PREVENTIVE MEDICINE 16, 319–333 (1987)

The Problem of Accidental or Inadvertent Nuclear War[1,2]

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INTRODUCTION

In the nuclear age, there are questions more profound and more serious than ever before as to the conduct and obligations of government, not only toward their own citizens, but toward all peoples who may be affected by their policies and actions. In this light, a medical analogy can be drawn between the doctrine of informed consent and the conduct of the superpowers, for surely governments have the same responsibility to populations as physicians have to individuals. The failure of U.S. and Soviet policymakers to recognize the potential effects of their actions on the rest of the world goes hand in hand with the absence of any consideration of the doctrine of informed consent.

In recent years, the malpractice doctrine has been broadened considerably to include the physician's duty to obtain an informed refusal, to warn third parties, and to notify patients whenever past procedures or treatments are discovered to be potentially hazardous. The physician has the duty to disclose information to related third parties when harm to others is reasonably foreseeable.

Applied to the present international situation, this doctrine would mean fully informing the uninvolved world about nuclear winter and the hazardous radioactive fallout that would envelope Europe and other continents if U.S./U.S.S.R. policies and stockpiles combined to cause global injury. Yet, those countries without any voice in major "defense" decisions have never been adequately informed or given the "right of refusal."

As they have watched the nuclear stockpiles mount year after year, the uncommitted world has become increasingly anxious about the threat of unintentional or accidental nuclear war. Why has their concern become so intense?

It seems clear that neither superpower would intentionally initiate a nuclear war, due to their knowledge of the annihilatory effects of their huge stockpiles. It is far more likely that nuclear war will come through misunderstanding, miscalculation, misinterpretation, or accident.

What do these terms mean? *Accidental* nuclear war is undesigned and unforeseen, occurs by "chance," and is unintended, unexpected, and unpremeditated. An accidental launch of a missile at Washington or Moscow is interpreted as an

[1] Presented at the International Scientific Symposium on the Dangers and Prevention of Nuclear War, Washington, DC, September 14, 1986.

[2] Supported by grants from the Carnegie Corp., the John D. & Catherine T. MacArthur Foundation, the W. Alton Jones Foundation, the New Prospect Foundation, and the Ruth Mott Fund.

0091-7435/87 $3.00

aggressive act; or, in a crisis, with the country on launch-on-warning, a false alert is perceived as a true alert, and the intercontinental ballistic missile (ICBM) defense is launched

Inadvertent nuclear war occurs because of inattention, oversight, misperception, misunderstanding, or failure to respond appropriately where no nuclear conflict has been anticipated or desired. It is not initiated by either party with the intention of achieving specific and well-defined national goals beyond the destruction of an adversary. It begins in a crisis, despite the fact that neither side desires it and that both sides are following programs designed to avoid nuclear war

Among the potential triggers of inadvertent nuclear war, nuclear weapons accidents require consideration if only because they assume far more significance in times of international stress than in peacetime.

NUCLEAR WEAPONS ACCIDENTS

"Broken Arrows" and "Bent Spears" are the military code names used to indicate major accidents (the former) and less severe incidents (the latter) involving nuclear weapons A Broken Arrow has been officially defined as

> Any unexpected event involving nuclear weapons resulting in accidental or unauthorized launching, fire or use which could create the risk of out-break of war; or nuclear detonation; or burning of a nuclear weapon; radioactive contamination; and seizure, theft or loss of a nuclear weapon (14)

A Bent Spear, less severe, covers

> any unexpected event involving nuclear weapons or components which results in damage to a nuclear weapon (14)

Because of the secrecy surrounding weapons accidents, their exact number is a matter of conjecture. The U.S Department of Defense (DOD) officially lists 32 U.S Broken Arrows between 1950 and 1980 (11). The most comprehensive estimate appears to be that of the Stockholm International Peace Research Institute (SIPRI), which documents 125 nuclear accidents, major and minor combined, between 1945 and 1976, about one every 2½ months. Included in this figure are 22 publicly known Soviet accidents, 8 British, and 4 French (14) The public figures represent a minimum number

If the United States stresses nondisclosure, other countries with nuclear armaments do the same to an even greater degree. The DOD list of Broken Arrows involves largely long-range bomber aircraft (B-52s) Since nuclear weapons are carried in many other types of aircraft, as well as in frigates, destroyers, and submarines, it would be naive to assume that accidents have never occurred on these other delivery systems

In 1977, it was disclosed that nine U S. nuclear-bomber accidents had occurred between 1950 and 1960 over Canada or Canadian territorial waters. There have been at least nine occasions on which U.S. submarines have collided with foreign, apparently Soviet, vessels. Some of these submarines were armed with nuclear weapons.

One well-described accident occurred on January 17, 1966, over Palomares, Spain A B-52 carrying nuclear weapons collided with a KC-135 aerial tanker during a refueling operation The B-52 dropped four nuclear bombs. High explosives in two bombs detonated, spewing plutonium over a wide agricultural area. The cost of cleanup amounted to $50 million, and 5,000 barrels of contaminated topsoil were shipped to a nuclear waste burial site in North Carolina (20). An aviator misjudged, and a terrible accident followed At least 10 nuclear bombs have never been recovered from accidents

HAZARDS OF NUCLEAR WEAPONS ACCIDENTS

No nuclear weapon accident has ever caused a nuclear detonation While this may occur, its likelihood is slim. This is because the safeguards built into weapons design have a great deal of redundancy (10) The weapons will withstand tremendous physical impacts as well.

There are other dangers. Nuclear submarine accidents in peacetime may be reviewed carefully and their causes determined In time of crisis. the sinking of a submarine may be interpreted as a deliberate act of provocation. In June 1981, a nuclear-powered Soviet submarine with about 90 people aboard sank in the northern Pacific. A previous sinking of a Soviet submarine had occurred in 1970. Two U.S. nuclear submarines have sunk in accidents, one at Cape Cod with 129 aboard and one in the mid-Atlantic with a crew of 99.

Accidental launches may be a far greater threat. The explosion of a nuclear weapon on an adversary's territory is the worst possible case, but accidental launching of nuclear-capable missiles in a time of crisis would constitute a grave threat. The time required to verify the nonnuclear character of the missile or the accidental character of its launch might not be available

There have been five reported instances of U S. nuclear-capable missiles flying over or crashing into or near the territory of other nations These include a Mace missile overflight of Cuba and a crash of a Matador missile into the straits of Taiwan after an aberrant flight toward China (9)

In spite of present safeguards, the increasing number of weapons implies an increase in the absolute number of accidents As systems become more complex, the possibility of malfunction rises Perhaps most significantly, more nations are in the process of acquiring nuclear weapons Developing nations may rely more on "man-guided delivery systems," and they may lack the technologically advanced safety features of the more industrialized countries.

HUMAN INSTABILITY

On May 26, 1981, the day after Memorial Day, an EA-6B Prowler jet crashed into the flight deck of the nuclear aircraft carrier Nimitz off the southern coast of Georgia The plane burst into flames in a tragedy in which 14 men lost their lives and 44 others were injured. The crash destroyed four fighter aircraft and damaged 60 others, at a cost of more than $200 million It was the worst accident in the history of U S peacetime naval aviation

Three weeks later, New York Congressman Joseph P. Addabbo, who chaired the House Appropriations Subcommittee on Defense, informed the press that many of the marines and sailors killed had had traces of drugs in their systems.

The pilot of the EA-6B had 6 to 11 times the recommended level of the antihistamine brompheniramine in his system. He had been taking the prescription drug without the military's approval. A congressional committee looking into the accident concluded that the effects of the medication—which, at such a level, can cause sedation, dizziness, double vision, and tremors—together with other stress factors, probably helped precipitate the pilot error that caused the crash. A government investigation revealed that, among naval personnel in general, 28% had used amphetamines during the prior year (1).

The extent of drug use uncovered in the investigation would be alarming even if it were exceptional. But several government studies have found drug abuse to be widespread throughout the armed forces. This situation assumes special importance in light of a 1982 report by an investigative arm of the House Appropriations Committee indicating that many of the military's drug incidents and arrests have involved personnel responsible for controlling and maintaining nuclear weapons (1).

About 112,000 individuals are involved in handling the United States' nuclear arms (1). Most are responsible for strategic nuclear weapons—long-range weapons for a war waged on Soviet and American territory—including the air force's land-based ICBMs and nuclear bombers and the navy's submarine-launched ballistic missiles. In addition, about 14,500 army personnel work with tactical or theater nuclear weapons—shorter-range weapons for a war that might be fought on the battlefields of Europe (1).

The military is deeply concerned about ensuring the psychological stability of its nuclear weapons personnel and takes special precautions in appointing them. The heart of the effort is the Personnel Reliability Program, designed to select competent and reliable persons to manage and control the nation's nuclear arms. The program screens candidates both for "critical" jobs (commanders of nuclear weapons delivery units, pilots and crews of delivery aircraft, and delivery unit personnel with access to and technical knowledge of nuclear weapons) and for less autonomous "controlled" positions (security guards, storage and supply personnel, and launch personnel in nuclear missile silos).

The Personnel Reliability Program selects only individuals thought to meet a variety of qualifications, such as physical competence, mental alertness, and technical proficiency; dependability and flexibility in adjusting to changing work environments; social adjustment and emotional stability; the ability to exercise sound judgment in an emergency; and a positive attitude toward nuclear weapons duty. The initial screening procedure includes a security clearance and a background investigation into individuals' personal and professional activities and affiliations, including a check of police records, former teachers, employers, and personal references. Then the candidates' personnel files are reviewed, and they receive a medical evaluation. They are also briefed on the workings of the Personnel Reliability Program.

More telling than what is included in the screening process, however, are the omissions. No psychiatric interview or psychological testing is required, and if up-to-date medical records are available, the candidate need not have a physical examination. Further, because of the secrecy that surrounds many assignments, even when a review of the records suggests that a medical examination is essential, the examining physicians may have little knowledge about the position for which they are screening the candidate. The medical records of the candidate's family—which might contain information about psychiatric problems, alcoholism, or a history of drug abuse—are not reviewed.

Once a candidate is appointed, no one from the Personnel Reliability Program follows up to ascertain that the job is being carried out adequately. Instead, the appointee's superiors are relied upon to report any unusual behavior, and co-workers are expected to evaluate one another. Needless to say, inertia, camaraderie, peer pressure, and personnel shortages (which create a need for extra hands, however unstable) may hinder honest evaluations.

Independent evaluations of the Personnel Reliability Program are not available; it is not even clear whether the military has conducted such studies. One indirect measure of the program's effectiveness in screening out undesirable candidates, however, is the number of persons appointed through the program who are later decertified (removed from their positions). Program regulations dictate that individuals should be decertified if they are found guilty of negligence, serious civil infractions, repeated alcohol or drug abuse, or other aberrant behavior that might lead to unreliable performance. According to Defense Department figures, from 1975 to 1984, some 51,000 individuals were decertified—an average of more than 5,000 per year (Table 1) (2). Among these, the majority were decertified for drug and alcohol abuse or psychiatric problems (Table 2).

No one can argue with the wisdom of removing individuals discovered to be unstable. But the high rate of decertification is disturbing, because it suggests that there are inherent weaknesses in the Personnel Reliability Program as a screen for stability. Even though the rate seems to be on the decline, more than 3,000 personnel were decertified during 1985 alone. So, at any given time, thou-

TABLE 1
PERSONNEL RELIABILITY PROGRAM TOTALS AND DECERTIFICATIONS (1975 TO 1984)

Year	Total	Decertifications
1975	119 625	5,128
1976	115 855	4,966
1977	118 988	4,973
1978	116 253	5 797
1979	119 198	5,712
1980	114 028	5,327
1981	109,025	5,235
1982	105 288	5,210
1983	104 772	5,085
1984	103 832	3,766
	Average 112,686	Total 51,199

Sources: Department of Defense (DOD), OSD, "Annual Disqualification Report, Nuclear Weapon Personnel Reliability Program," RCS DD-COMP(A) 1403, Calendar Year Ending December 31, 1975, 1976, 1977; DOD, OSD, "Annual Status Report, Nuclear Weapon Personnel Reliability Program," RCS DD-POL(A) 1403 Year Ending December 31 1978 1979, 1980, 1981, 1982, 1983, 1984.

TABLE 2
PERSONNEL RELIABILITY PROGRAM (PRP) SUMMARY TABLE: REASONS FOR PRP DECERTIFICATIONS (1975–1984)

Reason	Total decertifications (1975–1984)	Percentage
Alcohol abuse	4 519	9
Drug abuse	17,136	33
Negligence or delinquency	4,107	8
Court-martial or civil conviction; behavior contemptuous toward the law	8,185	16
Physical, mental, or character trait or aberration	10 541	21
Poor attitude	6 711 (1978 to 1984)	13 (19 in 1978–1984)
Total decertifications	51,199	

Sources Derived from DOD, OSD, "Annual Disqualification Report, Nuclear Weapon Personnel Reliability Program," RCS DD-COMP(A) 1403, Calendar Year Ending December 31 1975, 1976, 1977; DOD, OSD "Annual Status Report, Nuclear Weapon Personnel Reliability Program" RCS DD-POL(A) 1403 Year Ending December 31 1978 1979 1980 1981 1982 1983 1984

sands of potentially unstable individuals have day-to-day responsibility for handling nuclear weapons.

Since the Personnel Reliability Program appears to be an imperfect screen, it would be encouraging to know that the pool of people from which candidates are drawn is basically fit. But the military population in general suffers from high rates of drug and alcohol abuse and psychiatric disturbances.

In a 1980 Defense Department survey of 15,000 randomly selected military personnel, 36% admitted to using illegal drugs (Table 3). Forty percent of the respondents between the ages of 18 and 25 years had used marijuana during the preceding month, 10% had taken amphetamines, 7% cocaine, 5% hallucinogens, and 1% heroin (6). In the navy, more than one-quarter of respondents under age 25 years admitted they had been "high while working" during the preceding year—half of them on more than 40 days (Table 4) A 1981 survey of U S. personnel at military installations in Italy and West Germany found that drugs were used *on*

TABLE 3
PROPORTION (%) USING DRUGS IN THE U S MILITARY

		Service			
Use period	Total DOD	Army	Navy	Marine Corps	Air Force
Any drug use					
Past 30 days	27	29	33	37	14
Past 12 months	36	38	43	47	23

Source Ref (6)

TABLE 4
WORK IMPAIRMENT (%) DUE TO DRUG USE

		Service			
	DOD	Army	Navy	Marine Corps	Air Force
Total with any impairment	21	22	28	28	9
High while working	19	21	26	25	8
Lowered performance	10	12	15	13	3

Source Ref (6)

duty by 43% of army personnel, 17% of air force personnel, 35% of marines, and 49% of navy personnel. A full 60% of the crew of the aircraft carrier U.S.S. Forrestal used drugs on duty (21)

Alcohol abuse has also been widely reported According to the U.S Naval Safety Center in Norfolk, Virginia, the effects of alcohol and hangovers played a role in 15 to 20% of major naval aircraft accidents in 1979 (22). Defense Department officials testified before Congress in 1982 that an estimated 28% of army personnel and 21% of naval personnel drank while on duty (21). The highest prevalence of drinking was reported among senior officers.

Any drug- or alcohol-induced instability in the people chosen to handle nuclear weapons is likely to be exacerbated by the character of the work itself. The isolation aboard nuclear submarines and in nuclear missile silos, unnatural work shifts, and, in times of emergency, the stress of being responsible for nuclear weapons are all likely to affect job performance.

Unnatural work schedules cause additional problems for some military personnel. The routine duties of the navy's nuclear submarine crews are organized around an 18-hr cycle, composed of three 6-hr shifts. Crew members work one shift, and then take 12 hr off before working another. The schedule is not in keeping with the body's biological clock—the internal mechanism that coordinates the hourly release of hormones, sleep–wake cycles, and other physiological processes that follow 24- to 25-hr cycles.

Many investigators have reported high rates of emotional disturbance and impaired coordination among military personnel and civilian employees forced to work when their circadian rhythms dictate they should be asleep (15) The reliability problems posed by violating circadian rhythms would be compounded during a prolonged nuclear alert, with missile crews working double shifts, bomber pilots on sustained airborne alerts, and submarine personnel on duty for extended stretches.

Similar on-the-job stresses probably are faced by the personnel who handle the Soviet Union's nuclear weapons. Although reliable information about the stability of Soviet military personnel is scarce, a few generalizations seem valid.

Abuse of hard drugs has not been as large a problem in the Soviet Union as in the United States. The annual death rates from opiates in the Soviet Union are much lower than those in the United States On the other hand, many soldiers returning from Afghanistan are said to have used hashish and to have brought the habit home with them.

More significant, alcoholism is a problem of epidemic proportions in the Soviet Union. About 45,000 Soviets died in 1976 from acute alcohol poisoning—100 times the number of victims reported that year in the United States. Per capita consumption of alcohol in the Soviet Union has more than doubled in the past 20 years. Alcohol abuse among the Soviet military is even more common than among the population at large (7). According to one estimate, one-third of Soviet military personnel are alcohol dependent, and heavy drinking is said to be especially common among officers (26).

There seems little doubt that a Soviet counterpart to the Personnel Reliability Program exists, though details about it are not public. Soviet officials are clearly aware of the stress to which nuclear weapons personnel are subject and attempt to select these people carefully. A 1984 article in the Soviet *Military Medical Journal* emphasized the importance of psychological testing in selecting individuals who are intellectually and emotionally able to handle complex and demanding military technology.

Still, the Soviet military appears to be afflicted with many of the same staffing problems faced by the U.S. armed forces.

Even if it is true that rank-and-file nuclear weapons personnel of both superpowers are sometimes undependable, does it matter?

In the United States, as in the Soviet Union, tactical nuclear weapons cannot be as tightly controlled as strategic arms during periods of international tension. Thus, tactical weapons are more vulnerable to misuse by unstable personnel. In crises, commanders might find it essential to give subordinates the authorization codes needed to launch tactical weapons, to avoid delay if the order to fire were issued. Such devolution of control could put hundreds of people in a position to fire such weapons as artillery projectiles and short-range ballistic missiles.

Most U.S. nuclear weapons are fitted with "permissive action links" that inhibit the weapons until the proper combination, supplied by the National Command Authority (the President and the Secretary of Defense), is entered electronically. Before an intercontinental ballistic missile can be fired, a total of four officers at two launch control sites, or capsules, connected to the missile silo must decide individually to launch the weapon.

Controls over the firing of submarine-launched ballistic missiles (SLBMs) are less stringent. The navy maintains no permissive action links on SLBMs; it argues that, in times of crisis, it cannot be dependent on authorization codes transmitted from Washington because communications could easily be disrupted by, say, the electromagnetic pulse triggered by an atomic explosion. The captain and crew of a nuclear submarine are supposed to receive higher authorization before firing a missile, but if they should decide to act independently, there are no technical safeguards to prevent them from launching the weapon.

Nevertheless, in peacetime, the inadvertent firing of even a submarine-based missile is unlikely, because numerous crew members would have to approve of, and participate in, the launch. The problem arises during crises, when measures to guard against inadvertent launches tend to undermine launch readiness. To

ensure that their forces are able to respond rapidly to an attack, commanders on both sides might loosen safeguards—issuing advance authorizations, reducing the number of people necessary for a launch, or partially "enabling" weapons so that they could be fired quickly. In doing so, they might open the way for unstable personnel to exert control over nuclear weapons.

SYSTEMS FALLIBILITY

What about faulty warnings in the nation's missile alert system? These occur when an odd movement or an infrared signature is detected by satellite guards, signaling the possibility that an SLBM or ICBM has been launched. Between January 1979 and June 1980, 3,703 minor alerts or "routine missile display conferences" were called to evalute ambiguous sensory data in the warning systems (23).

False warnings can also be caused by computer malfunction. A NORAD spokesman indicated that failures in computer or communications systems may happen two to three times a year.

Random technical errors within the communication codes and computer software are inherent in missile alert systems. During an 18-month time span in 1979 and 1980, NORAD reported 147 warnings that were serious enough to invoke threat evaluations. An additional five major false alarms occurred as well, for which the appropriate military units and various top officials were called to a preliminary state of alert:

- On October 3, 1979, an SLBM radar picked up a low-orbit rocket body that was close to decay and generated a false launch and impact report.
- On November 9, 1979, false indications of a mass raid were caused by inadvertent introduction of simulated data into the NORAD computer systems.
- On March 15, 1980, four Soviet SLBMs were launched from the Kuril Islands as part of a training program, one of which generated an unusual threat signal.
- On June 3 and June 6, 1980, false alerts were caused by a bad computer chip (23).

The most serious aspect of false alarms is the decreasing time span we are allowing ourselves for efficient checking of errors. The shorter the delivery time of new weapons, the more likely that we or the Soviets are to move to launch-on-warning policies. This dependence, coupled with shorter checking time, clearly implies the greater likelihood of a launch-on-false warning. The *New York Times* said it clearly: "If the world is ever blown up by mistake it will be because men are recklessly shortening the time they should have to detect it" (16).

Other aspects of the more widespread communications system have shown themselves prone to mishap and error. The Hot Line, set up to facilitate speedy and direct communication between the two national leaders during a crisis, has had a series of false interruptions. Furthermore, no special measures have been taken to protect it from nuclear explosions (3).

A topic of great concern is the reliability of complex systems in general. A well-known computer failure was the synchronization problem between backup computers that delayed the first launch of the space shuttle. There is a large computer communications network in the United States, called the ARPA–NET, that links together quite a number of machines and is intended to be very redundant and reliable The network collapsed completely in October 1980 because of a kind of grid lock, in which some routing tables became mixed up and various communications computers kept exchanging messages in attempts to get the situation straightened out (4)

Charles Perrow suggests that major accidents may be inevitable within complex technological systems Simply put, these systems are usually composed of many distinct parts, and these parts interact in many different ways. To this "interactive complexity" we must add tightly coupled processes. These happen very quickly within the systems and, once in motion, cannot be stopped at any precise point because the interactions are so closely linked In a tightly coupled system, the entire system responds to a small, technical stimulus located in one part (18)

High-risk systems can be characterized by the rarity of serious accidents coupled with the unacceptable level of damage if one does occur. When the consequences of mishaps are so great, the systems cannot afford to learn from their mistakes; they simply cannot make mistakes They must therefore be run on a trial-without-error basis:

> Time after time, control systems, imposed in the name of error prevention, result only in the elimination of search procedures the curtailment of the freedom to analyze, and a general inability to detect and correct error (13)

Here, the conflict becomes clear: The high-risk military system is far too dangerous not to control, yet too complex to control completely. The very controls that are so necessary and integral a part of this system may ultimately lead to its failure; error in one part will bring the whole system down. In this nuclear age, the whole system is composed of the U.S and Soviet nuclear forces, for they are tightly coupled together (5).

SECURITY OF NUCLEAR WEAPONS AND MATERIALS

The security of nuclear materials, both weapons and weapons-grade plutonium and uranium, offers a major area of concern. In 1974, the Cyprus crisis between Turkey and Greece brought the security of nuclear weapons into sharper focus. U S tactical nuclear weapons were stored in both Turkey and Greece at this time, despite the instability of the relationships between the two countries. According to one report at the time, "Only a U.S custodial unit, normally a handful of men with police dogs on an airbase, plus a complicated arming device, stood in the way of an unauthorized use of the weapons" (19)

In 1984, in Orlando, Florida, eight nuclear weapons protesters broke into a Pershing 2 missile plant and wandered around the complex for nearly an hour. The group's purpose was to reveal "an appalling lack of security of one of the most dangerous weapons in the world" One member stated that had the group been terrorists, they "could have blown-up, destroyed, or removed one of the weapons and taken it with us" (8).

The control of nuclear fuel is a major problem. At the Department of Energy's

Savannah River Reprocessing Plant, between fiscal years 1955 and 1978, the plant had a net shortage or Material Unaccounted For (MUF) of 145.5 kg of plutonium-239 (25). The Department of Energy assumes that none of this lost material was diverted and attributes the overall shortage to basic measurement inaccuracies and normal operating losses. The general accounting office stated that there is "no valid basis for this assumption" and that there is no definitive assurance that plutonium has not been diverted (25)

In short, the inherent uncertainty in the accountancy of nuclear fuels means that the protection and detection of possible diversions may not be reliable. In October 1965, a nuclear reprocessing plant in Apollo, Pennsylvania, announced a shortage of 178 kg of U-235 over the previous 8 years. In the following 6 months, the plant reported an additional loss of 36 kg of U-235. The losses at Oak Ridge bring the U.S. total of enriched uranium unaccounted for to 4,500 kg since 1950, enough for 225 Hiroshima-size bombs (17).

THEFT BY THE NONSTATE ADVERSARY

Given that it is possible to obtain nuclear material, would there be an individual or group willing to take such high risks? Growing concern about nonstate nuclear adversaries is based on a number of factors. Recent terrorist acts reveal a developing sophistication in the use of technology, intelligence, and communications systems, as well as a growing interdependence and networking among terrorist groups in different parts of the world. Another cause for increasing concern is the realization that reasonably intelligent people may be able to design and build a nuclear explosive

How likely is a serious act of nuclear violence? The record of threats and acts of violence against nuclear facilities in the United States totals 288 incidents between 1969 and 1975 (Table 5) (24)

What will the next attempt at nuclear extortion bring? Potentially, a terrorist group with a nuclear device could render their opponent ineffective and remain anonymous and/or unlocatable. The opponent could not threaten to retaliate against an unknown adversary Furthermore, a terrorist group could deliberately misidentify itself to provoke hostilities If a group had more than one explosive, its position would be even stronger The terrorist group need not have an actual second device after a successful first threat; the group could bluff its way into additional gains (12).

TABLE 5

THREATS AND ACTS OF VIOLENCE AGAINST U.S NUCLEAR FACILITIES, 1969–1975

Bomb threats	240
Bombings or attempted bombings	14
Incidents of arson, attempted arson, or suspicious fires	22
Forced entries or other security breaches	12
Possible diversion of plutonium	1

Source Ref. (25).

PROLIFERATION

Proliferation is clearly a major concern, and the amount of available fuel is steadily increasing. At least 33 nonnuclear states appear technically capable of making nuclear weapons within the next 10 years: 11 in the short term, 10 in the intermediate term, and 12 in the long term (Table 6). The increasing potential for production of nuclear weapons and for new nuclear powers suggests that regional conflicts between countries that do not at the present time have nuclear weapons may ultimately become a potential catalyst of nuclear war.

Proliferation will lead to an increased uncertainty about a nation's intentions, as well as about its capabilities. It may initiate a worldwide nuclear arms race. In the Middle East and South Asia, a type of weapons race is already in progress for the nuclear option.

Proliferation replicates the inherent hazards of any nuclear weapons system (Fig. 1). With weapons placed in the hands of many people, in an environment with fewer safeguards and security measures, an increase in Broken Arrows must

TABLE 6
POTENTIAL NTH COUNTRIES[a]

(A) Countries that appear technically capable of detonating a nuclear device in the short term (within less than 1 and up to 3 years of a decision to do so):	
Argentina	Italy
Canada	Japan
Taiwan	South Africa
West Germany	Spain
Iraq[b]	Sweden
Israel	
(B) Countries that appear technically capable of detonating a nuclear device in the intermediate term (within 4 to 6 years of a decision to do so):	
Belgium	The Netherlands
Brazil	Norway
Czechoslovakia	Pakistan
East Germany	Poland
South Korea	Switzerland
(C) Countries that appear technically capable of detonating a nuclear device in the longer term (within 7 to 10 years of a decision to do so):	
Australia[c]	Libya[c]
Austria	Mexico
Denmark	Portugal
Egypt	Romania
Finland	Turkey
Iran	Yugoslavia

Note. Table indicates technical capability only. There is no speculation inferred on the political motivation to develop a nuclear weapons capability.

[a] Unless otherwise mentioned, information is derived from U.S. Energy Research and Development Agency (ERDA), April 1977, *in* Congressional Research Service. "Nuclear Proliferation Factbook," p. 325. U.S. Govt. Printing Office, Washington, DC, 1980.

[b] Spector, L. S. "Nuclear Proliferation Today," pp. 165–188. Vintage Books. New York, 1984.

[c] *The New York Times*, July 14. 1981.

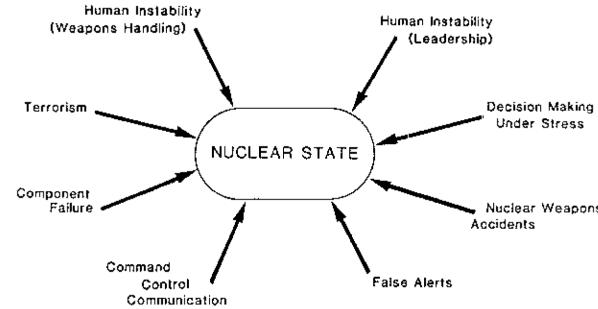

FIG. 1. Sources of risk.

be anticipated. Reluctance to share computer technology and safety systems means that each new nuclear power will have to learn from its own mistakes. There is a heightened possibility that a terrorist group might steal nuclear weapons or materials or that an irrational leader might authorize the irrational use of nuclear weapons.

Thus, proliferation will augment international tensions, allow for more destructive wars in less time, increase regional instability (particularly in the Middle East), and increase the likelihood of ultimate superpower confrontations and accidental or inadvertent nuclear war.

CONCLUSION

It may be said that accidental or unintentional war is, in fact, an event of low likelihood. But the magnitude of such an event—no matter how unlikely—is so great that we must understand the elements involved.

We know that is is impossible for a space shuttle with a schoolteacher on board to blow up seconds after launch or for a commercial airliner packed with passengers to be shot down by a military fighter plane. We know that nuclear power is a clean, safe energy source and that the occurrence of a Chernobyl disaster is a "one in a million" possibility. When these impossible events occurred, they proved once more the central lesson of the century—that the impossible is always possible.

The resolution of conflict among the great powers is a long-term problem; the preservation of nuclear peace is the indispensable prerequisite. For each potential inciting factor to inadvertent nuclear war, there is a series of steps that the nuclear nations might undertake. Some of these solutions are short range, some intermediate, and some long:

- A more multipolar international order
- Strengthening the nonproliferation treaty
- Controlling nuclear fuels, and preventing thefts
- A joint U.S.–U.S.S.R. accident prevention commission
- Exchanging information about nuclear safety devices and safeguards
- Increasing the authority of the standing consultative commission
- Establishing better crisis prevention and management procedures

The list could go on.

The law of cumulative probability illustrates that we are living with a finite probability of nuclear conflict—accidental or otherwise If this event of relatively low likelihood is projected over a sufficient time span, the likelihood may then begin to approach certainty.

So, we must grapple with this problem to understand it, and do everything in our power to cut the risk Perhaps what we need most is another set of Ten Commandments for the Nuclear Age:

1. First and foremost, thou shalt not use nuclear weapons
2. Thou shalt not test or produce or deploy new nuclear weapons.
3. Thou shalt not make decisions for the planet without the consent of the innocent bystander nations.
4. Thou shalt not demonize thine adversaries.
5. Thou shalt not indulge in "macho" or inflammatory rhetoric; neither the United States nor the Soviet Union needs to prove its manhood any longer
6. Thou shalt not bully thy neighbors
7. Thou shalt not attack thy neighbors.
8. Thou shalt communicate with thine adversaries on the basis of planetary needs, rather than national power blocs
9. Thou shalt freeze and then reduce nuclear weapons as a model for the non-nuclear powers so as to prevent proliferation around the globe.
10. Thou shalt prevent the militarization and nuclearization of outer space and preserve it for peaceful purposes

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