLISTIC MISSILE FUZE



DETONATION SPREAD: SUPER-FUZE



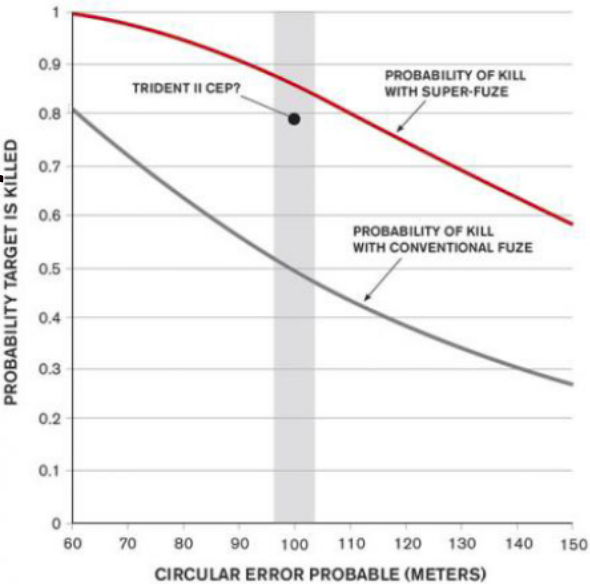
example of modernization

MC4700 fuze on the W76-1/ Mk4A

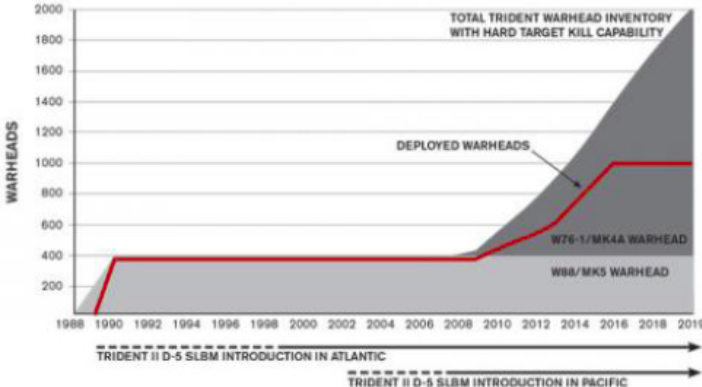
The newly created capability to destroy Russian silo-based nuclear forces with 100-kt W76-1/Mk4A warheads vastly expands the nuclear warfighting capabilities of US nuclear forces, left with an enormous number of higher-yield warheads that would then be available to be reprogrammed for other missions.

This increase in capability is astonishing—boosting the overall killing power of existing US ballistic missile forces by a factor of roughly three—and it creates exactly what one would expect to see, if a nuclear-armed state were planning to have the capacity to fight and win a nuclear war by disarming enemies with a surprise first strike.

100 KT LOW AIR-BURSTS, 10,000 PSI TARGET (MK4 OR MK4A WARHEAD FUZE)



HARD TARGET KILL-CAPABLE WARHEADS ON US BALLISTIC MISSILE SUBMARINES



In order to limit the risks of a nuclear war and to maintain a form of (precarious) nuclear stability, a set of treaties have been worked out since the late sixties, at international, regional and bilateral level.

The present global modernization is affecting all of them

nuclear modernization and the NPT

- ❖ *Article VI: Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.*
- ❖ *ICJ, 8 July 1996: There exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control.*
- ❖ **2000 NPT Review Conference: 13 practical steps of a Nuclear Disarmament Plan of Action**
- ❖ **2010 NPT Review Conference: 22 actions for nuclear disarmament**

- ❖ **the programs of the five NWS are violating the spirit and the letter of these provisions**

nuclear modernization and the NPT

2000 NPT Review Conference step 9:

- ❖ *Further efforts by the nuclear-weapon States to reduce their nuclear arsenals unilaterally*
- ❖ *Increased transparency by the nuclear-weapon States with regard to the nuclear weapons capabilities and the implementation of agreements pursuant to Article VI and as a voluntary confidence-building measure to support further progress on nuclear disarmament*
- ❖ *The further reduction of non-strategic nuclear weapons, based on unilateral initiatives and as an integral part of the nuclear arms reduction and disarmament process*
- ❖ *Concrete agreed measures to further reduce the operational status of nuclear weapons systems*
- ❖ *A diminishing role for nuclear weapons in security policies to minimize the risk that these weapons ever be used and to facilitate the process of their total elimination*
- ❖ *The engagement as soon as appropriate of all the nuclear-weapon States in the process leading to the total elimination of their nuclear weapons*

nuclear modernization and the NPT

2010 NPT Review Conference: actions

- ❖ **Action 5:** *The nuclear-weapon States commit to accelerate concrete progress on the steps leading to nuclear disarmament, contained in the Final Document of the 2000 Review Conference, in a way that promotes international stability, peace and undiminished and increased security. To that end, they are called upon to promptly engage with a view to, inter alia:*
 - (a) Rapidly moving towards an overall reduction in the global stockpile of all types of nuclear weapons;*
 - (b) Address the question of all nuclear weapons regardless of their type or their location as an integral part of the general nuclear disarmament process;*
 - (c) To further diminish the role and significance of nuclear weapons in all military and security concepts, doctrines and policies;*
- ❖ **Action 18:** *All States that have not yet done so are encouraged to initiate a process towards the dismantling or conversion for peaceful uses of facilities for the production of fissile material for use in nuclear weapons or other nuclear explosive devices.*

nuclear modernization and proliferation

modernization and long-term programs cause:

- ❖ Indian and Pakistani proliferation irreversible**
- ❖ North Korean de-proliferation problematic**
- ❖ Israeli participation in a nuclear weapon free zone unrealistic**
- ❖ risks of proliferation in North-east Asia**
- ❖ risks of proliferation in Middle-east**
- ❖ tensions in the relations between nuclear weapon states and NNWS**
- ❖ resistance of several NNWS to adhere to IAEA's Additional Protocol**

nuclear modernization and the CTBT

Recognizing that the cessation of all nuclear weapon test explosions and all other nuclear explosions, by constraining the development and qualitative improvement of nuclear weapons and ending the development of advanced new types of nuclear weapons, constitutes an effective measure of nuclear disarmament and non-proliferation in all its aspects

- ❖ **the Comprehensive Test Ban Treaty signed in 1996 is not yet entered into force, missing the requested ratifications**
- ❖ **the upgrading of existing weapons does not necessarily require new full tests**
- ❖ **countries with great experience and facilities for simulations can also produce new (if not specially sophisticated) weapons without explosive tests**
- ❖ **test might be necessary for the production of warheads for MIRVed missiles by Cina, India and Pakistan**
- ❖ **North Korea may need additional tests**
- ❖ **should not the present test moratorium hold, the very survival of CTBT wold be jeopardized**

nuclear modernization and the FMT/FMCT

Fissile Material Treaty/Fissile Material Cut-Off Treaty

- ❖ explosive fissile material (HEU and weapon-grade Plutonium) is essential for nuclear weapons**
- ❖ India, North Korea and Pakistan are increasing their inventories and their production capabilities**
- ❖ all other countries have suspended the production of fissile material for military purposes**
- ❖ the Conference on Disarmament in 1994 started discussing a possible treaty preventing the production of new explosive fissile material and for the reduction of existing stocks, but the work in Geneva is blocked by the veto of Pakistan**

modernization and bilateral arms control

- ❖ the development of new cruise missiles endangers the INF treaty
- ❖ the strong competition in the present qualitative arms race makes extremely difficult any progress beyond the New Start
- ❖ the growing interest in nuclear weapons apt for actual use in battlefields makes impossible any limitation of non-strategic weapons



impact on human rights

UNGA 19 December 2016 Declaration on the Right to Peace

Article 1 Everyone has the right to enjoy peace such that all human rights are promoted and protected and development is fully realized.

Article 2 States should respect, implement and promote equality and non-discrimination, justice and the rule of law, and guarantee freedom from fear and want as a means to build peace within and between societies.

- ❖ the modernization programs are keeping high the fear of nuclear annihilation for most of this century in peace-times too
- ❖ the extremely high costs for modernization, exceeding globally a trillion US dollars in next 30 years, *de facto* reduces the resources necessary for reaching freedom from want and the promotion of social values
- ❖ the modernization increases the power within societies of the military-industrial complex, a risky condition for democratic values.

global impact of modernization

- ❖ the nuclear powers are strongly re-stating their indefinite time dependence on nuclear weapons as an essential component of their security**
- ❖ because of pursuing new types of nuclear warheads or delivery systems or modifying existing systems to create new capabilities, we are experiencing further escalation of tensions and the acceleration of an increasingly unstable, global technological arms race.**
- ❖ modernizations drive suspicion, worst-case planning and nuclear competition**
- ❖ regional tensions are becoming more complex and risky**
- ❖ the creation of new facilities and the formation of a new generation of nuclear researchers/technicians will perpetuate further modernization indefinitely**

first necessary step:

save the stability of the nuclear regime

- ❖ **refuse nuclear postures aiming at actual war fighting**
- ❖ **stop, possibly by formal agreements, the development of the most destabilizing systems**
 - **nuclear cruise missiles**
 - **short range systems**
 - **non strategic forces**
 - **ABM systems**
- ❖ **defend and strengthen arms control agreements**
 - **NPT, CTBT, FMT/FMTC**
- ❖ **develop research on verification of nuclear weapons disposition and dismantling**

**the key to reverse the present dangerous
trend must be somewhere**

our generation was unable to find it

**we hope you have the creative phantasy to
look in the right place**

sources

D. Browne et al., *The Trident Commission: Concluding Report*, British American Security Information Council, London, July 2014.

P.R. Chari, *India's Nuclear Doctrine: Stirrings of Change*, Carnegie Endowment for International Peace, Washington DC, June 4, 2014.

***China's Military Strategy*, The State Council Information Office of the People's Republic of China, Beijing, May 2015.**

T. Dalton and M. Krepon, *A normal nuclear Pakistan*, Carnegie Endowment for International Peace and Stimson Center, Washington, DC, August 2015.

Defense Intelligence Agency, *Russia Military Power Building a Military to Support Great Power Aspirations*, Washington, DC, June 2017.

V. Dvorkin, *Risky Contradictions: Putin's Stance on Strategic Arms and Missile Defense*, Carnegie Moscow Center, February 10, 2016.

International Panel on Fissile Materials, *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production*, IPFM, Princeton, 2015.

The Joint Chief of Staff, *The National Military Strategy of the United States of America 2015*, Washington, DC, June 2015.

H. Kristensen, *A step in the right direction: the Obama administration's 2010 Nuclear Posture Review*, FAS Public Interest Report, 63 n2, Summer 2010, pp. 4–6; "Nuclear Weapons Modernization: A Threat to the NPT?", *Arms Control Today* 44, May 2014.

Kristensen, H.M. and Norris, R.S. (2014) "The B61 family of nuclear Bombs", Bulletin of the Atomic Scientists, 70(3), 79–84; (2014) "Slowing nuclear weapon reduction and endless nuclear weapon modernization: a challenge to the NPT?", Bulletin of the Atomic Scientists 70 (4), 94–107;. (2014) "Israeli nuclear weapons, 2014", Bulletin of the Atomic Scientists, 70(6), pp. 97–115; (2017) "US nuclear forces, 2017", Bulletin of the Atomic Scientists, 73(1), 48-57; (2017) "Russian nuclear forces, 2017", Bulletin of the Atomic Scientists, 73(2), 115-26; (2016) "Chinese nuclear forces, 2016", Bulletin of the Atomic Scientists, 72(4), 205–11;(2017) "Indian nuclear forces, 2017", Bulletin of the Atomic Scientists, Vol. 73(4), 205-9; (2016) "Pakistani nuclear forces, 2016", Bulletin of the Atomic Scientists,72(6), 368-76.

O. Meier, *The 2015 NPT Review Conference Failure - Implications for the Nuclear Order*, report FG03-WP No 04 October 2015, GIIISA, Berlin, 2015.

National Nuclear Security Administration, *Fiscal Year 2017 Stockpile Stewardship and Management Plan – Biennial Plan Summary*, Washington, DC, March 2016.

I.E. Rinehart and D. Gitter, *The Chinese Military: Overview and Issues for Congress*, Report R44196, Congressional Research Service, Washington, DC, September 2015.

R. Sokolsky and G. Adams, "The Problem With NATO's Nukes. Time to Rid Europe of Its Cold War Legacy", *Foreign Affairs*, February 9, 2016

J.B. Wolfsthal, J. Lewis, and M. Quint, *The trillion dollar nuclear triad*, James Martin Center for Nonproliferation Studies, Monterey, CA, January 2014.

A.F. Woolf, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, Report RL33640 , Congressional Research Service, Washington, DC, November 2015.



pascolini@pd.infn.it
<http://perlascienza.eu>

 @apascolini