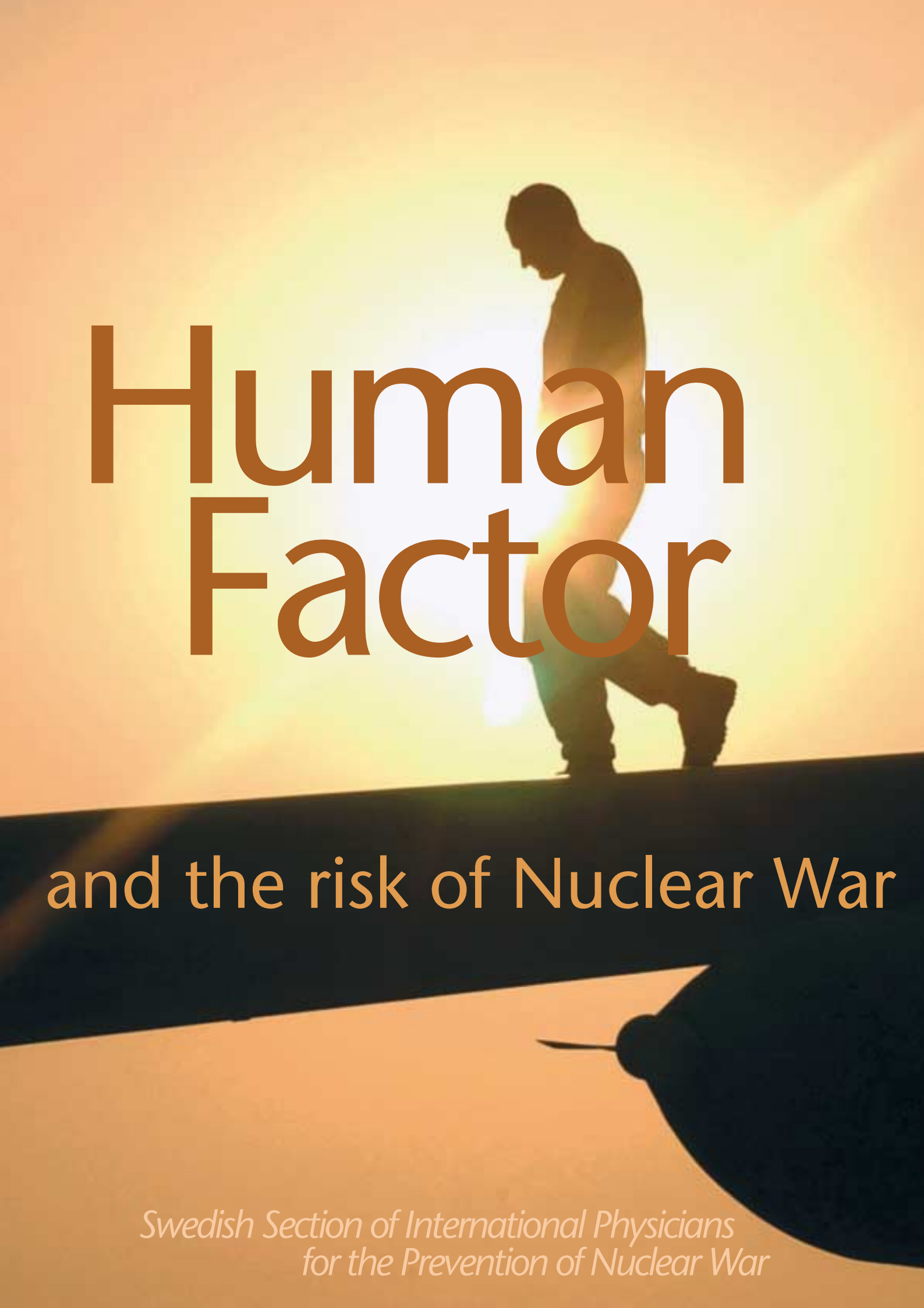


Human Factor

and the risk of Nuclear War

Swedish Section of International Physicians
for the Prevention of Nuclear War

Human to Err

Christina Vigre Lundius

"*We have created a world in which perfection is required if disaster beyond history is to be permanently avoided. But in the world of human beings, perfection is unachievable. The more weapons we deploy and the greater their geographic dispersion, the more people will be interacting with them. And the greater will be the likelihood of disaster resulting from human error."*

Prof. Lloyd J. Dumas, Bulletin of the Atomic Scientists , Nov. 1980

In the fall of 1999, I once again found myself in Moscow. Leo Feoktistov, one of the foremost scientists who had worked on the development of the Soviet nuclear bomb, had written a book, "*Nukes Are Not Forever" in* which he speaks strongly for the abolition of all nuclear weapons.

I had become friends with Academician Feoktistov during a voyage aboard the *M/S Anna Akhmatova* to the nuclear weapons testing ground on *Novaya Zemlya.*

Together with a colleague from Germany, I was invited to the Russian Ministry of Defense for a discussion, as our organization has been on several previous occasions. This time we met with leaders of the Nuclear Risk Reduction Center. As the millennium change was close at hand, we discussed the possible risk associated with the computers. I asked the general in charge of the center if nuclear weapons are really needed, and he answered: "Mankind does not need nuclear weapons, but while they continue to exist we have to increase their safety."

After our discussion we were shown the center which monitors all of the radar stations that are keeping an eye on the Russian borders.

In my work as a physician I deal with problems of shift work and its consequences and risks. I inquired about the working hours for the people manning the monitors and telephones, and was told that they worked for 24 hours without sleep!

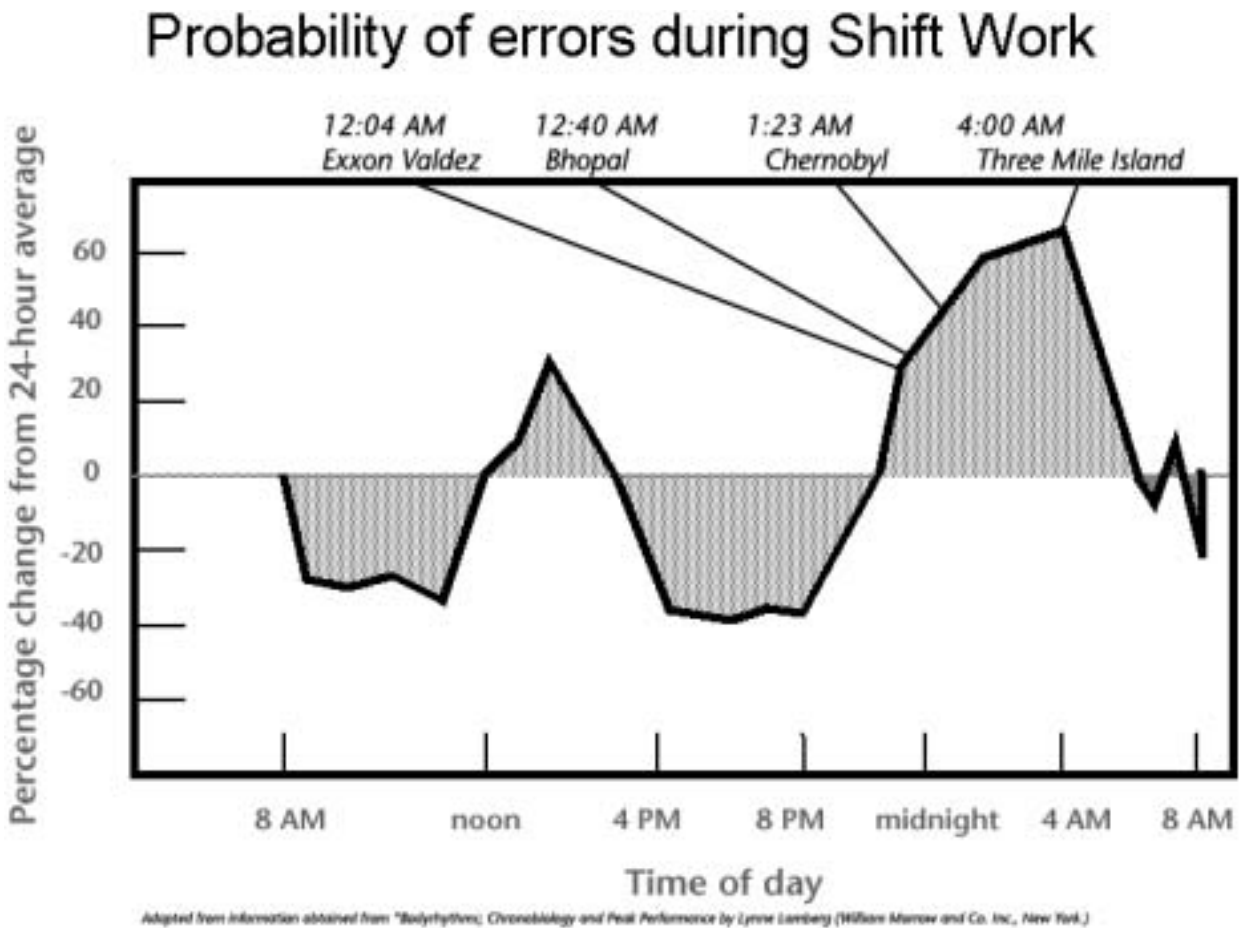
My duties and my experience tell me that night time work increases the risk of accidents and mistakes. We also know that at the end of a 16 hour shift, the accident rate increases threefold. A 24 hour shift must increase the risk even further.

I thought about major accidents such as Chernobyl, Three Mile Island and Exxon Valdez that all have been linked to fatigue during night work.

The night shift workers in the company in which I am employed say: "To fall asleep during the night shift is normal, if only for a few seconds or minutes. Especially if you have a monotonous

task, or if you work alone."

As a young hospital doctor, I personally experienced very long work hours, up to 48 hours or more, and I have felt how easy it is to fall asleep, or to make bad judgements.



Many major accidents happen at night. This was the case on Good Friday 1989 when the Exxon Valdez oil tanker ran aground at Bligh Reef, Alaska, the December 1984 gas leak at Union Carbide's chemical plant in Bhopal, India, the March 1979 and April 1986 nuclear power plant accidents at Three Mile Island in Pennsylvania, U.S. and Chernobyl, Ukraine. Numerous reports have found that night time work, and long work hours increases the risk of accidents and mistakes. At the end of a 16 hour work shift, the accident risk increases threefold.

At the Nuclear Risk Reduction Center, there was a sincere interest in continuing our contacts. I knew that neuroscience studies at the Karolinska Institute in Stockholm have shown links between sleepiness and fatigue, and human mistakes and increased risk of accidents. We agreed to continue an exchange of seminars on these subjects, as well as to encourage further studies on the influence of alcohol, drugs and psychological factors and disease.

We were in total agreement: To err is human, but we must do all we can to prevent human mistakes that could lead to an accidental nuclear detonation or nuclear war.

Christina Vigre Lundius, *M.D. and board member of SLMK, the Swedish Section of Internationl Physicians for the Prevention of Nuclear War*

A Global Catastrophe

Gunnar Westberg

"During our long periods cruising deep in the ocean, often for several weeks, I rarely got more than a few hours of sleep per night. For several days I stayed on the bridge, keeping awake with coffee and vodka. There were times when I was so tired, I found it difficult to see which lights were green and which were red on the instrument panel. And, yes, during this period I and my crew had the capability to launch our missiles with more than a hundred nuclear charges.

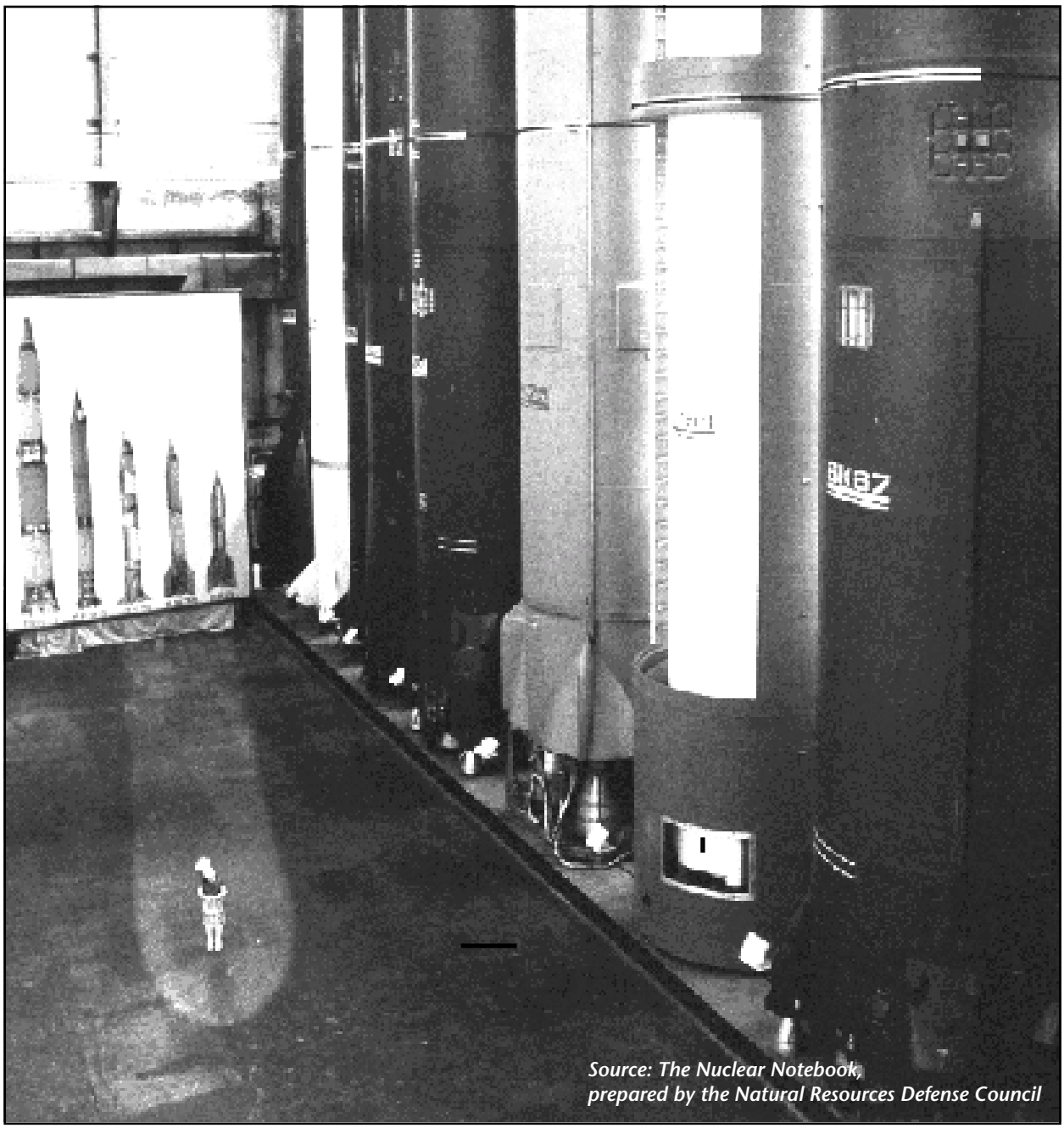
Retired Soviet Admiral, with many years of service as a submarine commander, as told at an IPPNW meeting in Moscow.

At this moment several thousand intercontinental missiles charged with nuclear warheads are on hair trigger alert, almost all of them in Russia and the United States. If satellite or border surveillance systems show that a country is being attacked by strategic nuclear weapons, the plan is to "launch on warning," so that the land/based strategic missiles will be on their way long before they can be destroyed in their silos. The result of such a launch would be destruction of all human civilization, maybe all humankind. At the press of a button. The time available to evaluate the information - real attack or technical snafu – and to make the decision to exterminate mankind would be approximately ten to fifteen minutes. And how is it determined whether a massive nuclear attack is truly in progress, or simply a computer glitch or perhaps a few rockets fired in misjudgment?

No man or woman should have to bear this responsibility.

During the terrible time of the Cold War, for more than thirty years, we all felt threatened by the possibility of a nuclear war by mistake. In his book, *"The Limits of Safety"* Scott D. Sagan cites many incidents which might have ignited a nuclear holocaust. These were mishaps only on the U.S. and NATO side of the equation. Many dangerous incidents more are unknown. Examples of a few frightening situations are described below.

Now that the Cold War is over, the risk for an accidental all-out nuclear war has lessened. However, it is not zero. Mistakes can always be made. And we have no guarantee that the present good and trusting relations between Russia and the United States will remain forever. If the relationship deteriorates, if trust and fear returns, we would be a lot safer if nuclear weapons had



Source: The Nuclear Notebook, prepared by the Natural Resources Defense Council

been abolished. If the nuclear weapons states retain their arsenals, proliferation to many other countries is inevitable. Is it really possible to believe that nuclear war can be avoided if nuclear weapons are in the hands of politicians and generals in 20 or 30 countries around the globe? Even a "limited nuclear war" might kill tens of millions of people and make large areas of the planet uninhabitable. If nuclear weapons are going to spread to many countries, the least the established nuclear powers can do is to set an example by removing their nukes from high alert and persuading all "new" nuclear weapons countries to do the same.

In recent years some nuclear weapons countries have, in defiance of international law, declared that they may consider using their weapons even if they have not been attacked with such weapons. This theory of "First Strike" dramatically increases the risk for misunderstanding and mistakes.

Proliferation also increases the likelihood that terrorist organizations might acquire or otherwise gain control of a nuclear weapon, perhaps even nuclear-armed missiles. It could well be that terrorists would use these with the intent of making a hated government believe that it has been attacked by another nuclear weapons country and thereby start a nuclear war. This might sound

like a fictional "James Bond scenario." But then, so would the September 11 attack on the United States have appeared before it happened.

Examples of critical situations

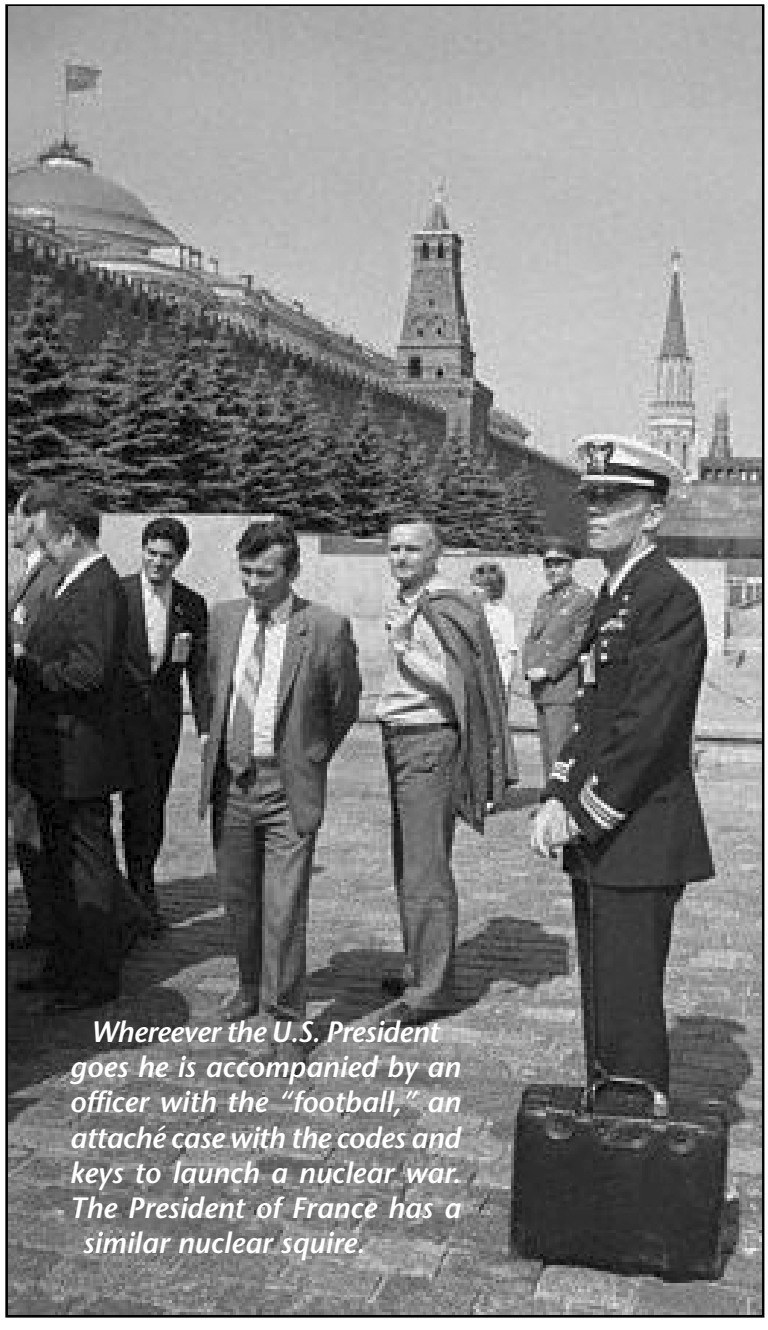
The Cuban missile crisis in 1962 may have been the most dangerous situation the world had ever experienced. A majority of President Kennedy's advisors favored an invasion of Cuba. They were not aware that the Soviet Union at that time had already installed 162 operational atomic warheads on the island. Four Soviet submarines equipped with nuclear torpedoes were also cruising in the area. In order for any of them to launch a nuclear torpedo, three officer in the submarine had to act in agreement. According to newspaper reports from a conference in Havana in 2002, one of the officers refused. His name was reported to be "Second Captain Vasili Arkipov." Perhaps it should be recorded in history books. He may have saved the world.

On November 9, 1979, duty officers in four separate U.S. command centers observed a radar pattern indicating a large number of Soviet missiles in a full-scale attack on the United States. During the ensuing six minutes, full scale preparations for a nuclear retaliation were made. A U.S. Senator, who happened to be present in the command center, reported afterwards of "absolute panic" in the center. A check of the U.S. satellites by the NORAD command thankfully showed that they were functional and no Soviet rockets were in flight. If, by chance, several satellites had been out of contact or malfunctioning at that moment the situation could have been deadly.

The misinformation was caused by an exercise tape running on the computer system.

On a September night in 1983, the monitors in a Soviet command center suddenly showed a picture of first one, then five, intercontinental missiles approaching Soviet territory from the United States. The observation was reported by the officer on duty, Colonel Stanislav Petrov, to his superior. Petrov, however, also expressed that he believed the observation to be in error, as there was at the time no reason for a U.S. attack. If the political situation had been more tense, preparations for a Soviet missile launch would have been made, risking a similar reaction on the U.S. side. Escalation to a nuclear war could have followed.

We have been lucky so far, but we will not know beforehand when our luck has runs out.

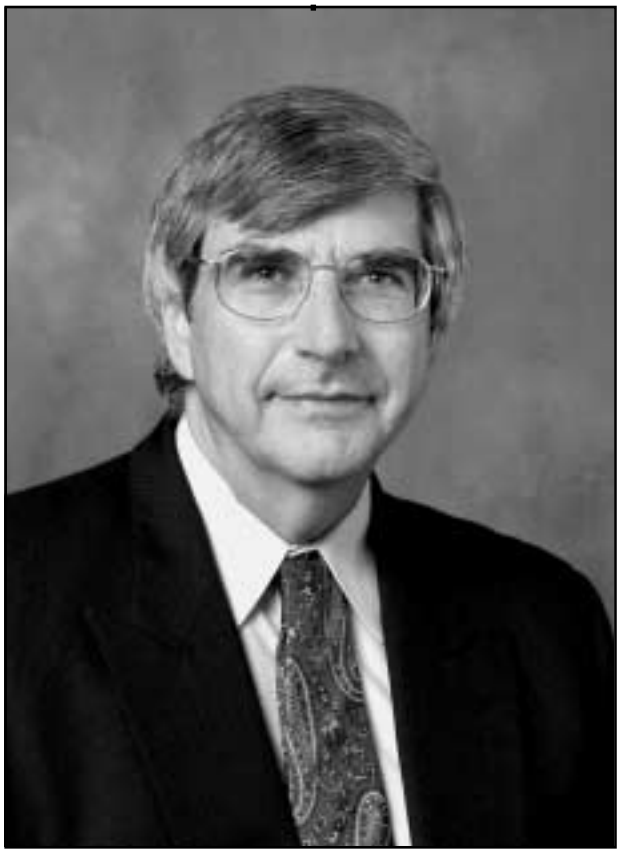


Whereever the U.S. President goes he is accompanied by an officer with the "football," an attaché case with the codes and keys to launch a nuclear war. The President of France has a similar nuclear squire.

Gunnar Westberg, *Professor of Medicine at the University of Gothenburg, and also President of SLMK, the Swedish Section of International Physicians for the Prevention of Nuclear War.*

Lethal Arrogance

Ordinary mistakes can have extraordinary consequences. Dialing the wrong number on a telephone is easy. It happens every day. But entering the wrong numbers into an airplane's navigational computer, can result in a disaster. Lloyd J. Dumas, professor of political economy at the University of Texas at Dallas and author of Lethal Arrogance: Human Fallibility and Dangerous Technologies, has studied the impact of human error for many years.



On April 26, 1986, something went terribly wrong at the Chernobyl nuclear power plant. It was known to be poorly designed, and could be dangerously unstable. But rather than correcting the problems, stricter rules were implemented.

"The new regulations did not make much difference on that April morning, since six major safety systems had been disconnected on purpose," Dumas says. "It was the deputy chief engineer, the person in charge of the operation, who was mostly responsible for breaking the rules. This is an example of a poorly designed facility, and of bad management decision making that caused serious trouble."

The American chemical company Union Carbide's facility in Bhopal, India, had a well constructed security system. But on December 3, 1984, a giant cloud of poisonous methylisocyanate gas rose from the plant and spread over the city. The toxic fumes killed at least 2,000 people and injured more than 200,000.

"That day, workers had siphoned off refrigerants from the tank where the methylisocyanate was stored, disabling the refrigeration system, designed to keep the chemical safe by keeping it cool."

"At the same time, maintenance workers shut off the scrubbers, designed to prevent toxic gases from being vented. Yet another group shut down the torch, designed to burn any toxic

Union Carbide's facility in Bhopal, India.

that managed to get by the scrubbers, in order to repair corroded pipes."

"In all, three out of four security systems were turned off. Simultaneously," says Lloyd Dumas.

Boredom, stress or anticipation

Boredom can be another reason for humans to err. A monotonous job can lead to boredom and to a dangerous lack of attention. People also sometimes become unreliable because they start using alcohol or drugs to battle boredom. Other try to cope by sleeping on duty or trying to stay awake by playing games to take their minds off the boring routine.

Boredom itself can be stressful and high stress is another important reason why people make mistakes. Human error is also more likely when someone is expecting or anticipating something might happen. In a stressful situation, filled with anticipation, it is easy enough to misinterpret what you see, so that it conforms to what you expected to see, Professor Dumas says.

In 1987 the American warship *USS Stark* was attacked by the Iranian Air Force, and 37 sailors were killed.

The following year, the *USS Vincennes* was involved in battles with Iranian ships in the Persian Gulf. As it got closer to July 4, the American Day of Independence, the crew aboard the American warship was on heightened alert, having been told to expect an attack.

Suddenly the Americans saw an airplane taking off from Iran. They saw it starting to dive, as if to attack. Checking civilian airline schedules, they saw no civilian aircraft that were supposed to be taking off at that time of the day. So the *USS Vincennes* fired two missiles, destroying the plane and killing everyone on board.

"As it turned out, the plane was actually a civilian airliner, flown by Iranian Airways. When the guide to the flights was checked again, it was clearly listed, right were it was supposed to be. The aircraft had also been transmitting a signal from its transponder that identified it as a civilian airplane."

Yet the crew on the *Vincennes* misinterpreted it as a fighter plane.

"The crew was obviously under a great deal of stress. They were in combat. Most certainly, they had the *USS Stark* on their minds. And when they saw that plane coming out of Iran, they believed that they were being attacked just like the *Stark* had been a year earlier. And so they misinterpreted everything to go along with that picture."

It is clear that there are major issues of human fallibility within the nuclear military. Between 1975 and 1990, 66,000 U.S. military personnel were permanently removed from duties involving nuclear weapons, because they were judged to have become unreliable. That is an average of 4,100 people per year for a decade and a half.

In his book, Professor Dumas lists no less than 89 major publicly reported nuclear arms-related accidents between 1950 and 1994. That means, on average, there was one accident involving nuclear weapons every six month over the 45 years. It is not known how many more accidents may have gone unreported.

"Very often these kinds of accidents occur within the military forces of a country, or even within an industry, and they are hushed-up. When they can, they usually are. So I consider that list of 89 accidents to certainly be an undercount," says Lloyd Dumas.

Murphy's Law says: "Anything that can go wrong, will go wrong." Professor Dumas asks: "How many mistakes have you made today? How often have you seen Murphy's Law in action? Unfortunately, Murphy's Law applies to weapons of mass destruction and other dangerous technologies as much as it applies to anything else."

According to a 1998 study by the U.S. General Accounting Office, human error was a contributing factor in almost 75% of the most serious class of U.S. military aircraft accidents in 1994 and 1995. In November 1999, the Institute of Medicine of the U.S. National Academy of Sciences issued a report finding that medical errors cause more deaths each year in the United States than breast cancer or AIDS.

Waking up to the Real Threats to Security in the Post-Cold War World

Lloyd J. Dumas

When the Cold War ended more than a decade ago, we all breathed a collective sigh of relief. We knew the world had not suddenly become a peaceful place, but a least we had managed to bring the nuclear arms race to a close without the nightmare of a nuclear war. By a combination of good sense and good luck, we had somehow managed to exorcise the terrifying specter that had haunted all of us since that mushroom cloud first rose into the morning sky over Hiroshima.

Of course we knew the arsenals of nuclear weapons had not disappeared. But that was just a matter of time, a final detail, a footnote to the history of history's most dangerous arms race.

Especially in America, now the only global superpower, with the world's mightiest military to protect us, and our former Cold War rivals rapidly receding from center stage, there was a feeling that our homeland was finally secure.

Then came September 11th, 2001. The devastating terrorist attack that struck the United States on that day, shattered New York's massive World Trade Center, a piece of the Pentagon, thousands of innocent lives and the illusion that sophisticated technology and powerful weapons could keep us safe.

Thousands of ordinary people going about their day-to-day lives became the victims of an enemy who cared nothing about our fleets of warships, bombers and missiles, who was undeterred by a nuclear arsenal capable of turning any country into rubble within hours – an enemy who turned the fruits of our won technology against us. Over 33 years, more than 14,000 international terrorist attacks by sub-national groups around the world had taken a total of 9,000 - 10,000 lives. In one terrible day, almost 3,000 new victims were added to the list.

It had been 135 years – more than six generations – since this kind of deliberate slaughter was seen on the mainland of the United States. It became natural for Americans to assume that this was something that always happened somewhere else. Now we know that the U.S. is vulnerable, too.

While the American illusion of invulnerability has been shattered, there is another illusion we have yet to relinquish, one we share with much of the world – the illusion that a species as prone to error and malevolence as ours can indefinitely control all the technologies we create, no matter how powerful, no matter how dangerous, and permanently avoid disaster. More than just an illusion, it is a lethal form of arrogance.

No form of this illusion is more threatening to human survival than the belief that we can indefinitely maintain arsenals of devastating nuclear weapons without eventually triggering nuclear war, by intention or by mistake.

First, we will briefly explore the pervasiveness of human error, then consider the nature and genesis of accidental war. Finally, we will take a brief look at the form of malevolence that links the possibility of accidental nuclear war with what has become a daily reality of present day life -- the threat of terrorism. This link is malevolence in one of its more virulent forms, the terrorism of mass destruction.

Human Error

According to a 1998 study by the *U.S. General Accounting Office*, human error was a contributing factor in almost 75% of the most serious class of U.S. military aircraft accidents in 1994 and 1995. A 1998 study by the *Union of Concerned Scientists* of the nuclear power plants (representing a cross section of American civil nuclear industry) concluded that nearly 80% of reported problems resulted from worker mistakes or the use of poorly designed procedures. In November 1999, the Institute of Medicine of the *U.S. National Academy of Sciences* issued a report finding that medical errors cause more deaths each year in the United States than breast cancer or AIDS.

As we briefly survey some of the most important aspects of human error in dangerous technological systems, keep two key points in mind. **The first is that failures do not have to be continuous in order to be dangerous.** A drug or alcohol impaired nuclear weapons guard is not alert and ready to act the moment terrorist commandos try to break into a storage area, there could be a major disaster. Because there is no way to know when those critical moments occur, every failure of reliability must be taken seriously.

The second point is that the difference between a trivial error and a catastrophic error lies not in the error itself, but in the surrounding situation. Many of the most trivial kinds of mistakes that all of us make on a daily basis would be disastrous if made in a very different context. For example, making a telephone call begins by entering a sequence of numbers on a keypad. The sequence is fed into computers that switch the call. If we inadvertently enter the wrong number, the wrong telephone rings, and we have to redial the call. The error is trivial. But the pilots on American Airlines flight 965, headed for Cali, Colombia in 1995, made essentially the same mistake. They inadvertently entered the wrong sequence of numbers into a computer, the plane's navigational computer, and the plane steered into a mountain, killing everyone on board.

Boredom

For all the potential risk involved, much of the day-to-day work of many of those who deal with dangerous technologies is really quite boring.

Guarding nuclear weapons storage areas, going through checklists in missile silos, monitoring control panels at nuclear power plants is not all that stimulating. Boring work dulls the mind, leading to a lack of vigilance. Laboratory studies have shown that after a few weeks, people exposed to extremely monotonous living and working environments sometime experience serious mood swings, diminished judgement and even hallucinations.

The things people sometimes feel driven to do to cope with grinding boredom can also cause serious problems. They may try to distract themselves by focusing their attention on more interesting or amusing thoughts, which means they are not paying close attention to the task at hand. They may play games.

For example, in the late 1970s, Tooele Army Depot in Utah contained enough GB and VX nerve gas to kill the population of the earth one hundred times over. According to newspaper reports, the guards at Tooele sometimes distracted themselves from the boring routine by drag racing their vehicles. They played marathon card games. Arsonists once burned down an old building inside the Army Depot while guards on the night shift played poker. There were also reports of frequent sleeping on the job. Sometimes people try to make boredom more palatable by drinking or taking drugs. An American sailor who served as helmsman on the nuclear aircraft carrier *Independence* during the late 1970s and early 1980s, claimed that he used LSD almost every day *on duty*. He said it was the only way to get through eight hours of extremely boring work.

Stress

Working with dangerous technologies can also be very stressful. Sustained high levels of stress can lead to serious physical problems, such as a compromised immune system and serious emotional problems, such as severe depression and even post traumatic stress disorder (PTSD). PTSD includes difficulty concentrating, extreme suspicion of others, recurrent nightmares and emotional detachment, all of which tend to reduce reliability. At least 500,000 of the 3.5 million American soldiers who served in Vietnam have been diagnosed as suffering from PTSD, as many as 30% of them may never lead a normal life without medication and/or therapy.

Drug and Alcohol Abuse

Boredom and stress can lead to drug and alcohol abuse. Data released by the Pentagon for the years 1975-1990 show that almost 20,000 American military personnel were permanently removed from nuclear duty over that period as a result of drug abuse. Alcohol abuse added about another 7,000 to the total.

The Fallibility of Groups

One common strategy for assuring that an unreliable individual cannot cause a disaster in the nuclear military is to require that a group act together to, say, launch a missile attack. But sometimes groups can be less reliable than individuals.

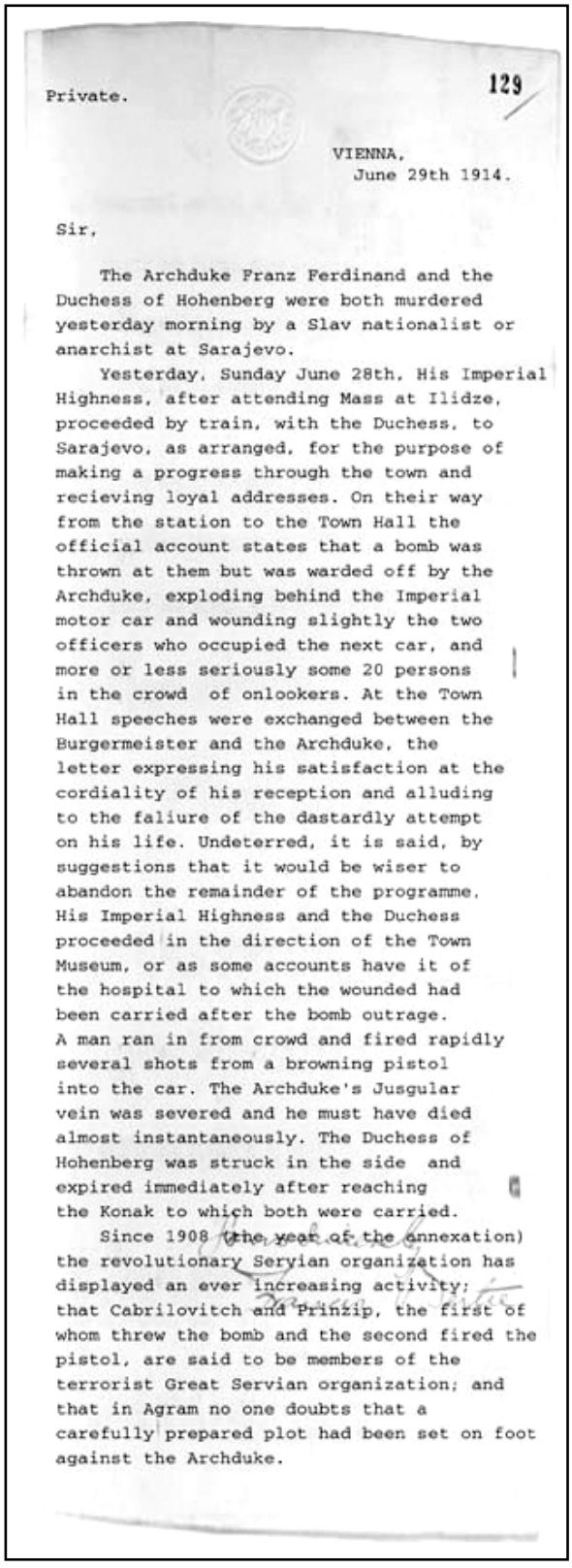
In bureaucracies, the flow of information from subordinates to superiors is often distorted. One classic example is the "good news" syndrome; subordinates edit problems out of the information they send to higher management in order to pass along a more pleasant picture. The result of all this good news is that top-level decision makers have a very distorted picture of what is really going on. And this problem tends to get worse, not better, when there is more at stake, as in organizations dealing with dangerous technologies.

"Groupthink" occurs when the quality of decisions made by a group deteriorates as a result of the pressure to maintain consensus among its members. Increasingly isolating themselves from other points of view, group members can develop an illusion of invulnerability that sets the stage for very risky decision making. For example, during the Korean War, after the North Koreans had been successfully driven out of the South by U.S.-led U.N. forces – the original goal of the war – groupthink was involved in the U.S. decision to press on and invade North Korea. Even though the Chinese threatened to enter the war if North Korea was invaded, and every member of the key American decision group believed that a Chinese entry would be a disaster for the U.S., they somehow managed to convince themselves that the Chinese would never challenge U.S. forces. They decided to invade. The Chinese made good on their threat and entered the war. They overwhelmed the American forces and drove them deep into South Korea. Years of fighting followed to regain the lost ground. That reckless, foolish decision cost millions of lives.

Group psychosis is a situation in which a crazy but charismatic leader is able to draw the otherwise sane members of a group into his or her own delusional world by isolating them and controlling the conditions in which they live. Twentieth century examples include the Reverend Jim Jones and his followers at Jonestown, Guyana, in the 1970s and David Koresh and the Branch Davidian at Waco, Texas, in the early 1990s.

Suppose a charismatic military commander, who seemed fully functional, had become deeply disturbed. With great control over the lives of troops already primed for obedience by the very nature of military life, such a commander might be able to draw them into his or her delusional world. The crew of a nuclear missile submarine is isolated for months at the time. The captain has nearly complete control of the conditions in which they live and work. And every nuclear missile submarine carries enough firepower on board to devastate any nation on earth.

In short, relying on groups does not solve the human reliability problem.



Private. 129

VIENNA,
June 29th 1914.

Sir,

The Archduke Franz Ferdinand and the Duchess of Hohenberg were both murdered yesterday morning by a Slav nationalist or anarchist at Sarajevo.

Yesterday, Sunday June 28th, His Imperial Highness, after attending Mass at Ilidze, proceeded by train, with the Duchess, to Sarajevo, as arranged, for the purpose of making a progress through the town and recieving loyal addresses. On their way from the station to the Town Hall the official account states that a bomb was thrown at them but was warded off by the Archduke, exploding behind the Imperial motor car and wounding slightly the two officers who occupied the next car, and more or less seriously some 20 persons in the crowd of onlookers. At the Town Hall speeches were exchanged between the Burgermeister and the Archduke, the letter expressing his satisfaction at the cordiality of his reception and alluding to the faliure of the dastardly attempt on his life. Undeterred, it is said, by suggestions that it would be wiser to abandon the remainder of the programme, His Imperial Highness and the Duchess proceeded in the direction of the Town Museum, or as some accounts have it of the hospital to which the wounded had been carried after the bomb outrage. A man ran in from crowd and fired rapidly several shots from a browning pistol into the car. The Archduke's Jusgular vein was severed and he must have died almost instantaneously. The Duchess of Hohenberg was struck in the side and expired immediately after reaching the Konak to which both were carried.

Since 1908 (the year of the annexation) the revolutionary Servian organization has displayed an ever increasing activity; that Cabrilovitch and Prinzip, the first of whom threw the bomb and the second fired the pistol, are said to be members of the terrorist Great Servian organization; and that in Agram no one doubts that a carefully prepared plot had been set on foot against the Archduke.

Nuclear War by Accident

In January 1987, the Indian Army prepared for a major military exercise near the bordering Pakistani province of Sind. Because Sind was a stronghold of secessionist sentiment, Pakistan concluded that India might be getting ready to attack and moved its own forces to the border. The two nations had already fought three wars with each other since 1947. Both of them were now nuclear-capable; Pakistan was widely suspected of having clandestine nuclear weapons. The build-up of forces continued until nearly one million Indian and Pakistani troops tensely faced each other across the border. The threat of nuclear war hung in the air as they waited for the fighting to begin. Then, after intense diplomatic efforts, the confusion and miscommunication induced by human error began to clear and the crisis was finally defused. India and Pakistan had almost blundered into a catastrophic war by accident.

In 2002, tensions once more flared between the two, as India concluded that a murderous attack on the Indian parliament carried out by Kashmiri separatists had been supported by Pakistan. Now there was little question that both sides possessed arsenals of nuclear weapons and missiles that could be used to deliver them. Threats and counter-threats filled the air. A small misstep, a human error induced misinterpretation, and those missiles might have begun to fly. Pakistan and India share a border with China (some of it in the region of Kashmir), which has a much larger nuclear arsenal. Aside from the catastrophic loss of life that would result from a nuclear war between the two, if one of those nuclear-armed missiles accidentally landed in China the world could have been drawn into a much larger conflagration. And the whole chain of events could easily have been set in motion by human error.

Is this exaggeration? Do we have any real evidence that a disastrous war can actually be started by mistake? Think back to 1914. Two alliances of nations were locked in an arms race, faced off against each other in Europe. Both sides were armed to the teeth and convinced that peace would be maintained by the balance of power they had achieved, despite the growing tensions.

Then on June 28, 1914, Archduke Ferdinand of Austria-Hungary and his wife were assassinated by a Serbian nationalist. The assassination set in motion a chain of events that rapidly ran out of control of Europe's politicians and triggered a war that no one wanted. By the time it was over, nine to eleven million people had lost their lives. Yet the whole thing might have been prevented, but for a simple failure of communications.

The Kaiser had sent the order that would have stopped the opening attack of World War I (the German invasion of Luxembourg on August 3, 1914) before it was to begin. But the message arrived thirty minutes late. In a classic understatement, the messengers who finally delivered the belated order said, "a mistake has been made."

For an accidental nuclear war to occur, there has to be a triggering event. During the nuclear age, there have been many serious false warnings of nuclear attacks that could have played a key role in unleashing nuclear forces by mistake.

For example, in 1995, Russian warning radars detected a rocket rising from the Norwegian Sea that appeared to be a U.S. submarine-launched Trident missile targeted at Moscow. The warning was relayed all the way up to President Yeltsin, who had only a few minutes to decide whether to launch a nuclear attack in response. Fortunately, the Russian military determined that they had made an error in projecting the missile's trajectory. It was headed far out to sea, not targeted on Moscow. The rocket was American, but it was not a Trident missile. It was a scientific probe designed to study the Northern Lights. The Russian government had been told of the launch, but apparently "a mistake had been made," and word never reached key military commanders.

Today, a decade after the Cold War, we still keep much of the U.S. nuclear force on high alert, increasing the probability of accidental war.

It is also possible that a sufficient deadly terrorist attack could trigger an accidental nuclear war. Consider the following: 1) the U.S. has declared a loosely defined "war on terrorism" and demonstrated a propensity toward using massive military force in response to terrorist attack; 2) President Bush has officially cast the nations of the world into two camps, by publicly declaring that all countries are either "with us or with the terrorists"; 3) the Pentagon's (January, 2002) *Nuclear Posture Review* has led to speculation that we may be ready to use tactical weapons as "bunker busters" and the like in future military assaults against nations the U.S. considers to be "with the terrorists." Under these conditions, a mass destruction terrorist attack on U.S. soil might lead to a military counterattack involving nuclear weapons against a country we supposed or assumed had aided or encouraged the terrorists, when they actually had not. Could terrorists actually launch such an attack?

The Terrorism of Mass Destruction

There are two basic ways that terrorists might carry out an act of mass destruction. One is to use weapons of mass destruction that they have built, bought or stolen. The other is to stage a conventional terrorist bombing of a toxic chemical plant, a nuclear power plant or a toxic chemical or nuclear waste storage area.

On April 23, 2002, the New York Times reported: "A top leader of Al Qaeda now in custody has told American interrogators that the terrorist group is close to building a crude nuclear device and may try to smuggle it into the United States." He was apparently talking about a "dirty bomb," a conventional explosive wrapped in radioactive material. But terrorists could do better than that. All the information necessary to design a nuclear bomb has been available in the public literature for decades. More than twenty years ago, two undergraduate students - one at Princeton, one at M.I.T. - independently designed workable nuclear weapons using only publicly available sources. In 1996, Time Magazine reported that seventeen scientists at Los Alamos Nuclear Weapons Labs had been given the assignment of designing AND building terrorist-type nuclear weapons using "technology found on the shelves of Radio Shack and the type of nuclear fuel sold on the black market." They successfully assembled more than a dozen "homemade" nuclear bombs.

If the terrorists who bombed New York's World Trade Center with airliners had used even a crude, inefficient nuclear weapons instead, the death toll would not have been in the thousands, it would have been in the tens off thousands.

Terrorists might also be able to steal – or buy – a well-designed, ready-made weapon. In 1997, on American television, Russian General Alexander Lebed claimed that Russia had lost track of some 100 "suitcase" nuclear bombs. On April 23, 2002, the New York Times reported: "The White House cut 93% of a recent [$380 million] request by the [U.S.] secretary of energy for money to improve the security of [American] nuclear weapons and waste."

What about conventional attacks against nuclear facilities? In early 2002, the U.S. reported that it had found diagrams of nuclear power plants in suspected terrorist hideouts in Afghanistan.

We may have already had a very close call. The fourth jetliner, the Boeing 767 that crashed near Somerset, Pennsylvania, during the barrage of hijacking on September 11, flew out of the East Coast headed west and slightly south. After it was hijacked, it looped around and headed east again, and apparently went down when the passengers and crew fought the hijackers.

When the plane crashed it was headed toward, and only about 120 miles (about fifteen minutes flying time) from the Three Mile Island nuclear power plant.

The Nuclear Regulatory Commission has admitted that the containment of American nuclear power plants were not designed to withstand the impact of a 767 flying at 500 miles per hour. If the plane had reached and crashed into the nuclear reactor at Three Mile Island, we likely would have had an American Chernobyl on our hands.

Conclusions

We humans are a very powerful and capable species, but we are not perfect, and we never will be. Our fallibility is part of what makes us human, and like it or not, we must recognize that it will always be with us. It sets inherent limits on our ability to avoid error, even disastrous error.

There are also those among us who consider human life, that physicians are trained so carefully to preserve, to be just another commodity, expendable in the quest for whatever goals they seek. Perhaps someday we will find a way to stop creating such people. But until that day comes we must remove even the possibility that they can acquire the means by which to do catastrophic damage to our species.

There are better ways to fight terrorism than with massive force, there are better ways to achieve security than through the threat or use of nuclear weapons. We are such adaptable species, there is little doubt that we can learn to use them.

We can no more avoid the binderies imposed by our fallibility than we can revoke the laws of nature. If we want to survive, let alone prosper, we must learn to live within those binderies. There is no other choice.

On March 28, 1979 a sequence of events; equipment malfunction, design related problems and worker errors, led to a partial meltdown of Unit 2 at the Three Mile Island nuclear power plant near Middletown, Pennsylvania. The main feedwater pumps stopped running, which prevented the steam generators from removing heat from the reactor. Signals available to the operators failed to show exactly what had happened, why they took a series of actions that made conditions worse by simply reducing the flow of coolant through the core.

Dr. Lloyd J. Dumas, *Professor of political economy at the University of Texas at Dallas. His research and teaching interests include: national and international security; economic development and economic transition; macroeconomic theory and the economics of military spending. His sixth book is highly interdisciplinary, "Lethal Arrogance: Human Fallibility and Dangerous Technologies."*

The Right to Human Error: the Price of the Issue

Sergey Kolesnikov
Alexander Yemelyanenkov

It is generally accepted that a human being has the right to human error. This applies equally to the housewife standing before a gas stove and the operator of complex manually operated mechanical systems. There is a clear relationship in this: the more powerful and dangerous this manually operated system is, the higher the price of human failure, and the more far-reaching the consequences.

It is even difficult to imagine the extent of the catastrophe and its consequences as a result of human error made by a team or a single operator, during the application of nuclear technology and involving nuclear weapons, including their delivery systems, based on that technology. There have been quite a few such incidents and events in recent history when everything seemed to hang on a razor's edge and man found himself face-to-face with an irredeemable calamity.

The materials of the joint research project by the Russian Committee of the "*International Physicians for the Prevention of Nuclear War*" movement, together with their colleagues from Sweden and the United States, entitled *"Incidents at nuclear installations with nuclear weapons and their consequences as a result of human error"* bear ample witness to this.

During the 1950s and 60s, the Soviet Union, as well as the United States, France and later China conducted many tests of nuclear arms and their delivery vehicles under conditions as closely resembling those on the battlefield as possible.

Ballistic missiles with nuclear warheads were launched from the central and eastern regions of the country (for example, from the Kapustin Yar and the Chita area launch pads) with the explosions of the warheads over Novaya Zemlya or in the vicinity of the Barents Sea. The trajectory of the missiles passed over some heavily populated areas and industrial sites of the country.

Flight tests of nuclear-armed anti-aircraft missiles were being conducted during the same years at the Kapustin Yar test site. The warheads were detonated at great heights (so-called high-altitude nuclear explosions, nuclear arms testing in space). The navy tested torpedoes with nuclear warheads, which were commissioned in the Russian Navy. (One such test took place in 1975 and two others in 1961). The firings were made from diesel-powered submarines of the Northern Fleet at the southern tip of Novaya Zemlya. Long-range bombers of the strategic air force frequently conducted tests and training with real drop of nuclear bombs in the Novaya Zemlya area.

Fortunately, most of these tests were successfully completed in the "regular" mode, as the military say. There were, however, some unforeseen, including some very dangerous situations.

In the mid-1950s, an accident occurred on board a Soviet military aircraft, which had taken off with a nuclear bomb for a test drop, but the aircraft had to return to base for an emergency landing with a fully activated nuclear device on board! Instructions for such a contingency did not exist.

Emergency situations (explosions, accidents, fires, technical malfunctions) occurred several times during test and training vehicle missile launches from the Tyura-Tam (Baikonur), Kapustin Yar and Plesetsk test sites.

Missile launch from the Plesetsk test site.

On January 26, 1983, a missile launched from the Plesetsk test site, fell into the middle of the Northern Dvina River near a settlement in the neighboring region. As the missile hit the ice, it exploded and caused a hole of about 100 meters in diameter. The rocket, together with the remaining unburned fuel, sank. Due to the dangerous contamination of water in the Northern Dvina (including heptyl) the water supply for Archangelsk and other inhabited places using the water supply downstream from where the rocket fell, was cut off.

One of the latest serious incidents was the explosion and fire during the test launch of a new sea-based ballistic missile that occurred at the Nenoksa (Archangelsk region) test site on November 19, 1997.

Submarine accidents

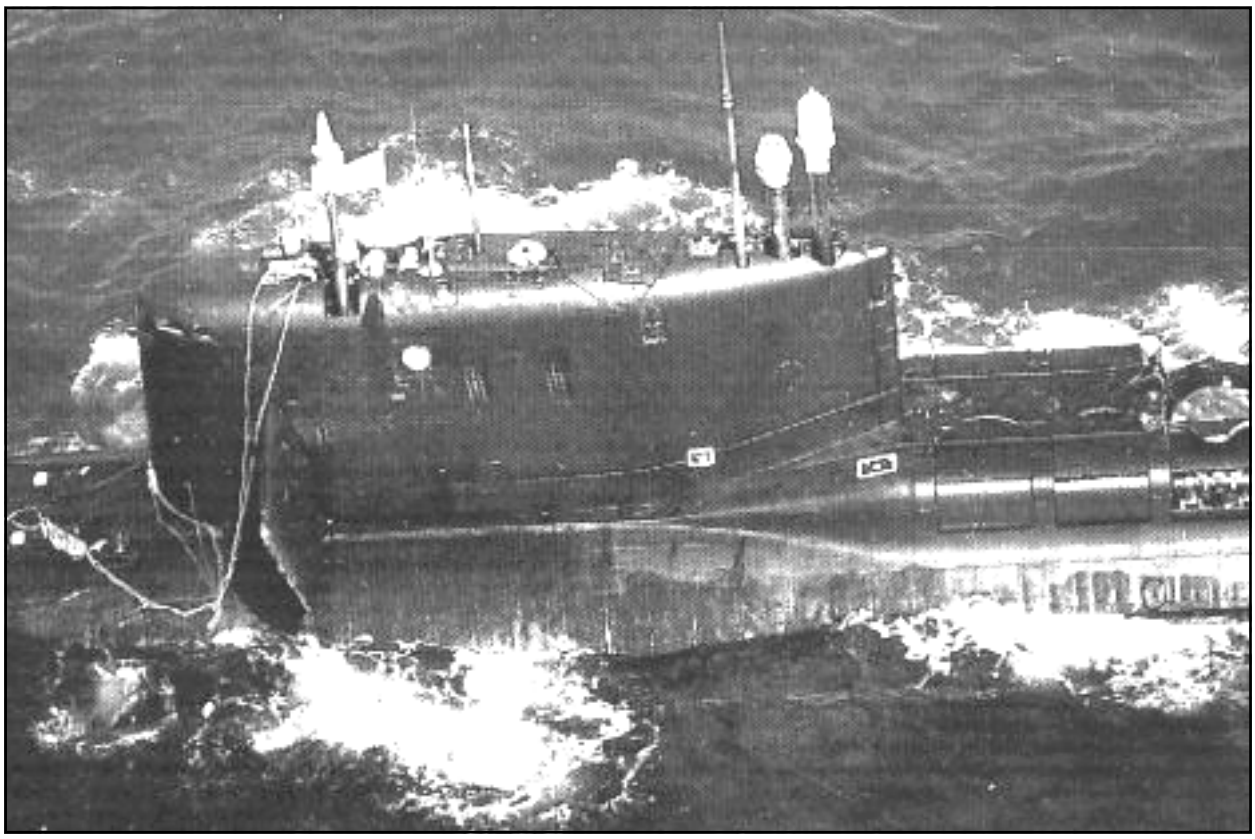
Quite a few dangerous situations occurred during sea patrol and test launches from submarines and surface ships in testing and training areas in the Barents and the White Seas (Northern Fleet) and off the Far East Coast of Russia where ships from the Pacific Fleet are based.

On June 25, 1983, the Soviet nuclear submarine K-429, with cruise missiles on board, sank at a depth of 39 meters in the training area in Sarannaya Bay (off the coast of Kamchatka) due to an error on the part of the crew. Sixteen members of the crew died. The submarine was raised on August 9, 1983.

On October 6, 1986, the Soviet nuclear submarine K-219, with two reactors and 15 ballistic missiles on board, sank off the coast of Bermuda as a result of an explosion in a missile silo. Four of the crew died.

On April 7, 1989, the Soviet nuclear submarine "*Komsomolets*" with two nuclear-tipped torpedoes on board went down in the Norwegian Sea. Forty-two crew members died.

In discussing the situation in the nuclear Navy, one has to admit that the hypothetical danger exists in reality, even during the regular refueling operations in the reactor active zones of nuclear-powered submarines (the so-called "*Operation No. 1*"). A typical example of this is the explosion in the reactor of a nuclear-powered submarine in Chazhma Bay (the Pacific Fleet) and the events that proceeded it.



On October 6, 1986, the Soviet nuclear submarine K-219, with fifteen ballistic missiles on board sank off the coast of Bermuda.

On August 10, 1985, an explosion occurred in the reactor, together with a radioactive fall-out, during refueling aboard the nuclear-powered submarine K-431, tied-up at the dockside of the Chazhma Bay naval base (military township Shkotovo-22, near Vladivostock). Ten people died as a result of the injuries they sustained at the moment of the accident - eight officers and two seamen of the emergency service. Ten people were victims of acute radiation sickness and reaction to the radiation was noted among 39 people. In all, 290 people were subjected to overdoses of radioactivity during the accident and during the clean-up operations. As a result of the explosion in the reactor, the hull of the submarine was damaged, many of the operational systems were knocked out of action, and the newly filled fuel was dumped overboard. The fire lasted four hours. The radioactive fall-out in the atmosphere was widespread - aerosol fall-out was registered at a distance of 30 kilometers from the explosion. Submarines and special-purpose vessels in the vicinity off the explosion, as well as piers, the site and industrial structures of the plant were seriously contaminated by radioactivity. The epicenter of radioactive contamination settled on the waters of the bay, particularly hard by the submarine itself - the sector where the accident occurred for a long time remained in contact with the seawater due to the hole in the hull. The fate of the sub has not been decided to this day. The nuclear fuel has not been unloaded yet.

Recently, it became known that the Chazhma Bay incident repeats almost step-by-step an accident, which had been kept secret and which happened 20 years(!) earlier, at the repair dockside in Severodvinsk. On February 12, 1965, during the refueling of the reactor active zone of nuclear submarine K-11, due to carelessness of the crew, an unauthorized start-up of the reactor took place (go-ahead, full-power) causing gas vapor emission and fire. The site of the plant, the wharfs and the waters of the harbor were radioactively contaminated. The reactor section was filled with water during the firefighting operations. As a result, 350 tons of highly radioactive water was formed. Another 150 tons penetrated into the turbine section. In order to avoid sinking the sub, the radioactive water, according to witnesses and participants of the events, was pumped overboard - right into the waters of the base.

The submarine afloat, but the reactor section had to be cut out and replaced. The reactor section, in which the accident occurred, was eventually sunk in Abrasimov Bay off Novaya Zemlya.

Transports, overloads and social factors

Another serious danger is human error on the part of the crew during operational checks of nuclear-tipped missiles and torpedoes on board surface ships and submarines.

On September 8,1997, during an operational check of the missile silos sector of the nuclear-powered submarine K-417 of the Pacific Fleet, pressure inside one of the missile silos reached a critical level due to an error by one of the operators. A leakage of fuel components began from the damaged fuselage of an intercontinental ballistic missile and the nuclear warhead (up to one megaton of destructive power) was torn off by the mounting pressure and thrown into the waters off the coast of Kamachatka. According to the evasive admissions of the participants in this event, more than a month was spent on the search and the subsequent neutralization of the warhead.

As long as nuclear arms exist, we will inevitably be confronted with other risks directly connected to them. Here is just a short list of such threats:

- High danger level during transportation of nuclear warheads and their components by rail, sea and air.
- Explosions and detonation of conventional ammunition as a result of which damage to nuclear arms devices in the immediate vicinity could occur with ensuing conflagration and scattering of radioactive components.
- Overloading of nuclear cemeteries due to sharp and massive nuclear arms reductions.

Missing deadlines for operational checks on nuclear warhead ready for action.

- Social factors (insufficient material support, alcohol and drug addicition, psychological and physiological deficiencies among the service personnel, etc.)
- Incidents at guard posts protecting missile installations on alert and at nuclear weapons storage facilities.
- The inevitable lowering of the vigilance and responsibility levels during watch on nuclear-powered submarines not at sea, but in harbor, within sight of one's living quarters. And, something which should be stressed particularly, collisions at sea between submarines with nuclear weapons on board.

In February of 1992 the multipurpose nuclear-powered submarine K-276, a "Sierra-2" submarine like in the photo above, collided during surfacing with the nuclear-powered submarine "Baton Rouge" from the U.S. Navy.

Here are two recent examples:

February 11, 1992, 20:16 hours, the Barents Sea. The multipurpose nuclear-powered submarine K-276 ("*Sierra-2*" according to NATO classification) of the Northern Fleet collided during surfacing at a depth of approximately 20 meters, with the nuclear-powered submarine "*Baton Rouge*" of the U.S. Navy of the Los Angeles class. Both submarines were armed with nuclear missiles, torpedoes and mines. The "*Baton Rouge*" had one nuclear reactor, the Soviet submarine had two. According to the command of the Russian Navy, the collision took place within Russian territorial waters. A representative of the U.S. Navy insists that the incident took place in international waters, however, he does not deny that the "*Baton Rouge*" was on a reconnaissance mission within the training areas of the Northern Fleet.

March 20, 1993. At about 09:00 hours, the nuclear-powered submarine "*Borisoglebsk*" ("*Delta-4*" according to NATO classification) of the Northern Fleet, collided with U.S. Navy submarine "*Grayling." Both* were below surface. The press service of the Russian Navy, not having precise information about the nationality of the "stranger," issued the following announcement: "The commander of the foreign submarine, attempting to observe the movements of our sub, lost ASDIC contact with it. Maneuvering in an unprofessional way he created a dangerous situation which led to the collision..." The announcement noted the "low level of responsibility and training of the commanders and crews of foreign submarines, conducting such reconnaissance..." There were no evaluations of the crew of the Russian sub. The U.S. Navy command acknowledged the sub to be its own. That was all. There were no comments in response.

The analysis of a large number of incidents, including those causing loss of life and considerable material damage (the loss of warships, aircraft, the destruction of industrial sites, the pollution of the environment, etc.) shows that in a number of cases, a seemingly insignificant technical malfunction turns into a serious accident, and the accident into a catastrophe.

And here we are against, once again, the human factor - to what extent is the reaction of personnel, the rising to the occasion, adequate (that is, professional and timely) during emergency situations (break-down, fire, explosion, technical damage, etc.)? What influences the outcome? In many cases, the factors repeat themselves: the quality of professional training, the level of expert knowledge, practical experience, morale, general psychological condition and of personal spiritual and physical qualities.

In the recent past, when Admiral Sergey Gorhkov commanded the Soviet Navy, aboard all ships, submarines and at all shore bases, you could hear his well-worded saying:

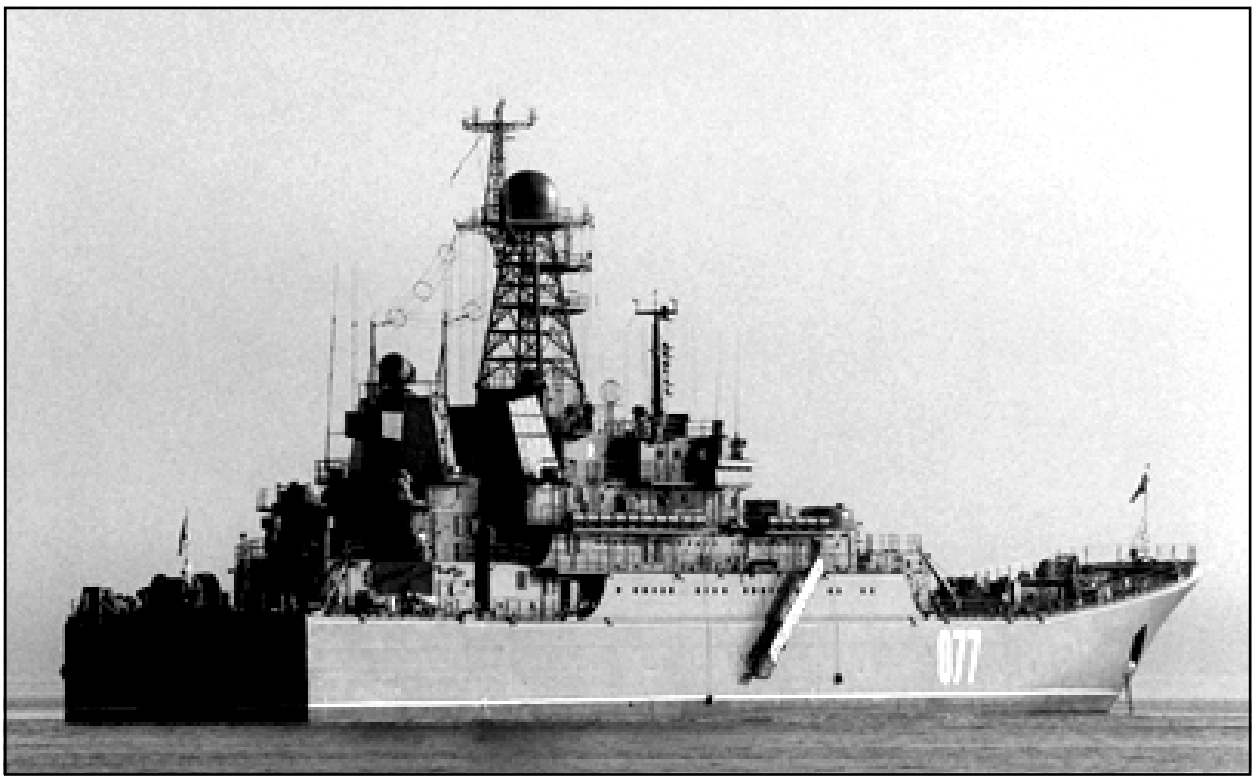
"There is no justifiable and unavoidable accident! Accidents and the reason why they happen are created by people through their irresponsibility and their lack of professionalism."

This harsh and categorical, but not unfounded statement, made after the loss of the "*Komsomlets*" in 1989, was ostracized and rejected as inhuman and politically incorrect. However, that did not mean to say that there was a reduction in the number of accidents and their causes. Fires, explosions of ammunition on warships and shore bases, collisions between nuclear submarines, accidents in reactors and missile silos - all these are not a full list of those emergency situations, which in a different combination of circumstances, could have had far greater tragic consequences.

In connection with this, it is appropriate to recall the words of Academician Valery Legasov who died before his time. He directly took part in the clean-up operations at Chernobyl and did a great deal so that we would be able to know the truth about this catastrophe and be able to draw lessons from it. Shortly before his tragic death, Academician Legasov gave this warning:

"Mankind, having armed itself with powerful technological resources, has only just begun to think how it can protect itself from them. Now we have to fight not against that which has already exploded or is about to suddenly explode tomorrow. We have to realize once and for all: we have to fight for the creation of protective technology, which is adequate enough to deal with that power which has been given into the hands of mankind. This is a problem that concerns the whole world. I am for the respect for ergonomics - for building the right and reasonable relationship between man and machine."

One would like to think that the worst incidents are over. But, unfortunately, reality does not allow us to build such illusions.



A Ropuchhka II amphibious assault ship at anchor near Vladivostok, as the ship readies for Exercise Cooperation From the Sea '96, a joint exercise between the Russian Federation Navy and the U.S. Navy in conducting disaster relief and humanitarian missions.

Some reminders:

The loss of "*Challenger*." The nuclear sub "*Kursk" catastrophe*. The collision between a Boeing cargo plane and the Tu-154 airliner with children on board over Lake Constance, Switzerland in the summer of 2002. The Siberian Airlines plane shot down in error by an anti-aircraft missile during exercises by Ukrainian forces. The demonstration flight by a fighter over the military airfield in Lvov, which crashed onto the crowd. The Il-86 airbus of the Pulkovsky Airlines, which crashed during takeoff at Sheremetevo airport near Moscow. The endless series of crashed of Russian helicopters in the Northern Caucasus and other places. Frequent collisions of warships, including submarines, between themselves and with merchant ships. And, finally, the tragic loss of the "*Columbia "space* shuttle.

To be continued?

Sergey Kolesnikov, *IPPNW Vice President, IPPNW-Russia Co-President,*
Deputy of the RF State Duma,
Academician of the Russian Academy of Medical Sciences.
Alexander Yemelyanenkov, *journalist, scientific observer of*
"Rossiskaya Gazeta" national daily,
IPPNW-Russia Program Coordinator from 1998 to 2001.

No Room for Mistakes

Gunnar Westberg

"Any military commander must admit when he looks back, if he is honest, that he has made mistakes that did cost lives, maybe thousands of lives. I have, we all have. But we learn from our mistakes. We don't often do the same mistakes twice, and certainly not time and again. But with nuclear weapons there is no place for mistakes. There is no learning time with nuclear weapons."

Robert McNamara,
former U.S. Secretary of Defense,
from the documentary film "Fog of War."

At the 1985 Fifth International Conference of International Physicians for the Prevention of Nuclear War, IPPNW, in Budapest, the head of the Soviet Nuclear Energy Department stated that the risk for a meltdown or similar catastrophe in a Soviet nuclear reactor was less than one in a million reactor years. I was present at the lecture and remember the statement vividly. That was before Chernobyl.

The Chernobyl incident was caused mainly by an unforeseen combination of human mistakes. Many wars have also started by an unexpected combination of mistakes and misunderstandings.

One such mistake must never happen: A large nuclear war. That would be the mistake to end all mistakes.

"Launch on Warning" of intercontinental nuclear missiles on high alert meant that when the commander-in-chief of a nuclear weapons state has sufficient reason to believe that the country is attacked by many nuclear missiles, the country's own nuclear missiles should be launched to prevent them from being destroyed before launch. The time available for decision may be fifteen minutes, in some situations much less. Launch on Warning is also a basis for deterrence through "Mutual Assured Destruction" (MAD).

At the present time the political relations between Russia and the United States of America are open and cordial and a nuclear attack from either side is said to be "unthinkable." If that is the case, why do both countries retain their doctrines of Launch on Warning and keep their missiles on High Alert? The military and political leaders of the two countries have not answered that question. Perhaps they are less trusting than we know?

Nuclear weapons remain a "cornerstone of the military system in the foreseeable future," for both Russia and the U.S. There is no guarantee that the apparent confidence between the two countries will last for the "foreseeable future." When the trust is gone, it will be too late to reach an agreement on nuclear abolition.

Today, after more than a decade of increasing trust and partnership between Russia and the U.S., is the best time ever to decrease the risk of nuclear war. If not now, when?

If a nuclear charge explodes in Moscow and perhaps in one or more other Russian cities and at the same time there is malfunction in several satellites, and warnings are sounded that missiles may be approaching the country, what would the reaction be at the Russian command center? Today, hopefully, this would be interpreted as a large terrorist attack, simultaneously affecting the power supply and information systems. In the future there may be a different political climate. Conflicts between Russia and The U.S., e.g. regarding oil-rich countries in Central Asia, may increase the tension. Will the Russian response at that time really be one of "wait and call Washington?" Is there enough time? The state would be set for the final mistake.

The strategic nuclear missiles of Russia and the U.S. are said to be "detargeted." If a missile is launched unauthorized, for instance by a computer, the missile has no target co-ordinates in its navigational system, or possibly, the target is in the Arctic. Let us hope that this is true. However, retargeting can be done in seconds or minutes when a launch is initiated by humans. Detargeting does not protect us from human mistakes.

Mistakes will always be made. We must try to decrease the risk that the mistake leads to a catastrophe. More time is needed, so that facts can be checked, alternative responses found and contact can be made with the "enemy."

The first step to decrease the risk of annihilation by mistake is to **take all nuclear missiles off High Alert**. This can be done electronically, by building delays into the systems, giving some time to reconsider the situation. Electronic dealerting is probably not verifiable by the other side. However, it can be argued that even a dealerting without verification would decrease the risk of a massive response to a false warning. Especially for the U.S., with its enormous arsenal of invulnerable submarines carrying nuclear weapons, unverifiable bilateral electronic dealerting should be an attractive step to greater security.

Unverifiable dealerting is, however, seen as insufficient by the nuclear powers. A **verifiable delay system** can be obtained by a **covering of all missile silos** with large amounts of dirt, which would take several hours to remove. "**Decoupling**" has also been proposed. The nuclear charges should then at all times be stored at a certain distance from the missile, requiring hours to recouple. Both preparations for launching can be checked by satellites. Immediate inspection must be granted when suspicious changes in missile readiness are seen from space.

Dealerting and delay for submarines is a difficult task. The British government has solved the problem by being able to contact the nation's only nuclear-armed submarine on patrol, only once every twenty-four hours. Methods have been proposed also for U.S. and Russian submarines to implement a delay system. Experts in these countries have not reported sincere evaluations of such proposals.

As part of the Nunn-Lugar/Cooperative Threat Reduction Program; A Russian shipyard worker uses a cutting torch to breakdown a large bulge section of a Russian Oscar Class submarine at the shipyard in Severodvinsk.

Deep cuts in the arsenals of strategic nuclear weapons down to less than 1,000 for BOTH the United States and Russia, carried on a small number of submarines, would greatly decrease the risk of a nuclear war by mistake. Launch on Warning would be unnecessary. But neither the U.S. nor Russia plans such deep cuts. They intend to keep the capacity to kill all mankind "for the foreseeable future."

A few steps to prevent mistakes and misunderstandings should be taken immediately:

Working conditions for personnel in strategic command centers should be at least as favorable for alertness and vigilance as for air traffic controllers. Active observation periods at the monitors should be interspersed with adequate rest. First of all **a security culture** must be established where the reporting of all accidents, all mistakes, all attacks of "micro sleep" should be actively encouraged.

To decrease the risk of misunderstandings and to increase trust, officers responsible for the strategic nuclear weapons readiness **from Russia, USA and China** and perhaps other nuclear weapons states, should meet regularly. They should review scenarios when mistakes could be made, develop means to contact each other within seconds in a critical situation and in general work to prevent disastrous misunderstandings.

Even if we do whatever possible to decrease the risk of mistakes, we must ask ourselves: Do we believe that nuclear weapons can be allowed to exist for decades and centuries without being used? And if they are used, how can we believe that their use will not escalate to a large nuclear war?

So what should be abolished first, nuclear weapons or mankind?

Human Factor Meetings

Klas Lundius

September 1999: Meeting at the RF Ministry of Defense, Risk Reduction Center. Discussion about shift work.

May 21-24, 2000: 2000 Dialogue Meeting in Moscow. Round table discussion "Changing Nuclear Policy and Military Doctrine."

November 9-11, 2000: Seminar hosted by SLMK and the Swedish National Defense College, Stockholm. "Risk of Accidental War: The Human Factor."

May 19-25, 2001: Seminar and Dialogue Meeting in Moscow. Press conference at Novaja Gazeta "Nuclear Risk Reduction: Human Factor Effect."

November 19-21, 2001: Seminar in Uppsala, Sweden. A delegation from Minatom, Moscow participated. "The human factor in the high technology developed society - fatigue due to respiratory, stress, sleep, pain disorder - diagnostic and therapeutic approaches."

March 23-27, 2002: Seminar in Moscow: "Nuclear Technologies and Security: Human Factor." Meeting with the Minister of Health.

May 2-4, 2002: Workshop at the IPPNW World Congress in Washington D.C.: "The Human Factor and Risk of Accidental Nuclear War." DC with lobbying on Capitol Hill.

May 14-18, 2003: Dialogue Meetings in Moscow and meeting with the Speaker of the Duma and the Atom Minister. Press conference at Rossiska Gazeta.

Thirty minute program on Russian Television with Sergei Kapitza, Dr. Christina Vigre Lundius and Prof. Lloyd Dumas. The title of the show: "Obvious vs. Incredible!" The topic of the program was "The Human Factor."

November 2003: Start-up meeting for a booklet project on the Human Factor.

Klas Lundius, *Executive Director SLMK,*
The Swedish Section of International Physicians
for the Prevention of Nuclear War.

Photographs

Cover: *Courtesy of U.S. Department of Defense*
Page 4 Probability of Error During Shift Work: *Adapted from information obtained from "Body-rhythms: Chronobiology and Peak Performance copyright 1994 Lynne Lamberg p. 197 William Morrow and Co., Inc., New York.*
Page 6 *Young girl in front of nuclear missiles.*
Page 7 *Man with suitcase: Courtesy of U.S. Department of Defense*
Page 8 *Professor Lloyd J. Dumas: Courtesy of University of Texas at Dallas*
Page 9 *Union Carbide, Bhopal, India> Courtesy Chris rainier, U.S. Chemisafety*
Page 10 *Woman at monitor: Courtesy of U.S. Department of Defense*
Page 12 *India-Pakistan: Courtesy of U.S. Department of Defense*
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Page 16 *World Trade Center: Civil Air Patrol, New York Wing Mission.*
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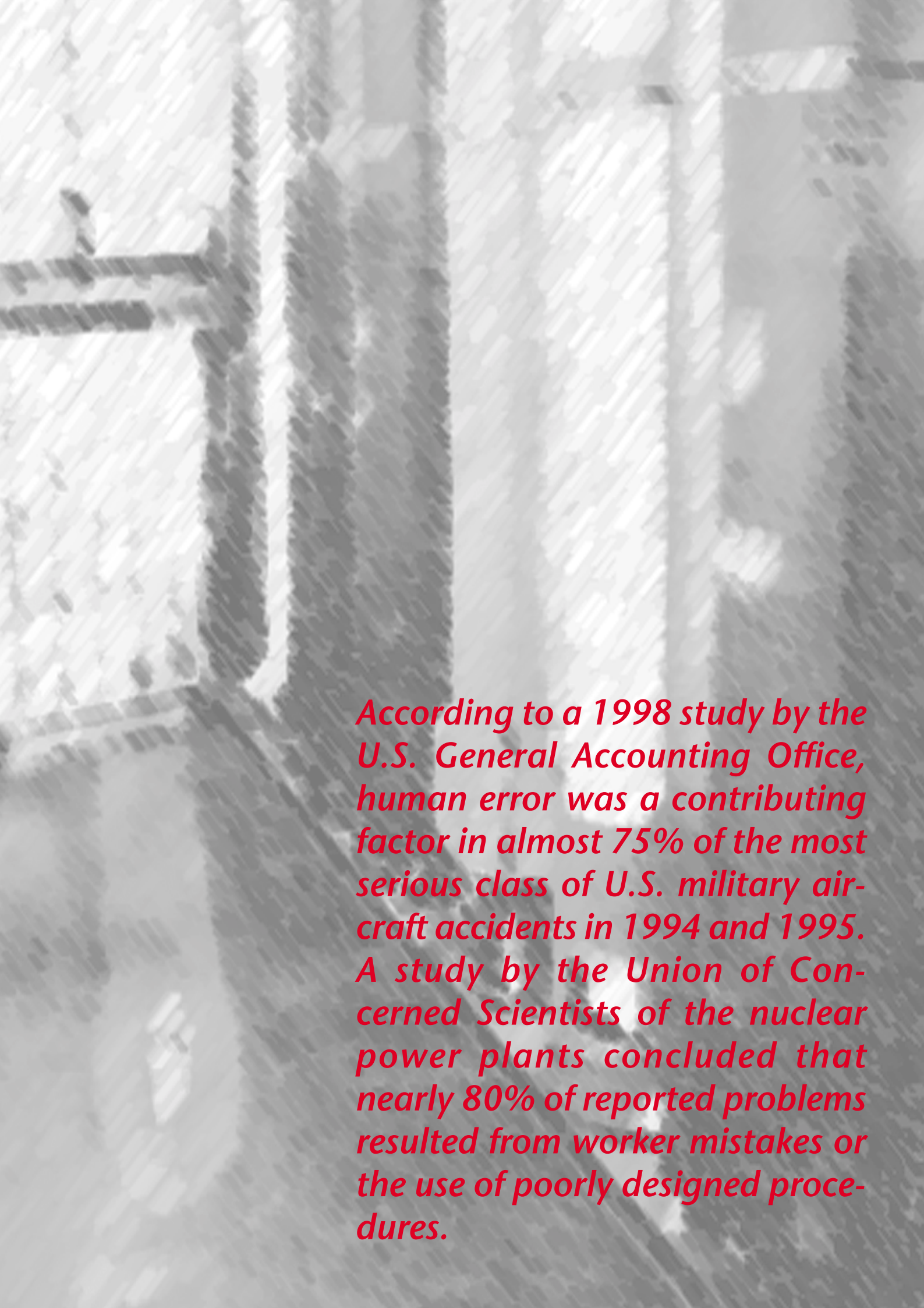
Page 21 *Russian nuclear-powered submarine K-276: Courtesy of www.hazegray.org*
Page 23 *Russian amphibious assault ship: Courtesy of www.hazegray.org*
Page 24 *Robert McNamara: Courtesy of The White House*
Page 26 *Russian shipyard worker disassembles submarine: Courtesy of U.S. Department of Defense*

Human Factor - and the Risk of Nuclear War
is published by Svenska Läkare mot Kärnvapen, SLMK
The Swedish Section of
International Physicians for the
Prevention of Nuclear War, IPPNW.
English edition edited by Claes Andreasson



According to a 1998 study by the U.S. General Accounting Office, human error was a contributing factor in almost 75% of the most serious class of U.S. military aircraft accidents in 1994 and 1995. A study by the Union of Concerned Scientists of the nuclear power plants concluded that nearly 80% of reported problems resulted from worker mistakes or the use of poorly designed procedures.