Existing Nuclear Armed States And Weapons

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Physical environment

Nuclear weapons are the most destructive means of war ever invented by man. Their destructive power is mindboggling and numbs imagination - so that nuclear weapons and associated theories, strategies and politics are commonly perceived as abstract subjects detached from horrific reality of their lethal capabilities.

The destructive power of nuclear arms is measured in kilotons (Kt) or megatons (MT), which relates them to a corresponding quantity of thousands or millions of tons of conventional (TNT) explosive. A standard nuclear warhead of the kind deployed in many hundreds on strategic missiles of the USA and the USSR in the 1960-1970's (1-2 MT) possessed destructive power of the sum of all conventional munitions exploded by all state-participants during the Second World War of 1939-1945. The largest US nuclear weapon deployed on Titan-2 missiles and as gravity bombs on heavy bombers (9 MT) was 650 times more powerful than the atomic bomb that devastated Hiroshima on August 6, 1945. The largest Soviet warhead, deployed on SS-9 land-based missiles, was 1,670 times more powerful than Hiroshima bomb (25 MT). The largest nuclear weapon ever created was the air dropped bomb exploded by the USSR in October 1961 over the test range on polar Novaia Zemlia islands. Its power was 4,000 times bigger than Hiroshima bomb (58 MT). Initially the plan was to test 100 MT bomb, but in view of unpredictable consequences the yield was reduced almost by half, but even then the shock wave circled the globe three times. The smallest nuclear weapons ever developed were atomic mines, tactical short range missile warheads and artillery shells (0.25-0.001 Kt).

By various estimates at its peak in1984-1985 the aggregate world stockpile of nuclear weapons deployed by all nuclear weapon states reached approximately 68,000 warheads. Their cumulative destructive power peaked in 1974 at a level of about 25,000 MT – 830,000 times more than the combined power of two atomic bombs, which were dropped on Hiroshima and Nagasaki and killed about 140,000 people during a few hours after airbursts on August 6 and 9, 1945. Most of those weapons in 1985 were deployed by the United States and the USSR (about 98%) and the rest belonged to Britain, France, China, Israel and South African Republic. Individually the USA arsenal reached its top in 1967 at 32,000 warheads and that of the USSR - in 1985 at 45,000 warheads (alternative estimate is 36,000-39,000 warheads).

However, the destructive power of nuclear weapons is much larger than their yield measured in kilotons or megatons might indicate. This is so because beside the shock wave, by which conventional explosives kill and destroy, nuclear weapons' most lethal instant effect is thermal radiation which usually has much larger incinerating radius than the demolition radius of shock wave. All nuclear weapons also murder or cripple living creatures by direct radioactive emission and by residual radiation, which may contaminate large areas and make them uninhabitable for centuries. Radiation effect causes leukemia

and other cancer deceases, which thereafter make people die during many decades – the victims of Hiroshima and Nagasaki are still perishing in hospitals. Radiation damages DNA code and triggers terrible mutations of newly born humans and animals for many generations.

In the 1980's Western and Soviet scientists conducted research that showed what climatic effect of large-scale nuclear war might be. Enormous pollution of atmosphere by debris and smoke would screen the sunlight for decades and lead to what was called Nuclear Winter – a phenomenon somewhat similar to the one that allegedly killed dinosaurs 65 million years after the Earth collided with big comet or asteroid. Sharp fall of climate temperature would extinguish many species of flora and fauna, drastically change ecological balances, and cause famine and general collapse of societies even not directly affected by nuclear explosions.

New research published in 2007-2008 showed that even a limited use of nuclear weapons, which is envisioned by doctrines of the USA, Russia, Britain and France, or which might happen between third nuclear weapon states may cause severe global climate change. For instance, a nuclear exchange between India and Pakistan using about 100 warheads (abut 1% of total present world arsenal) over urban areas would produce global ozone depletion. The smoke from burning cities would be lifted to the upper atmosphere and last for several years, with all the ensuing consequences for the climate, agriculture and health of peoples around the globe.

The term 'nuclear' usually covers both principle classes of nuclear weapons: atomic and hydrogen (also called nuclear and thermonuclear). The former uses uranium or plutonium metals containing more than 90% of isotopes uranium-235 or plutonium-239 as the explosive material. The Hiroshima bomb used U-235 and Nagasaki – Pu-239. Initially the USA and the USSR manufactured, tested and deployed atomic bombs, which are also called fission nuclear weapons since their explosion is produced by an instant release of energy trough the splitting of atoms by neutrons in the chain reaction, starting once the critical mass of fissile material is assembled. The critical mass of U-235 is about 50 kilograms and that of Pu-239 is 10 kilograms. The trigger for producing a critical mass is a high energy conventional explosive. The physics of atomic weapons place certain limits on their explosive yield at a few hundred kilotons, but above 50 Kt a fission charge becomes too costly and cumbersome to pack in a deliverable warhead.

Hydrogen weapons provide for virtually unlimited explosive power of up to many dozens of megatons. This class of nuclear explosives is also called fusion or thermonuclear weapons because they are based on release of energy through the fusion of deuterium and tritium atoms, caused by very high temperature (10-100 million degrees Kelvin, compared to 14 million inside the sun). This temperature is produced using fission atomic charge as a trigger. The principal fusion material is lithium-6 deuteride, a solid chemical compound. However the fusion reaction is not the principal source of yield, but rather an additional source of free neutrons, which produces additional fission reaction of the plutonium or uranium core – this process is called "boosting". This technology permits manufacturing relatively small explosive devices of very high yield which are easy to fit into a great variety of delivery systems.

Most contemporary nuclear weapons are combination fission-fusion devices. The Hiroshima atomic bomb weighted more than 5 tons and had a yield of 15 Kt – yield-to-

weight ratio of 0.0045 Kt for 1 kilogram. Modern weapons have this ratio at 1-3 Kt for 1 kg; hence a 200 Kt weapon may weight only 100 kg.

Thermonuclear weapons were invented in the USA and the USSR in the early 1950's and they presently constitute the bulk of nuclear warheads arsenals of the USA, Russia, Britain and China. Other nuclear states have atomic munitions. Israel, India, and North Korea possess plutonium nuclear charges, while Pakistan has uranium munitions. Compared to uranium charges plutonium explosives render more yield for the given weight of nuclear material, but require much more sophisticated conventional trigger mechanism (implosive type).

Nuclear weapons delivery vehicles are generally subdivided in two classes: strategic and sub-strategic. Sub-strategic systems are further divided into medium-range, theater and tactical (battlefield).

Strategic weapons generally have greater range and warhead yield, but their principle difference is in their missions and targeting. Strategic arms are assigned the task of destroying opponent's capacity to wage war by inflicting huge (unacceptable) damage on its strategic forces, conventional forces, economic assets and infrastructure, and urban-industrial centers. Such missions may be performed through a first (counterforce or disarming) strikes – or retaliatory (second) strikes. By the commonly accepted strategic logics the first strike should be primarily targeted at strategic forces and command-control sites of an opponent in order to disarm it, or at least to reduce as much as possible the expected damage from its retaliation. A second (retaliatory) strike by the same logic should be primarily targeted at opponent's economic and urban-industrial centers and, if feasible, on its residual strategic forces and command-control centers.

Nuclear deterrence at the global level allegedly stems from these capabilities of strategic forces and prevents nuclear (chemical or biological) and large scale conventional aggression of potential opponent against oneself or one's allies by the high probability of inflicting on the enemy the damage, which would be much higher than any gains it might wish to reach by aggression.

The yields of strategic warheads are presently within the range of a few dozens kilotons to a few megatons. Their accuracy, measured as a radius of a circle around the target within which the impact is expected, is from several hundreds to less than one hundred meters for ballistic missiles and a few meters for cruise missiles. Since the middle 1960's cities or population *per se* have not been deliberately targeted by the USA or the USSR, but in view of their co-location to other military and economic sites were considered as a "collateral damage", which amounted to dozens of millions of instant fatalities associated with massive strike options.

Due to the nature of the mission, as well as the range and yield of strategic weapons – all or most of their targets are selected and assigned in advance in peacetime, integrated in highly complex operational plans and preprogrammed in on-board computers of missiles, bombers and submarines. Most of the present strategic ballistic missiles have alternative targets' attack programs which may be changed within a few minutes.

Also in view of the destructive potential of strategic forces and the consequences of their use the USA, Russia and other great powers have been taking measures to enhance so called negative control (i.e. to prevent their unauthorized use either through a technical malfunction or by an act of the personnel). The legitimate heads of states are permanently accompanied by communication officers carrying nuclear "football" suitcases, so that in case of emergency the information quickly reaches national command authorities (NCA) for them to take decision on the appropriate reaction and transmit a coded signal to strategic command centers, without which the authorization of weapons launch cannot be received by missiles', bombers' and submarines' crews. Additional measures are also taken to prevent unauthorized actions at launch control centers and to provide survivability of the NCA even in nuclear strike environment (deep hardened underground command centers, airborne command centers etc.).

It is possible to conclude that at present the possibility of unauthorized use of strategic weapons is very small – at least with respect of five great nuclear powers (with some uncertainty about China due to lack of transparency of its command-control systems). Of much greater concern is the possibility of miscalculation or a decision based on the wrong information by the NCA under the stress of a possible crisis – in particular if strategic doctrine and operational plans require a very quick decision on strategic force employment, usually associated with the so called hair-trigger alert nuclear posture or launch-on-warning posture (see more below).

Strategic early-warning systems consist of missile launch detection infrared space satellites and land- and sea-based long range radars. Air-defense radars serve as the means of detecting attacking aircraft and cruise missiles.

By the present classification strategic forces are those which constitute the subject of US-Soviet and nowadays US-Russian START negotiations. These are land-based intercontinental ballistic missiles (ICBMs) of the range of 5,500 km and more, sea-launched ballistic missiles (SLBMs) on nuclear strategic submarines (SSBNs) and heavy bombers, usually with ranges more than 10,000 km and armed with gravity (air-dropped) bombs, short-range air-to-surface missiles (SRAMs) and long-range air launched cruise missiles (ALCMs). Land-based ICBMs are based in hardened underground launch silos or on ground-mobile launchers mounted on wheeled transporters. All these missiles and bombs have thermonuclear warheads, sometimes with variable yield. Many ICBMs and all SLBMs are equipped with multiple individually targeted re-entry vehicles (MIRVs) also called multiple warheads (each aimed at individual target), as well as decoys and other missile defense penetration aids.

Recently the USA has started deployment of a variety of new types of strategic weapons – conventionally armed long-range precision guided missiles, relying on sophisticated space navigation and communication systems for pin-point accuracy. During the 1990's the USA deployed many hundreds of long-range conventional SLCMs and ALCMs on its attack submarines, surface ships and heavy bombers. In addition it is planned to deploy cruise missiles and ballistic missiles with conventional warheads on some US strategic submarines. Russia is developing a long-range conventional H-101 ALCM for its heavy bombers. The new strategic conventional capability is promoted by the USA as a weapon against terrorists and rogue states, but is perceived by Russia as a new strategic threat to its deterrence and strategic stability.

Sub-strategic nuclear weapons by definition are those with ranges shorter than 5,500 km. One sub-class of these arms is constituted by land-based intermediate and medium range ballistic missiles (IRBMs and MRBMs) and medium range bombers, carrying nuclear munitions in bombs and air-to-surface missiles. As a rule, medium range nuclear weapons have yield in the same range as strategic arms and are targeted at the same classes of sites (military and urban-industrial) as strategic weapons, depending on their accuracy. Hence, such forces have traditionally been considered strategic, despite their having medium instead of intercontinental range. In the past the USSR and the USA deployed medium range ballistic and cruise missiles in Europe and Asia: for instance, Soviet ground-mobile SS-20 IRBM, Tu-22 Backfire bombers, ground-launched cruise missiles (GLCMs) and US Pershing-2 and ground-launched cruise missiles. All Soviet and US IRBMs, MRBMs and GLCMs were eliminated by the 1987 Treaty on intermediate nuclear forces and shorter range forces (INF-SRF Treaty). In addition that Treaty provided for the elimination of some shorter range (operational-tactical) land-based ballistic missiles of 500-1,000 km ranges: US Pershing-1 and Soviet SS-22 and SS-23 missiles.

As of now the only existing US and Russian intermediate class nuclear weapons are sea-launched cruise missiles (SLCMs) of up to 3,000 km range deployed on nuclear attack submarines (and in the past on US surface ships) and Russian Tu-22 Backfire medium bombers. Among other nuclear powers Britain and France do not have medium range nuclear weapons, while China, Israel, India, and Pakistan possess them in considerable numbers. North Korea has tested and deployed medium range ballistic missiles but most probably does not have nuclear munitions to deliver by these systems.

Another sub-class of sub-strategic nuclear weapons are tactical nuclear weapons (TNW) usually having shorter than 500 km range and lower yield (although on both range and yield there are exceptions to this rule). Most importantly, according to commonly accepted strategic logic TNW differ from strategic and medium range nuclear arms in so far as they are assigned missions of attacking enemy's armed forces and rear infrastructure at the theater of military operations. Hence, their role is not to cripple the economy, population and strategic nuclear capability of an opponent, but to thwart its large scale military operations. Allegedly such a capability deters a large scale conventional, chemical, biological or tactical nuclear aggression of a potential opponent. Alternatively it may be perceived as deterrence against opponent's use of TNW in response to one's conventional operations. During the Cold War NATO deployed about 7,000 tactical nuclear weapons in Europe to offset Soviet conventional superiority, while Warsaw Pact deployed 10,000 such arms to counter Atlantic Alliance.

Whatever the theory or war plans, it should be clear that any massive use of tactical nuclear weapons would be virtually equal by its devastating immediate and long term consequences to the use of strategic nuclear arms in densely populated regions, such as Europe (including European part of Russia), Japan, north-eastern and eastern coastal areas of China, India, Pakistan, Iran and Korean peninsula. This is all the more so that the large numbers of TNW still remaining in Europe and their integration with conventional armed forces and their infrastructure imply just such massive employment in case of a large-scale armed conflict. As a matter of fact Hiroshima and Nagasaki bombs were purely tactical by the present standards.

The primary distinctive feature of TNW is their predominant use of conventional platforms, launchers and delivery vehicles of the armed forces, which are called dual-purpose weapons. They are no different from conventional arms except that they are usually equipped with special wiring and electronic blocking devices to prevent their unauthorized use. Large parts of TNW are not targeted at pre-selected sites and are to be used during combat actions against targets of opportunity. This means that the decision on the employment of such nuclear weapons is to be delegated to field commanders before or during the conduct of combat operations. It is commonly assumed that since TNW are closely intertwined with conventional forces and arms, their safety and negative control systems (i.e. systems and devices for preventing unauthorized use) are much less centralized or fail-safe than is the case with strategic (intercontinental of medium range) forces.

Historically the numbers and composition of TNW have been changing. In various times ground forces of nuclear powers and their allies were equipped with nuclear demolition munitions (nuclear mines), nuclear shells for artillery, and short-range tactical ballistic missiles (as an example of exceptions mentioned above, some of such missiles had megaton yield warheads). The air forces have been employing fighter-bombers and ground attack fighters with nuclear gravity bombs and air-to-surface missiles (as another example of exceptions to theoretical definitions, many strike aircraft had ranges in excess of 1,000-2,000 km). The navies had attack nuclear and conventional submarines and surface ships armed with nuclear torpedoes and anti-ship, anti-submarine, surface-to-air missiles and depth charges. Naval land-based and carrier- based aviation was equipped with nuclear air-to-surface missiles, torpedoes and depth charges. According to unconfirmed information, even special forces were provided nuclear “suitcases” or “ransacks’ for subversive actions.

Routinely TNW, in contrast to strategic weapons, are not deployed on their delivery vehicles, except naval nuclear arms on ships and submarines while at sea. Otherwise tactical nuclear munitions are stored at depots at armed forces bases. This constitutes the principal difference between strategic and sub-strategic weapons, which implies the major difficulty of their counting, reduction and elimination in the context of traditional disarmament. US-Russian parallel unilateral commitments on TNW reductions of the early 1990’s did not envision any agreed definitions, counting rules or verification procedures. Hence, having brought serious physical reductions in TNW this policy has created uncertainties and mutual mistrust as to actual remaining numbers, location, types and missions of this class of nuclear arms.

Presently TNW are in possession of the USA and Russia (in drastically reduced numbers during the last twenty years), France (although it classifies its land- and carrier-based tactical nuclear capable aircraft as an arm of strategic force), probably China, as well as Israel, India, and Pakistan. North Korea has short-range missiles, but certainly lacks compact nuclear munitions to arm them.

Nuclear armed states. The nuclear statistics is highly controversial and speculative even with regards to the great nuclear powers. Discrepancies stem from different counting rules of strategic weapons, opaque data on tactical nuclear arms, big uncertainty about nuclear munitions stored in reserve or awaiting dismantling, utilization or reprocessing. The official data on China is not available at all.

The United States[1]**,** according to authoritative estimates, currently possess 2,702 nuclear warheads, of which 2,202 are on offensive strategic and 500 on tactical nuclear forces. US strategic offensive forces consist of 450 Minuteman-3 ICBMs, some of which are equipped with 1 warhead and some with 3 MIRV warheads up to an estimated total of 550 warheads.

The sea arm consists of 18 nuclear missile submarines, each having 24 Trident-2 SLBMs capable of delivering 8 MIRV warheads. However, the total number of their missiles and warheads, which may be inferred from official clarifications, is not 432 and 3456 correspondingly. Apparently, the USA does not count 4 SSBNs earmarked for equipment with sea-launched conventional cruise missiles or another 2 boats usually in overhaul and the number of warheads on remaining submarines and missiles is an average of 4 which makes up to a total number of 288 missiles and 1,152 nuclear warheads. This force loading is called "operationally deployed" in contrast to the one implied by START-1 counting rules. Of the 14 SSBNs with Trident-2 missiles, 8 are based and conduct patrols in the Pacific and 6 – in the Atlantic. On the average 50-60% of sea-based force is on patrol at any given time – about 600-700 warheads always ready for launch upon receiving order from NCA.

Besides, 4 out of 18 strategic nuclear submarines are being converted to carry about 600 conventional SLCMs. Also a plan is discussed to retrofit each of 14 remaining strategic SSBNs with 2 Trident-2 ballistic missiles with MIRV-type precision guided conventional munitions.

The bomber force consists of 93 B-52H and 20 B-2 heavy bombers of which "operationally deployed" are 44 and 16 respectively with 350 ALCMs. A force of 67 B-1B bombers was converted for conventional arms and is not counted as nuclear delivery vehicles. There are also estimated 150 nuclear gravity bombs on B-52H and B-2 bombers which are not counted as separate warheads under START-1 counting rules.

Due to the discrepancies between US "operationally deployed" counting method and START-1 counting rules, the difference of estimates of US strategic force levels may be as large as about 300 delivery systems and 3,000 warheads. This discrepancy was one of the principle obstacles to finalizing the US-Russian 2002 Moscow SORT and presently constitutes an issue of discord at the US-Russian negotiations on the follow-on to START-1, which expires on December 5, 2009. Nonetheless, even by stringent START-1 counting rules, present US strategic force levels are much lower than they were in late 1980's (about 12,000 warheads) or compared to START-1 ceilings (6000 warheads and 1600 delivery systems).

Much deeper reductions took place during the last two decades regarding US tactical nuclear weapons in line with bilateral US-Soviet and US-Russian parallel political commitments of the early 1990's and unilateral additional reductions. Compared to about 8,000 TNW at Army and Air Force bases (7,000 in Europe and 1,000 in Asia) and unknown numbers on naval vessels in late 1980's, American present force consists of approximately 500 active warheads: 400 gravity bombs and 100 warheads for Tomahawk SLCMs (also called TLAM/Ns). Of these around 200 bombs are still deployed at 6

[1] SIPRI Yearbook 2009. Armaments, Disarmament and International Security. SIPRI. Oxford University Press. 2009. pp. 346-353.

airbases in 5 European states (Belgium, Germany, Italy, the Netherlands and Turkey). These bombs are earmarked for delivery by US F-16 fighter-bombers as well as by allied Belgian and Dutch F-16 aircraft and German and Italian Tornado tactical strike airplanes. TLAM/Ns are stored at naval bases in the USA and are designed for deployment on Loa-Angeles and Virginia class nuclear attack submarines. However the official data on US TNW is mute, in particular on the number of bombs deployed in Europe.

Still greater uncertainly is associate with nuclear weapons in storages which are subdivided into active, reserve or spare warheads, relatively quickly deployable on assigned delivery systems, and inactive – held in long-term storage and awaiting dismantlement, utilization and possible recycling of their fissile material for manufacturing new warheads. Unofficial estimate is that the USA presently has 2,500 warheads in inactive storages and 4,200 awaiting dismantlement.

American nuclear arms modernization program does not envision construction of new ballistic missiles, submarines or heavy bombers. The service life of Minuteman-3 ICBMs has been extended till 2030 and higher yield (300 Kt Mk-21/W-87) warheads from dismantled MX Peacekeeper missiles are installed on Minuteman-3 ICBMs. The production of a modified Trident-2 SLBMs is going on to equip Trident/Ohio SSBNs, which are expected to serve till 2030-2040. The Air Force is developing a new generation nuclear ALCM designated as Enhanced Cruise Missile (ECM).

The future composition of the US strategic force will be affected by the new START treaty negotiated by the USA and Russia. By the year 2020 it may be planned as comprising 100 MIRVed and 200-300 single warhead Minuteman-3 ICBMs, 12-14 SSBNs (each with 10-12 Trident-2 SLBMs equipped with 3-4 MIRV warheads) and 50 B-52H and B-2 bombers with gravity bombs and ECM system.

Earlier in the decade a development program of new sub-kiloton deep penetrating warhead for destruction of underground hardened targets (allegedly belonging to rogue states or terrorists) was cancelled by Congress. A new heated debate is expected around a program of the development of Reliable Replacement Warhead (RRW) supposedly needed to ensure the reliability of US nuclear arsenal in the absence of nuclear tests and to provide higher safety against technical accidents and unauthorized access and use. The RRW might be planned as a replacement of US existing ballistic missiles' warheads and may be bargained in Congress as a trade-off for ratification of the CTBT. On the other hand, this program would politically contradict President Barack Obama's call for consistent progress towards a nuclear free world. Current US plans envision maintaining nuclear warheads production facilities and capacity to manufacture new warheads through the expansion of life-extension program to add new design features to nuclear munitions. The rate of old warheads dismantling at Pantex Plant at Texas is about 350 units per year. It would take 12 years to eliminate the backlog of warheads slated for retirement.

Russian Federation's strategic offensive nuclear force presently constitutes the most transparent, accurate and non-controversial part of the overall picture of the world nuclear arsenals. In 2009 it consisted of 634 delivery vehicles and 2,825 nuclear warheads. Russian ICBM force had 385 launchers and missiles carrying 1357 nuclear warheads (on the average of 500 Kt yield). In particular there were 68 heavy SS-18 silo-based missiles (each equipped with 10 MIRV warheads), 72 SS-19 silo-based missiles (6 warheads each), 180 light ground-mobile single warhead SS-25 (Topol) ICBMs, and 50

silo-based and 15 ground-mobile single warhead SS-27 (Topol-M) missiles. About 90% of ICBM force (1,200 warheads) is constantly ready for launch within minutes of receiving the order from the head of state.

The sea-based force is comprised by 13 SSBNs, 208 SLBMs and 612 nuclear warheads. Active force consists of 6 Delta-IV submarines in the Northern Fleet, each with 16 SS-N-23 missiles, equipped on the average with 4 MIRV warheads. The Pacific Fleet has 5 older Delta-III submarines, each with SS-N-18 missiles, carrying an average of 3 MIRV warheads. On the average only 1-2 submarines are constantly on patrol (60-100 warheads), compared to 10-15 during Cold War time. One Typhoon submarine is used for tests of a new Bulava-30 SLBM and according to START-1 counting rules has 20 launchers and missiles, and one new Delta-V SSBN is still in the shipyard but counted as carrying 12 missiles. The air leg consists of 77 heavy bombers and 856 AS-15 cruise missiles, including 63 old Tu-95 (Bear-H) and 14 newer Tu-160 (Blackjack) airplanes.

Sub-strategic nuclear force of the Russian Federation is much less transparent. By the end of the 1980's Soviet TNW consisted of about 23,000 nuclear weapons. Presently most estimates put it at about 2,000 weapons. Of these approximately 600 are air-to-surface missiles and gravity bombs on 120 Tu-22M (Backfire) medium bombers and 400 Su-24 (Fencer) strike aircraft, 200 are missiles, bombs and depth charges on land-based naval aircraft: 60 Tu-22M, 60 Su-24, 60 Be-12 and Il-38 airplanes. Around 400 nuclear weapons are on naval ant-ship, anti-submarine, air-defense missiles and torpedoes for submarines and surface ships. It is commonly assumed that in peacetime all these weapons are stored in depots at AF and Navy bases, except when a few naval missiles and torpedoes are loaded on ships and submarines leaving for sea patrol duty.

Emulating NATO strategy of the Cold War time, Russia is maintaining relatively large TNW force to offset NATO growing conventional superiority, enhanced by its expansion to the east. Moscow is reluctant to discuss limitations or reductions of tactical nuclear arms unless NATO expansion is stopped and conventional forces are strictly limited and deeply reduced. Besides, TNW may be seen as a counterbalance for potential China's conventional superiority in the east.

During the 1990's all ground forces TNW were redeployed to centralized storages deep inside Russian territory, as well as a large part of Air Force, Navy and Air Defense tactical nuclear warheads. At such storages tactical and many strategic warheads (removed from dismantled ICBMs and SLBMs) are kept on the shelves in containers, and are serviced as spare munitions for replacement of deployed warheads. Otherwise they wait for being dismantled for utilization (including the blending of weapons grade uranium to be used as atomic power plans fuel) or for fissile materials recycling for newly manufactured warheads. The total number of Russian nuclear weapons in central storages is unknown but most probably it is counted in many thousands.

The modernization program is designed to renovate the strategic force, largely of the 1970-1980's vintage, that is becoming obsolete in mass due to its initial designs (in Cold War years Soviet nuclear arms were built to serve no more than 10-15 years) and lack of maintenance in a period of protracted economic crisis and depression of the 1990's. The ICBM force is being modernized by the deployment of ground-mobile SS-27 Topol-M missiles, which after the year 2009 will be introduced as a new modification equipped with MIRV warheads. The Navy is building a new Delta-V SSBNs (1 is to be

commissioned shortly and 2 more are in various phases of construction), and testing a new Bulava-30 MIRVed SLBM for these submarines. However the development of both the new SSBN and the new SLBM has encountered serious technical problems, construction delays and huge cost overruns.

The AF is continuing the production of Tu-160 bomber at a very slow rate (one every few years) and developing a new ALCM (H-101) for dual use with nuclear or conventional warhead.

Sub-strategic forces are being modernized with a new tactical land-based missile called "Iskander", which may be equipped with nuclear or precision guided conventional warhead and have a variable short or medium range. This missile is being deployed in small numbers (only 2 launchers in 2005-2008) but is being considered by Moscow for potential deployment in Kaliningrad region as a countermeasure to possible US BMD site construction in Poland. It is possible that a new Russian Su-34 fighter-bomber will also be certified for delivering tactical nuclear weapons.

Future Russian strategic force numbers will be declining due to mass withdrawal of old systems of the 1970-1980's vintage and slow rate of new deployments. The new START follow-on treaty limits presently negotiated will primarily affect the service life extension programs of old systems, since the new ones would easily fit under much lower ceilings. In particular, by the year 2020 at current deployment rate Russia will have no more than 140 SS-27 Topol-M ICBMs, 30 SS-19 ICBMs, 3-4 Delta-V submarines with 44-60 Bulava-30 SLBMs and 16-17 Tu-160 bombers – which amounts to 250 delivery vehicles and 1200 warheads.

The warhead number is quite flexible and may be as low as 300-500 depending on the MIRV packages on missiles and loading of bombers. Technically this opens the door to quite a radical strategic nuclear disarmament, provided that the United States agree to go down too and other military and political problems are resolved (BMD, precision guided strategic conventional weapons, theater conventional forces imbalances, third nuclear states arms control engagement, sub-strategic nuclear forces, potential space arms, etc.)

France has the third largest strategic force in the world consisting of 108 delivery vehicles and 300 nuclear warheads. In particular, there are presently 3 Triomphant class SSBNs with 48 missiles and 240 warheads (each boat with 16 M45 SLBMs equipped with 4-6 MIRV warheads). One submarine is usually on patrol. In addition 60 Mirage 200N land-based and 24 Super Etendard carrier-based strike aircraft are capable of delivering in total about 60 ASMP medium-range air-to-surface missiles. Modernization program includes a 4th SSBN (to be commissioned in 2010), deployment of a longer range M51.1 SLBM system, and a new Rafael strike aircraft with a new ASMP-A nuclear missiles. Although by START-1 classification French airplanes would be counted as tactical or medium-range delivery vehicles, they are considered an arm of "Strategic strike force". It is planned to reduce the number of nuclear capable airplanes by half, which may bring force numbers down to 100 delivery vehicles and 250-270 warheads. France does not possess sub-strategic nuclear forces (beside aircraft).

Great Britain's nuclear arsenal consists of 4 Vanguard SSBNs with a total of 48 Trident-2 missiles and 144 nuclear warheads. Submarines and warheads are British while

missiles are leased from the United States. While each submarine has 16 launch tubes the number of missiles deployed corresponds to 3 SSBNs, since 1 is always in overhaul. Of the deployed 3 submarines 1 is on sea patrol at any given time. It is commonly assumed that there are 10 spare missiles and 40 warheads in storage. Some unofficial sources indicate that some SLBMs are deployed with only 1 warhead of much reduced yield to provide for a limited nuclear strike option allegedly against rogue states.

After a heated debate in 2005-2007, which lingers on till now, a decision was taken by the government to start planning for construction of a follow-on class of submarines, for leasing a modified Trident-2 missiles from the USA and developing a new type of nuclear warheads after 2024, when the Vanguard class SSBNs end their service lifetime. It was also officially declared that British sea-based nuclear force is on reduced alert status and an actual missile launch would require a long time of preparation after receiving an order. However it is very difficult to understand how it can be arranged technically and no authoritative explanation has been offered. Britain does not possess any other leg of strategic force or any sub-strategic nuclear weapons.

China is the only one of the five legally recognized under NPT nuclear weapon states, that does not provide any official data on its existing and planned nuclear forces. The official justification of this policy is that China's nuclear forces are much smaller than those of other nuclear powers and secrecy is needed for better deterrence by way of introducing uncertainty to the plans of a hypothetical aggressor.

China officially makes a lot of its unilateral nuclear no-first use (NFU) commitment, which is not matched by any other of the five nuclear powers. This commitment is substantiated by vague hints to the effect that in peacetime China's missiles are kept separately from their nuclear warheads, although there is no clear official description of this practice. If this is true, it may also be explained by a lack of reliable systems and devices for preventing unauthorized nuclear weapons use, as was the case with first generation US and Soviet ballistic missiles of the 1950's.

It is commonly assumed that for a nuclear weapon state to assume a no-first use posture means adopting a purely second (retaliatory) strike strategy. However China's nuclear forces and command-control systems are lacking the required survivability and its early warning systems are inefficient. China's official argument that it plans mating missiles to warheads after receiving a nuclear attack is highly dubious. Another argument - that the warheads will be put on missiles in a state of emergency – undermines its attempts to substantiate its no-first-use pledge, since after bringing missiles to high readiness China may technically use them in a first or pre-emptive strike.

Foreign official and academic estimates presently assume China is in possession of about 130 land-based ballistic missiles of intercontinental, intermediate and medium range, all of them being currently single-warhead. Of these 17 old DF-3A and 60 new ground-mobile DF-21 are intermediate and medium range, and 37 old fixed based DF-4 and DF-5A are intercontinental missiles. The new generations ICBMs are represented by about 20 ground-mobile DF-31A missiles in some respects similar to Russian SS-25 Topol ICBMs. China also is testing one experimental Xia class nuclear submarine with 12 JL-1 SLBMs and is believed to be constructing a new Jin class SSBNs with JL-2 missiles. The bomber force consists of 20 old H-6 medium range airplanes, copied after Soviet Tu-4 jet bomber of the 1950's vintage.

China vehemently denies having tactical nuclear weapons but is commonly believed to possess around 150-350 tactical cruise and ballistic missiles, many of which are deployed within reach of Taiwan across the straight. PRC has an unknown quantity of DF-11 and DF-15 short-range ballistic missiles (SRBMs), probably capable of carrying nuclear warheads. In 2007, the deployment of DH-10 cruise missiles was initiated, with their deployment on Hong-6 bombers, as well as in the land-based version. Around 40 air bombs may be delivered to target by medium range and obsolete Hong-6 bombers, and by Qian-5 strike aircraft.

Possibly a new nuclear capable fighter-bomber is in development on the basis of Russian Su-30 and Su-35 tactical aircraft. According to unconfirmed information China asked to buy Russian Tu-22M medium bombers and Oskar (Kursk) class attack atomic-powered submarines with nuclear capable anti-ship missiles. Altogether China is ascribed approximately 190-200 nuclear warheads which makes it a fourth (and potentially a third) largest nuclear weapon state. No information exists on probable nuclear stockpile.

India does not provide official data on its nuclear forces. It is generally believed that it has 60-70 operationally deployed nuclear weapons. India has taken a no-first use pledge, but made a reservation about the possibility to use nuclear weapons in response to an attack with chemical or biological weapons.

Indian ballistic missile force consists of *Prithvi-1* SRBMs (150 km range) and *Agni-1,* and *Agni-2* MRBMs (700-1,000 km). The *Agni-3* MRBM (3,000 km) is in the testing stage. India also has sea-based ballistic missiles of the *Dhanush* class. Its test launches were conducted from surface vessels. In 2008 a *K-15* SRBM was tested from an underwater stationary platform. Indian nuclear warheads are probably kept separate from missiles in peacetime. Medium range *Mirage-1000H Vajra* bombers and *Jaguar IS Shamsher* strike bombers may also be used for carrying out nuclear raids. Russian-made *MiG-27 Bahadur* and *Su-30MKI* fighter planes can carry nuclear weapons as well, and *Su-30MKI* fighter planes are equipped for mid-air refueling from an *Il-78* tanker airplanes.

Pakistan's nuclear forces, for the lack of governmental information, are estimated by various sources at approximately 60 nuclear weapons. All of them have also been manufactured after nuclear tests were conducted in 1998, and can be delivered to targets by ballistic missiles and by fighter planes. They are probably separated from missiles in peacetime. Pakistan has 2 types of SRBMs *(Hatf-3 Ghaznavi* and *Hatf-4 Shaheen-I* of 400-450 km range), and 1 type of *Hatf-5 Ghauri* MRBMs (2,000 km). The *Hatf-6 Shaheen-2* MRBM is in its testing stage. The *Ghauri-2* MRBM is being developed. All of these systems are ground-mobile. The ground-based *Hatf-7 Babur* cruise missile is undergoing testing. It is claimed that this system is technically similar to the Chinese DH-10. *Babur* is being developed in both air-based and sea-based versions. The latter is to be deployed on diesel submarines of the *Agosta* class.

It is assumed that Pakistan's missile program is being developed with the active cooperation of the DPRK and, in the past, the PRC. Apart from ballistic missiles, nuclear weapons can be delivered to target by the US-manufactured *F-16 A/B* fighter plane. Nuclear weapons can also be deployed on the *Mirage-V* fighter plane manufactured by France, and the *A-5* airplanes manufactured by China.

Israel differs from other nuclear states by not only withholding official information on its nuclear forces, but by having never officially confirmed having them at all. Israel is estimated to possess from 60 to 200 nuclear weapons. About 50 of them are missile warheads, and the rest are deliverable by aircraft. In peacetime these weapons are probably not kept at a high level of readiness. Depending on the estimates of the size of Israel's nuclear potential by the warheads number it is either comparable to or exceeds nuclear weapons stockpile of Britain, as well as that of India and Pakistan. Israel has 50 *Jericho-2* MRBMs (1,500-1,800 km range) capable of striking, among others, targets in the south of Russia. In 2008 Israel tested *Jericho-3* MRBM with a maximum range of 4,800–6,500 km, which brought it across the threshold of intercontinental ballistic missiles class.

Apart from missiles Israel has one of the most powerful air force in the world; including 205 US-made *F-16* fighter planes (modifications A, B, C, D and I) capable of carrying nuclear weapons. A new development is Israel's acquisition of 3 *Dolphin* class diesel-powered submarines, manufactured in Germany. In 2006 Israel ordered 2 more submarines. The torpedo tubes on these submarines were probably restructured as SLCM launchers to accommodate a sea-launched nuclear capable cruise missile, similar to US tactical *Harpoon* type anti-ship missile. Hence Israel is developing its own version of nuclear Triad.

North Korea. In October 2006 the DPRK conducted a nuclear explosion which, in the opinion of experts, was not fully successful. A second nuclear test happened in June 2009. In all probability the DPRK may possess a 5-6 nuclear explosive devices on the basis of plutonium. However, it is generally agreed that North Korea so far has not been able to miniaturize its nuclear explosive devices sufficiently to allow their delivery by ballistic missiles or aircraft. It is estimated that North Korea possesses hundreds of Hwasong SRBM and a few dozen *No Dong* MRBMs. Testing of the Taep'o-dong ICBM in 2007-2009 were unsuccessful.

Short-notice alert. During the years of Cold war huge resources were invested in raising combat readiness of nuclear forces. As of now, in contrast to the past, the only nuclear weapons kept on high alert status and ready to launch within minutes after receiving orders are US and Russian ICBMs and SLBMs on submarines on sea patrol, part of Russian SLBMs on submarines at bases, French and (with some uncertainty) British SLBMs on submarines at sea. All US and Russian heavy bombers were taken off alert (airplanes removed from runways and their nuclear weapons placed in storages at airbases). All US and Russian sub-strategic nuclear weapons are de-alerted, except a few Russian naval nuclear torpedoes and tactical missiles on attack submarines at sea patrol. All Chinese, Indian, Pakistani, and Israeli nuclear forces are believed to be kept off alert in peacetime, with commonly adopted practice of separating warheads from missiles and aircraft.

Strategists and operation planners usually make a distinction between short-notice alert and hair-trigger alert. The former relates to all combat ready weapons that *may be* launched quickly (in few minutes time) after receiving the order, primarily ICBMs and SLBMs at sea. The latter is associated with weapons that *must be* launched quickly upon receiving information about an opponent's attack in order to avoid destruction on the ground. This concept is also called launch-on-warning (LOW) or launch-under-attack (LUA). With ICBM flight time being about 30 minutes and SLBM - 15-20 minutes, these

concepts provide political leaders with decision-making time of only 4-8 minutes (detracting the time of missile attack detection and confirmation and the time for the response launch sequence and fly-away). And this time would be available only if the leaders are safe and ready, and everything works perfectly according to planned procedures.

Altogether there are now probably about 3,000 nuclear warheads of the USA, Russia, France and Britain at launch ready status at any given moment in peacetime. Of those around 2150 are on hair trigger alert in line with LOW/LOA concept and operational plans: US and Russian ICBMs and Russian SLBMs on submarines at bases.

In the 1990's the five great powers concluded agreements on de-targeting their strategic forces from each other territories, which was technically implemented through withdrawing flight programs from missiles' on-board computers or inserting zero-flight programs. However this did not have any tangible effect on strategic balance or operational planes and turned out to be primarily a symbolic and largely PR-gesture. The reason was that such software modifications are unverifiable and reversible in minutes.

No doubt, maintaining several thousand nuclear warheads on hair-trigger alert is an ultimate absurdity of nuclear deterrence twenty years after the end of Cold War, when political, economic and security relations at least among the P5 render deliberate nuclear attack virtually unthinkable. Moreover it was and remains extremely dangerous. During Cold War years there were dozens of false alarms on both sides and the fact that nuclear war did not erupt out of technical malfunction or decision-makers miscalculation should be to an important degree attributed to sheer luck.

Nowadays a number of new dangers are contributing to such catastrophic possibility. Proliferation of nuclear weapons and ballistic missiles to an expanding number of states with inadequate negative control makes unauthorized or deliberate provocative launch of a missile much more probable and threatening as a trigger of massive nuclear exchange. Of special concern is proliferation of long-range cruise missiles and sea-based ballistic and cruise missiles which are capable of delivering an anonymous strike. Some of new nuclear states are politically unstable and a launch of nuclear weapon may happen there as a result of civil war, putsch, contest among rival groups or between political and civilian leaders for control over nuclear weapons. Of particular concern are presently countries like North Korea and Pakistan, in future – Iran, if it develops nuclear weapons to match its ballistic missile development program.

As a result of nuclear proliferation there is a growing danger of terrorists getting access to nuclear materials or weapons. A terrorist nuclear explosion in one or several capitals may provoke a spontaneous nuclear exchange by great powers' forces on hair-trigger alert.

Although the P5 are working hard on making their command-control and early warning systems more reliable and fail-safe (and besides, launch-on-warning would not be initiated in response to a single missile flight), there is a new threat of cyber terrorism which might theoretically disrupt computerized networks and emulate false alarms or initiate launch command sequence. This danger would be much higher in relation to new states with nuclear weapons and ballistic missiles. Even if warheads are separated from

missiles in peacetime, during a crisis they will be mated and might be launched by a cyber terrorist attack.

Although there are compelling security reasons for the P5 (or P-4, beside China) to take their nuclear missiles off alert and for the USA and Russia to abandon hair-trigger alert – it is a very complicated problem, and easier said than done. The state of mutual nuclear deterrence imposes its own logic; in particular there are arguments in favor of hair-trigger alert (LOW/LOA plans):

- If not launched on warning, many missiles would be destroyed by a counterforce strike of the other side and retaliation would be much weaker, which might undermine deterrence. This is most appealing to Russia with a large portion of its warheads deployed on silo-based ICBMs, submarines at bases and vulnerable bomber at airfields (about 90% in peacetime). The United States will maintain a growing relative counterforce capability (nuclear and conventional) against fewer Russian forces in the foreseeable future.
- There is great uncertainty on how command-control systems would function after being hit by a deliberate nuclear strike, while in LOW mode it would operate virtually under peace-time conditions.
- The prospect of US massive ballistic missile defense might further reduce Russian retaliatory strike power, if only surviving missiles are launched in delayed retaliation after receiving US counterforce attack. Massive launch-on-warning would be more difficult to intercept by BMD.
- The other side has LOW concept and plan, and deterrence would be weakened by unilateral cancellation of it by any party.
- Mutual removal of LOW/LOA concepts and plans would be either unverifiable (like de-targeting), or too difficult to negotiate in a technically feasible, verifiable, safe, cost-effective and fairly balanced way in view of the asymmetries of US and Russian nuclear forces, concepts and perceived threats.

The main problem of de-alerting stems from the fact the one side hair-trigger posture is not so much induced by a similar posture of the other, but rather by the other side's counterforce capability. Due to asymmetries of strategic balance equal steps of de-alerting may affect each party in different ways. For instance, mutual US-Russian de-alerting of the principle hair-trigger alert force – ICBMs, would make US missiles virtually invulnerable, while leaving Russian ICBMs highly vulnerable to US Trident-2 SLBMs, sea-launched cruise missiles and in future – to US long range precision guided conventional weapons.

De-alerting is not to be treated in off-handed way as an adjunct to disarmament. If it is not just a symbolic act, but tangible and practical method of reducing tensions of nuclear balance and facilitating disarmament, it may be as complicated and in some ways more radical, than disarmament. De-alerting should be operational and technical, comprehensive, equal to both sides and implemented in a phased way. It should in parallel envelop ICBMs (removal of warheads from missiles and/or other technical measures), SLBMs on submarines at bases (removal of warheads or missiles from the launch tubes), sharp reduction of SSBN patrol rates at sea, and bombers (pylons and internal launch racks removed, nuclear weapons stored away from airfields).

Ballistic missile defenses. Defensive strategic weapons are foremost ballistic missile defenses (BMD) of the USA and Russia, assigned the mission of intercepting offensive strategic ballistic missiles at various parts of their trajectory. Initially BMD systems were deployed by both nations in limited numbers in the late 1960 and early 1970's, and then were restricted by Anti-Ballistic Missile Treaty (ABM Treaty) of 1972. The BMD systems relied on ballistic missile early warning systems, battle management radars and ballistic anti-missiles of various ranges armed with nuclear warheads.

Russia maintains one strategic BMD site to protect Moscow area with one battle-management radar and about 50 short-range nuclear armed anti-missiles.

After abrogation of the ABM Treaty in 2002 the USA started deployment of conventionally armed precision guided (direct-impact) BMD system in California (about 30 long-range ballistic anti-missiles), Alaska (3 anti-missiles) and planned the third site in Poland (10 anti-missiles) and Czech Republic (battle management radar).

Although officially designed against rogue states (foremost Iran and North Korea) the European deployment became a cause of bitter controversy between the USA and Russia, which considered it a threat to its nuclear deterrence. China for the same reason is concerned by US tactical ship-based missile defenses, deployed to protect Japan and South Korea from North Korean missiles.

Another component of strategic defense consists of radars, fighter interceptors and surface-to-air (SAM) missiles assigned the mission of defense against strategic bombers and tactical aircraft, as well as against cruise missiles of various classes and types. Some of SAMs and air-to-air missiles for fighter interceptors were armed with nuclear warheads. The USSA had a huge Air Defense system, comprised by 2,000 fighter-interceptors and 11,000 surface-to-air missiles of various types, but it has been almost totally dismantled by Russia in the 1990's. New SAM systems (like Russian land-based S-300 or US ship-based Standard-3) have both anti-aircraft and anti-missile capability.

American current long-range BMD program has been perceived by Russia as a potential threat to its deterrence capability – even though defenses might be directed against third parties. The necessity for planning forces and negotiations on disarmament for decades ahead makes even limited BMD deployments look like a "foot in the door" and encourages military countermeasure well in advance. For example, the United States' decision in 2002 to withdraw from the 1972 ABM Treaty and begin testing and deployment of strategic BMD system, officially justified as a defense against countries like PDRK and Iran, impelled Russia to increase its reliance on its nuclear deterrent capabilities.

Moscow extended the service of the intercontinental ballistic missiles with multiple re-entry vehicles and even purchased several dozen of these missiles from storage in the Ukraine, as well as officially announced the development of a new strategic missile system with gliding and maneuvering re-entry vehicles for overcoming "any BMD." Additionally in 2008 Russia threatened to deploy Iskander SRBMs in Kaliningrad region to target possible US BMD site in Poland. US BMD program has become one of the principle obstacle to START-1 follow-on treaty and it will certainly be a major issue at the negotiations on further deep nuclear arms reductions.

Likewise, China out of concern about its strategic deterrence reacted very nervously and negatively to US strategic BMD in Alaska and California, as well as to theater BMD sea- and land-based systems in the Far East (Aegis/Standart-3 and THAAD), although formally designed against PDRK.

Among nuclear weapon states, as long as they are not allies and stay within reach of each other's nuclear forces, almost any BMD development and deployment would be seen as destabilizing. It would encourage build-up and (or) modernization of offensive nuclear arms and hinder negotiations on mutual nuclear disarmament.

As for third nuclear states, their response to BMD would take a form of efforts at nuclear weapons and missiles development, as well as acquisition of alternative delivery systems (cruise missiles, aircraft). The examples of Iran and PDRK are quite persuasive in this respect. At regional level the effect of BMD is the same: Israeli defense is encouraging Iranian missile programs, Pakistan reacts at Indian defense in the same way. Only joint BMD development by the USA and Russia, Russia and NATO and eventually by P5 and G-8 might discourage third states' nuclear and missile programs – primarily by demonstrating their political and military unity.

Vertical proliferation. New types of nuclear weapons may be developed in future, like US deep penetrating sub-kiloton nuclear munitions (bunker-busters), enhanced effect weapons (neutron enhanced radiation warheads, electro-magnetic pulse warheads, X-ray lasers etc.). They would most probably be destabilizing by lowering nuclear threshold and creating an illusion of nuclear arms being more usable and not threatening escalation to an overall catastrophe.

Fragile states. The danger of future nuclear proliferation lies not only in the fact that with the growth of the number of countries involved in conflicts, the use of nuclear weapons will become more probable. The problem is more serious: most of the new countries that possess or will acquire nuclear weapons do not have adequate survivability of their delivery systems or reliable early warning or command-control systems. Their internal political situations are frequently unstable, and there is a great probability of civil war and rebellions. The risk of a first or a preemptive strike, as well as the unauthorized use of nuclear weapons, would be much greater for these countries.

Nuclear materials. The likelihood that nuclear materials or warheads from these countries would intentionally or unintentionally fall into the hands of terrorist organizations sharply increases in light of the specifics of their ideology, foreign policy and internal political situation, corruption in civilian and military agencies, and the low reliability of the security services and the means for protection and control over nuclear armaments and materials.

Of special concern is the huge world stockpile of uranium of significant degrees of enrichment, as well as plutonium for energy, military, and scientific purposes (by estimated data, up to 1,700 tons of uranium and 460 tons of plutonium.[2]) Other sources estimate military plutonium stockpile at 155 tons and civilian plutonium at 1,700 tons (1,855mtons total), while the weapons grade uranium – at 1,725 tons and civilian highly

[2] C.D. Ferguson, W.C. Potter. 'Improvised Nuclear Devices and Nuclear Terrorism, Weapons of Mass Destruction Commission, No 2 (Stockholm, 2004,) p. 35.

enriched uranium at 175 tons (used in naval power plans and some research reactors)[3]. Most of these materials (above 90%) are in the stockpiles of the USA and Russia, but even a relatively small amount stored in other countries presents a serious danger, taken into account that only about 100 kg of enriched uranium may be enough for manufacturing a Hiroshima-yield crude nuclear explosive device by terrorists.

These huge stocks of nuclear materials in both the nuclear countries, threshold states and non-nuclear countries are maintained using extremely varied accounting systems and the conditions for storing them and protecting them from hijacking or sale to criminal elements is far from reliable.

It is commonly assumed that the safest are nuclear warheads on deployed strategic forces of the P5 and in centralized storages. TNW munitions are less secure when stores at armed forces depots. Weapon grade uranium and plutonium of the P5 is considered sufficiently well preserved and guarded. Less secure is low enriched uranium and civilian plutonium, used in power plants and for other peaceful purposes. Still less safe is irradiated nuclear fuel containing uranium, plutonium and many other radioactive materials.

It is hard to make a judgment about military nuclear stockpiles of other than P5 states. Most probably they are quite safe in India, Israel and PDRK, but some doubts exist about the situation in Pakistan. As for civilian nuclear materials, their safety differs greatly from state to state, the most secure being non-nuclear weapon states of NATO and EU, Japan and other countries, foremost those which have ratified IAEA safeguards 1997 Additional Protocol.

Policy Environment.

Deterrence: theory and practice. It is commonly assumed that the sense of nuclear deterrence is making nuclear weapons not tools for conducting war, but a political instrument, which guarantees that nuclear weapons will not be used in practice - neither within the context of a premeditated attack nor as a result of the escalation of a non-nuclear conflict between nuclear nations. Now, in the sixth decade of the nuclear era, this circumstance is seen as being perfectly natural. An accepted truism is that nuclear deterrence has saved the world from nuclear war and prevented the third world war despite global confrontation between West and East during four decade of Cold War. Some even talk about “civilizing” effect of nuclear weapons on politicians and military and on the international politics.

However, the reality of nuclear deterrence is much more controversial: there is no clear watershed between nuclear deterrence and nuclear warfighting.

Even the most destructive strategic nuclear forces (SNF) carry out their political mission of deterrence specifically through their ability to carry assigned combat missions – i.e. destroy certain targets, and nothing else. These missions are embodied in

3 Weapons of Terror: Freeing the World of Nuclear, Chemical and Biological Weapons. Weapons of mass Destruction commission. 2006. P. 70.

operational plans, target lists and flight programs loaded into ballistic and cruise missiles' onboard computers. These operational plans provide for the use of weapons with varying degrees of expected effectiveness in a first strike, a launch-on-warning (LOW) strike, launch-under-attack (LUA), or delayed retaliatory second strike. Strike options envision massive salvos, limited groupings or even single missile nuclear strikes at various combinations of states and targets.

The "gray area" of no clear distinction between the concepts of deterring and waging nuclear war relates even more to operational-tactical and tactical nuclear systems than is the case with SNF. Since TNW are viewed as means to promote success in a theater or at the battlefield more rapidly or offset an enemy's superiority in conventional forces, with tactical nuclear weapons it is nearly impossible to draw a distinction between deterrence and warfighting. On the other hand, the division of nuclear weapons into strategic and tactical categories is also quite conditional. For the USSR/Russia American forward-based nuclear forces (FBS) in Europe have always been equated to strategic weapons, since from their forward bases they can reach deep into the territory of the USSR/Russia. For Eastern Europe and Russian neighbors in Asia, in turn, Russia's tactical nuclear weapons are also seen as equivalent to strategic weapons both in operational range and destructive consequences of their use.

In contrast to common perceptions the current nuclear doctrines and operational planning are not confined to pure deterrence on the basis of second strike retaliation. During the Cold War US Single Integrated Operational Plan (SIOP) envisioned various massive and limited strike options against the USSR, its allies and China, and target lists contained as much as 20,000 preprogrammed targets. With the disintegration of the Warsaw Pact and the USSR, with deep reductions of Russian armed forces, and in parallel with US SNF reductions - the target lists were shortened considerably. Present US strategy is based on the so called OPLAN (operations Plan) 8010-08 Global Deterrence and Strike, which focuses on Russia and China, and apparently on some "rogue states", and provides for great flexibility of nuclear and conventional combinations of strategic strike options.

This example is being followed by Russia. As early as 1993, Russia officially abandoned the 1982 pledge made by the USSR on no first use of nuclear weapons. Having affirmed this position in 2000-2001, Moscow now is emphasizing the crucial role of nuclear weapons in providing for its security. Its military doctrine calls for maintaining parity with the USA and preserving nuclear deterrence with the capability "to inflict the designated (planned) level of damage on any opponent". Besides Russia's Strike Plan provides for a possibility of "measured combat use" of strategic forces for "demonstration of resolve" or for "de-escalating aggression"[4], which translates into specific warfighting missions. Most of US and Russian flexible strike options imply first strike or first use of nuclear weapons.

Both France and Great Britain have in their official nuclear doctrines (and so, allegedly, in operational planning) selective options for nuclear strikes which implicitly usually mean first or preemptive/preventive attacks. China formally has given a no-first-use pledge, which implies a second strike retaliatory strategy. However with respect of

[4] Urgent Goals for the Development of the Armed Forces of the Russian Federation. RF Ministry of Defense. October 2003. Moscow. p. 41-42

hypothetical US or Russian nuclear attack, due to the ineffectiveness or vulnerability of China's command-control and early warning systems and nuclear forces *per se* such a strategy is hardly credible. Hence China's NFU pledge most probably is a no more than a political and propaganda gesture like that of the USSR in 1982.

Presently the official nuclear postures of the eight nuclear states, as openly declared or implied by various authoritative statements (beside PDRK, which has not formalized it in any way) may be presented in a systematic way as follows:

- All of them envision the use of nuclear weapons in response to a nuclear attack upon their territory.
- All of them envision the use of nuclear weapons in response to a nuclear attack upon their allies and forces abroad (except China, India, Pakistan and Israel which have none of those).
- All, except China, plan the first use of nuclear weapons in response to an attack by chemical or biological weapons.
- All, except China and India, envision the first use of nuclear weapons in response to an overwhelming attack with conventional forces against oneself or one's allies (as Russia puts it "in response to a large-scale conventional aggression in a situation critical for national security…"[5]).
- All, except China and India, may initiate the use of nuclear weapons to pre-empt or prevent an attack by missiles or other delivery systems, which might carry weapons of mass destruction.
- The United States envisions the use of nuclear weapons in various other contingencies if seen necessary.
- Russia may decide to selectively initiate the use of nuclear weapons to "deescalate an aggression", or to "demonstrate resolve", as well as to respond to a conventional attacks on its nuclear forces, command-control and early warning sites (including satellites), atomic power plants, storages and other nuclear-containing targets.

In all cases addressees of nuclear retaliation or pre-emption are the states which initiated an attack, the states from which territories nuclear weapons or other WMD were launched, or states allied with or supporting the aggressors. Obviously, the P5 openly or tacitly treat nuclear deterrence as an indispensable and legitimate instrument of their security and military policies that they are born to have, while claiming that other countries have no right to acquire. Thus, the end of Cold War has actually lowered, not raised the nuclear threshold, to say nothing of abandoning nuclear deterrence and warfare planning.

Negative security assurances. When the Nuclear Non-Proliferation Treaty was signed in 1968 the United Nations Security Council adopted a Resolution 255 containing a general positive security assurance to non-nuclear weapon sates, joining the Treaty, and recommending that the P5 provide their negative security commitments – i.e. a pledge not to use nuclear weapons against non-nuclear NPT member states. Every year since 1978 the UN General Assembly has adopted resolutions of a general nature on negative nuclear security assurances. In 1995 in connection with the NPT Extension Conference five permanent members of the UN Security Council (P5), made official declarations on the non-first use of nuclear weapons (NFU). In these standard statements Russia, the USA,

[5] The Military Doctrine of the Russian Federation. Nezavisimaya Gazeta, April 22, 2000.

Britain, France and China pledged not to use nuclear weapons against non-nuclear weapon states, which were members of the NPT. However in the statements of four great powers (except China, which made an unequivocal NFU pledge) there were five conspicuous exemptions:

- The pledge was addressed only to the NPT member-sates.
- Within the NPT it was directed only to non-nuclear states.
- It was not related to a non-nuclear weapon states of the NPT, allied with a nuclear-weapon state.[6]
- It did not concern an NPT non-nuclear state, if such a state was participating in joint military operations with a NWS against the pledging power.
- It was not related to a non-nuclear weapon state, if such a state committed an armed aggression against the pledging power (or its allies or armed forces) while being allied with another NWS.

While it is possible to understand political or military logic underlying the above exemptions, they virtually deprived the P5 pledge of any serious substance. Moreover, instead of diluting a political or military utility of nuclear weapons and reassure NPT non-nuclear members states, which by its Article II had taken obligation not to acquire nuclear weapons – such an equivocal pledge did just the opposite. It reconfirmed an important role of nuclear weapons in national security, foreign policy and defense strategy of the P5.

Nonetheless in 1995 the UN Security Council summarized these statements and adopted Resolution 984 of negative security assurances (with exemptions) to non-nuclear states. The Review Extension Conference decided that further steps were necessary to assure non-nuclear weapon states against nuclear threat. An idea of signing a convention legally fixing full-scale commitments of NWS to non-nuclear NPT states was supported in 1995 by Russia and Britain, but was not endorsed by other nuclear powers, which claimed that such a commitment would contradict the doctrine of nuclear deterrence. The 2000 NPT Review Conference stated that legally binding assurances were needed, and at the 2005 Review Conference non-nuclear weapon states urged P5 to provide such pledges. Nonetheless up to now unequivocal assurances have not been taken by any nuclear power, except China.

Is nuclear deterrence relevant? As the above considerations show, the essence of the nuclear deterrence phenomenon and its role in international security over the past half-century has been exceedingly ambiguous and contradictory. Nuclear weapons might have played a role as a factor in averting World War III, or maybe we were all just very lucky. In this case, it was a very good thing that history has no subjunctive mood. But the future role of nuclear deterrence is quite dubious.

First of all, there is a disparity between the thrust of deterrence and the threats and challenges that arose after the Cold War. Deterrence stays effective, but only against extremely improbable and far-fetched threats: against nuclear aggression, or a large-scale

[6] This point is somewhat mute. It is not clear whether NFU would cover an ally of a NWS, with which the pledging state is in conflict, if such an ally does not participate in this conflict. Still, since the standard formula covers NNWS "supporting" an aggression and allies are obliged to support each other in a serious conflict - it follows that NFU does not provide security assurance to allies of NWS.

conventional attack by P5 against one another and their allies. But deterrence does not work against the new, real-life threats of the modern world: the proliferation of WMDs, international terrorism, ethnic and religious conflicts, trafficking in narcotics and weapons, trans-border crime, illegal immigration, etc.

The question of whether or not nuclear disarmament could restrain nuclear proliferation remains debatable. But it is obvious that nuclear deterrence cannot halt the process of proliferation and it is entirely plausible that it encourages further expansion of the nuclear club.

Specifically, nuclear deterrence cannot be used against organizations of international terrorism, including the hypothetical threat that such organizations might acquire nuclear weapons or explosive devices. The terrorists do not have traditional or convenient sites that could be targeted for the use of, or the threat of the use of, nuclear weapons: territory, industry, a population, or a regular army, which could be targets in a strike of retribution.

Secondly, the mutual nuclear deterrence establishes tangible limitations on the ability of the major powers to respond collaboratively to new threats and challenges. The kind of collaboration typical of the Cold War, when arms control treaties such as the NPT were signed, is not sufficient today. The initiatives on the interaction of secret services and special-purpose forces and joint policies against WMD proliferation (such as the Proliferation Security Initiative) demand a significantly higher level of trust and cooperation. Still greater unity is needed for joint military operations against terrorists and the ”rogue” and “failed” states that support and harbor them, for the common early warning systems for missile launches initiated by the United States and Russia, as well as for cooperation on the development of joint BMD systems. The same is true of much more stringent nuclear and missile export controls; programs to enhance safety and accountability for stockpiles of nuclear weapons and materials; internationalization of nuclear fuel cycle elements; the implied provision of greater transparency and eased mutual access to secret facilities; and the verifiable worldwide cessation of the production of nuclear weapons materials.

However, it is impossible to imagine such a high level of collaboration as long as the P5 still have thousands of nuclear warheads targeted at one another and on hair-trigger alert for immediate launch, and while all these countries are modernizing their strategic nuclear forces to ensure a guaranteed devastating strike capability against each other, even if this is no longer on the forefront of declaratory polices of the United States, Russia and other nuclear powers.

The third reason is related to expenditures. It is often assumed that nuclear forces cost significantly less than general-purpose forces. In the military budget of any given year, this is absolutely true (in Russia and the United States, 10% to 15% is allocated to strategic nuclear forces, including support systems). But taking into account the cost of a weapon system's entire lifecycle, which for strategic nuclear forces amounts to two-three decades or more, as well as the cost of safely dismantling and utilizing nuclear weapons after they have been withdrawn from service, not to mention the expense of disposing of the uranium and plutonium contained within warheads, then the picture no longer looks quite so clear.

Thus, in order to preserve a state of mutual nuclear deterrence, the major powers are spending tremendous resources that, under different circumstances, could have been used with great success to solve other military and security tasks. Furthermore, significant intellectual and technological assets are also being diverted to nuclear deterrence. Large state and private research and political organizations and economic, technical, and intellectual potentials are locked up in the support of nuclear confrontation, instead of being reallocated to the real and important needs of international security.

Nuclear disarmament. After a decade of mockery and neglect nuclear disarmament has returned to US-Russian and other nuclear powers' official documents and political commitments. In particular Washington and Moscow are conducting intensive talks on the START-1 follow-on treaty after its expiration in December 2009. At Moscow summit in July 2009 the two sides agreed to reduce warheads number down to 1500-1675 units and delivery vehicles number to 500-1100 units. Still there are serious controversies and serious obstacles to overcome.

In contrast to President Obama's call for a nuclear free world, the practical policy of the United States for the first disarmament step is quite conservative. It wishes to implement most of the reductions through removal of part of MIRV warheads from missiles to storages and by conversion of many strategic weapons for delivering conventional munitions. Despite all general reservations about nuclear disarmament Russia is ready for a more radical first step and wants reductions to ensure elimination of warheads and dismantling of launchers (hence the wide gap in the announced delivery vehicles ceilings). On the other hand, Russia is reluctant to commit itself to much deeper reductions after START-1 follow-on, in view of US/NATO advantages in BMD technologies, conventional weapon systems and forces, and space support and potential strike capabilities.

Great Britain, France, and China are not planning to accept any legal limitations on their nuclear forces, pointing to the huge superiority of the two largest nuclear nations, and are going on with long-term modernization and in some aspects a build-up of their nuclear arsenals.

Israel, India, Pakistan and North Korea are not contemplating any limitations or reductions of their nuclear forces or development programs. Iran is continuing its uranium enrichment and plutonium recycling programs and missile development projects, while accusing the P5 of reneging on their commitment to nuclear disarmament under NPT Article VI.

The record is quite controversial regarding transparency of nuclear forces and programs. The United States and Russia are fully transparent about their strategic forces and modernization programs, although US data on the principles of "operational deployment" is not clear enough. Both sides provide rather vague information on their TNW and highly inadequate data on their nuclear weapons and materials stockpiles, while Russia is relatively more secretive than the USA.

France and Britain are quite open about their strategic forces and programs, but do not give away the details of their actual SLBMs' warhead loading. Britain is transparent on its nuclear weapons and materials stockpile, as well as warheads production record.

China is completely opaque on its nuclear forces, programs and stockpiles, and provides only a huge volume of propagandistic descriptions and assurances on its "purely defensive" strategy and forces.

The same is true of India and Pakistan. Israel does not officially acknowledge even possession of nuclear weapons. PDRK claims having serial production of nuclear weapons but does not provide any details.

Overall Risk

For some time following the end of the Cold War, there was an illusion that the nuclear competition would soon end and the accumulated arsenals of mass destruction would be abolished. But things turned out much more controversial in reality.

On the one hand, large numbers of surplus nuclear weapons inherited from more dangerous times have been and are being retired. In terms of the numbers of nuclear warheads, the five nuclear weapon states have reduced their forces by 88% (in 2009 estimated 8,500 deployed warheads[7], compared to 68,000 in 1985). This has been implemented through formal arms control treaties, parallel reductions and unilateral force readjustments. The figure, often provided on the aggregate holdings, including stockpiles, is 23,000 to 27,000 warheads, but it is highly arbitrary and cannot be used in a serious analysis. The aggregate yield of world nuclear arsenals has also been drastically reduced.

However, the modernization of nuclear weapons goes on and the current plans of P5 (and most probably of other nuclear states as well) envisions further refinement, and in some cases build-up of these arms for decades to come.

What was still worse, the great powers have dismantled the entire set of agreements on nuclear disarmament, so as to gain more freedom of action in technical development and planning for the use of nuclear weapons, which is reflected in official military doctrines, weapon programs, and budgets.

The United States has withdrawn from the 1972 ABM Treaty and has not ratified the Comprehensive Nuclear Test Ban Treaty (CTBT) of 1996. The Conference on Disarmaments talks on the Fissile Materials Cut-off Treaty (FMCT) has been deadlocked for many years, as well as discussions on preventing the arms race in space. Together with the ABM Treaty, other treaties had been discarded as well: START II (1993), START III Framework Agreement and ABM Delineation Agreement (1997). Moscow 2002 SORT has never been finalized. Russia threatened to withdraw from the INF-SRF Treaty of 1987, and suspended its implementation of CFE Adaptation Treaty of 1999 (which may indirectly affect the prospects of TNW reduction talks). This has put the NPT under growing pressure, the NPT Review Conference of 2005 was a failure and the next Conference of 2010 will depend on the success of US-Russian strategic talks. Thus, the whole system of control over nuclear arms is subject to erosion, with serious and predictable consequences in the form of an increasing number of new threats and risks.

[7] S.N. Kile, V. Fedchenko, H.K. Kristensen,'World nuclear forces', SIPRI Annual 2009: Armaments, Disarmament and International Security (Oxford University Press: Oxford, 2009), pp. 345-377.

The end of the global confrontation and the vanishing danger that any use of nuclear weapons would escalate to a global catastrophe caused the United States, Russia, and a few other nuclear powers to be more “easy-going” in devising operational plans for the actual use of nuclear weapons (in combination with new conventional arms). There was an increased emphasis on preventive or preemptive, small-scale, and demonstrative nuclear strikes. Thus the end of the Cold War indeed has lowered the nuclear threshold, instead of raising it, to say nothing of altogether ending the practical planning of nuclear war.

Nuclear weapons proliferation creates great danger of regional nuclear wars in the Middle East-Persian Gulf, South Asia and the Far East, which would have catastrophic social, environmental and political consequences. Even assuming that nuclear deterrence really worked between West and East during the Cold War, it is not obvious at all that it would similarly work among new nuclear states in future.

The relentless nature of mutual nuclear deterrence and arms development has had a negative effect on political relations between the former opponents. It reinforces historical mistrust, a mutual suspicion that the “strategic partners” are hiding secret war plans, and promotes fear of an inadvertent or accidental nuclear attack. Continuous American and Russian adherence to hair-trigger alert postures (LOW) will be more risky in future - in the context of nuclear and missile proliferation and the rising possibility of accidental, provocative strike or nuclear terrorist act.

Whether nuclear deterrence had saved the world peace or not in the past - in future it will not be able to provide security for the leading nations and for the world at large. With the end of the Cold War nuclear deterrence has stayed most effective against those addressees who no longer need to be deterred, but is has become least effective with respect to those who must be deterred from threatening international security.

Nuclear deterrence encourages proliferation of nuclear weapons with all of the consequent new dangers, including the possibility of terrorists’ obtaining nuclear explosive devices. At the same time nuclear deterrence, lying at the heart of nuclear balances and arms races, creates quite tangible barriers to cooperation among the great powers and regional states in fortifying international security: foremost in uniting political, military and economic resources in stopping and reversing nuclear proliferation and suppressing international terrorism.