Report of the International Working Group
Moving Beyond Missile Defense and Space Weapons
INES / Abolition 2000
Fall 2021, Berlin, Germany

ines
International Network of Engineers and Scientists for Global Responsibility

Editor: Subrata Ghoshroy

Editorial Review Board:

Claus Montonen, Jürgen Scheffran, and David Webb

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Executive Summary:

Missile Defense Systems and Weapons in Space - Serious Consequences for Global Peace and Security

Editor:
Subrata Ghoshroy

Editorial Review Board:
Claus Montonen, Jürgen Scheffran, Dave Webb

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This report is dedicated to the memory of Dietrich Schulze – scientist, union organizer, life-long peace activist, anti-fascist, and indefatigable fighter for world peace and against all forms of war and militarism.

Dietrich Schulze passed away on December 19, 2019 in his birthplace Karlsruhe, Germany, at the age of 79. Dietrich was a scientist, who departed from his scientific work to work for peace and social justice. After earning his Ph.D. in electrical engineering, he worked in nuclear energy research in Karlsruhe, later becoming an organizer for the trade union organization, called Verdi. Following his retirement from professional life, Dietrich dedicated his life toward organizing for peace and against militarism and fascism. As INES Council-member Reiner Braun wrote in his eulogy, Dietrich hated war and the warmongers. His tireless commitment to the movement against rearmament and nuclear weapons – be it in the campaign against Pershing 2 and cruise missiles, or against wars in violation of international law. As a scientist and an engineer, he had a clear analytical mind, and one who always had a critical view of his own profession. He never forgot the role of science and technology in the cause of fascism and militarism. As a human being, he abhorred violence, whether from the right, or the left. He worked tirelessly for his causes. In the last decade before his death, Dietrich led the movement in Germany to demilitarize the universities by forcing them to adopt a "Civil Clause" in their charters. He was at the forefront of a largely student-based movement that saw the adoption of such clauses in many universities in Germany. His absence is deeply missed. Rest in peace, Comrade.

Dietrich Schulze, Ph. D. (1940-2019)

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Our work is largely done by activists working voluntarily, but our projects would acquire a much greater impact if our resources were greater. Hence, we need your help to be able to carry out our work. We would very much appreciate your donations, please pay anything you can into the account of our member organisation, become a member of INES or renew your membership by paying $25 or its equivalent in Euro. You can join INES by simply filling out a short form on our website.

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i. Introduction

On November 20, 2000, the U.N. General Assembly, by a vote of 97 to 0 with 65 abstentions, adopted a resolution demanding a comprehensive approach to missiles that would "contribute to international peace and security." The resolution gave impetus to civil society to take up the issue. One such initiative was a project by the International Network of Engineers and Scientists Against Proliferation (INESAP)[1]. They produced a report called Beyond Missile Defense by an international team of scientists and policy analysts[2]. Jayantha Dhanapala, then U.N. Under-Secretary General for Disarmament, forwarded the report to the U.N. General Assembly in 2002. They made a number of far-reaching recommendations, summarized later, to develop a verifiable global treaty to ban the development, testing, proliferation, and the acquisition of missiles.

It has been two decades since the above-mentioned U.N. resolution and the publication of the INESAP report. During this time there has been little or no action toward controlling missiles and missile defense systems. On the contrary, a signal event took place within a short time after the U.N. resolution. It was the U.S. unilateral withdrawal on July 1, 2002 from the Anti-Ballistic Missile (ABM) Treaty, which served for thirty years as a landmark in the history of arms control agreements. In the post-ABM treaty years, there has been proliferation of both missiles and missile defense systems. Our focus for this report is global missile defense systems, because of their adverse impact on strategic stability.

Similar to the previous effort, INES organized anew an international work-

1 INESAP was a network within INES.

2 Lichterman, A., Z. Mian, M. V. Ramana, and J. Scheffran. 2002. Beyond Missile Defense. INESAP, GRACE, WSLF.

ing group in the summer of 2016 to study the consequences for international peace and security resulting from both the ongoing development and deployment of missile defense systems globally as well as the programs to develop weapons in space. From the start, the group reached a conclusion that, as desirable as it might be, it would not be practical to advocate a global missile ban in the present international situation. The focus instead should be on banning missile defense systems and space weapons. However, one can still hope for missile control and moving towards ballistic missile disarmament/ban. In a nutshell, this report focuses on two subject areas, namely, missile defense and the weaponization of space. It explores the linkages between the two in the larger context of nuclear arms control and disarmament.

The membership of the working group is described elsewhere. It is important to note that the membership represents a broad spectrum of people who are individually affiliated to civil society organizations and universities. Some are former government officials and others are independent analysts.

Because of unforeseen circumstances, the work of the group could not proceed as planned. The present report is the product of mostly individual efforts in writing specific sections. In addition to the members of the original group, who contributed to the report, we invited several scholars outside the group to contribute. While we generally agree on the broad parameters of our analysis, it is by no means a consensus document. Therefore, the views expressed in the articles are solely those of the respective authors.

ii. About the Working Group

Listed in alphabetical order, the following members of the working group contributed to the report are:

Christian ALWARDT, Germany

Subrata GHOSHROY, U.S.A.

Masako IKEGAMI, Japan

Claus MONTONEN, Finland

Jürgen SCHEFFRAN, Germany

David WEBB, U.K.

Monica ZOPPE, Italy

Other contributors to the report are:

Vladimir KOZIN (Russia)

Rajaram NAGAPPA (India)

Götz NEUNECK (Germany)

Hui ZHANG (U.S.A./China)

There were three other original members of the group, namely, Timur Kadyshev (Russia), Alice Slater (U.S.A), and Tong Zhao (China), who did not participate beyond the first meeting. Subrata Ghoshroy acted as the coordinator for the group.

iii. A synopsis of the chapters

A brief synopsis of the sections of the report follows.

In Chapter 1, Professor Jürgen Scheffran, INES Co-Chair, who led the 2001-2006 INESAP study, has summarized the conclusions and recommendations from the earlier report pointing out their relevance today.

Chapter 2 contains two previously published articles by INES Co-Chair, Subrata Ghoshroy. In the first article, he discussed the history and the politics of the U.S. missile defense program. In the second, Ghoshroy describes his experience as a whistle blower in exposing the waste and fraud that is ever present in the U.S. missile defense program.

In Chapter 3, physicist and former INES Chair, Claus Montonen analyzes the impact of the landmark ABM treaty on the nuclear arms race.

In Chapter 4, physicist Christian Alwardt discusses in detail the technical aspects of the various segments of U.S. missile defense systems and their current status.

In Chapter 5, Götz Neuneck, former Deputy Director of the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), kindly permitted us to include a previously published article on the NATO missile defense programs and its ramifications for European security. He argued that missile defense deployment would further aggravate the already tense relations between NATO and Russia.

In Chapter 6, Professor Masako Ikegami has contributed a thoughtful paper on the recent decision by Japan to not go forward with further procurement

of the U.S. Aegis Ashore systems. She also suggests a peaceful way out of the Korean nuclear crisis.

Chapters 7 and 13 contain a Russian perspective, respectively, on U.S. missile defense and space programs by the veteran Russian diplomat Vladimir Kozin, drawing mostly from publicly available documents published by the Pentagon. He also touched briefly on the Russian response to counter the U.S. deployment of missile defense systems close to Russia. Kozin argues that U.S. efforts to make space an arena for active war fighting could lead to an arms race in space.

In Chapters 8 and 11, Professor Rajaram Nagappa, a distinguished former scientist of the Indian Space Research Organization, provides two excellent articles reflecting an Indian view of missile defense, and the weaponization of space, respectively.

In Chapter 9, biologist Monica Zoppe provides a unique perspective on how to confront the popular perception of space as a battleground.

Chapter 10 and 12 contain two important articles authored jointly by the Professor Emeritus David Webb and Professor Jürgen Scheffran. The article in Chapter 10 is on the prospects for arms control in outer space and argues strongly for the immediate consideration of the Prevention of an Arms Race in Outer Space treaty proposed for many years by Russia and China. In Chapter 12, the authors discuss the dual nature of missile defense and anti-satellite weapon systems, which demand a ban on both systems for each to be effective.

In Chapter 14, Hui Zhang, an eminent scholar on China, kindly permitted us to include a slightly modified version of a very balanced and well-written article on China’s nuclear modernization, which was previously published elsewhere.

In Chapter 15, we reprint another previously published article by Subrata Ghoshroy, that narrates the secret X-37B program to develop a long-duration, reusable space plane. Ghoshroy argues that it provides U.S a valuable platform to test space weapons and possibly deploy them in the future.

Chapter 16 contains an article by Prof. Jürgen Scheffran, who argues that proliferation of the delivery systems for the Weapons of Mass Destruction is a critical challenge for nuclear disarmament. Yet, there is no multinational treaty that restrict their development and use. He proposes an international missile control and a ballistic missile ban, complementary to the recent Treaty on the Prohibition of Nuclear Weapons.

Finally, we include in the report an INES NGO Statement entitled "Missiles, Missile Defenses and Space Weapons as Obstacles to Nuclear Disarmament," which was presented to the 2017 NPT Preparatory Committee meeting in Vienna.

iv. SECTIONS OF THE REPORT

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2. ***The U.S. missile defense systems – history, politics, waste, and fraud***

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   b. *The Price for Blowing the Whistle - Subrata Ghoshroy*

3. ***The Anti-Ballistic Missile Treaty***

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Jürgen Scheffran

v. Executive Summary

We believe that there are many factors that have contributed to the rise in global tensions in the new millennium, not the least of which is the "Global War on Terrorism," waged by the United States and Western allies such as Britain, France, and Germany. It was as being in response to the attacks on the U.S. mainland on September 11, 2001, by Islamic extremists. The invasions of Afghanistan in 2001, where Al Qaida, led by Osama Bin Laden, had a base, and Iraq in 2003, on the false premise of weapons of mass destruction, have become chapters in a war without end. After virtually destroying the two countries, the U.S. is still trying to extricate itself from the resulting quagmire. It is important to be aware of this backdrop as we analyze the international security situation.

For example, the U.S. have deployed missile defense systems ostensibly to counter a "missile threat" from what it calls sponsors of terrorism - countries like Iran and North Korea. They are also called "rogue states" in Western parlance. However, such a characterization is not universal. For example, both Russia and China disagree and they are deeply concerned by the U.S. actions as they regard these systems as detrimental to their nuclear deterrence capabilities and hence to the existing nuclear balance. On November 17, 2020, the U.S. announced the successful test of a ship-based, upgraded Standard Missile-3 interceptor against an ICBM, that it called a "representative threat." Russia expressed its deep concerns about the test.

Russia has also been highly critical of the unilateral U.S. withdrawal in 2002 from the ABM treaty. However, despite its reservations, in the ensuing years, Russia negotiated two arms reduction treaties with the U.S. The first was called the Strategic Offensive Reduction Treaty, which was signed by the U.S. President George W. Bush and the Russian President Vladimir Putin in

May 2002. The second was the New START treaty, which the U.S. President Barack Obama and the Russian President Dmitry Medvedev signed in April 2010. The latter was due to expire in February 2021, but in a welcome decision, the Biden administration agreed to extend the treaty with Russia by five years. It is set to expire on 5 February, 2026.

Reportedly at Russia's insistence, both these treaties included in their preambles specific language that recognized the linkage between offensive and defensive missile systems. In other words, missile defense systems could cause an arms race, and developments since then have led to both Russia and China becoming much more vocal in their opposition to missile defense systems.

Along with their diplomatic opposition to Ballistic Missile Defense (BMD), both countries also continue their advocacy for a treaty to prevent the weaponization of outer space. For many years they have repeatedly submitted to the UN Conference on Disarmament (CD) a draft treaty called the Prevention of Arms Race in Outer Space (PAROS). Each time their efforts have been thwarted by the U.S. The stalemate in the CD and the subsequent status quo are clearly advantageous to the U.S. because it enables them to continue to develop space weapons technology without any restrictions. However, they also make it possible for Russia and China to do the same, if they so choose.

Apparently, the U.S. is still fighting the Cold War that most people believe ended nearly thirty years ago, and is pursuing an unrestrained military buildup for global dominance. We are witnessing military budgets as excessive as those during the height of the decades-long super power confrontation following the end of WWII. While the Pentagon budget has continuously increased in the post-war decades, a large buildup started during the George Bush Presidency from 2004 to 2008 and continued, more or less, through the Obama years, only slowing a little after the crash of the

financial system of 2008, and picking up pace again in Donald Trump's administration from 2016 to 2020. The growth currently seems to continue under President Biden.

U.S. has spent nearly $10 billion a year on missile defense alone for the past two decades, leading to a total expenditure of $250 billion on missile defense since the beginning of the Strategic Defense Initiative by President Ronald Reagan in 1983. As if to put icing on the cake, President Obama added a 30-year, trillion-dollar program to modernize the U.S. nuclear-weapons complex - a clear indication that the U.S. military is once again seeking nuclear supremacy – a "first strike" capability against Russia and China.

The situation is becoming more dangerous as time goes by because big military powers like Russia and China feel that they cannot sit idly by as the U.S. continues with its belligerent posture. They are taking steps to counter perceived threats from the U.S. and so the Cold War-era nuclear arms race is being reignited.

The first victims in this race are the bilateral arms control talks between the U.S. and Russia. In 2001, Russia withdrew from the Conventional Forces in Europe (CFE) Treaty in protest against the U.S. abandonment of the ABM Treaty. In 2016, Russia pulled out of a landmark nuclear security agreement that required both the U.S. and Russia to dispose of the stockpile of many tons of weapons-grade plutonium in each country's inventory. Russia accused the U.S. of non-compliance regarding the plutonium contained in warheads that were dismantled under other treaties.

Another landmark treaty was the 1987 Intermediate-Range Nuclear Forces (INF) treaty between the U.S. and Russia. It was the first arms control agreement ever to abolish a whole class of nuclear weapons, banning all missiles having a range between 500 km and 5500 km. The treaty has recently suffered the same fate as the ABM treaty. We recognize the signifi-

cance of its loss, and appreciate the commentary thus far in the disarmament community. We are, however, unable to address this issue here due to a lack of resources.

As if the absence of a dialogue between the two nuclear super powers was not dangerous enough, Russia and China are both building up their nuclear weapons capabilities. Particularly noteworthy is the tremendous growth in China's military spending in the last decade. China now spends nearly three times as much as Russia on its military and only the U.S. spends more, although there is a huge gap between the two.

Russia has reportedly developed technology to defeat missile defense systems, including a maneuvering warhead and hypersonic delivery systems. Recently, Russia has demonstrated its sea-launched cruise missiles in Syria and Russian space technology is highly developed. The Soviet Union had developed ABM and various Anti-Satellite (ASAT) technologies many years ago. However, most of the Soviet weapons development programs for outer space and BMD were discontinued after the disintegration of the U.S.S.R., when the military budget of the newly formed Russian Federation shrank at one point by as much as 80% before recovering to the present level of about $60 billion. Russia has modernized its military industrial complex and has recently begun to develop new weapons systems.

Although China appears not to be focusing on missile defense systems, per se, it has developed kinetic ASAT systems and conducted experiments with laser weapons, which would have dual BMD capability. In 2007, China tested an ASAT system against one of its own satellites. It was followed soon after by a similar test by the United States. China appears to be focusing more on asymmetric warfare against a far superior U.S. military. One example is an anti-ship missile for area denial and another is the development of cyber weapons, both defensive and offensive. The U.S. military critically depends on satellites and other space systems for warfighting,

which makes it particularly vulnerable to an ASAT attack.

The Gulf War in 1991 saw the debut of a regional power, Iraq, deploying intermediate range SCUD missiles. Although Iraq and Iran had earlier fired missiles at each other throughout their conflict in the 80's, the world seemed not to notice. It was only after Iraq's targeting Israel and its attack on the Khobar Tower in Saudi Arabia, that killed tens of U.S. soldiers, that missiles and missile defense took up a front seat in the global security debate. What followed was the proliferation of missiles and missile defense systems around the world.

In the Middle East, Israel has missiles with various range capabilites and sophisticated missile defense systems such as the Iron Dome. Gulf countries like Saudi Arabia and the United Arab Emirates have acquired U.S. missile defense systems like the Patriot Advanced Capability-3. Other countries such as Turkey, Syria, and Iran have acquired advanced Russian air and missile defense systems such as the S-300 and S-400, and Iran is also developing advanced missiles.

In South Asia, India has developed an array of ballistic missiles both short and intermediate range. It clearly has the technological capability to develop longer-range strategic missiles, given its advanced space launch technology. India has also indigenously developed missile defense systems with technological assistance from Israel and the U.S.; it has also developed a supersonic cruise missile in collaboration with Russia. Pakistan has developed several missiles in the short and intermediate range, largely with assistance from China. It hasn't so far elected to develop any missile defense systems, reportedly opting instead for battlefield nuclear weapons to overcome India's superior conventional forces and its rudimentary missile defense capacity.

In East Asia, there is an explosive situation that has evolved from decades of aggressive U.S. policies on the Korean peninsula, although there is an

uneasy calm for the moment. In addition to the many U.S. military bases in the region, there are thousands of active-duty U.S. troops deployed in South Korea and Japan seventy-five years after the end of the World War II, and the defeat of Japan. More than six decades have passed since the armistice that halted the fighting in the Korean peninsula was signed, but it did not end the war. The U.S. is still resisting efforts to formally end the war because it fears it may have to withdraw its troops from the region.

A policy of threats, isolation, and sanctions on North Korea has pushed the regime there so far that they embarked on a dogged effort to develop nuclear weapons and intermediate range missiles, and even possibly some with ICBM capability in the not-too-distant future. Instead of assisting with negotiations, the U.S. government, regardless of its partisan affiliation, has adopted various policies to squeeze North Korea hoping for a collapse of the "regime." It has conducted massive joint military exercises with South Korea to intimidate the North, even involving B-2 stealth bombers, which can carry nuclear weapons, stationed in Guam. Citing a bogus rationale, it has gone ahead and deployed the Theater High Altitude Area Defense (THAAD) missile defense system in South Korea. Japan has also acquired U.S. PAC systems and although it recently cancelled two U.S. Aegis Ashore missile defense systems it has, or is obtaining, a number of Aegis missile defense equipped destroyers.

The main argument against ballistic missile defense is that it threatens to nullify nuclear deterrence, thus injecting dangerous instability into the relations between nuclear armed superpowers. Ultimately this argument is based on the view that deterrence is the deciding factor preventing a nuclear war. During the past decades this view has been challenged. Conscious of the catastrophic humanitarian consequences of even limited nuclear wars, a large section of the peace movement embarked on an attempt to delegitimize nuclear deterrence, i.e., the threat to use nuclear weapons. As is well known, the result was the Treaty on the Prohibition

of Nuclear Weapons (TPNW), which has now entered into force. In a world without nuclear weapons, defense against conventionally armed missiles loses much of its apocalyptic allure.

However, we are not yet at the goal of a world free of nuclear weapons. None of the so-called nuclear weapon states has acceded to the TPNW, nor are they likely to do so in the near future. Our report is to be seen as a comment on the situation today and our recommendations have an immediate urgency. But we are not abandoning the vision of a nuclear weapons free world enshrined in the TPNW. To many the goal may seem utopian, but equally utopian is the expectation that our good fortune in so far avoiding an accidentally started nuclear war will last forever.

As we have already indicated at the beginning, this report does not necessarily reflect a single unified opinion. Various constraints stood in the way, which made it difficult for us to develop a more comprehensive report. As such, it should be viewed as a sequel to the 2002 report entitled Beyond Missile Defense, cited before, which clearly spelt out the structure of a missile ban treaty. Although a missile ban seems like a distant dream, the fundamentals of the previous report are still valid.

Israel has been bombing Gaza over the last several years inflicting heavy casualties on the defenseless and captive two million Palestinians, who live there under an Israeli blockade. The Palestinian fighters affiliated with the militant group Hamas have been launching rockets from the besieged territory targeting Israel, most of which, according to the Israeli military, are intercepted by the Iron Dome system. TV and print media reports of the "success" of the Iran Dome in "saving Israeli lives" abound. We feel that we would be remiss, if we did not at least briefly comment on the performance of the Iron Dome.

While the system reportedly intercepted 90% of the threatening rockets,

presumably 10% penetrated the defense system and caused some damage to buildings, although comparatively little, and a small number of fatalities in Israel. These rockets are so inaccurate that a third of them have so far landed in Gaza before crossing into Israel, according to press reports. Yet, proponents of the Iron Dome system are loudly proclaiming its "success" in saving lives. We believe, however, that the Iron Dome is not the answer to rocket attacks for a couple of reasons. First, the enormous difference in cost between the home-made rockets and the Iron Dome's Tamir interceptor missile. The rockets likely cost a few hundred dollars, while a Tamir missile costs $80,000 or more apiece. Second, the interception of relatively low speed, short-range rockets, launched by Hamas, does not necessarily prove that the system will be capable of stopping long-range rockets with higher speeds, which will likely be the case in a war with Iran, for example. Furthermore, as even the unsophisticated Hamas rockets have demonstrated, the system can be overwhelmed by a so-called salvo attack - the launching of a large number of rockets at once.

We repeat that missile defense is not the answer to rocket attacks, ending the occupation and making peace with the Palestinians is.

This report will, hopefully, bring some clarity to the new situation and thus help civil society to focus on perhaps a more achievable near-term objective, such as a ban on missile defense systems and a ban on weaponization of space.

Finally, we would like to say that we have been writing this report in a fast-changing international security situation that might make some observations outdated. Two significant events took place in the lapsed time, which are worthy of note. One was the summit meeting on June 16, 2021, in Geneva between Presidents Biden and Putin. They agreed to return their country's Ambassadors to their respective posts and to resume the bilateral dialog on strategic stability. It was a welcome development in an

otherwise bleak situation, although U.S. has continued its hostile attitude towards Russia by imposing more sanctions after the meeting. The other is the US troop withdrawal from Afghanistan and the subsequent collapse of the Afghan government, which was led by Ashraf Ghani, who fled the country as Taliban forces quickly advanced and then overtook Kabul, the nation's capital. As events unfolded, there was complete chaos at the Kabul airport as the U.S. troops attempted to evacuate Americans and citizens from the allied countries, including Afghans, who number in thousands, that want to leave the country fearing reprisal by the Taliban. The long-term ramifications of the Taliban victory over the U.S. and NATO forces will be assessed in the months ahead. Two decades of war cost over $2 trillion and over 3500 allied casualties. Countless Afghans died and much of the country destroyed like Iraq, Libya and Syria that faced NATO's wars. We hope that it brings to an end these endless wars so that resources can be redirected to fighting pandemics and the raging climate emergency.

vi. Recommended Next Steps

1. We urgently warn against a dangerous situation developing in the further militarization of outer space from the testing of anti-satellite weapons.

2. We strongly recommend that attention should be focused on banning both missile defense and anti-satellite systems globally.

3. We demand an immediate halt to the deployment of missile defense systems in Europe and the removal of existing systems.

4. We recommend that the Intermediate Range Nuclear Forces Treaty between U.S. and Russa be revived immediately and discussions toward achieving a multilateral treaty be vigorously and seriously pursued.

5. We resolutely support moves to create Nuclear Weapon Free Zones in Europe and the Middle East.

6. We welcome Japan’s decision not to proceed with the procurement of the Aegis Ashore missile defense system and urge Japan to sign and ratify the TPNW.

vii. Biography of the authors

Contributors

Christian Alwardt, Ph.D., is a physicist. He is a senior researcher at the Institute for Peace Research and Security Policy at the University of Hamburg (ISFH), where he conducts research in the fields of emerging technologies, arms control and international security.

Masako Ikegami, Ph.D., is a professor at the Tokyo Institute of Technology, Tokyo. Previously, she was director of and a professor at the Center for Pacific Asia Studies at Stockholm University. Her research includes arms control, disarmament, nonproliferation, and nuclear security.

Vladimir P. Kozin, Ph.D., is a Member of the Academy of the Natural Sciences and the Academy of Military Sciences (Russia), a Member, Expert Group, Foreign Relations Committee, Russian Senate. He is the author of 16 monographs on arms control.

Claus Montonen, Ph.D., Emeritus Lecturer in theoretical physics, University of Helsinki. Founding member and former chair of INES. He is a board member of the Finnish NGO Technology for Life and a coordinator of ICAN Finland.

Rajaram Nagappa is a Visiting Professor at the National Institute of Advanced Studies, Bengaluru. He was for many years a highly-regarded scientist at the Indian Space Research Organization. His research includes missiles, militarization of space and space security.

Götz Neuneck, Ph. D., is a Senior Research Fellow at the Institute for Peace Research and Security Policy at the University of Hamburg (ISFH). He is the Chair of German Pugwash, and also Chairman, of the "Physics and Disarmament" section of the German Physical Society (DPG).

Jürgen Scheffran, Ph.D., is a professor in geography at University of Hamburg and chair of the Research Group Climate Change and Security at the Center for Earth System Research and Sustainability. His expertise also includes international security and arms control of missiles, space and nuclear weapons. He is the Co-Chair of INES.

Dave Webb, Ph.D., is Emeritus Professor of Leeds Beckett University, Chair of the Campaign for Nuclear Disarmament (CND) and Convenor of the Global Network Against Weapons and Nuclear Power in Space.

Hui Zhang, Ph.D., is a senior research associate at the Belfer Center for Science and International Affairs at Harvard University, where he leads a research initiative on China's nuclear policies.

Monica Zoppè, Ph.D., is a cellular and molecular biologist, has been engaged in environmental and peace activism for over 20 years, dedicating special attention to the theme of biological weapons.

Subrata Ghoshroy is a Research Affiliate with the Program on Science, Technology, and Society at the Massachusetts Institute of Technology, USA and a Visiting Professor at the Tokyo Institute of Technology. An electrical engineer by profession, Subrata spent many years in military R&D before becoming a whistle blower. He is also the Co-Chair of INES.

viii. Abstracts of the articles in the full report

Despite so many negatives, why missile defense continues to enjoy bipartisan support in U.S. Congress?
Subrata Ghoshroy

The program to develop a missile defense system has existed in one form or another for nearly six decades. While the program was controversial from the beginning, and faced nearly unsurmountable technical challenges, it has enjoyed bipartisan support in the U.S. Congress for the past two decades and with it continued funding. By a wide bipartisan majority, both chambers of Congress authorized more than $740 billion for defense spending for the fiscal year 2021. There is about $20 billion in it for missile defense. While $20 billion may not seem significant in a $740 billion military budget, one needs to recognize that the taxpayer has invested nearly $200 billion on missile defense in the past two decades and another $100 billion in the decade before with little return on investment. This paper narrates a brief history of the program over nearly six decades and its various ups and downs culminating in a bipartisan consensus to support the program in the final days of the Clinton Presidency. The paper explores the whys and the hows of the program's long survival with little real oversight. Aggressive lobbying and campaign contributions from contractors helped solidify Congressional support for the program. The author argues that the program has just become a "honey pot" that has produced tens of billions of dollars in defense contractor revenue and profits. When Congress gets serious about cutting waste in the federal budget so that social needs like healthcare, and efforts to combat climate change, can be funded, it could find that missile defense is an obvious choice. The author urges Congress to begin serious oversight of the program that is yet unproven, arguably unnecessary and that is causing major frictions with Russia and China.

The Price for Blowing the Whistle when Facing Ethical Dilemmas
Subrata Ghoshroy

Many engineers and scientists join the defense sector, because it offers well-paying opportunities to work on challenging technical problems. However, some face ethical dilemmas about the nature of their work and its end use. Examples range from the Manhattan Project that developed the atom bomb during World War II, to the more recent Project Maven at Google that used artificial intelligence for combat drones. In both of these cases, several project participants questioned the morality of their work. The problem in most cases is that individuals have to make difficult choices alone when facing an ethical dilemma. There is very little choice in finding alternative work since defense organizations do not typically have nondefense projects. This paper narrates two case studies drawing on the author's own experience working on the Pentagon's missile defense program. The first relates to author's experience in a laser weapon program and the second, as an investigator for the US Government Accountability Office. The research methodology is strictly narrative. It describes the author's efforts to bring to light the ethical lapses and the lessons learned.

THE IMPACT OF THE ABM TREATY ON THE NUCLEAR ARMS RACE
Claus Montonen

"Alternative history writing" is used to envisage a world where no agreement on limits on ballistic missile defences would have been reached. The effects on the number of nuclear weapons, nuclear weapons technology and missile defence technology of the two superpowers are speculatively estimated. Third parties: the "minor" nuclear powers and nuclear-weapons-free states are found to be beneficiaries of the ABM Treaty.

The Status of U.S. Ballistic Missiles Defense Programs
Christian Alwardt

The United States is not only at the forefront of the research and development of ballistic missile defense (BMD) systems, but also its deployment. It focusses on two areas of application, namely, on the one hand Homeland Defense to protect the US mainland, and on the other, protection of U.S. overseas regions, forward-based troops, and allied territories. In general, limited and reliable missile defense can be a legitimate tool to protect specific areas, or regions from very distinct threats. However, it can also result in an increased threat perception by others because of its multiple uses. It could also have possible spillover effects, such as the deployment disrupting military balances of power, causing misunderstandings in turn. In this context, China and Russia have both been raising such concerns for years regarding U.S. global missile defense architecture and deployment plans. This article reviews the current status of the four main U.S. BMD programs: the Ground-Based Midcourse Defense (GMD); the naval Aegis Ballistic Missile Defense system deployed onboard ships and ashore; the land-based Theater High Altitude Area Defense (THAAD); and the Patriot PAC-3 tactical BMD system. To date, no major area defense system is functional, nor has any been proven effective. Yet, U.S. BMD programs aggravate great power competition, forcing nuclear weapons modernization and threatening existing, as well as future, arms control efforts.

The EPAA and its implications for European Security
Götz Neuneck

Especially after 9/11, a “Global Missile Defense” became the centerpiece of the Bush administration’s policy to protect the United States, but also its allies, US forces and friendly countries against long-range missiles. For Europe, the original idea was to place an interceptor site with 10 two stage GBIs in Poland and a fixed, potent, “European Midcourse Radar” in the Czech Republic. This configuration was mainly designed to intercept Irani-

an missiles heading to the US, but under some conditions these interceptors could also shoot down Russian ICBMs. Some parts of Southern Europe would also not be covered by the GBI footprint.

Missile Proliferation and Security Dilemma in East Asia
Masako Ikegami

In East Asia, missile proliferation is accelerating in an action-reaction dynamic. Ironically, the missile arms race in East Asia has intensified after the end of the Cold War when the United States and the Soviet Union/Russia drastically reduced their non-strategic nuclear missiles after the 1987 INF Treaty. In its wake, a 1991 Presidential Nuclear Initiative created a missile vacuum in the Asia Pacific region, which was filled by rapid expansion of missile forces in China and North Korea. The 1996 Taiwan missile crisis prompted the US development and deployment of missile defense systems. Japan entered into co-development of sea-based missile defense (Standard Missile-3 Block IIA) with the United State. After North Korea test- fired in 1998 a Taepodong-1 missile, Japan procured and deployed Patriot Advanced Capability (PAC-3), Aegis-equipped destroyers, and transportable TPY-2 BMD radars. However, China and North Korea's rapidly expanding missile forces enabled both "saturation attack" and highly lofted-trajectory missiles as well as hypersonic missiles, thus rendering missile defense systems obsolete. This prompted Japan's strategic shift to focus on building up offensive capability such as long-range missiles and hypersonic weapons, while cancelling the Aegis Ashore. The US over-investment in missile defense systems had two adverse effects. Firstly, a classical action-reaction dynamic, no difference from the Cold War security dilemma, triggered a new arms race of offensive systems, especially, long-range hypersonic weapons. Secondly, missile defense programs can be a source of lucrative R&D funds for defense industry. The "military-industrial complex "exploits the "uncontrollable and unaccountable program with lax oversight" for profits despite poor defense value and effects. Missile defense was once presented as a galaxy of exotic

concepts and technologies that would make nuclear war obsolete. Instead, it has given rise to a phase of vicious escalation of weapons technology in an action-reaction dynamic, and aggravated the security dilemma ever since end of the Cold War.

Evolution of the U.S. Missile Defense system: a Russian perspective
Vladimir Kozin

The article examines the rapid development of the U.S. missile defense system pursued by the Donald Trump administration. Special emphasis is given to the examination of the main tasks, technical backup and financial resources allocated for the implementation program in the long run. An analysis is presented of how the collaboration in this field between U.S. and its allies expanded globally during this time. It also assesses the importance of the 2019 Missile Defense Review amongst other key military strategies of the United States that were formulated during 2017-2020. The chapter also incorporates a brief assessment of the implications of the deployment of U.S. missile defense systems globally and compares the capabilities of the missile defense interceptors with that of the hypersonic glide vehicles, which do not have any legal arms control restrictions, and which are gradually improving.

Public Acceptance of Space as a battleground
Monica Zoppè

The public perception of war has always shifted with the times. After the rise and fall of the possibility of nuclear war, in the public imagination, Space Wars are now growing in the mind of people as a distant, but acceptable possibility. This view is generated by a prevalence of space war in films, books and, especially, video games, which is an important 'cultural food' for generations from the millennials to the youth of today, and

is sustained by the presentation of space technology as mostly dedicated to civilian uses. Yet, the major players in space are the military forces of a few countries, and the prospect of a democratic, universal governance of space appears to be ever more difficult to achieve.

Prevention of an Arms Race in Outer Space: Obstacles and Options
Dave Webb and Jürgen Scheffran

Since the beginning of the Space Race there has been international concern about the possibility of an Arms Race in Outer Space. Nations and groups of nations have made various attempts to introduce treaties and ways forward to try and ensure that this does not happen. However, so far only very limited progress has been made and we consider here the various ways in which treaties, agreements and rules are formulated and the main initiatives that have been made so far. Despite some essential agreements on how some commercial aspects of space use might be conducted, almost all attempts to prevent an arms race and the stationing of weapons in space have failed. We consider the main reasons for this and suggest possible ways forward.

Anti-Satellite Weapons and Ballistic Missile Defense: the Siamese Twins?
Dave Webb and Jürgen Scheffran

The development of space technologies for civilian and military purposes is proceeding apace. As we get to depend more on satellites, their vulnerability becomes a growing problem. The major space-faring states have now openly developed and tested anti-satellite weapons in the form of missiles launched from the ground in the same way as an interceptor rocket in a ballistic missile defense system would be launched. Space systems frequently have a dual-use characteristic. In this chapter we look at the various types of anti-satellite weapons and ballistic missile defense systems. We highlight the common technologies and outline the different technological problems

faced by the two roles. A major problem posed by this duality is the difficulties that it causes for any possible arms control agreements in the future. However, there seems little likelihood of progress in these areas until there is more trust and understanding between nations and much more commitment to the common development of space technologies for the benefit of all.

The USA seeks military domination in space
Vladimir Kozin

The article contains an analysis of the most recent U.S. activity in outer space that is gradually transforming it into a warfighting battlefield. It assesses the evolution of Washington's current policy in space, and outlines its basic military and political elements. It also examines its financial resources that are to be allocated to guarantee unfettered U.S. access to space. Special attention is given to intelligence gathering systems and space-based striking elements deployed in space. The author is of the opinion that uncontrolled weaponization of space and any quest for unilateral dominance in outer space will constitute the basis for an arms race of a qualitatively new type – the space-borne arms race.

China's nuclear weapons strategy and modernization program
Hui Zhang

Recently published documents, news reports, and other open-source information indicate that China is accelerating its current nuclear force modernization program. It is clear that it is driven largely in response to the growing U.S. missile defense program, which China perceives as a threat to its current minimum credible deterrent. While China is not altering its nuclear doctrine, it believes that it needs to enhance the reliability, survivability, and effectiveness of its retaliatory capability in response to a first-strike.

In addition to expanding the size of its nuclear arsenal, it is enhancing its delivery capabilities, for example, by increasing the number of ICBMs and making them more sophisticated. It is building more Multiple Independently Targetable Reentry Vehicle (MIRV) warheads as well as a new class of ballistic missile submarines. China's ongoing nuclear modernization aims to increase the survivability, reliability, safety, and penetration capability of its small nuclear arsenal and thereby assures a limited, reliable, and effective counterattack capability that will deter a nuclear first -strike. China's nuclear modernization program will likely continue to be guided by its nuclear policy, which is characterized by a no-first-use pledge and a commitment to "minimum nuclear deterrence." Finally, while China supports the total elimination of nuclear weapons, it does not believe it is in China's interest to participate in discussions about nuclear disarmament until U.S. and Russia reduce their arsenals to one thousand each, or lower.

The X-37B: Backdoor weaponization of space?
Subrata Ghoshroy

After spending 674 days in space, the military space plane known as the X-37B returned to Earth in October 2014. But no one really knows what its purpose was, or what it had been doing all that time, leading to all kinds of guessing in the popular press. Photos show something that looks like a baby space shuttle, and television newscasts suggested it could be a space bomber or a satellite meant to spy on other satellites. Using publicly accessible documents, the author attempts to piece together the plane's likely mission, and writes that the X-37B illustrates the United States' continuing interest in militarizing space and, possibly, weaponizing it in the future. He argues that such an approach inadvertently harms the security of the United States' own space assets.

International Control of Delivery Systems: Towards a Ballistic Missile Ban

Jürgen Scheffran

The proliferation of delivery systems is one of the critical issues of nuclear non-proliferation and arms control. Sophisticated delivery systems are costly and difficult to produce, and are visible parts of a nuclear weapon. Therefore, the control of nuclear-capable delivery systems would be an important step toward reducing the nuclear threat. When after the Cold War the huge nuclear and missile arsenals became obsolete, this offered an opportunity for effective missile controls. To reduce the missile threat and prevent destabilizing military reactions to missile proliferation such as ballistic missile defense, a pathway towards a nuclear-weapon-free world would be combined with controlling nuclear-capable delivery systems. It is reasonable to focus control on sophisticated systems like ballistic missiles, airplanes, cruise missiles and drones, which are explicitly designed for their military purpose.

Diplomatic initiatives are required to reduce the role of delivery systems in critical regions (Northeast Asia, South Asia, Middle East) and to develop an international norm. The most immediate candidate for control are ballistic missiles, which are perceived as especially threatening and provoke the development of ballistic missile defense. Facing technical difficulties and lengthy development periods for advanced ballistic missiles and missile defenses, there is a chance to contain the emerging missile race through a comprehensive international missile control regime. A Zero Ballistic Missiles (ZBM) regime has been proposed for the complete elimination of offensive ballistic missiles and combines unilateral declarations with regional and global multilateral agreements. A crucial aspect in the control and disarmament of delivery systems is verification which can build on an international monitoring system, including inspections and remote sensing on satellites, aircraft or on the ground.

ix. Acknowledgement

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We would like to express our sincere gratitude to all the contributors who so graciously accepted our invitation and contributed thoughtful and important articles.

As the coordinator of the MBMDS Working Group and the editor of this report, Subrata extends his personal thanks to each and every member of the group for writing one or more articles for the report, and for their patience, and understanding throughout this long ordeal. However, in the end, we would not have been able to complete the task but for the additional collective effort of three original members of the working group, who helped Subrata pull it together by writing, editing, proof reading the text, and serving as peer reviewers. They are Dave Webb, Claus Montonen, and Jürgen Scheffran. Together, they contributed much in enriching the content and helped improve the quality. Lucas Wirl deserves much credit for the design, layout, and production of the printed brochure and the accompanying on-line version of the full report. Kristine Karch ably managed our meagre finances and responded promptly to our many questions, while holding down a full-time day job as a computer scientist.

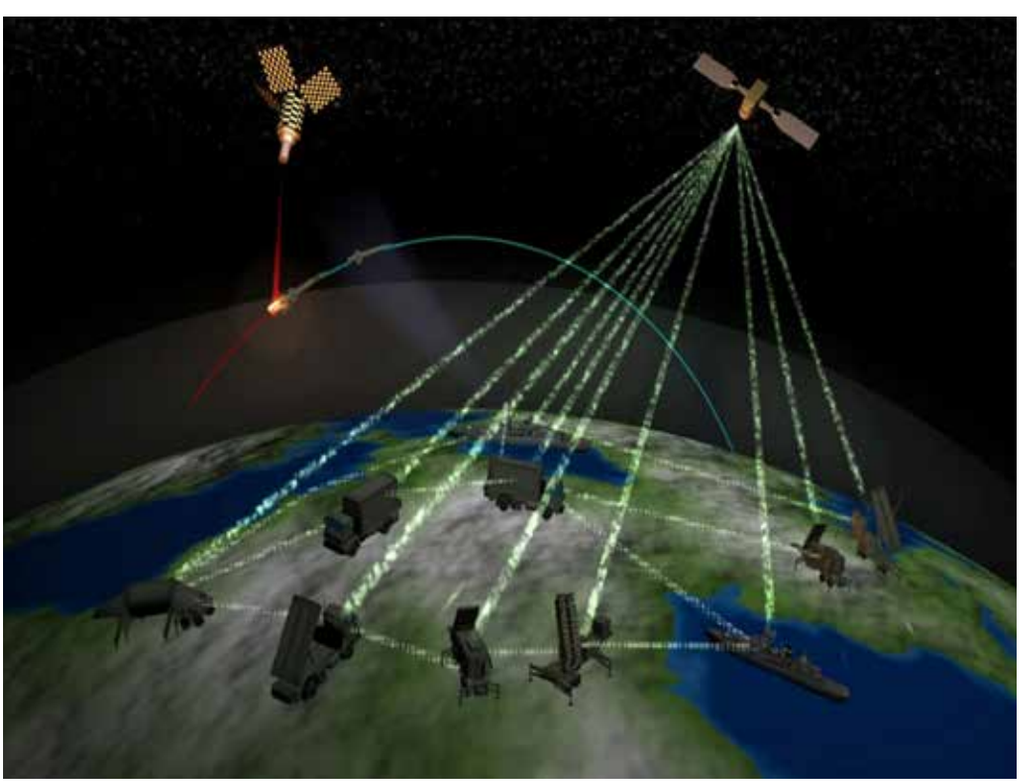
Finally, Subrata wrote the executive summary. Although, the editorial board

members kindly reviewed the text for accuracy, they may not necessarily agree with everything. Claus Montonen and Dave Webb deserve special thanks for kindly reading through the document one more time at the end, and discovered typos and other mistakes. Any remaining mistakes are solely the Editor's responsibility. I apologize in advance for them.

x. Illustrations

Note: The figures refer broadly to the specific chapters in the full report, as noted.

1.
Space-based missile defense redux?
Chapters 10 and 12 (Webb/Scheffran), Chapter 13 (Kozin)



2.
Global Hypersonic Weapons Projects

Chapter 10 (Webb, Scheffran) and Chapter 13 (Kozin)

3.
Space is already filled with orbiting junk.
Warfare in space would be catastrophic
Chapters 10 and 12 (Webb/Scheffran)

4.
X-37B before launching and after ground tests–
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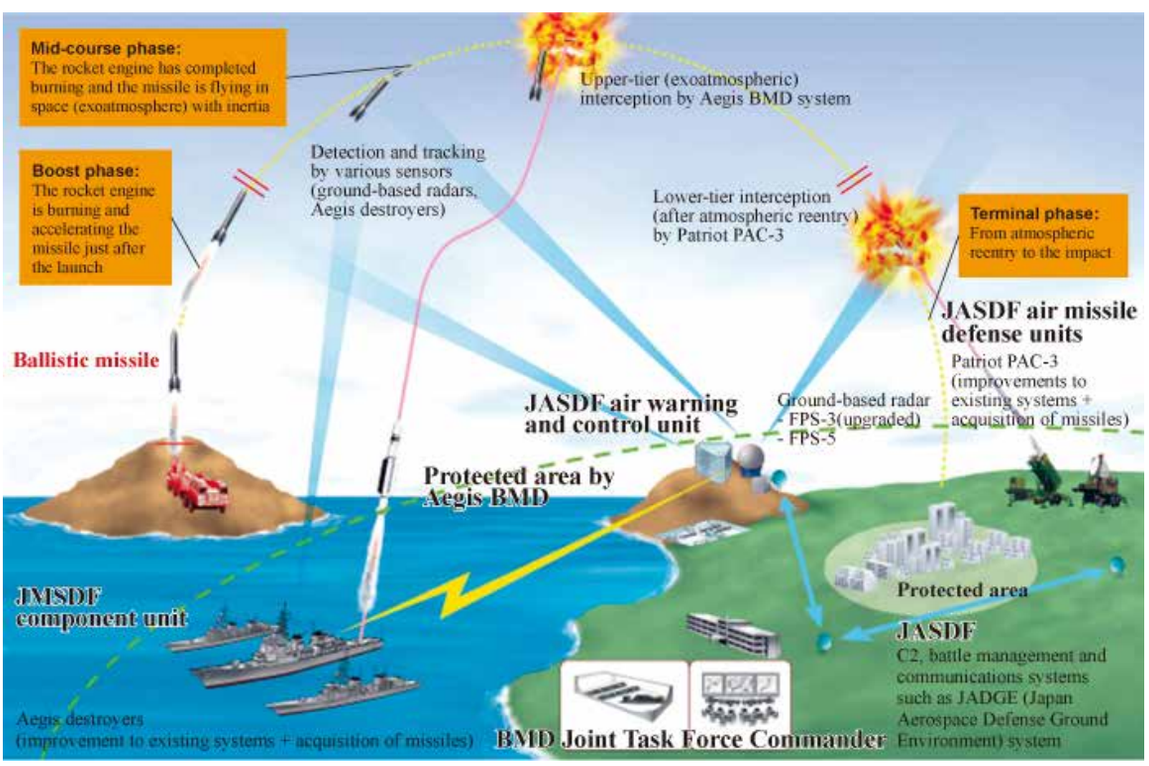
Chapters 10 and 12 (Webb and Scheffran), Chapter 13 (Kozin), Chapter 15 (Ghoshroy)
Pubic Domain

5.
Star Wars Video Game
Chapter 9 (Zoppe)

6.
Ballistic missile defense concept for Japan with US collaboration
Chapter 6 (Ikegami)



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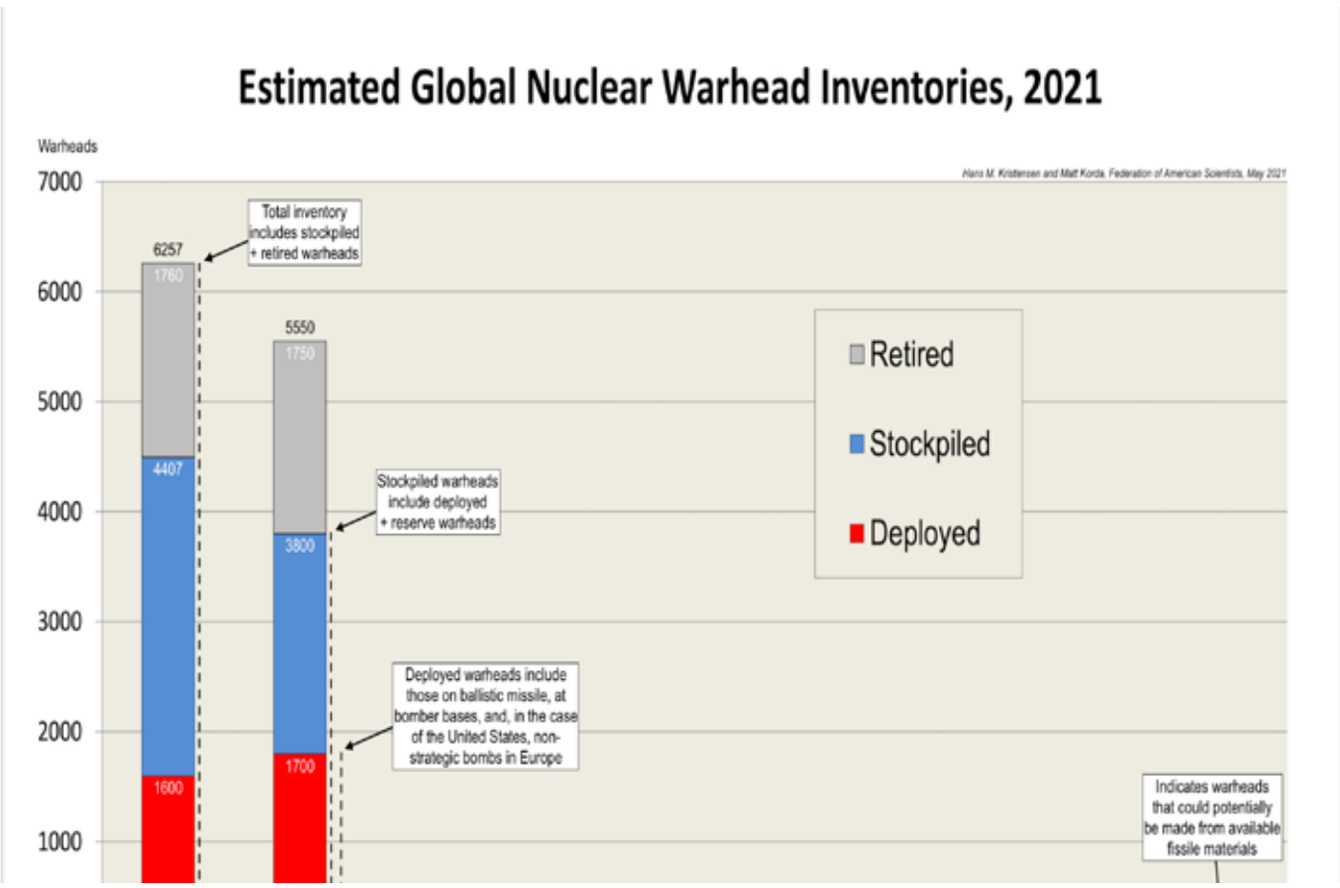
8.
NATO/US ballistic missile defense employing U.S. Aegis system
Chapter 5 (Neuneck), Chapter 7 (Kozin)

9.
NATO Ballistic Missile Defense architecture

Chapter 5 (Neuneck), Chapter 7 (Kozin)

10.
Global Nuclear Warhead Inventories, estimates 2021

Chapter 14 (Zhang)



xi. Missiles, Missile Defenses and Space Weapons as Obstacles to Nuclear Disarmament

NGO Statement to the
NPT Prepatory Committee Meeting 2017 in Vienna

International Network of Engineers and Scientists for Global Responsibility (INES)

Missiles, Missile Defenses and Space Weapons as Obstacles to Nuclear Disarmament

The opportunities for nuclear disarmament after the end of the Cold War were missed. Although the number of nuclear weapons of the United States and Russia have been reduced, there are still more than 15,000 nuclear weapons that threaten life on Earth. The number of nuclear weapon states has increased and new conflicts emerged, from Yugoslavia and the Iraq war to the civil wars in Afghanistan, Ukraine, Syria, Libya and other African nations, aggravated by the quest for expansion and dominance. Terror attacks, refugee movements and climate change are contributing to the world's instability. Grave concerns are justifiably held concerning the spiraling threats of missile proliferation, missile defense and space weapons programs, which are increasing the likelihood of nuclear war and are major obstacles to nuclear disarmament.

1. Nuclear weapons could be delivered by various systems, including aircraft, ballistic missiles, cruise missiles, artillery, and unmanned aerial vehicles. Ballistic missile technology has spread to more than 30 countries, many of which have access only to short range missiles. For the time being, only the five nuclear weapon states in the NPT have Intercontinental Ballistic Missiles (ICBMs). In addition, North Korea, India, Iran, Israel, and Pakistan have produced or flight-tested intermediate-range ballistic missiles with a range of between 1,000 km and 5,500 km. All those states continue to develop and test their missile arsenals. The United States is developing a new generation of conventional, precision-guided, long-range, hypersonic

missiles, capable of striking any target on earth within 60 minutes (Prompt Global Strike systems).

2. A number of countries are developing missile defense systems, including the United States and several other NATO members, Russia, Israel, Australia, India, Japan and South Korea. Although missile defense is still not a proven and operational technology, its development and deployment has severe negative impacts on the reduction and elimination of nuclear forces, and undermines strategic stability. US missile defense systems in Europe have poisoned the relationship with Russia and become an obstacle to the Conventional Forces in Europe Treaty, the 1987 Intermediate Nuclear Forces Treaty and the Strategic Arms Reduction Treaty. Military responses to the missile threat, such as nuclear deterrence, preemption, counter-proliferation and missile defence, may aggravate the risks of proliferation, provoke an offense-defense missile race and disrupt regional balances.

3. Outer space is turning into an arena of space warfare with military satellites, ballistic missiles, missile defenses and anti-satellite weapons, becoming integral components of war-fighting on Earth. Advanced space weapons, such as kinetic kill vehicles, conventional and nuclear explosives, maneuverable space mines and micro-satellites, and the use of particle, microwave and laser beam technologies, increase vulnerabilities and threats. Transforming space from the “common heritage” of humanity into a “high frontier” for space warfare where weapons are used “to, from, in and through” space, contains considerable risks for all states, making attempts to defend “space assets” potentially obsolete.

These highly complicated and destabilizing arms races increase the risk of nuclear war in the regional crisis hot spots of the Middle East, South Asia and Northeast Asia. The military standoff between the United States and North Korea on the Korean Peninsula could incite the whole region into nuclear war. Similar concerns exist in the wicked conflict over Syria. These developments have become obstacles for nuclear disarmament, blocking progress among major powers.

Since the NPT Review and Extension Conference of 1995, the nuclear weapon states did not fulfill Article 6 to end the nuclear arms race but rather intensified it by the modernization of their nuclear arsenals. The Anti-Ballistic Missile (ABM) Treaty was abandoned by the US in 2002, the INF Treaty and strategic arms reduction agreements are at stake.

In the dark age for nuclear disarmament the negotiations on a Ban Treaty allow all states of good will to move towards a nuclear-weapon-free world, without waiting for the nuclear weapon states and their allies. This approach can also serve as a basis for the international control of missiles, missile defenses and space weapons.

1. The NPT preamble emphasizes "the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a Treaty on general and complete disarmament under strict and effective international control", but does not specify how to achieve this ultimate goal. Besides US-Russian agreements, there are no treaty constraints on the acquisition, development, testing and deployment of missiles. The 1987 Missile Technology Control Regime and related mechanisms are largely based on export controls among potential missile suppliers, but their effectiveness is limited if motivation to acquire missiles persists. To reduce emerging missile threats will require a ban on certain missile types, as suggested by a multilateral INF Treaty. In 1996, the Canberra Commission called for a "global treaty controlling longer range ballistic missiles" and the exploration of a missile flight test ban which would effectively prevent modification or new missile designs.

2. A "missile freeze" could cover offensive and defensive missiles, extending a control regime on ballistic missiles to the international control of ballistic missile defense systems, reversing the US withdrawal from the ABM Treaty and fulfilling the 2000 NPT commitment to preserve and strengthen that Treaty.

3. Prevention of an arms race in outer space is more effective, less complicated and less expensive than any measures undertaken once an arms race is under way. A comprehensive approach to space arms control would go beyond specifying rules of the road and instead ban weapons that target space objects, space objects that target others or the Earth below, and prohibit the development, testing, and deployment of such systems before more advanced weapons become operational.

All governments should support the establishment of international controls on delivery systems and missile defense systems as part of a global process of reducing and eliminating nuclear forces, banning weapons in space and generally limiting strategic weapons. All nations with these common goals should formulate international laws that put increasing pressure on the major powers.

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