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Massive radiological releases profoundly differ from controlled releases

Estimating the costs of nuclear accidents

Cost estimates should be comprehensive and thus provide a global view

- No element of cost should be left out.
- Else, cost estimates are underestimated
- If accident costs are underestimated,
  the value of prevention will also be underestimated.
- Prevention expenses will then be lower
  than what would be optimal and excessive risk will be retained.

(bad) reasons why cost components could be overlooked - 1

- Certain costs appear quite difficult to estimate
- Resulting figures may lack the precision of those provided by such sciences as astronomy
- Any such arguments result in a zero estimate

- A poor estimate is better than no estimate at all
- A poor estimate can be turned into a parametrical estimate

(bad) reasons why cost components could be overlooked - 2

- Decisions would be purely political
- Costs estimate themselves would be purely political
- Any sort of figure could be produced for political purposes

- Precisely because poor figures *may* be produced, it should be an explicit objective to contribute to professionalism
- Balanced analyses should be produced, made available and largely explained to a vast public

Broad cost categories

- The classical cost component is what we refer to as Offsite Radiological Costs
- On-site costs are not negligible
- Image Costs and can be quite significant
- Costs related to power production
- In the most severe accident scenarios, sizeable areas of land can be strongly contaminated
- There can be additional costs

The severe nuclear accident in France

The severe nuclear accident in France

- Core melt on a French 900 MWe PWR
  followed by radioactive releases,
  more or less controlled and therefore *not massive*
- Source terms can be more or less severe in this accident family
  weather conditions can be more or less favorable
- Figures are estimated from the point of view of France
  they would differ from the point of view of the affected region
  and again from the point of view of the European Union

Cost of a representative severe nuclear accident in France

	b€	%
On-site costs	6	*5%*
Offsite radiological costs	9	*8%*
Contaminated territories	11	*10%*
Costs related to power production	44	*37%*
Image costs	47	*40%*
Total (rounded)	120	*100%*

A national but manageable catastrophe

- A national disaster (€120b)
  - Around 6% of annual GDP; 3-6 years of economic growth
  - Recent major industrial accidents only cost around € 2b…
  - Image costs and power costs account for 77% of the total and are practically not related to the particular region affected by the accident
- A manageable crisis
  - Purely radiological costs would account for less than 20% of total costs
  - Radiological refugees could be in the order of 3 500 (only…)
  - High-level crisis managers would face media chaos and high economic stakes rather than a full-blown radiological catastrophe

The major nuclear accident in France

The major nuclear accident

- Core melt on a French 900 MWe PWR followed by *massive* releases
- Again source terms can be more or less severe and weather conditions can be more or less favorable
- Again figures are estimated from the point of view of France, would differ from the point of view of the affected region, and from the point of view of the European Union

Cost of a representative major nuclear accident in France

	b€	%
On-site costs	8	*2%*
Offsite radiological costs	53	*13%*
Contaminated territories	110	*26%*
Costs related to power production	90	*21%*
Image costs	166	*39%*
Total (rounded)	430	*100%*

A major radiological catastrophe – 1 (costs)

- Radiological consequences could cost more than € 160b i.e.
  8 times more than for a typical severe accident
  and more than the *total* cost of a severe accident.
- Offsite radiological costs would be multiplied by 6.
- Costs of contaminated territories exceed 5% of annual GDP.

A major radiological catastrophe – 2 (numbers)

- Radiological refugees, could typically number 100 000
- Expected numbers of cancers would be high
- Psychological impacts would be significant
- Quantities of lost agricultural produce to be disposed of would be considerable
- Management of contaminated territories (apart from exclusion zones) would remain an on-going challenge for many years
- Neighboring countries would often also suffer from contamination

A major radiological catastrophe – 3 (implications)

- Such extensive radiological impacts would impose widespread suffering on affected populations
- Corresponding costs could be termed “human” costs and could elicit among decision makers a high level of willingness to pay for prevention
- In total, “human” costs would represent about 40% of total costs but might weigh more heavily in decisions

High “economic” costs

- Image costs and Costs related to power production are more diffuse and shared among the entire population; such “economic” costs would be quite high
- Image costs could reach the staggering figure of more than € 160b, as much as radiological costs.
- Costs related to electricity could typically be twice as high as after a severe accident (€ 90 b);
- These are reasoned estimate, orders of magnitude of corresponding costs.
  They are more uncertain than for severe accidents.

Huge total losses

- In total, a typical major accident could cost more than € 400b
  - more than 20% of annual French GDP,
  - more than 10 years' economic growth.
  - comparable to the cost of waging a regional war.
- The country would be irradiated and, in addition, would face extremely heavy losses. In all probability, this would lead to profound political and social transitions.
- Such a blow would durably stun the country, History would remember the catastrophe for decades, Western Europe would globally be affected.

Concluding remarks

- 1. Massive releases profoundly differ from controlled releases:
  - controlled releases lead to a largely economic crisis, most costs being borne by the entire population in a diffuse fashion.
  - quite to the contrary, massive releases result in massive radiological consequences and the number of victims can be considerable and include people from all walks of life.

Concluding remarks

- 2. Such information should be useful for crisis managers:
  - Should help develop a global vision of a nuclear crisis
  - This should help avoid major errors in the early stages, errors which can be quite costly in the long run
  - Crisis preparation could be improved if it is realized that radiological consequences are only part of the crisis and may be a minor part in economic terms.

Concluding remarks

- 3. Safety decisions may also be informed by this vision:
  - extreme cases carry huge stakes for the nation
  - therefore their lower probability may not balance their catastrophic potential.

Thank you for your attention