NPP-Study

„Calculation of a risk-adjusted insurance premium to cover the liability risks arising from the operation of nuclear plants "

11. May 2011

Markus Rosenbaum
Director
Versicherungsforen Leipzig GmbH

Assumptions / paradigms for the study

- Insurance type
- Insured risk
- Insured dangers
- Insured damages
- Insurance premium / premium calculation
- Secondary and primary analyses to determine the likelihood and severity of damages

Considered scenarios and types of damage

- Scenarios with an impact on the probability of occurrence:
  - Ageing of the NPP
  - Human error
  - Computer virus
  - Terrorism (targeted plane crash, assault with guided missiles, sabotage by insiders)
  - Earthquakes

- Types of damage/loss considered:
  - Fatal and non-fatal cancers
  - Genetic damage
  - Evacuation and relocation
  - Economic losses from the closure of certain areas and prohibition of consuming certain foodstuffs

Assumptions about the probability of a nuclear disaster

- "General" probability (from various sources):

  1:10,000,000 to 1:33,333

- Probability due to the ageing of the NPP:

  1:5,000.000 to 1:1,850

- Probability due to human error:

  1:9,090,909 to 01:30.300

- Probability caused by a computer virus:

  1:6,666,666 to 1:22,222

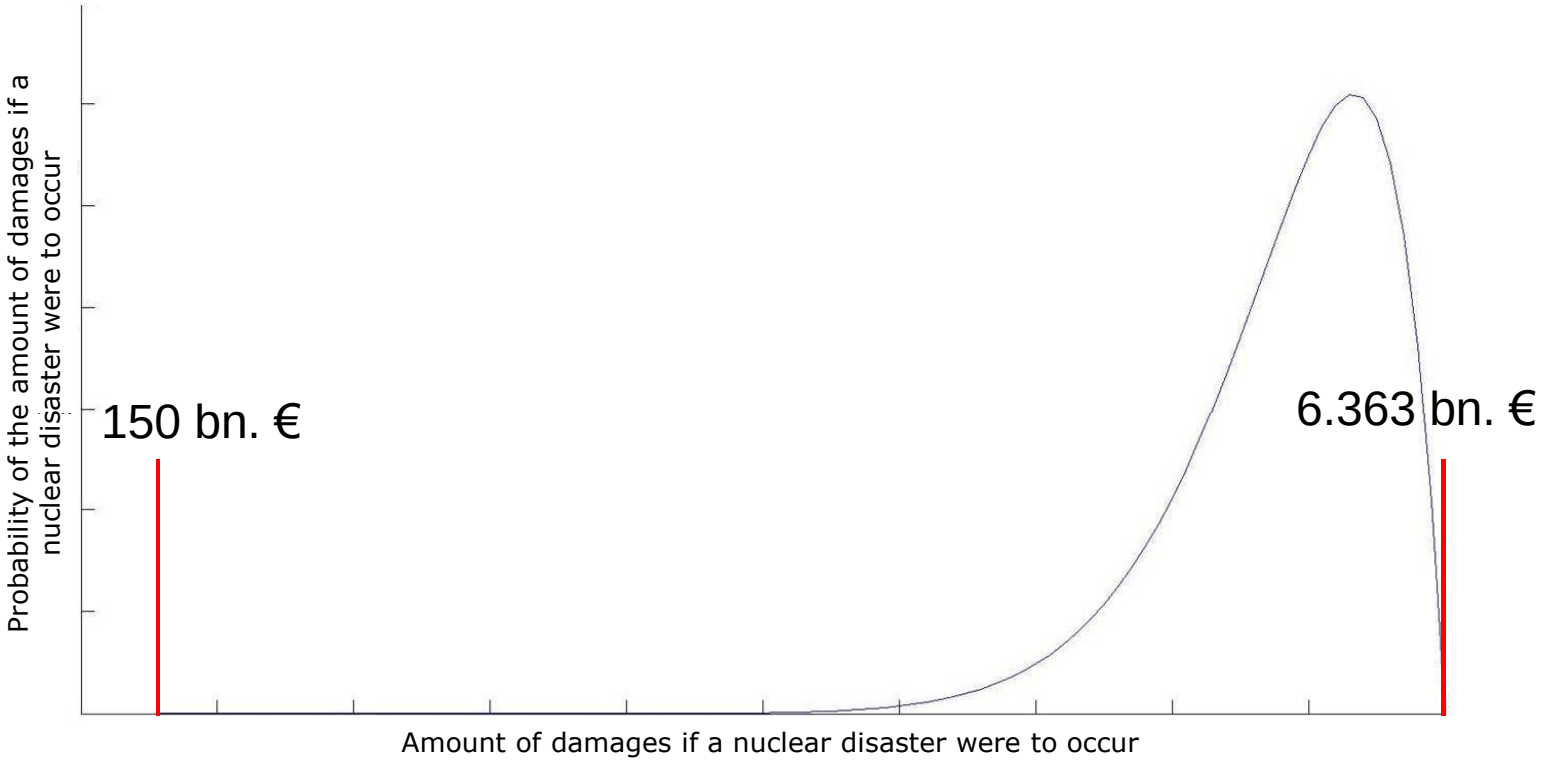
- Probability caused by an act of terrorism:

  1:1.000

Assumptions about the amounts of individual damages occurring due to a nuclear disaster

- Possible extent of damage due to fatal cancer cases:
  80.5 billion to 7,500 billion euros
- Possible extent of damage due to non-fatal cancer cases:
  74.5 billion to 1,230 billion euros
- Possible extent of damage due genetic damage:
  1 billion to 136 billion euros
- Costs due to evacuation and relocation:
  2 billion euros
- Loss of GDP from the relocation area:
  2.5 billion to 1,000 billion euros
- Economic loss due to bans on consuming certain foodstuffs:
  38 billion euros

Deriving a distribution function and simulation



- Subsequent simulation of random numbers and selecting candidates for extreme value distribution
- Maximum expected damages including safety margin: **6,090 billion euros**

Present value calculation for building up the amount of cover

- The premium payable is then derived from the present value calculation
- In this case: assuming that the amount of cover is built up for a single NPP

Provision period	**Annual premium per NPP**
Provision in 500 years	6.1 million euros
Provision in 100 years	19.5 billion euros
Provision in 50 years	72.0 billion euros
Provision in 10 years	556.2 billion euros

Apportionment of insurance premium on the price of electricity

- The following ranges of price surcharges result for the individual provision periods, depending on the form of the insurance (individual insurance of all risks vs. insurance of all risks in an insurance pool):

Provision	**Insurance premium in euros per kWh**	
	17 individual risks	**17 collective risks**
In 500 years	0,00074	0,00004
In 100 years	2,36	0,14
In 50 years	8,71	0,51
In 10 years	67,3	3,96

Bibliography

- Hohmeyer, Olav: *Soziale Kosten des Energieverbrauchs*, 1989
- Richard Ottinger et. al., *Environmental Costs of Electricity*, Oceana Publications Inc., New York, 1990
- Ewers, Hans-Jürgen; Rennings, Klaus: *Die volkswirtschaftlichen Kosten eines Super-Gau's in Biblis*, 1991
- Ewers, Hans-Jürgen; Rennings, Klaus: *Abschätzung der Schäden durch einen sogenannten „Super-GAU"*, 1992
- *Externalities of Energy* (ExternE) - A Research Project of the European Commission, 1995
- Eine Antwort der Bundesregierung auf eine kleine Anfrage zum Thema „Nuklearer Katastrophenfall", 2010
- Küppers, Christian; Pistner, Christoph: *Analyse des Bedrohungspotenzials „gezielter Flugzeugabsturz" am Beispiel der Anlage Biblis-A*, Öko-Institut e.V. Darmstadt, 2007
- *The Other Report on Chernobyl* (TORCH), 2006
- Die Methodenkonvention des Umweltbundesamtes zur ökonomischen Bewertung von Umweltschäden, 2007