

CNFE: Fukushima Nuclear Catastrophe –
Ten Years Later, 12 March 2021

Results from the flexRISK project and reflections on emergency preparedness

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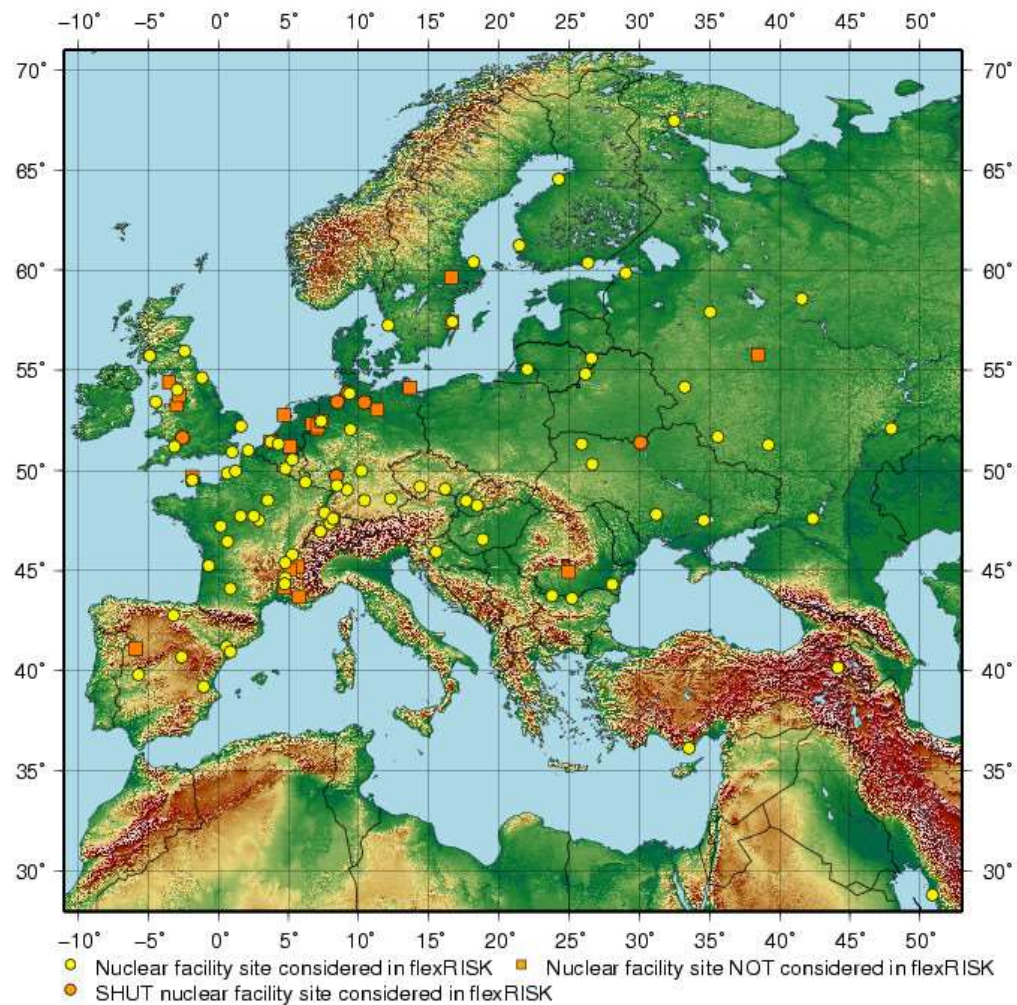
Overview

- The project flexRISK: Assessment of severe accident consequences
- Iodine prophylaxis as an example for an intervention measure
- Conclusions and outlook

The research project “flexRISK”

- Making visible the risk resulting from severe accidents in nuclear power plants (NPP)
- For each reactor, a realistic but worst case severe accident scenario with a large release was used
- Dispersion calculations for 2,788 real weather situations were made
- Results:
 - Contamination and dose for each reactor (Cs-137 and I-131 in Bq/m², I-131 in air, thyroid and effective doses)
 - Risk per NPP Unit
 - Risk export from NPP countries
 - Risk import by all countries
- Project team: University of Natural Resources and Applied Life Sciences, Vienna: Institute of Meteorology, Institute for Security and Risk Science; Austrian Institute of Ecology
- 2009-2012
- Funded by the Austrian Climate and Energy Funds

Nuclear sites in the flexRISK database



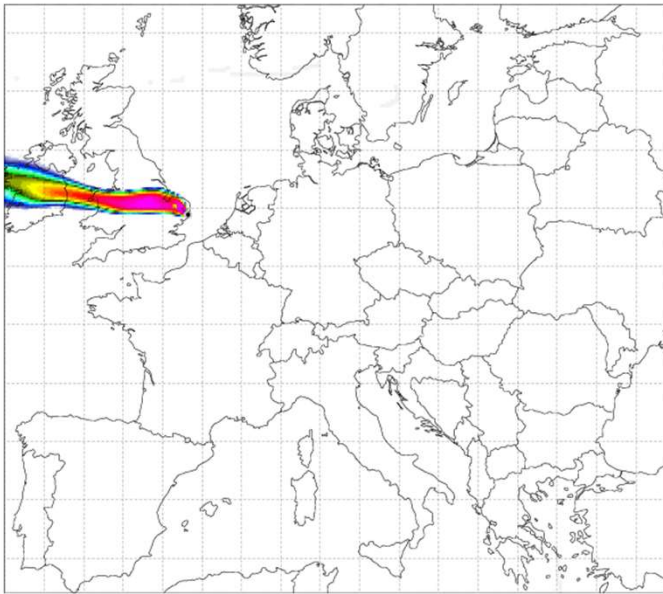
Take a look on the flexRISK website

- <http://flexrisk.boku.ac.at/en/results.html>

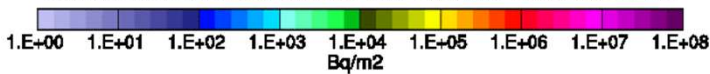
Sizewell B: scenario of a severe accident on three different days

Sizewell-B

Deposition from a 118.59 PBq release of Cs-137
Simulation start 19951110 19 Actual time 19951125 19

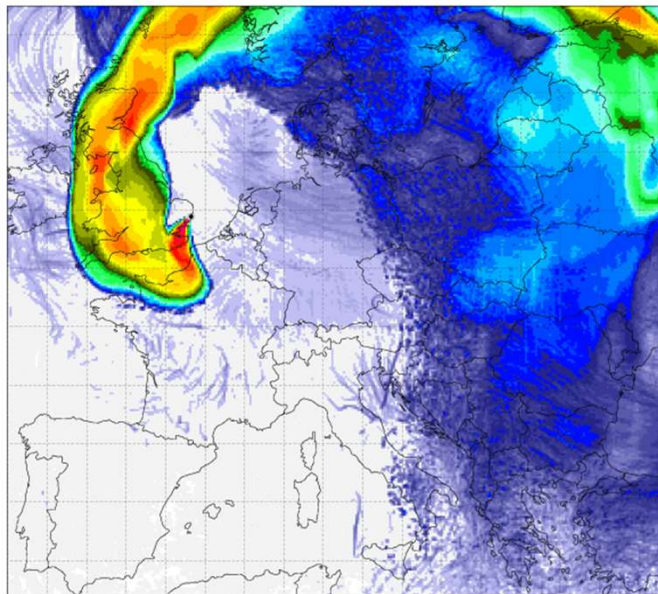


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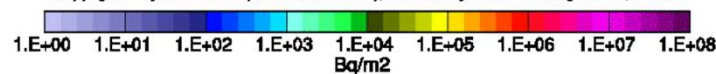


Sizewell-B

Deposition from a 118.59 PBq release of Cs-137
Simulation start 19950429 17 Actual time 19950514 17

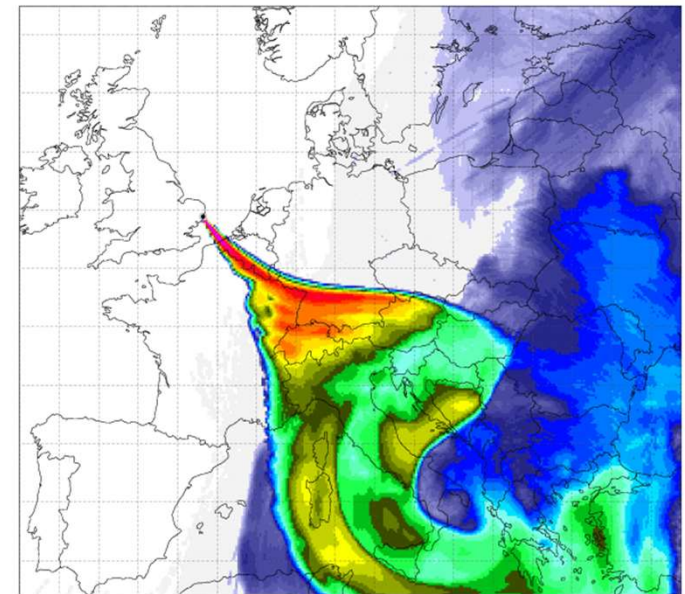


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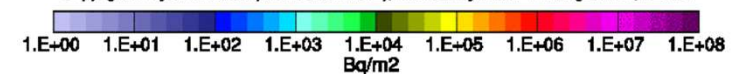


Sizewell-B

Deposition from a 118.59 PBq release of Cs-137
Simulation start 19950101 21 Actual time 19950116 21



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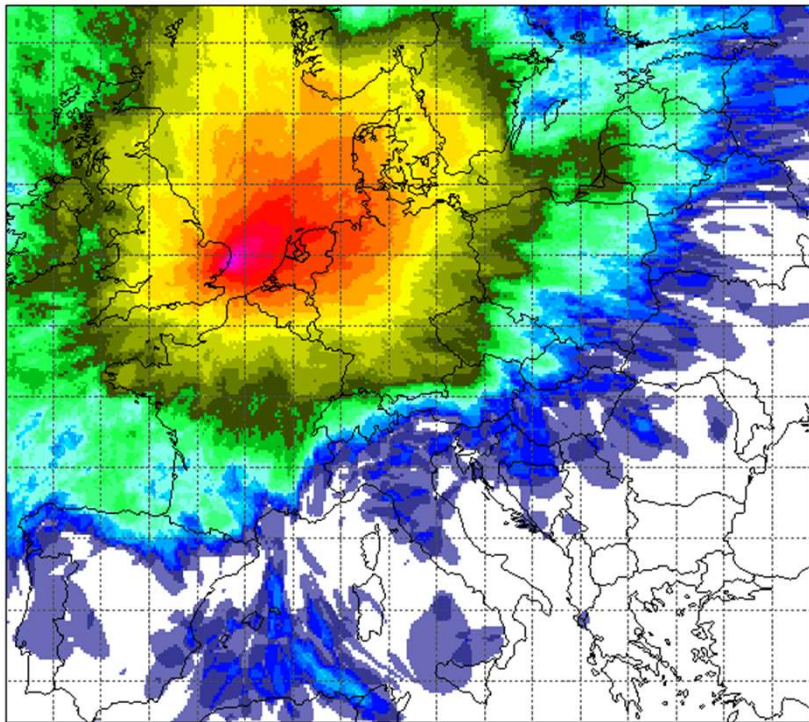


- Release of 118.6 PetaBequerel Caesium-137 (comparable to the Chernobyl release)
- Contamination with Cs-137 in Austria after Chernobyl in average 21 kBq/m² (lightgreen), up to 185 (dark yellow)

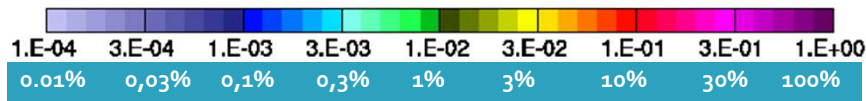
Weather-related risk from Sizewell B

Sizewell-B

[Weather-related] Probability of deposition > 185.00 kBq Cs-137/m²
Maximum in AT 1.51 %



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Only probability of deposition due to the weather

Frequency of occurrence of such a severe accident is not included

185 kBq Cs-137/m²: was the highest contamination in Austria after Chernobyl, in SU: the zone with the right of resettlement after Chernobyl

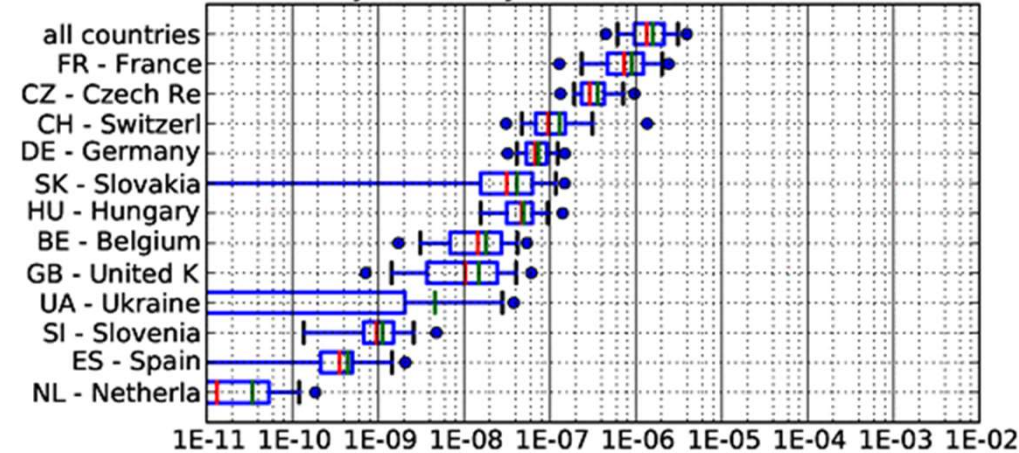
Risk import and export

- Example: Risk of exceedance of thyroid dose of 10 mSv (7d) for children in Switzerland
- Sum over all NPP units in Europe, weather-related risk, and accident frequency

Risk received by Switzerland

Scenario: Active 1/2012

Probability of 7-d thyroid dose for infants > 10 mSv



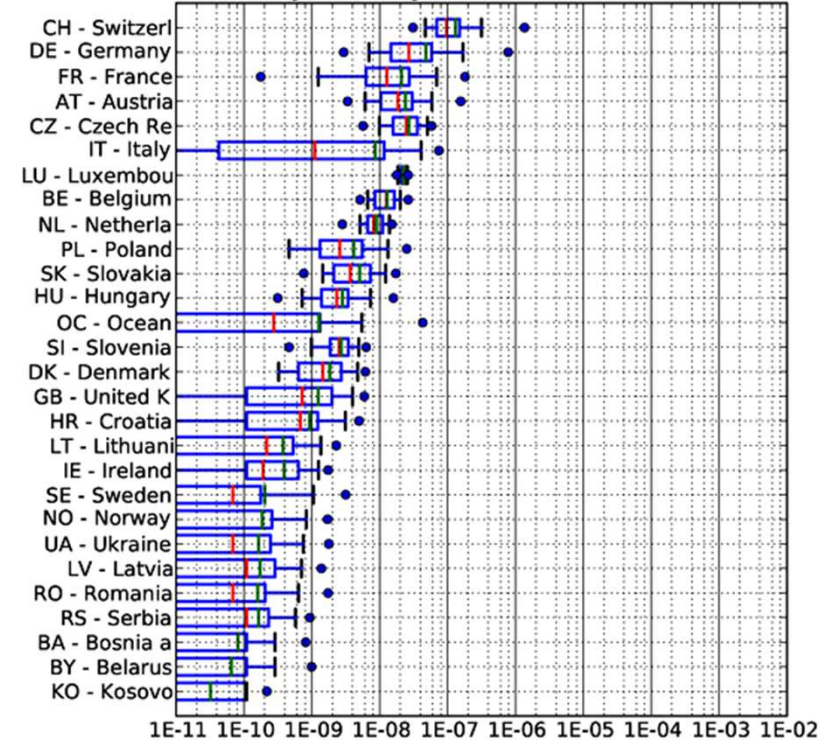
Green line = average probability

The highest risk does not only result from the nearest NPPs.

Risk originating from Switzerland

Scenario: Active 1/2012

Probability of 7-d thyroid dose for infants > 10 mSv



Intervention measures in case of severe accidents

- Sheltering
- **Iodine prophylaxis**
- Evacuation
- Temporary relocation
- Permanent relocation
- Food restrictions, decontamination, ...



Iodine prophylaxis: If potassium iodine tablets are taken before radioactive iodine arrives, it fills the thyroid with stable iodine, and the inhaled radioactive iodine cannot be stored in the body and will be excreted

Iodine prophylaxis starts at what expected thyroid dose?

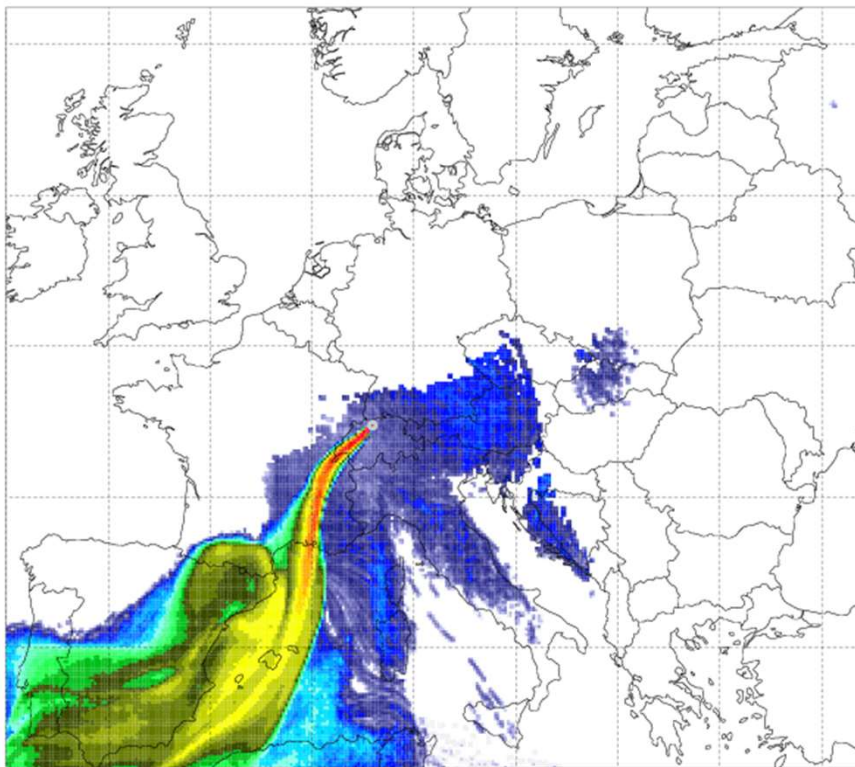
Country	Thyroid dose children and pregnant women in mSv	Thyroid dose adults in mSv	Zones where iodine tablets were distributed or are available for private household
Austria	10	100	Whole country: stored in schools and kindergartens; people can get them from pharmacies
Germany	50	250	Distributed upfront in 10 km around NPPs; Over 10 km: distributed only in case of accident; City of Aachen has upfront distributed the tablets
Switzerland	50	50	Up to 50 km around NPPs tablets were sent to every household

Accident in NPP Gösgen, CH: thyroid dose for children

Goesgen-1 | Thyroid dose infant 07 d

Release R01-25 | 486.4 PBq (20.00%) of I-131, etc.

Simulation start 19950413 11 stop 19950428 11 | Max AT 0.03



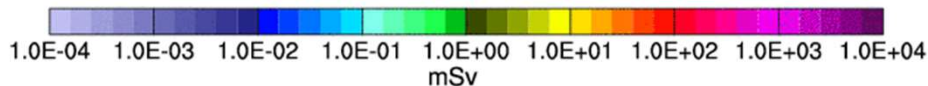
Geneva is 190 km from NPP Gösgen

This severe accident in NPP Gösgen will result in this weather situation in 10-50 mSv thyroid dose for children in the Geneva region

Iodine tablets are distributed to people in 50 km circle in Switzerland

(Distance of Geneva to NPP Bugey/F: 67 km)

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Results from a study in Germany

- Analyses of German emergency planning measures in the light of Fukushima experiences:
- German NPP Philippsburg: a release of about 10 % of iodine up to 30 days was calculated
- Results : in nearly all scenarios the maximal distance of 100 km was exceeded for thyroid dose intervention levels for children (50 mSv), up to 190 km distance
- Conclusion of the authors: emergency planning is not adequate
- Gering, F.; Gerich, B.; Wirth, E., Kirchner, G. (2012): Analyse der Vorkehrungen für den anlageninternen Notfallschutz für deutsche Kernkraftwerke basierend auf den Erfahrungen aus dem Unfall in Fukushima. Fachbereich Strahlenschutz und Umwelt, Bundesamt für Strahlenschutz, Salzgitter

Conclusions

- Severe accidents cannot be excluded.
 - Wheatley et al. (2016): A severe accident like in Fukushima can occur every 60-150 years with a probability of 50%, accidents like in Three Mile Island every 10-20 years.
<https://www.sciencedirect.com/science/article/pii/S2214629615301067>
- The flexRISK project helps to get a realistic picture of the dimensions of severe accidents
- Iodine tablets should be disseminated to the whole population upfront
 - This can also be done in individual cities, in addition to national or federal plans
 - If people are not aware of nuclear risk, they will not get the tablets
- Population needs to be better informed
 - Survey in Bulgaria and Romania: people living in the vicinity of Cernavoda did not even know about the NPP

Preparation activities for Cities

- City population has quick access to iodine tablets (including tourists, commuters)
- Focus on vulnerable groups:
 - Intervention measure “sheltering”: where should homeless people go?
 - Inform the population on emergency measures (in different languages, in sign language, in easy language), establish cooperation with community organisations trusted by vulnerable groups
- Inform people on nuclear risk, support alternative energy measures....

Outlook for flexRISK

- A flexRISK update is planned for 2021:
 - Update reactor data
 - Accident scenario like Fukushima (long releases)
 - Update of dose calculation to fit better to emergency measures (2d instead of 7d contamination phase)
 - Provide results for countries of interest
 - Scenario for Small Modular Reactors?

Contact and Links

- Gabriele Mraz: mraz@ecology.at
- flexRISK website: <http://flexrisk.boku.ac.at/en/index.html>
- Videos and presentations of today's event will be available here:
- http://www.ecology.at/wua_fukushima_event.htm
- <https://wua-wien.at/atomschutz/positionen-und-stellungnahmen/2292-tagung-10-jahre-fukushima>
- <http://www.joint-project.org/>