

# Unintended Nuclear War - Quick introduction to the topic

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## 1. Why is there such a risk?

### **False alarms in early warning systems**

The risk of an accidental nuclear war results primarily from early warning systems. These are based on sensors, very complex computer systems and networks for predicting and evaluating possible attacks by nuclear missiles. This can lead to false alarms, which can have very different causes (e.g. hardware, software, operating errors or incorrect evaluation of sensor signals). In peacetime and phases of political relaxation, the risks that the evaluation of an alarm message leads to a nuclear attack are very low. In such situations, false alarms are assumed in case of doubt.

### **Political crises – several events**

The situation can change drastically if there are political crisis situations, possibly with mutual threats, or if further events occur in a temporal context with a false alarm. For this purpose, an evaluation searches for causes, i.e. attempts are made to find causal relationships. If such causal connections are found and are logically plausible, there is a great danger that these are assumed to be valid, i.e. that the alarm message is assumed to be valid, even if independent events coincide at random.

### **Alarm chains**

The risks can be aggravated by alerting chains. As a result of an alarm signal from an early warning system, armed forces can be put on alert. Such activities are recognized by the enemy and can lead to an increased readiness for alert in conflict situations. This in turn has repercussions on their own assessment of the situation. If a false alarm with regard to attacking nuclear missiles occurs in crisis situations with mutual threats and events that are classified as hostile, then a chain reaction with ever higher alarm levels can be set in motion within minutes, which gets out of control.

### **Error-free software is not feasible**

Errors can never be excluded in a complex system and can be caused by both humans and computers. With complex applications, it is technically impossible to produce error-free software. Even if a software is proven to be correct with techniques of program verification, such proofs are only possible on the basis of a formal specification, which may itself contain errors. An important method to reduce errors in software development is testing. But testing an early warning system under real conditions will hardly be possible.

### **Rare errors are particularly dangerous**

If it is possible to improve early warning systems in such a way that false alarms only occur very rarely, security will not be increased. The rarely occurring alarm messages are then unusual and difficult to interpret. This significantly increases the risk that they will be taken

seriously, i.e. as valid. This is particularly true in crisis situations or when there are other events that can be related to them.

### **Not predictable – sudden event**

An “accidental nuclear war” is not directly predictable. As with other accidents in technical systems, there is no pre-warning. Like a “normal accident”, an accidental nuclear war can suddenly break out within a few minutes. After that, no correction is possible. Concerning normal accidents, certain actions are often taken afterwards to avoid such risks in the future. After a nuclear exchange of blows, such a future will hardly exist. In the case of nuclear war risk, we cannot wait until there has been a first “accident” in the form of an “accidental nuclear war” before taking actions to reduce these risks.

### **Doomsday Clock**

Since 1947, nuclear scientists have been setting a “doomsday clock” to alert the public to the current risk of nuclear war. The current state is 100 seconds to twelve, closer to twelve than ever before.

You can find a detailed description of the interrelationships here: <http://www.fwes.info/fwes-21-1-en.pdf>

## **2. Why will this risk grow significantly in the coming years?**

The risk of an accidental nuclear war exists above all, if an early warning system reports a missile attack in a crisis situation and if further events occur in a chronological context that can be put in relation to the warning message. The aspects described below will significantly increase the risk of an accidental nuclear war in the future.

### **climate change**

Climate change will probably lead to different regions becoming uninhabitable and thus causing more climate refugees. The available habitat is becoming smaller, important resources such as water are becoming scarcer. As a result, political crises and possibly even armed conflicts will become more frequent in the future. As a result, missile attack reports will become much more dangerous. The increased risk of a nuclear war due to climate change has also been taken into account in the nuclear war clock since 2007.

### **cyberattacks**

Cyber attacks can create dangerous and unpredictable interactions with early warning systems and nuclear forces, significantly increasing the risk of accidental nuclear war. So far, there is little experience of possible cyber war processes. A cyber war is probably difficult to control. There is the threat of an intensification of mutual attacks, which lead to an escalation spiral. New military strategies permit an attack with nuclear weapons even in the event of a serious cyber attack. Even if there is hope that such a reaction will not normally take place, the situation will change if there is a missile attack report (as a false alarm) in an early warning system in a temporal context. Possible interactions between cyberattacks and nuclear weapons are discussed in <https://www.fwes.info/fwes-21-1-en.pdf> sections 5.1 and 5.2, starting on page 17. This [example](#) shows a possible risk situation.

### **New arms race**

With the end of the INF contract a new arms race has begun. The effects of the planned arming of outer space and the development of hypersonic weapons, which are apparently difficult to locate and which will extremely shorten early warning times, are completely incalculable. This will drastically increase the complexity of possible alerts, and it will hardly be possible to test early warning systems for these new weapons.

Furthermore there are also indications of plans for smaller nuclear weapons that could be used sooner. An assumed lower operational threshold also increases the danger that an alarm message is assumed to be valid, as the use of nuclear weapons is more likely. This also increases the risk of an accidental nuclear war.

### **Automatic decisions**

The number and variety of objects in airspace will continue to increase (e.g. drones, satellites, hypersonic missiles). The evaluation of sensor signals will thus become more difficult and more and more artificial intelligence (AI) methods will be required to automatically make decisions for certain subtasks. The further development of weapon systems with higher accuracy and shorter flight times will also increasingly require artificial intelligence techniques. There are already demands to develop autonomous AI systems in connection with early warning systems, as there is no time for human decisions.

However, testing such systems under real conditions is hardly possible. Compared to other AI applications (e.g. autonomous driving), there will also be significantly less “learning data” to generate the necessary recognition criteria. This can lead to unpredictable effects that may not be evaluated and controlled by humans. In the short time available, it will usually not be possible to check machine decisions. The human being can only believe what the machine delivers. The problem of automatic decisions is addressed in <https://fwes.info/fwes-ki-21-1-1-en.pdf>

### **Many states with nuclear weapons**

There are now several states with nuclear weapons. Not only the USA and Russia have early warning systems, but also states such as China are building them up. These early warning systems can also lead to mistakes and wrong decisions with fatal global consequences.

### **War => Nuclear War**

If it comes to a military conflict in which states with nuclear weapons are involved in opposition, then most likely a “hybrid warfare” with increasing cyber attacks will follow. If, due to a computer error during a war conflict, an early warning system reports nuclear missiles that are attacking and if this is related to other events, e.g. serious cyber attacks, a causal connection is plausible for the evaluation teams. This means that there is a danger that the report of an attack will be accepted as valid, which can lead to an accidental nuclear war. Such a danger exists today not only between USA and Russia, but can be induced by any nation having nuclear weapons, e.g. in the context of a conflict between India and Pakistan. Even a limited nuclear exchange, e.g. between India and Pakistan, can lead to a nuclear winter with serious consequences for the humanity as a whole.