



Strål
säkerhets
myndigheten

Swedish Radiation Safety Authority

Review of Swedish emergency planning zones and distances

AUG meeting in Dublin
2018-04-23

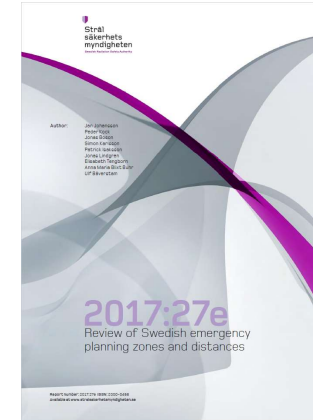
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Section for Emergency Preparedness and Response



Outline

- Background and sites
- Reference levels, dose criteria and intervention levels
- Postulated events
- Representative source term (NPP)
- Dispersion and dose calcs, post-processing
- Overall conclusions (NPP)
- The proposed emergency planning zones and distances

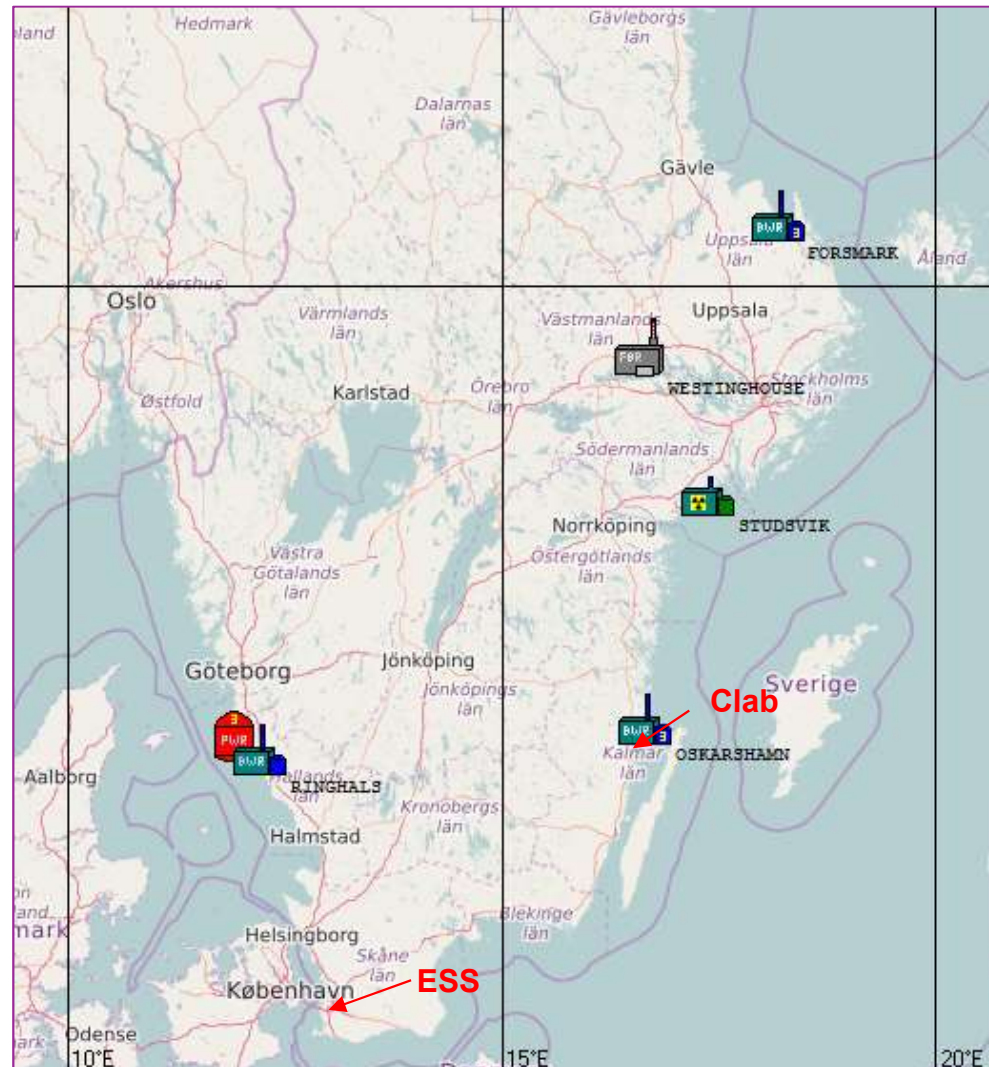
Background

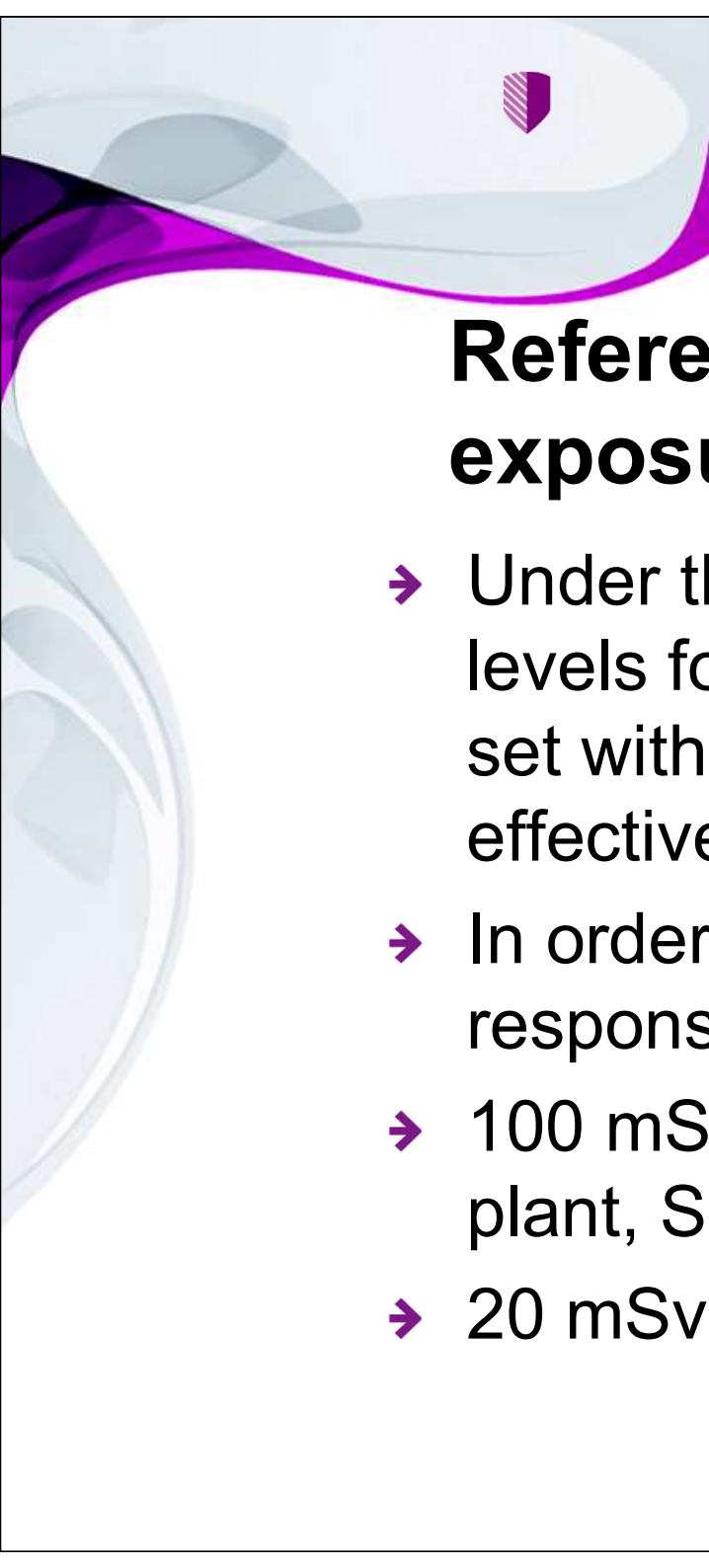


- Presentation at ARGOS meeting Sept 2017
 - Governmental assignment to SSM
 - Preliminary results for Westinghouse Electric Sweden's nuclear fuel fabrication plant in Västerås
- Final report published in Nov 2017
- Oral presentation at NERIS Workshop on Friday by Jan Johansson (PL): “New emergency planning zones and distances in Sweden”.
- English version of the main report available at:
<https://www.stralsakerhetsmyndigheten.se/en/publications/reports/radiation-protection/2017/201727e/>



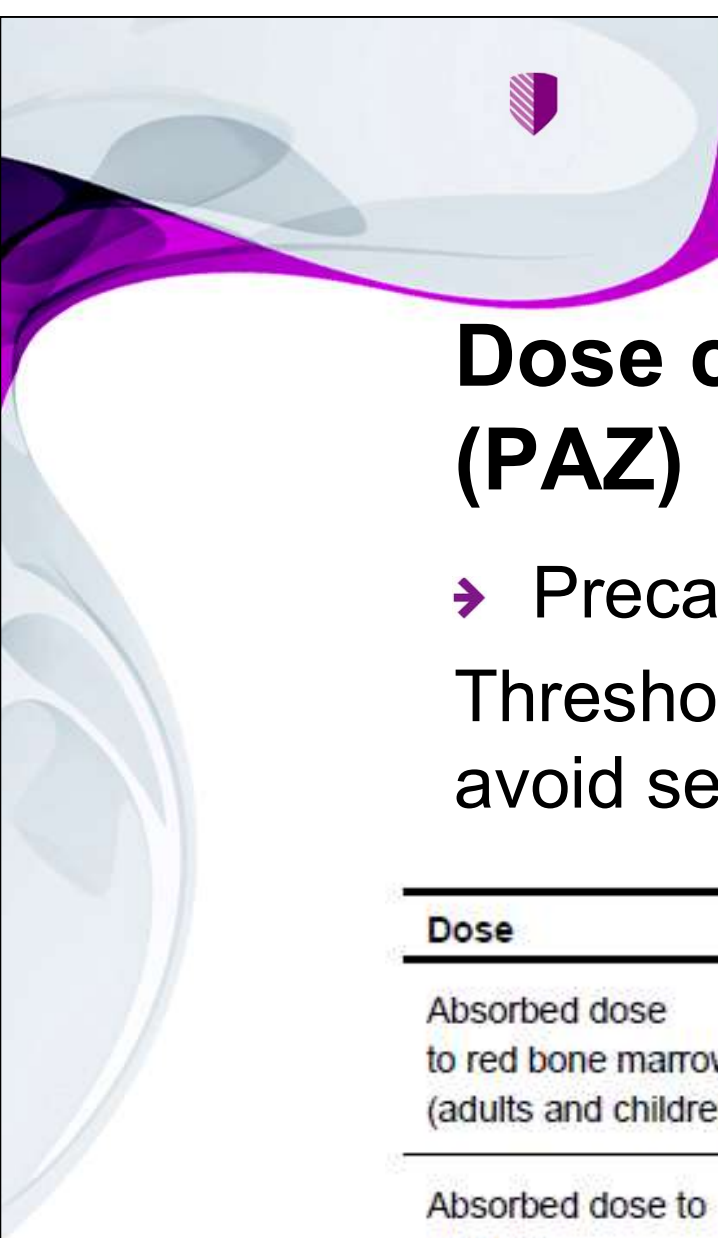
Sites in Sweden





Reference levels for emergency exposure situations

- Under the radiation safety directive, reference levels for emergency exposure situations are to be set within the interval 20-100 mSv acute or annual effective dose
- In order to produce an effective emergency response the number of levels should be small
- 100 mSv postulated event at a nuclear power plant, SBO without functioning mitigation systems
- 20 mSv all other postulated events

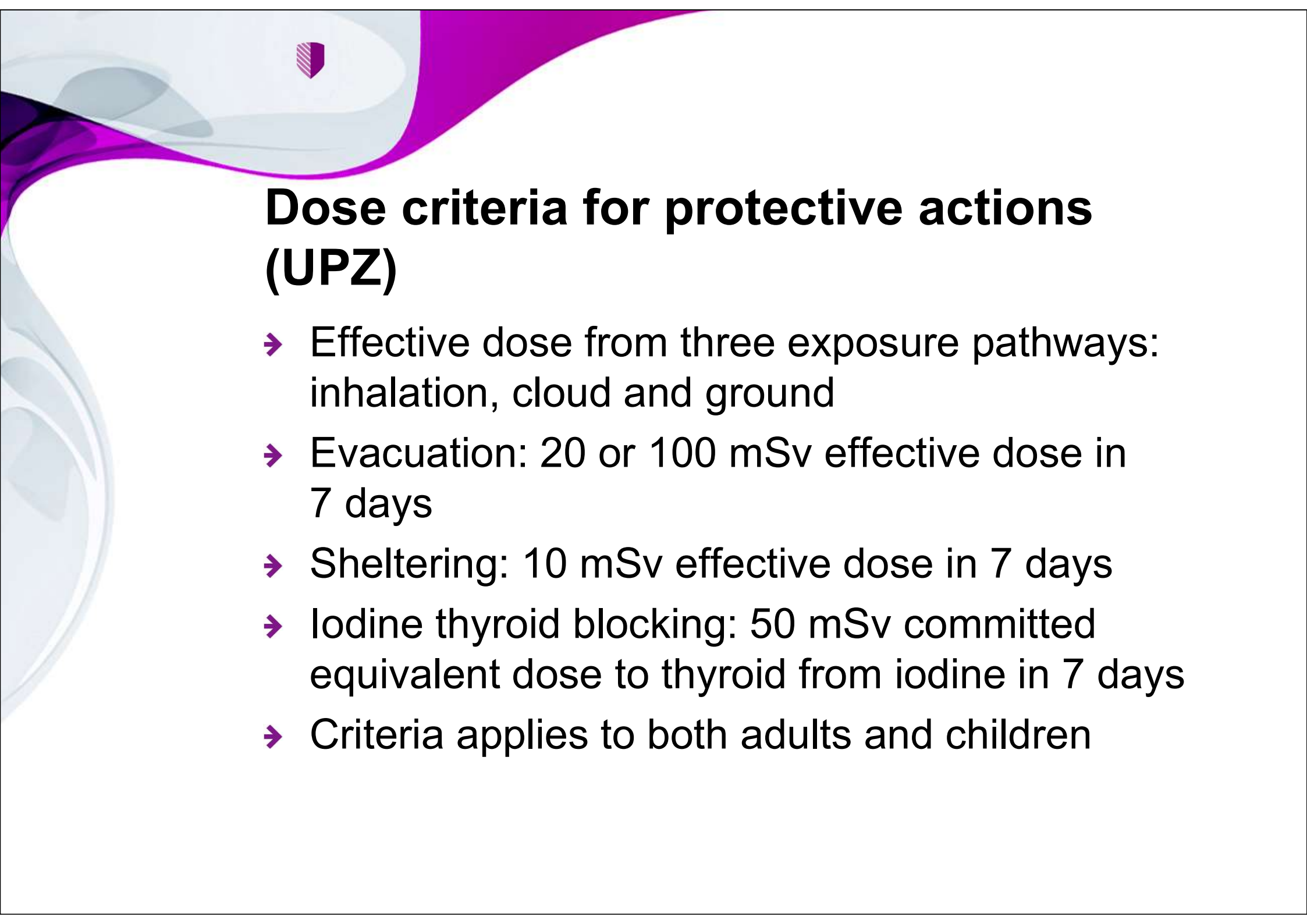


Dose criteria for protective actions (PAZ)

➤ Precautionary evacuation

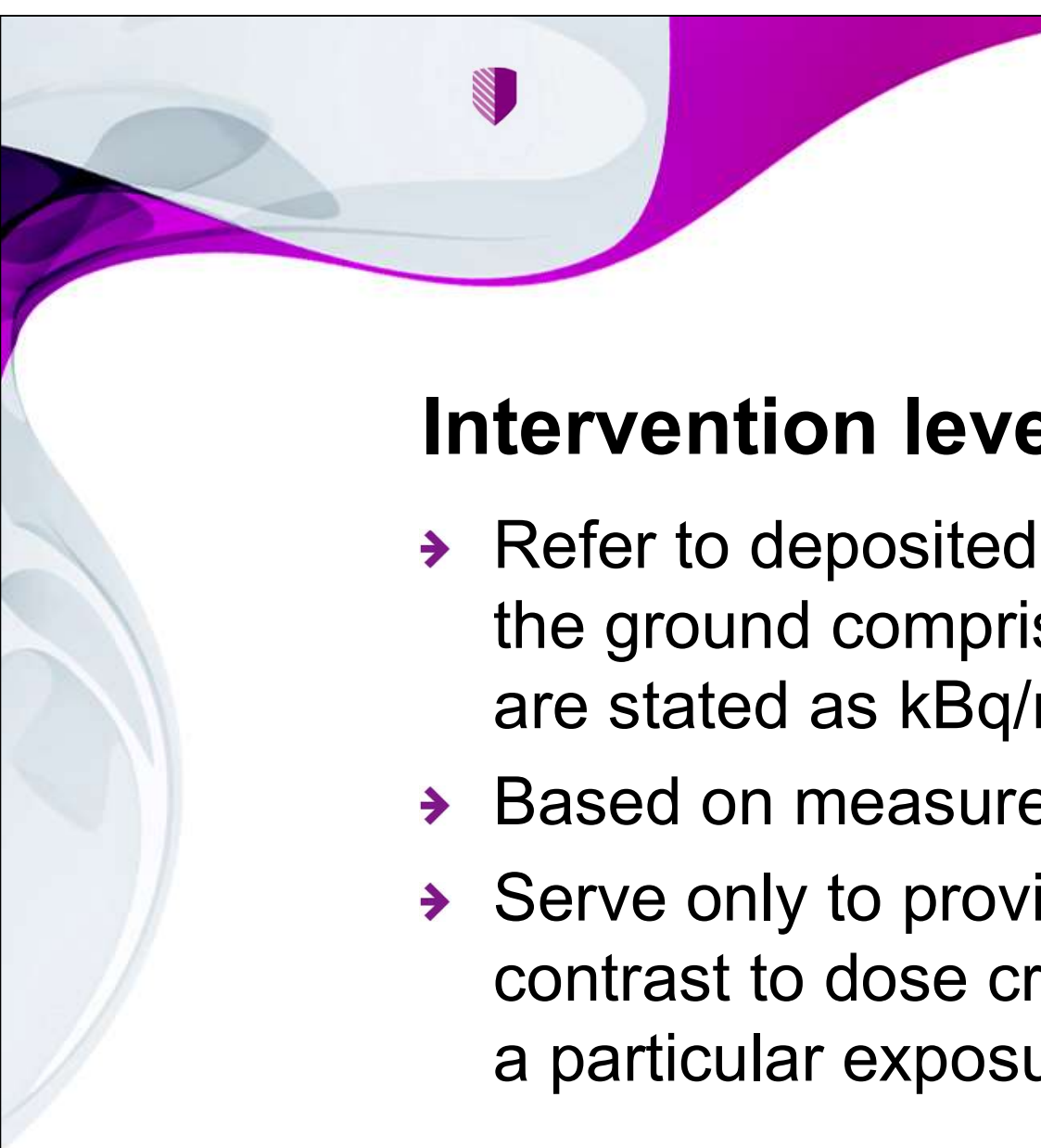
Threshold doses for protective actions in order to avoid severe deterministic effects:

Dose	Dose criterion	Comment
Absorbed dose to red bone marrow (adults and children)	1,000 mGy	Threshold dose corresponding to 1 per cent mortality without medical care
Absorbed dose to embryo	100 mGy	Threshold dose for the induction of malformations (2 to 7 weeks post conception)
Absorbed dose to brain of a foetus	300 mGy	Threshold dose for induction of severe mental retardation (8 to 15 weeks post conception)



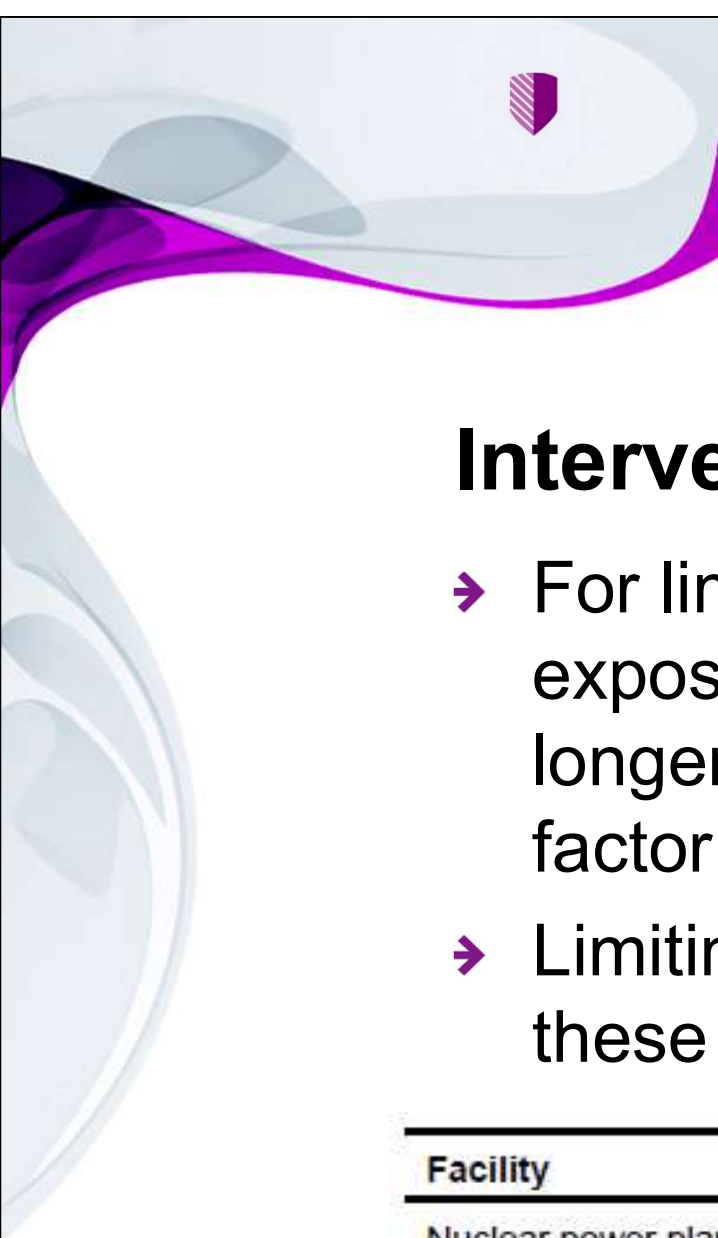
Dose criteria for protective actions (UPZ)

- Effective dose from three exposure pathways: inhalation, cloud and ground
- Evacuation: 20 or 100 mSv effective dose in 7 days
- Sheltering: 10 mSv effective dose in 7 days
- Iodine thyroid blocking: 50 mSv committed equivalent dose to thyroid from iodine in 7 days
- Criteria applies to both adults and children



Intervention levels

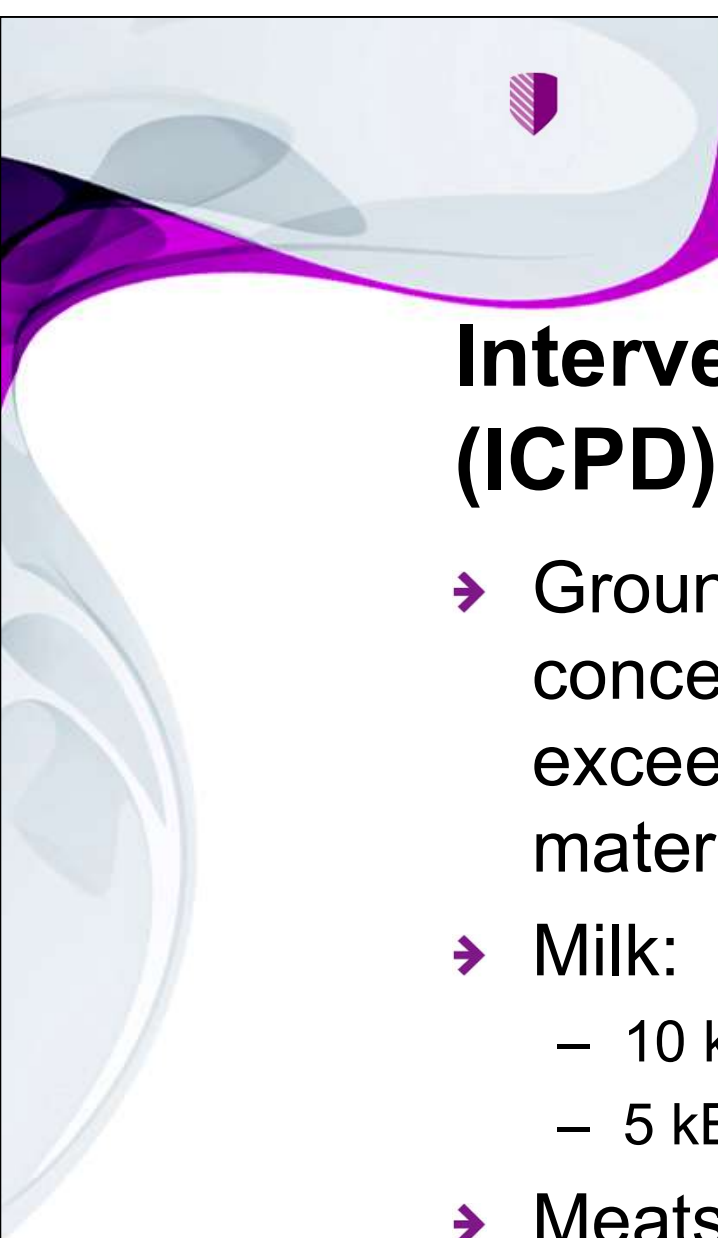
- Refer to deposited activity per surface unit on the ground comprising a certain nuclide, and are stated as kBq/m^2 .
- Based on measurement data.
- Serve only to provide guidance as they, in contrast to dose criteria, only take into account a particular exposure pathway.



Intervention levels for relocation (EPD)

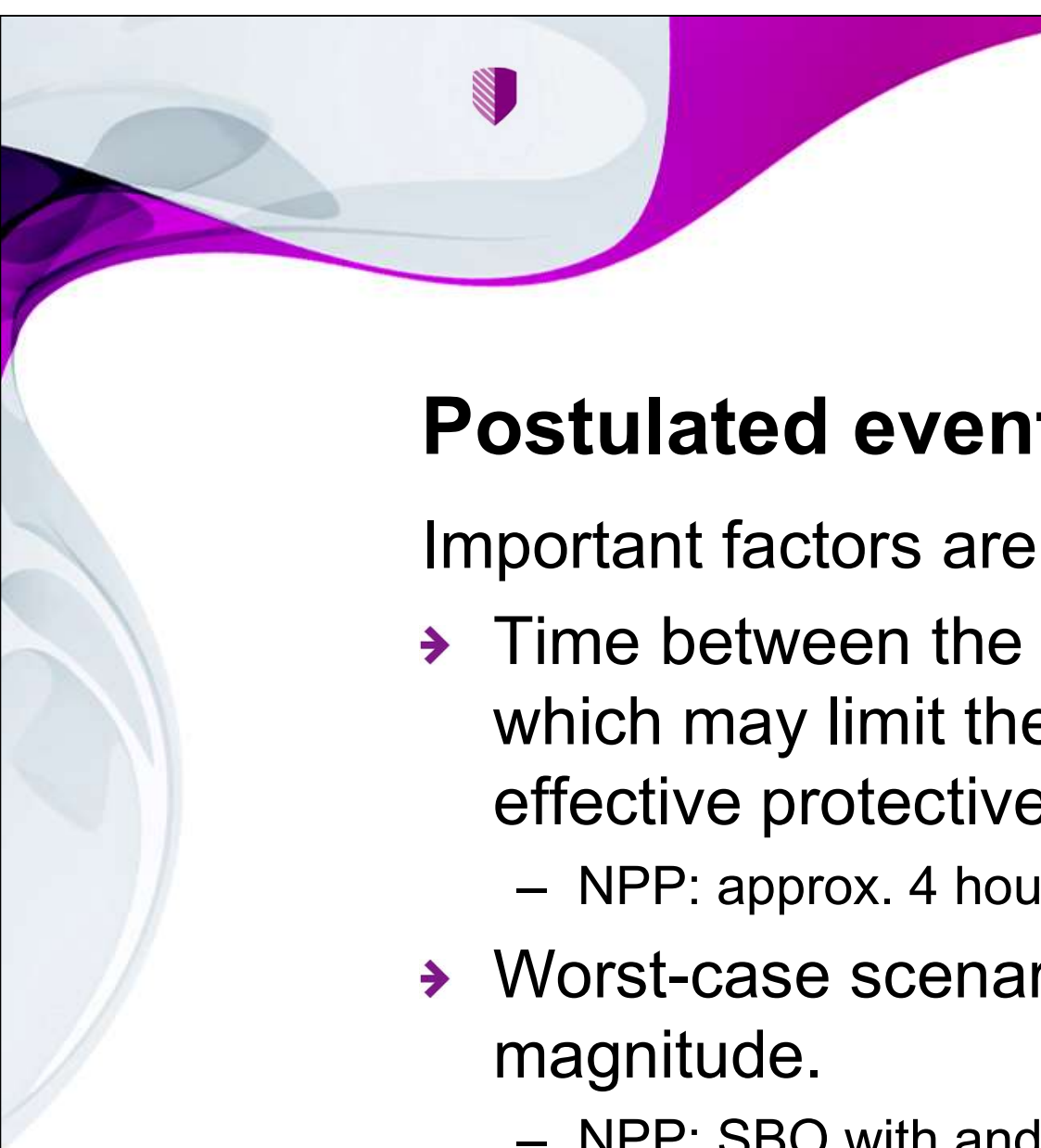
- For limiting the effective dose from external exposure due to ground deposition over the longer term. Include normal living (shielding factor 0,5 for all exposure pathways).
- Limiting the effective dose to 20 mSv from these nuclides during the first year:

Facility	Nuclides	Intervention level (kBq/m ²)
Nuclear power plant	Cs-137 + Cs-134	2,000
Clab	Cs-137 + Cs-134	3,000
	Co-60	1,000



Intervention levels for food production (ICPD)

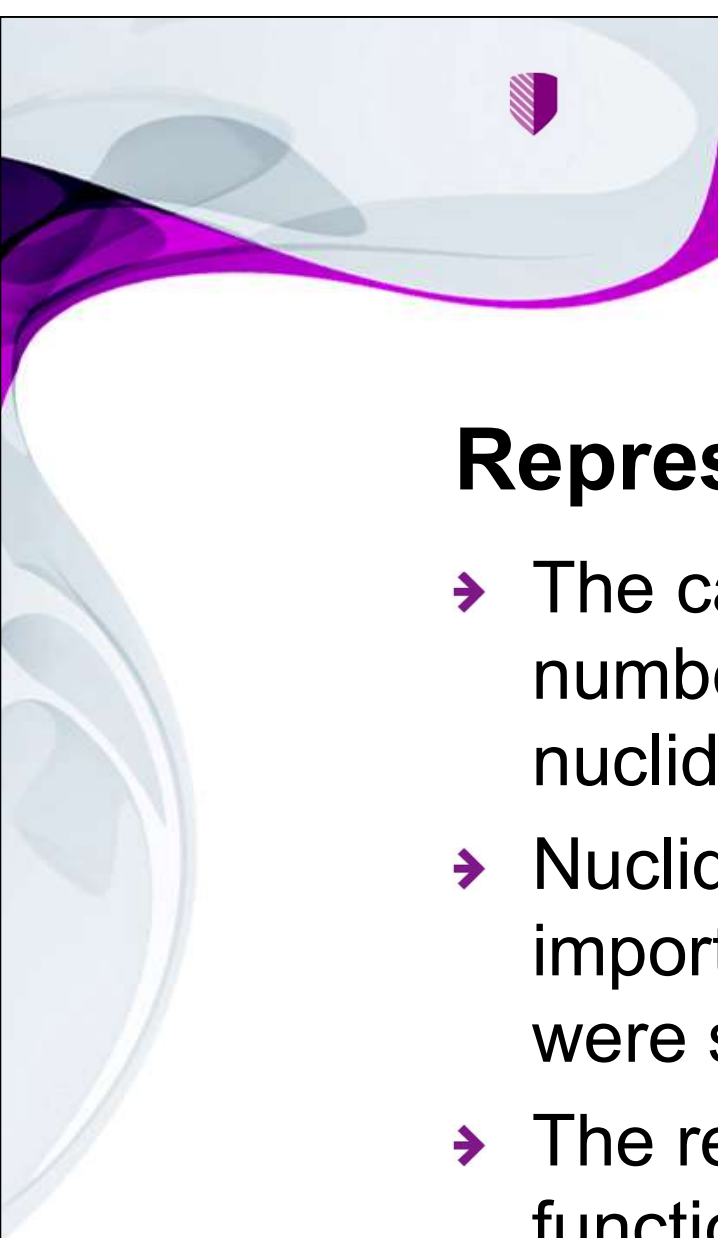
- Ground deposition that might lead to concentrations of radioactivity in foodstuffs exceeding the EU's limits for radioactive materials in foodstuffs and animal feed.
- Milk:
 - 10 kBq/m² Cs-134, Cs-136 and Cs-137 (in total)
 - 5 kBq/m² I-131
- Meats (beef, lamb):
 - 1 kBq/m² Cs-134, Cs-136 and Cs-137 (in total)



Postulated events

Important factors are:

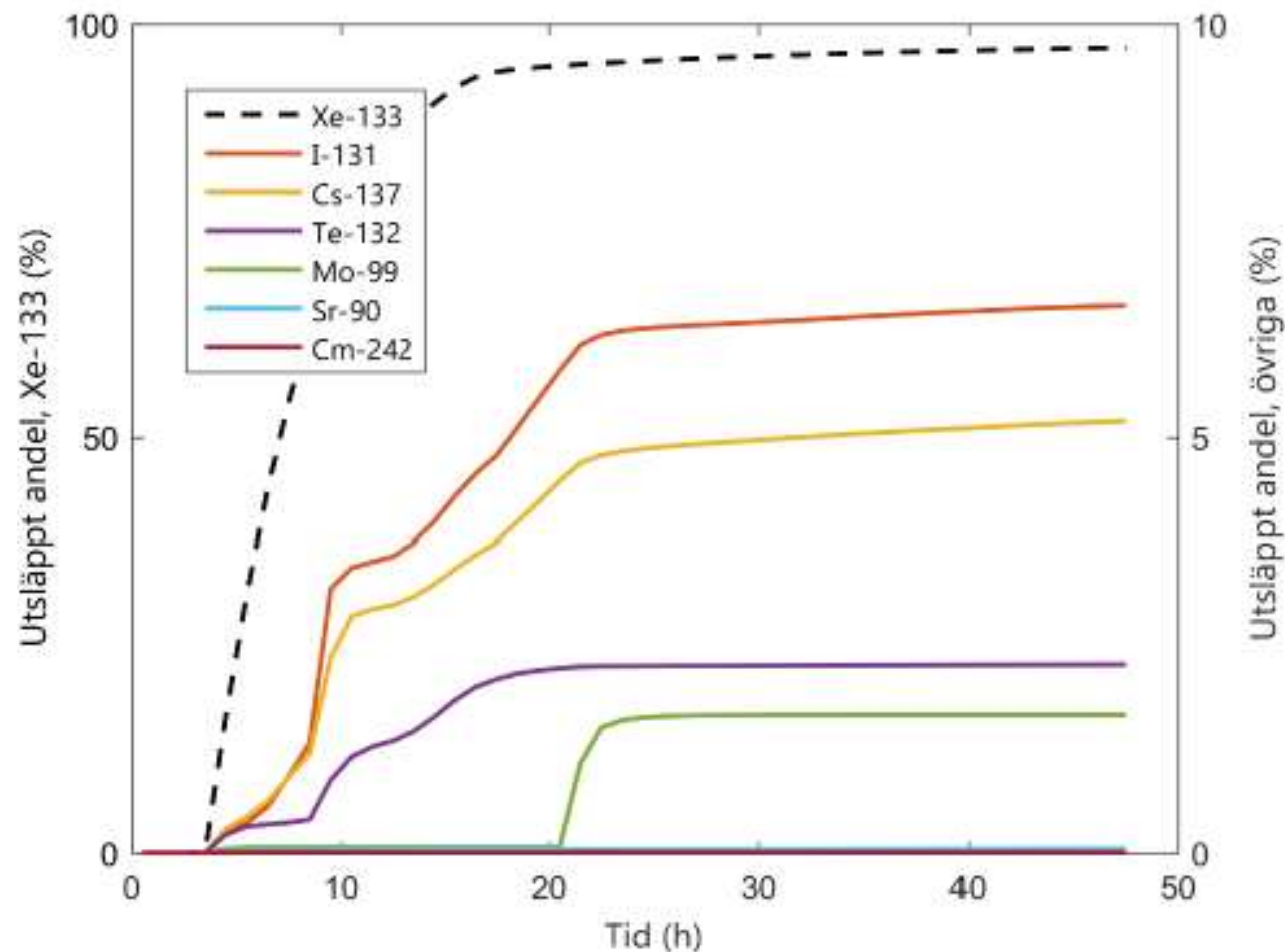
- Time between the initial event and a release, which may limit the potential to carry out effective protective actions for the public.
 - NPP: approx. 4 hours for the postulated events.
- Worst-case scenario in terms of release magnitude.
 - NPP: SBO with and without functioning mitigation systems

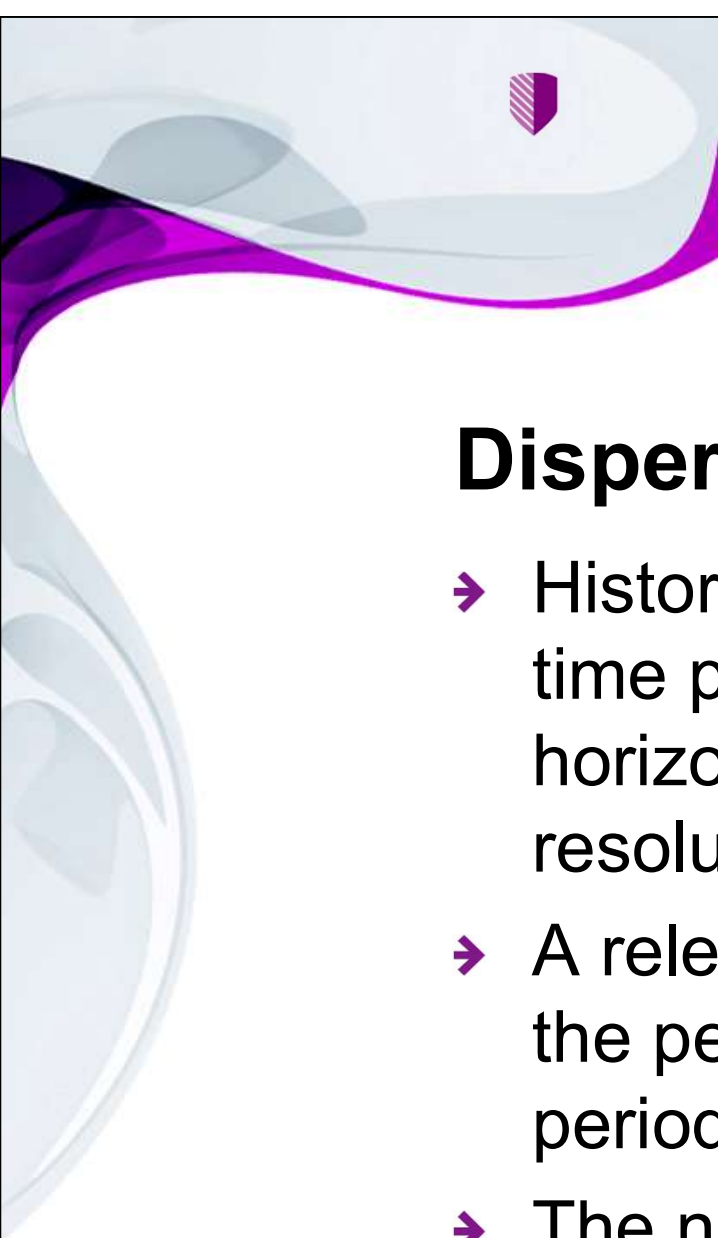


Representative source term - NPP

- The calculations are more or less linear to the number of nuclides. Reducing the number of nuclides opens up for better weather statistics.
- Nuclides significant to dose and nuclides important for measures (intervention levels) were selected: 29 nuclides out of 285 nuclides
- The released amounts for SBO without functioning mitigation systems are similar to those from Fukushima Daiichi 1-3 (airborne).

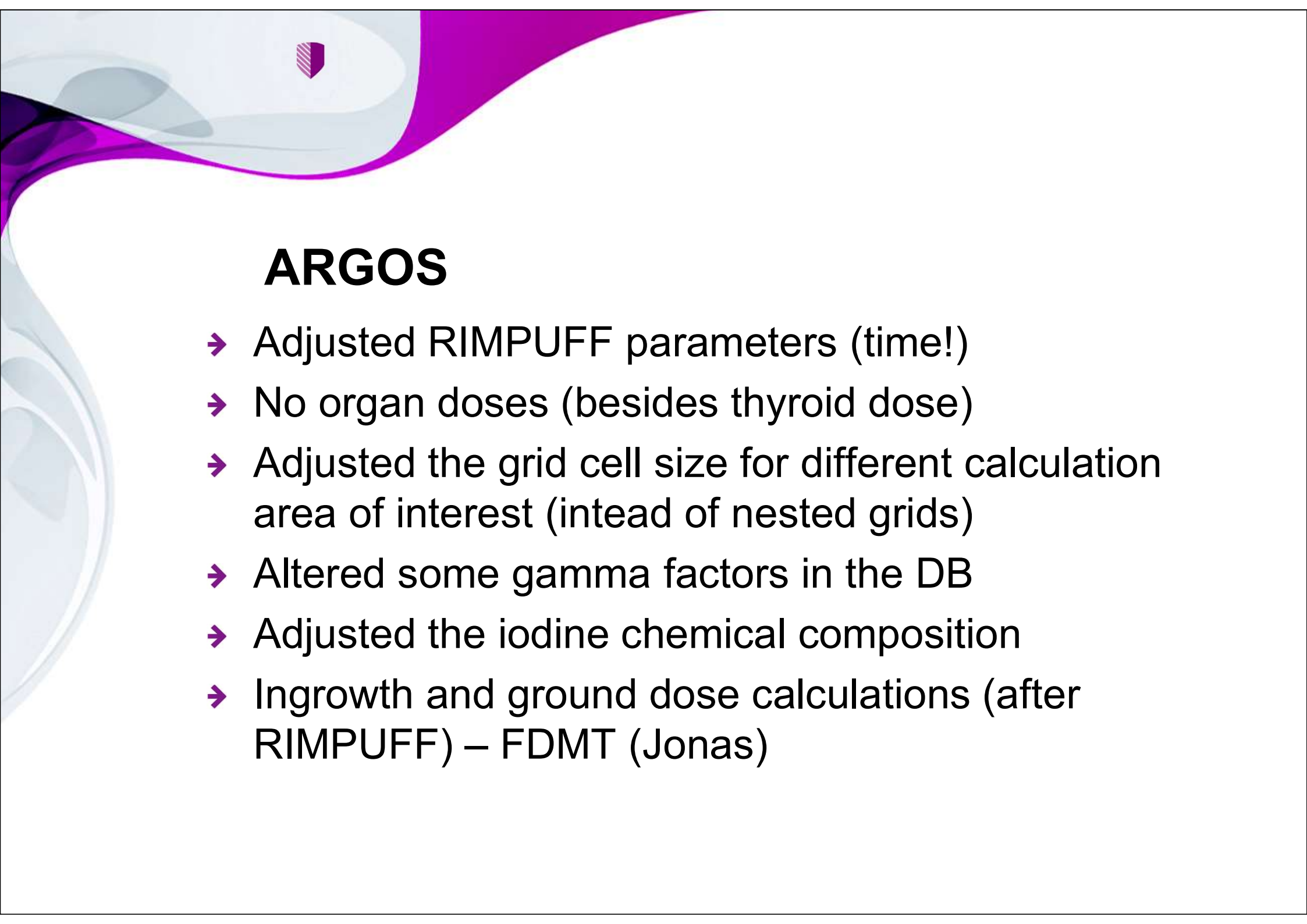
Release fractions (acc.) for the postulated event SBO without functioning mitigation systems





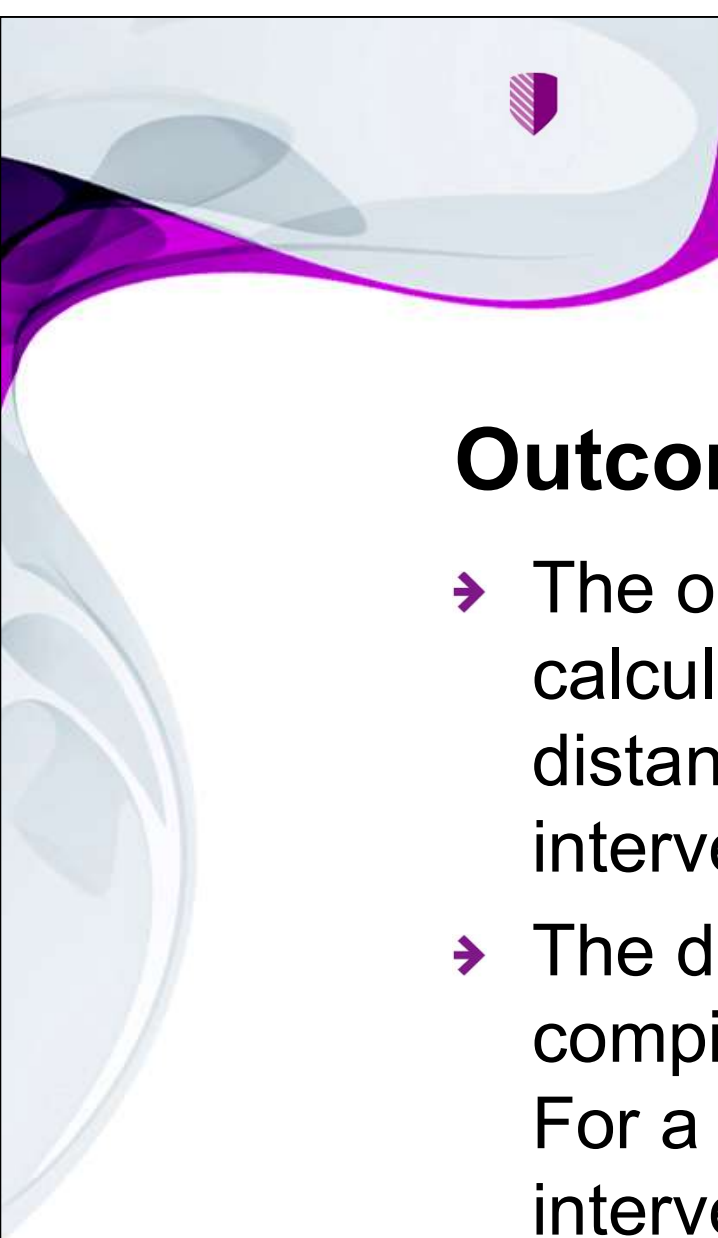
Dispersion and dose calculations

- Historical weather data from SMHI from the time period 2006-2015 (HIRLAM model 5,5 km horizontal resolution and 3 hours time resolution).
- A release taking place every 26th hour during the period. Each release was modelled during a period comprising 72 hours.
- The number of dispersion and dose calculations per postulated event and NPP: 4240



ARGOS

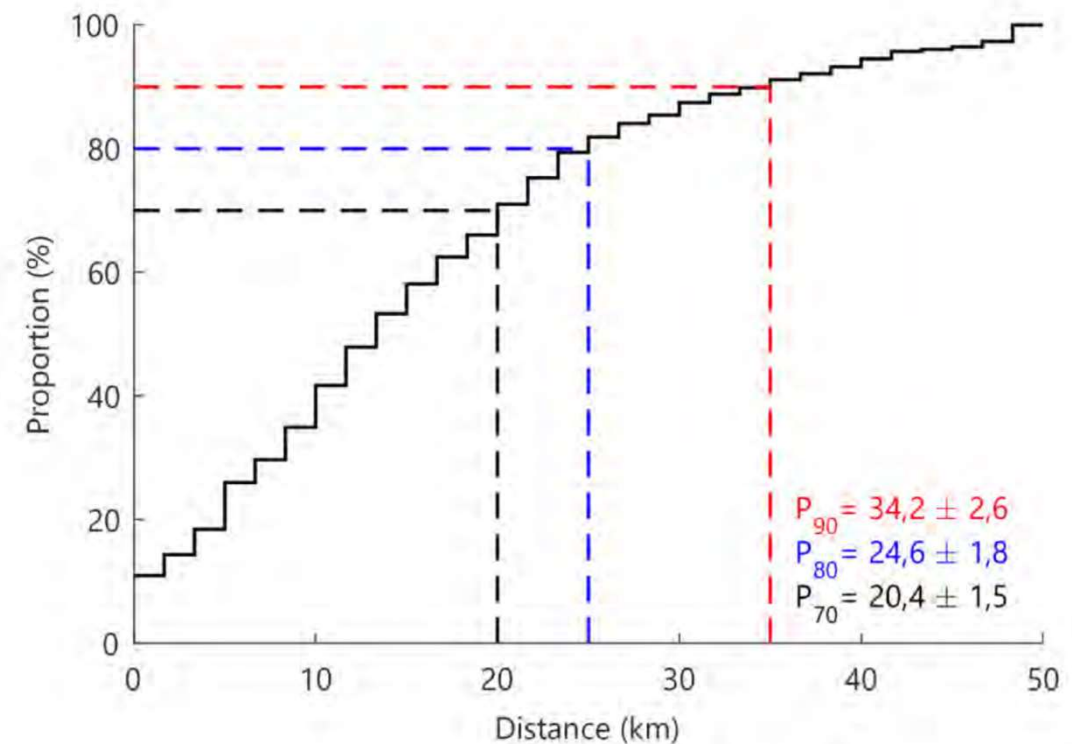
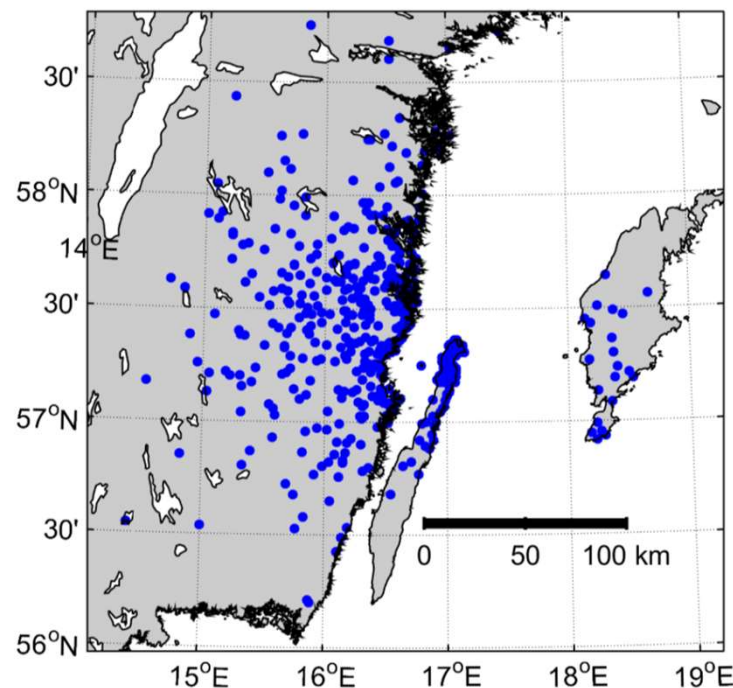
- Adjusted RIMPUFF parameters (time!)
- No organ doses (besides thyroid dose)
- Adjusted the grid cell size for different calculation area of interest (instead of nested grids)
- Altered some gamma factors in the DB
- Adjusted the iodine chemical composition
- Ingrowth and ground dose calculations (after RIMPUFF) – FDMT (Jonas)

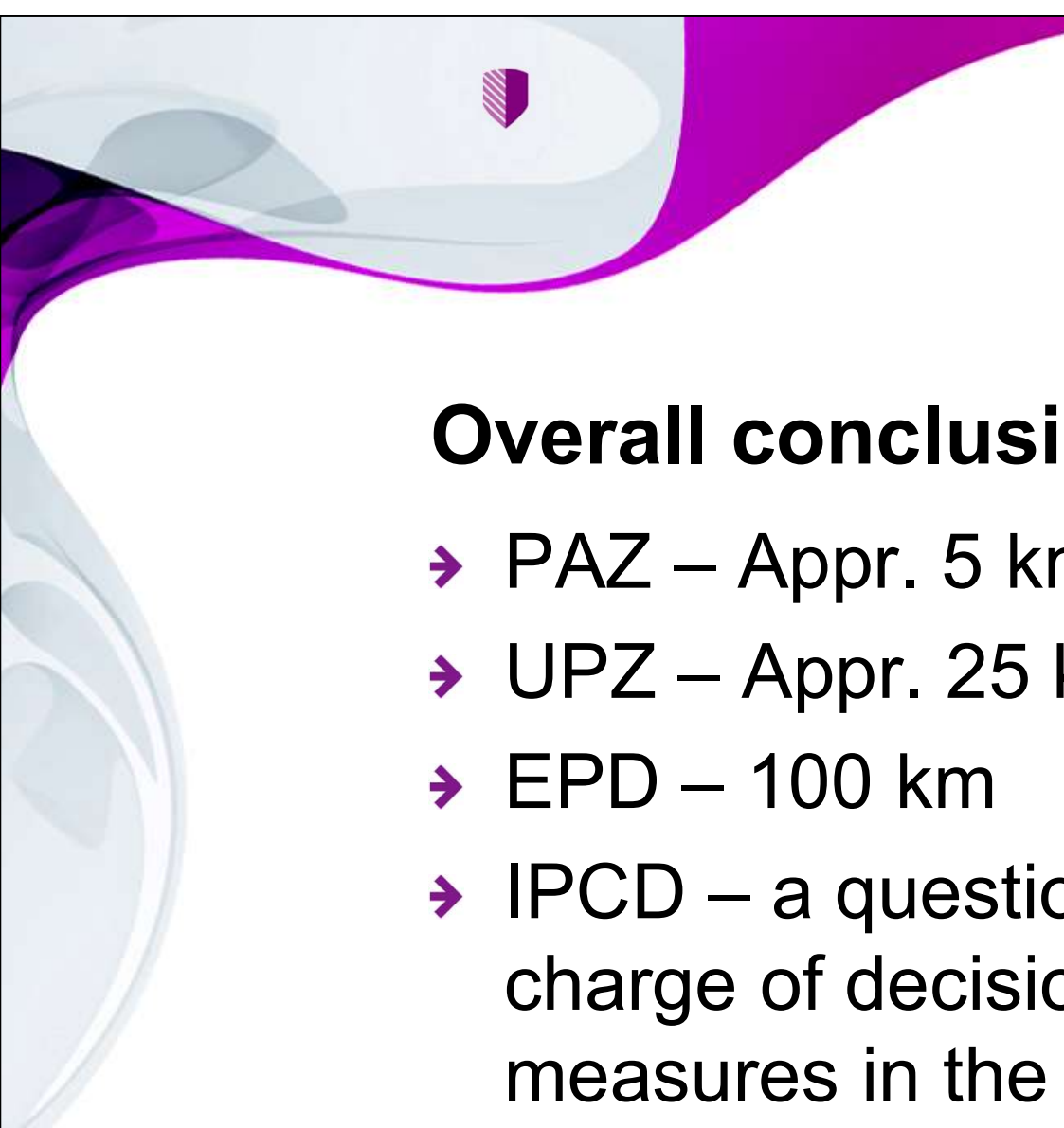


Outcome and statistical data analysis

- The outcome from dispersion and dose calculations is given in the form of a greatest distance at which a dose criterion or an intervention level has been exceeded.
- The distribution of these distances has been compiled in the form of cumulative histograms. For a certain dose criterion or a certain intervention level, each histogram illustrates the percentage of weather scenarios encompassed as a function of distance.

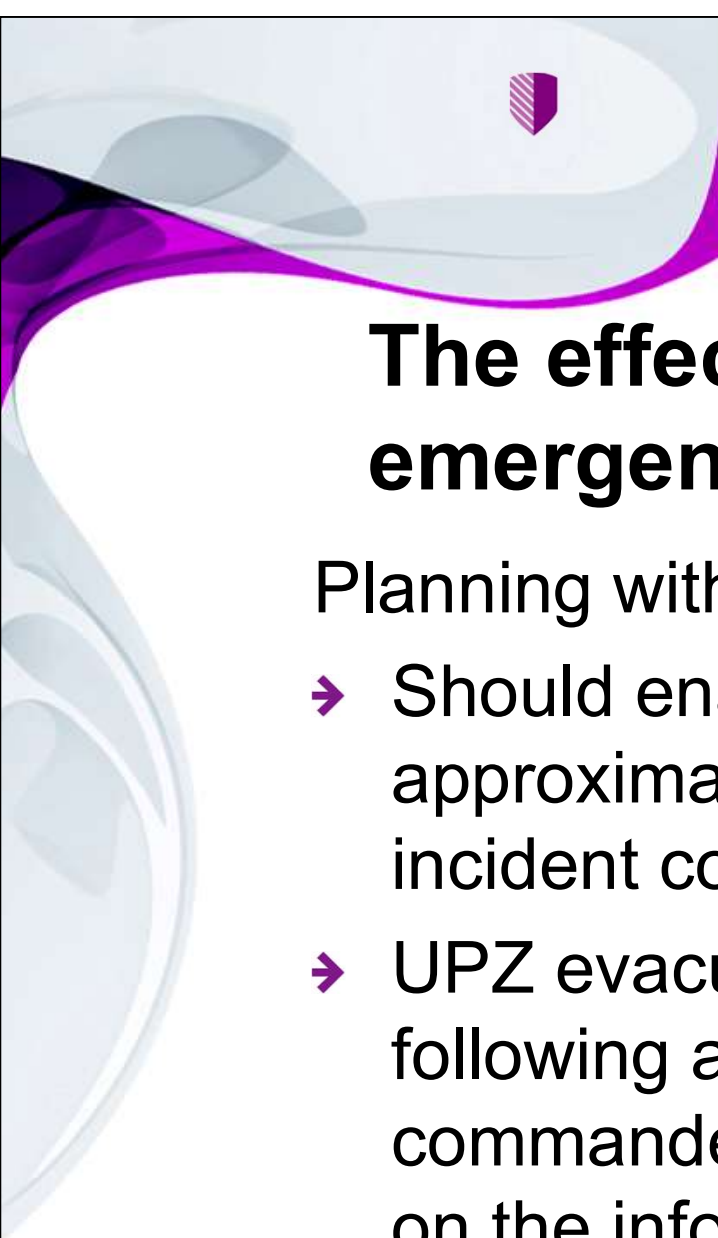
Example of outcome for a given dose criterion from dispersion calculations and the statistical data analysis





Overall conclusions for the NPPs

- PAZ – Appr. 5 km
- UPZ – Appr. 25 km
- EPD – 100 km
- IPCD – a question for other authorities (in charge of decision making and advising on measures in the food etc.). However, calculations show that fundamental planning is necessary throughout Sweden.



The effectiveness of the NPPs emergency plan

Planning with the county administrative boards (*e.g.*) :

- Should enable evacuation of the entire PAZ within approximately 4 hours after a decision taken by the incident commander
- UPZ evacuation in the wind direction within 12 hours following a decision taken by the incident commander up to either 15 km or 25 km depending on the information of the event. If evacuation is done up to 15 km then sheltering and ITB (predistr.) up to 25 km

New emergency planning zones and distances around nuclear power plants

- These zones are to be included in the emergency planning according to a proposal from SSM



New emergency planning zones and distances for other facilities

- The present UPZ extending approximately 700 m around the fuel factory (Westinghouse) is retained with minor changes
- The UPZ around the interim storage (Clab) will be limited to the site area and an EPD extending 2 km will be established

