Swiss Re

Nuclear risks in property insurance and limitations of insurability

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Focus report

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"As long as the nuclear bomb remains in the hands of the two world powers, there will be no war. The situation will become dangerous only when the necessary plutonium can be bought at the chemist's."

Otto Hahn (1879–1968) – Physicist and nuclear scientist, Nobel laureate

Cover image:
Photo composition

Introduction

Insurance portfolios have always been exposed to events that could potentially exceed the financial strength of an entire insurance branch. Accordingly, primary insurers measure out their capacity with care, optimising its effectiveness primarily by resorting to coinsurance and reinsurance.

Large commitments from various sources tend to accumulate among international reinsurers, who are obliged to handle the corresponding capacity in such a way that they could absorb even a catastrophic loss accumulation.

Since war and civil war are generally excluded from property insurance, (re)insurers primarily focused on loss accumulations from natural catastrophes in the past. Such events are at least partly insurable as there is comprehensive statistical material available over many years and because accumulations in the most exposed areas are closely monitored.

In the meantime, there has been growing concern among property insurers and reinsurers regarding political risks, and the risk of terrorism in particular. International terrorism cannot yet be assessed precisely enough in terms of its frequency and severity, and the entirely new loss dimension experienced with the terrorist attack on the World Trade Center in New York clearly demonstrated the limits of insurability to the entire insurance industry.

Even before the end of the last century, but more intensively since 11 September 2001, the international insurance industry has been screening its existing terms and conditions for potentially ruinous risks and has identified certain weak points. Swiss Re believes that one of the most perilous shortcomings in traditional property insurance and reinsurance concerns inadequate nuclear risk exclusions.

Special liability regime and property exclusions

When the power generating industry started building the first nuclear power plants some fifty years ago, society at large became aware of the potential perils related to their operation. It was widely realised that the further development of nuclear fission entailed the risk of a nuclear chain reaction running out of control. This would not only damage the nuclear installation itself but – far more seriously – could also trigger radioactive emissions resulting in enormous claims exposure over extensive geographical areas. These fears were confirmed some thirty years later with the failure of reactor No. 4 at Chernobyl in 1986.

The anticipated extent of loss from a nuclear accident was generally believed to justify a special liability regime. Such a regime would both ensure proper compensation for the public and foster the development of the nuclear power industry, which would otherwise be faced with an overwhelming burden. Accordingly, the operators' interests were secured by limiting their liability in time and amount, and the liability regime was introduced in the Paris Convention on Third Party Liability in the Field of Nuclear Energy and in the Vienna Convention on Liability for Nuclear Damage.

The conventions' principles have been included in the national legislation of most countries operating nuclear power installations. In addition, protection of victims has been established by both imposing strict liability on the installation operator and channelling all liability for losses following a nuclear event to him. The conventions provide that the liability of the operator must be insured or protected by other financial guarantees acceptable to the competent authorities. While this legal channelling of liability to the operator differs slightly from the economic channelling applied under applicable

Calder Hall, UK. The first commercial nuclear power facility.

US law, the practical implications of the two systems are the same.

Since there never was any understanding to cover nuclear risks in conventional property insurance, nuclear perils exclusions were generally introduced for two main reasons:

1. In industrialised nations which constructed and now operate commercial nuclear power facilities for peaceful purposes, international conventions and national laws have from the very beginning facilitated ways to channel strict causal liability immediately and exclusively to the installation's operator. The underwriting solution for liability risks arising from nuclear power plants and other nuclear installations used for peaceful purposes was to establish pools which serve to spread particularly severe risks.[1]

2. The peril of radioactive contamination of third party property is not insurable by conventional means. Similarly, the risks of an attack with nuclear weapons and of any accidental discharge of nuclear weapons are also uninsurable.[2]

Nuclear terrorism – a serious threat

From the start-up of the first commercially operated nuclear reactor (Calder Hall 1, UK, 27 August 1956, 50 MWe output) until the late eighties, neither property insurers nor their reinsurers appeared to be seriously concerned about any flaws existing in individual nuclear exclusions. Some deficits were known, eg a discrepancy between French law and certain policy conditions (see details in Conclusion) or the re-inclusion of the direct fire hazard resulting from a nuclear event – a "historic flaw" now firmly embedded in the laws of several US states (Standard Fire Policy Laws). However, little importance seems to have been attached to this "blemish", since a reactor accident in a nuclear power plant cannot trigger a nuclear explosion – nor, for that reason, can it be the cause of any conflagration.

Other occasionally observed flaws in property insurance policy exclusions, such as the use of the ambiguous term "war weapons", also went largely unnoticed, especially because there also were – and still are – flawless exclusions in many primary insurance markets[3].

Radiological effects, toxicity and explosive effects

All nuclear material degrades naturally as the atomic nucleus decays and thus releases energy. Depending on the type of material, this process can take anywhere from a split second to thousands of years. Some of the energy thus released escapes as radioactive radiation capable of causing severe damage to or even destroying property and life. This process is brought to bear when the dispersal of radioactive material leads to the contamination of life, land, infrastructure, buildings, cities etc. Since radioactive radiation cannot be perceived by the human senses and has long-term effects, such an event would have tremendous economic and psychological ramifications.

The toxicity of most nuclear materials is very high (eg plutonium).

In a nuclear bomb, nuclear fission is used to force a vast number of atomic nuclei to decay in a chain reaction within an extremely short time. The resulting nuclear explosion releases a huge amount of energy with an immense destructive potential. Along with radioactive radiation, the released energy is mainly perceived as a shockwave and a heatwave. While the mechanisms of a hydrogen bomb (H-bomb) or a neutron bomb differ slightly from those of an atomic bomb, their effects are very similar.

1 For more information see: "Nuclear insurance pools – history and practice", page 7

2 Until recently, ie before the emergence of international terrorism, there was a widespread misconception that nuclear weapons were entirely excluded by way of the war exclusion clause.

3 An example of a flawless nuclear exclusion is the clause used in the Swiss market. It generally excludes losses resulting from any change in the nuclear structure. This includes radioactive contamination, damage by a nuclear explosion and subsequent fire. However, coverage for fully processed radioisotopes for certain qualified end users such as hospitals and laboratories remain available by special endorsement.

Chain reaction in a nuclear power plant
The chain reaction is well controlled in a nuclear power plant, generating a continuous flow of energy rather than an explosion. A key aspect to bear in mind in this context is that a nuclear power plant is physically unable to explode like a nuclear bomb. Rather, the worst case scenario here is known as the meltdown of the reactor which would entirely destroy the premises and prompt widespread radioactive contamination and chemical poisoning. Physical destruction is largely limited to the actual nuclear power plant.

Similarly, the exclusions in reinsurance treaties appeared to be adequate as long as the threat of nuclear terrorist attacks using nuclear bombs or so-called "dirty bombs" was unknown or considered unrealistic.

As a case in point, the widely used London clause NMA 1975a[4] "Nuclear Energy Risks Exclusion Clause (Reinsurance)" refers to property and liability insurance policies as well as to the related reinsurance treaties and pool covers for nuclear power risks. It thus concerns coverage of potential damage to nuclear power plants and other nuclear installations as well as to liability claims resulting from the operation of such nuclear installations or from the utilisation, storage and transport of nuclear material including waste.

These exclusions therefore relate to accidents in the context of the peaceful utilisation of nuclear power. But even though the London clause and similar reinsurance agreements are invariably supplemented by a war exclusion clause, the latter only apparently closes the gap between peaceful and non-peaceful usage. After all, terrorism is at the seam between war and peace, and if terrorists obtain and use nuclear material this is not addressed by the existing set of exclusions.

Starting in the mid-nineties, reports began to appear in the specialist press on the possibility of future non-conventional wars – so-called low intensity conflicts – and new, related forms of civil war and terrorism. One particular issue concerned threat scenarios dealing with nuclear terrorism. These reports were based on the suspicion that nuclear material had disappeared in various former Eastern Bloc countries during the protracted and confused dissolution of the Soviet Union, and that it would therefore be possible to buy "ready-to-use" nuclear weapons, eg nuclear "suitcase bombs", in certain countries.

Some of these rumours have in the meantime hardened into certainty, and when in 2001 several biological terrorist attacks were launched using anthrax spores in the US, revealing gaps even in the US security plan against weapons of mass destruction, risk managers and security experts stepped up their efforts to analyse the novel threat scenarios posed by biological, chemical and nuclear terrorism. It soon became clear that several terrorist organisations are likely to have the technical, organisational and financial means to trigger, for example, a bomb containing nuclear material with a conventional ignition mechanism anywhere in the world.

Finally, since the 11 September attack on the World Trade Center in New York, it has become obvious that no moral scruples would stop international terrorists from using weapons of mass destruction against the civilian population.

Chernobyl. Destruction of the facility in 1986.

4 Note: While NMA clause 1975a is not commonly used in the US and Canada, clauses used in these countries (eg "Nuclear Incident Exclusion Clause- Physical Damage – Reinsurance – USA", NMA 1119), are identical in terms of the situation described above.

"Fat Man" replica
Replica of atomic bomb dropped during World War II.
Length: 3.25m
Diameter: 1.52m
Weight: 4898 kg
Yield: 21 kT TNT equivalent
Fissile material: Plutonium

"Fat Man" replica

Nuclear terrorism scenarios

Three basic scenarios are conceivable regarding the use of nuclear material for terrorist purposes:

- The dispersal of nuclear material using conventional chemical explosives – so-called dirty bombs – or spraying devices, such as agricultural crop duster aircraft. The term radiological dispersal device (RDD) is used in this context.
- Attack or sabotage on a nuclear power plant or other nuclear installations.
- The use of a nuclear bomb either from a military source or "home made", ie a so-called improvised nuclear device (IND).

One issue these scenarios have in common is their long-term radioactive contamination and chemical pollution over extensive areas. Cleanup or decontamination to recover the contaminated area after such an incident is inevitable and extremely time consuming and expensive.

Of the three scenarios, only the nuclear bomb has the potential for real mass destruction due to the vast amount of energy released by a nuclear explosion. An explosion of this type consists of three main components; the actual blast and thermal and radioactive radiation. Property damage is primarily triggered by the blast (shockwave) and the ensuing fire (heatwave). Since the heatwave released by a large bomb may have a greater radius than the actual blast, nuclear explosions do entail a substantial fire hazard which may trigger the cover of fire insurance policies in buildings situated even at a great distance from the point of the explosion.

Still, the deployment of a nuclear bomb appears to be the least likely of the three nuclear terrorism scenarios. Distributing suitable nuclear material to construct such a bomb is extremely difficult and requires highly specialised knowledge and engineering skills. A "home-made" nuclear bomb is believed to require some 20 – 50 kg of suitable nuclear material and assumes the dimensions of a medium-sized car.

Radioactive material found in taxi in Georgia

Tiflis, 17 June (Reuters) Two containers with several kilograms of highly radioactive material and toxic gas have been found in a taxi by Georgian police. The radioactive material could have been used to construct a "dirty bomb", a police spokesperson in the Georgian capital of Tiflis said on Monday. A "dirty bomb" contains conventional explosives which deploy radioactive material upon detonating, thus contaminating the surrounding area.

The containers were found during a routine check on 31 May. A container labelled in Russian and English contained some 80 kilograms of the radioactive isotope Cesium 137 and Strontium 90. The other container was filled with mustard gas.

Police suspect that the containers were to be brought to Turkey for resale. Two suspects have been detained. The taxi driver was unaware of the containers' contents.

(Translation of article from Neue Zürcher Zeitung, 18 June 2003)

Scenario	Dirty bomb	Attack or sabotage on nuclear power plant	Nuclear bomb
	Dispersal of nuclear material in a densely populated area with conventional chemical explosives.	Attack on a nuclear power plant with conventional weapons or explosives with the intention to release nuclear material ("big dirty bomb" or "forced Chernobyl scenario").	Attack with a nuclear bomb (nuclear explosion) eg on facilities or cities.
Possible sources of nuclear material	Various possible origins, eg industry, hospital, radioactive waste of nuclear power plant.	Existing nuclear material mainly allocated within the reactor vessel, radioactive waste building, fuel building or transportation containers.	Proliferation of nuclear material of military or civil origin that may be used for nuclear fission or fusion (eg enriched uranium or plutonium).
Primary consequences	Long-term radioactive contamination and chemical poisoning of an area by dispersion of nuclear material up to several dozen square kilometres.	Long-term radioactive contamination and chemical poisoning of the plant and a large surrounding area up to several thousand square kilometres (see Chernobyl).	Large area physical property destruction due to blast and heat-wave. Widespread and long-term radioactive contamination due to radioactive cloud and fallout.
Secondary consequences	Local: limited physical damage to property due to the propelling conventional explosive.	Severe physical property damage mainly limited to the nuclear power plant (total loss of the plant is probable).	Fires (following primary consequences).

All the same, the risk of nuclear material being proliferated has increased in recent years. Some countries which have owned nuclear weapons for a long time have become politically unstable, and their nuclear scientists have been forced to accept reduced pay or made redundant. Even so, it would still be difficult to acquire or handle a bomb of military origin for various reasons, such as the extremely strict security measures safeguarding the ignition process and specific maintenance requirements.

While the deployment of a nuclear bomb clearly is the worst possible scenario, the effects of a dirty bomb must not be underestimated. Dispersed in a large city, even just a few grams of nuclear material, such as Cobalt 60, could necessitate a long-term evacuation and cleaning of areas in the dimension of dozens of square kilometres. The main effect of this type of attack is the wave of fear which the long-term exposure and its inherent morbidity risk send through the affected population.

Nuclear exposure
The term nuclear exposure refers to the exposure of life and property to radioactive emissions or to the explosion of nuclear material, effects which are used to spread shock and fear in nuclear terrorism. Since handling nuclear material requires highly sophisticated knowledge and skills, only a very limited group of specialists is capable of pursuing such activities. The term CBRN terrorism is often used in this context (CBRN = Chemical, Biological, Radiological and Nuclear devices).

Nuclear insurance pools: history and practice

Insurers have been providing nuclear risk covers for approximately four decades, and their availability is now taken for granted. Even so, it must be borne in mind that a special mechanism was and still is used to amortise the security to which operators have become accustomed over time.

With the advent of the first civilian nuclear energy programmes, insurers were faced with the challenge of finding ways to provide cover for the nuclear industry. Criteria commonly used for assessing exposure could not be applied in this field, as there was no statistical data available and there was only a very limited number of insured installations, which ruled out the possibility of establishing a balanced portfolio even on a worldwide scale. At the same time, it was obvious that, although infrequent, accidents could be potentially catastrophic and involve very high amounts. Insurers realised that a nuclear catastrophe would almost certainly trigger claims from many different policies which would result in an unacceptable accumulation and a catastrophic exposure to solvency margins. It was clear from the start that individual markets could not cover the risk on their own – let alone individual insurers.

This prompted insurers throughout the world to exclude the risk of radioactive contamination from classes where it was considered uninsurable. In practice, this concerned all classes of business except life and marine and, in most countries, accident insurance. Nevertheless, an alternative was drawn up to provide cover for nuclear risks, as insurers in many countries decided to merge operations in nuclear insurance pools. These pools address energy-related risks and do not consider it their task to provide cover against nuclear weapons.

Pools and their operation

Pools are commonly formed for the following main reasons:

- The number of risks to be insured is too small to form a risk community
- The risk to be insured is largely unknown, eg involving an entirely new technology
- The risks to be insured require a capacity volume which the pool members are unable to provide individually
- The risk in question presents certain particularly hazardous aspects – such as enormous accumulations – which would render coverage by conventional methods difficult if not impossible.

Since all of these characteristics have been identified as issues underlying the insurance of nuclear risks, the pooling mechanism clearly is ideally suited to satisfy the insurance needs of this particularly sensitive class of business.

Pools operate on the basis of a set of principles that are common to nuclear insurance in all participating countries. For example, members keep their share in the pool for own net retention without recourse to reinsurance. Another principle is that pools are based on internal solidarity and mutual reinsurance. At the same time, this common basis of principles does not preclude certain operational differences among the countries in which pools operate, and some pools also provide insurance for radioisotopes or nuclides which are used for industrial, agricultural and medical purposes. Their argument is that all nuclear risks should be treated in the same way. Even so, as the risks concerned are not deemed to present a catastrophe exposure, they are usually insured outside the pooling system in most countries.

There are differences among nuclear pools not only in operational terms but also with regard to the classes of business underwritten. Virtually all pools provide third party liability insurance for operators of nuclear installations, since this class of business is the insurance industry's answer to the need for insurance protection arising from international nuclear liability conventions. Several pools additionally insure third party liability for risks pertaining to the transportation of nuclear material, while some also grant protection for workers compensation.

The conventions and relevant domestic legislation facilitate some exclusions from either liability or insurance. All pool policies comprise an exclusion for prescription periods exceeding 10 years. Natural disasters of an exceptional character are also excluded in most countries, while war and warlike events are not covered in any country.

It should be noted that terrorism as such has not been generally excluded to date. However, 11 September 2001 demonstrated that an act of terrorism may trigger an insurance loss exposure of previously inconceivable dimensions. Nuclear pools have reconsidered their position as a result. While the terrorism risk has been either excluded or sublimited in property covers for nuclear installations, finding a satisfactory solution has been more challenging with regard to liability covers, where cover is mandatory. Negotiations were conducted with the competent national authorities to extend the scope of insurance exclusions in the relevant act. To date, these discussions have been a success in countries which are considered to be particularly exposed to terrorism (US and UK) or which have introduced very high statutory insurance limits (Switzerland), and insurers cover the risk of terrorist acts up to a sublimit either per individual risk (Switzerland, UK) or over the entire pool portfolio (US).

The vast majority of pools provides cover for material damage to the operator's installation, usually in co-insurance with a nuclear installation operator captive. Material damage is fully self-insured only in a limited number of countries. Besides the conditions commonly applied in industrial fire business in a given market, coverage is extended to include damage due to uncontrolled reactivity, such as accidental chain reactions or overheating of a reactor, as well as accidental contamination by radioactive materials.

Cover for cleanup expenses in excess of or instead of the related property value is often available, as is machinery breakdown and business interruption cover, either under a separate policy or included with the material damage cover itself. A limited number of pools provides cover for risks related to the building or rebuilding of nuclear property by offering construction or erection all risk cover.

Efforts have also been made recently to launch less traditional covers, for example to provide general protection for the balance sheet of nuclear operators, or to introduce profit-sharing elements.

Conclusion: Eliminate gaps in reinsurance exclusions

The reassessment of nuclear risks brought to light certain gaps in property (re)insurance and revealed that the introduction of various national and private terrorism schemes has failed to improve the situation. In France, for example, insurers are required by law to provide coverage against terrorism in original property policies. Exclusions – such as nuclear terrorism – may be invalid.[5] Furthermore, the use of so-called "dirty bombs" with conventional triggers appears to be covered under certain policy conditions.

The existing uncertainties and shortcomings in various markets and the necessity to exclude the nuclear risk entirely from property reinsurance have fuelled efforts to establish flawless exclusion clauses in the relevant treaties, preferably matching adequate exclusions in original policies. An acceptable agreement could be formulated as follows:

"This reinsurance treaty excludes:

a) Nuclear energy risks in accordance with the Nuclear Energy Risks Exclusion Clause NMA 1975a; and

b) Any other liability, loss, cost or expense of whatsoever nature directly or indirectly caused by, resulting from, arising out of or in connection with nuclear reaction, nuclear radiation or radioactive contamination regardless of any other cause contributing concurrently or in any other sequence to the loss, save where such liability, loss, cost or expense arises under insurances or reinsurances expressly exempted from NMA 1975a in respect of which the reinsured has specifically granted cover.[6]"

The integral wording of the relevant underlying clause – in our case NMA 1975a – would, of course, have to be included as an addendum to the reinsurance treaty.

Excluding nuclear exposures from reinsurance agreements is but a first step. Insurance wordings will have to be changed as well to exclude nuclear exposures. Ultimately, laws will have to be amended in some jurisdictions to correct the situation for the insurance industry. Swiss Re wants to work with its clients to press ahead with these necessary changes.

5 Whether or not law no. 86-1020 of 9 September 1986 contradicts the usual nuclear exclusion used in French original property policies is controversial. Section V of the law reads: "Les contrats d'assurance de biens ne peuvent exclure la garantie de l'assureur pour les dommages resultant d'actes de terrorisme ou d'attentats commis sur le territoire national. Toute clause contraire est réputée non écrite."

6 This exception concerns only endorsements for radiation and contamination risks in connection with fully processed radioisotopes for end-users, such as hospitals and laboratories, and ionising rays resulting from medical, industrial and agricultural use.

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