Comparison of Approaches for Urgent Protective Actions specified in the National Radiation Emergency Plan of Turkey and adopted by the IAEA, HERCA-WENRA and Nordic Countries:

Taking into Account Uncertainties in The Very Early Phase

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Content

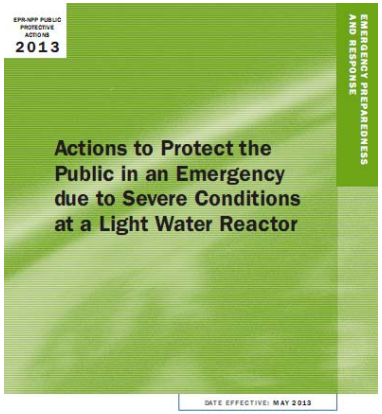
- Brief information about the documents
- Challenges regarding protective actions in the very early phase of a radiation emergency
- Urgent phase of an accident
- Comparison of the operational concepts

Brief Information about the Documents

EPR-NPP Public Protective Actions-2013

Actions to Protect the Public in an emergency due to Severe Conditions at a Light Water Reactor

- This publication was issued in the IAEA's Emergency Preparedness and Response (EPR) Series.
- **Aim:** Is to provide those persons who are responsible for making and for acting on decisions in the event of an emergency at an LWR with an understanding of the actions that are necessary to protect the public.
- It provides a basis for developing the tools and criteria at the preparedness stage that would be needed in taking protective actions and other actions.



Brief Information about the Documents

National Radiation Emergency Plan

- The National Radiation Emergency Plan has been developed by the Turkish Atomic Energy Authority (TAEK) and is going to be put into force by the coordinating authority (AFAD).

The main topics covered in the plan are:

- Terminology;
- Legal bases;
- The authorities in charge in the case of a radiation emergency;
- The related service groups;
- The roles of ministries, institutions and related service groups;
- Emergency response organizations;
- On- and off-site emergency response facilities;
- Concept of operations for all emergency preparedness categories;

Brief Information about the Documents

National Radiation Emergency Plan

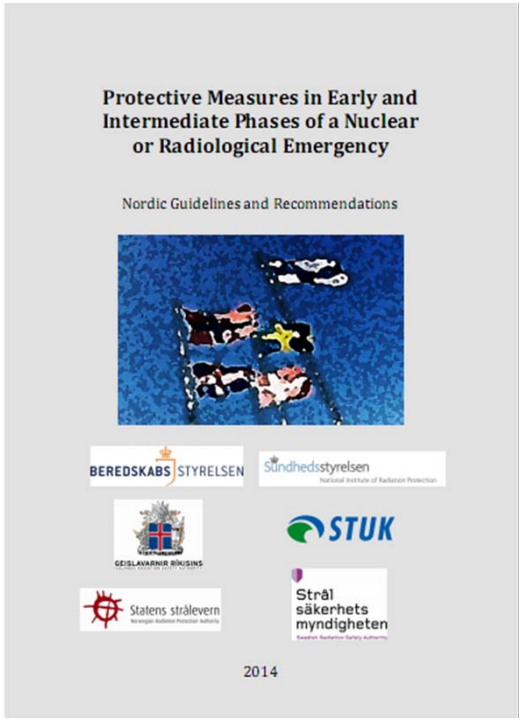
The main topics covered in the plan are (cont):

- Updating the NREP;
- Training, drills and exercises;
- International legal authorities and agreements;
- National guidance;
  - Emergency preparedness categories
  - Generic criteria
  - OILs
  - Guidance values for restricting exposure of emergency workers
  - Use of thyroid blocking agent
  - Time objectives
- Emergency planning zones and distances and areas to be cordoned;
- The list of teams and facilities required for response;
- Supporting materials.

Brief Information about the Documents

Nordic Flag Book (2014)

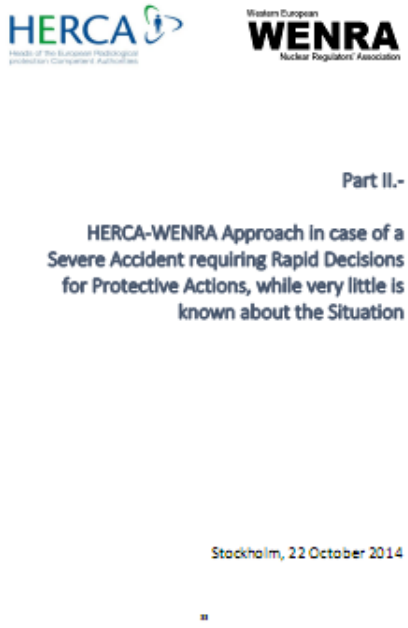
- The **Nordic guidelines and recommendations** were prepared by the Nordic radiation protection and nuclear safety authorities for protective measures in ***early and intermediate phases*** of a radiation emergency.
- It provides a common starting point for practical applications of protective measures for Nordic national authorities.



Brief Information about the Documents

HERCA-WENRA Approach in case of a Severe Accident requiring Rapid Decisions for Protective Actions, while very little is known about the Situation (2014)

- HERCA and WENRA propose a general approach for dealing with the initial stage of highly improbable emergencies.
- The “HERCA-WENRA approach”, was established to serve as a basis to complement existing arrangements in the initial phase of an emergency situation and allow better coordination of protective actions between European countries.



Challenges regarding protective actions in the very early phase of a radiation emergency

- Core damage can be foreseen, but loss of containment's integrity, hence time and duration of a major release of radioactive materials cannot be predicted in advance.
- Critical infrastructure (communication, transportation and electrical power) may be damaged.
  - Communication between national and local governments may be affected.
  - Instruments that are to be used for informing protective action decisions may be unavailable.

Challenges regarding protective actions in the very early phase of a radiation emergency (cont.)

- Wind direction may change in hours.
- Large populations may required to be evacuated.
- Vulnerable populations such as the elderly and the hospitalized may need to be evacuated.
- Thyroid blocking agents are required to be administered in time.

The very early phase of an accident
IAEA

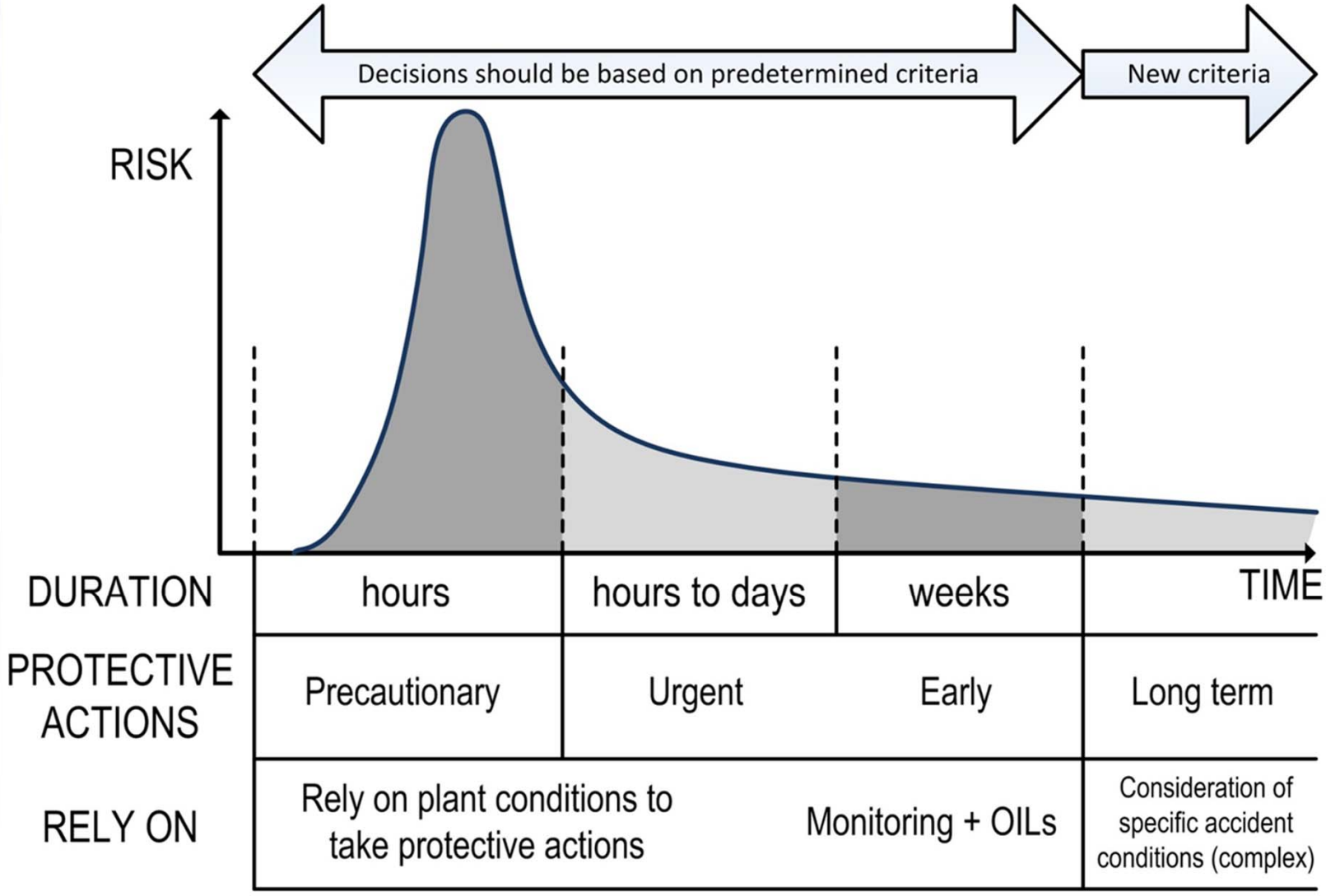


Figure is from the IAEA's training modules

The very early phase of an accident *IAEA (cont.)*

However, the phases of an accident are expressed more explicitly in terms of the protective actions.

- ***Urgent protective actions*** (***to be performed within hours to a day***)
  - *Iodine thyroid blocking;*
  - *Evacuation;*
  - *Short term sheltering;*
  - *Actions to reduce inadvertent ingestion;*
  - *Decontamination of individual;*
  - *Restricting ingestion of food, milk or water possibly contaminated.*
- ***Early protective actions*** (***to be performed within days to weeks***)
  - *Relocation,*
  - *Long term restrictions on consumption of contaminated food.*

The very early phase of an accident
Nordic Flag Book (early phase)

- “The threat and initial phase of a radiation hazard, including the initial events before deterioration of the shielding of a radioactive source or before radioactive material is released into the environment as well as the actual release”.
- It ends when the radiation level in the environment no longer increases and there is no further threat of additional, significant release.

The very early phase of an accident
HERCA-WENRA Approach

- HERCA-WENRA approach considers only the very early phase while very little is known about the situation.

Comparison of the operational concepts

Emergency planning areas and distances (in km)

IAEA	NREP	Nordic Flag Book	HERCA-WENRA
PAZ→3–5	PAZ→5	Evacuation→5	Evacuation→5[d]
UPZ→15–30	UPZ→20	[a]	Sheltering→20[e]
EPD→100	EPD→100	[b]	
ICPD→300	ICPD→300	[c]	

[a] evacuation up to 20-30 km

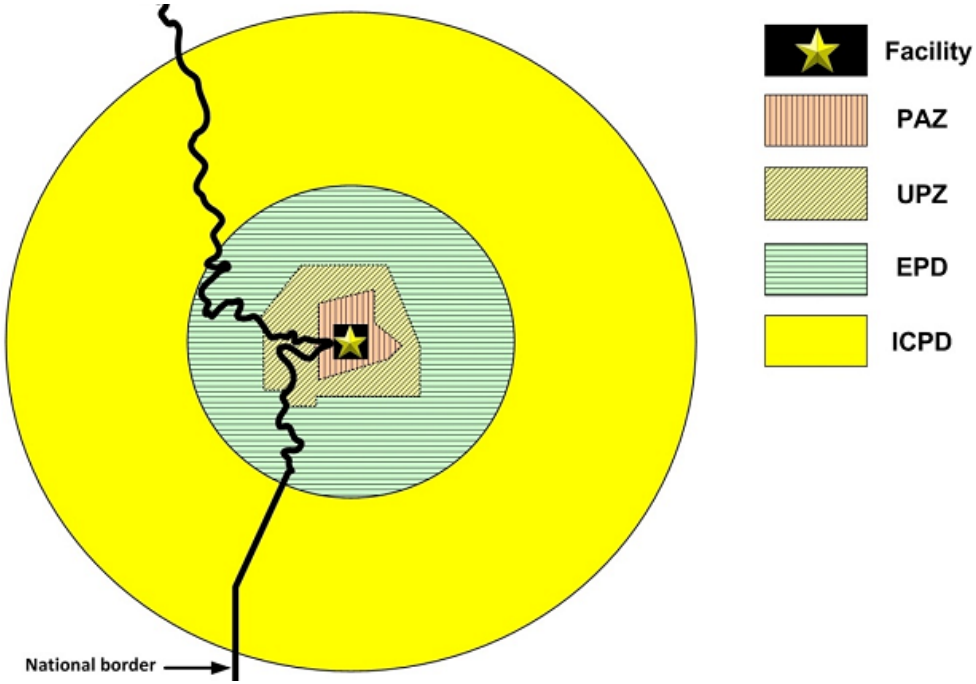
sheltering indoors up to tens of km

[b] partial sheltering indoors up to 200 km

[c] protection of livestock and other production in the range of thousands of km.

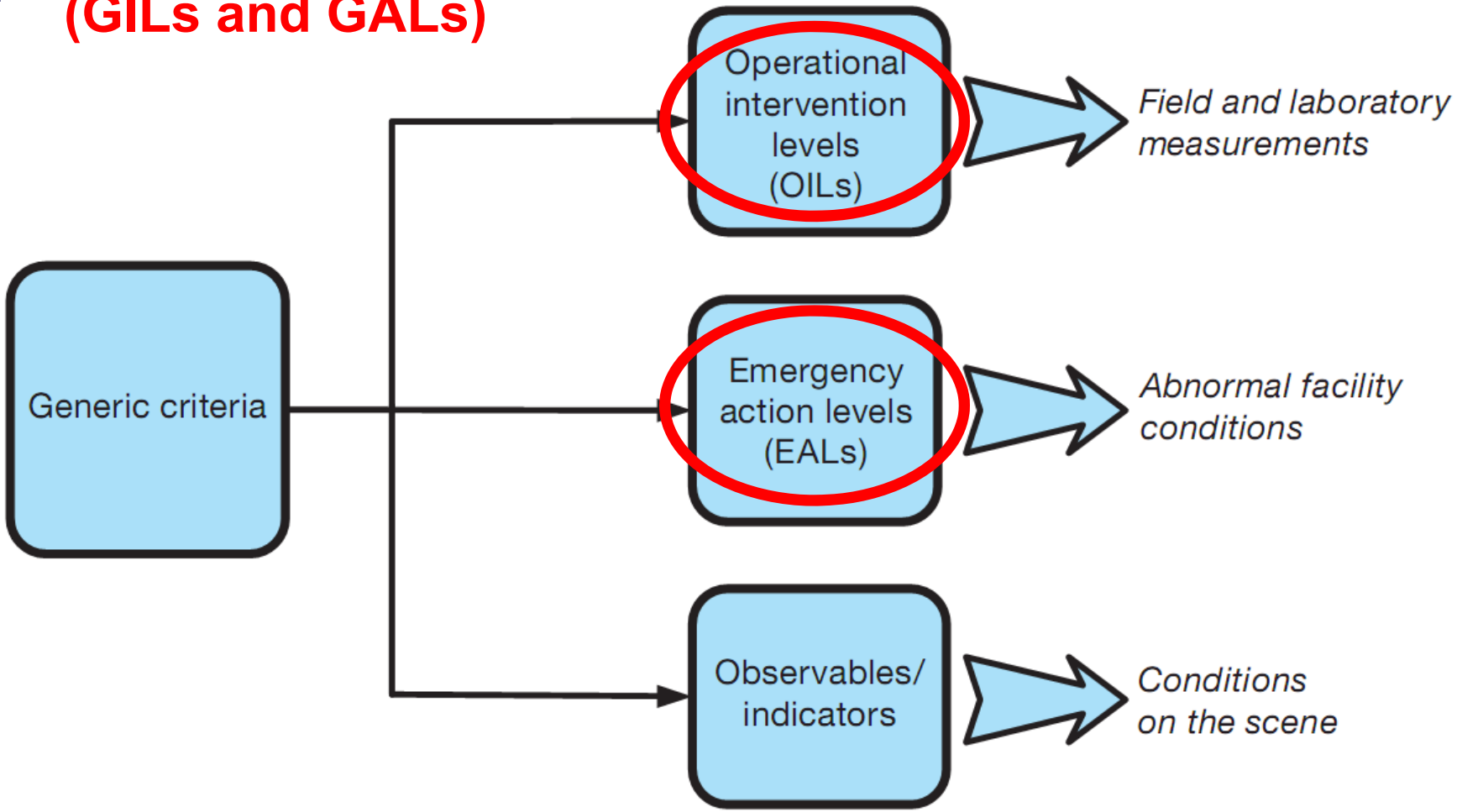
[d] can be extended to 20 km

[e] can be extended to 100 km



Comparison of the operational concepts
Decision making

- GSR PART 3 and GSG-2 → **Generic Criteria (GC)**
- GS-R-2 → **Generic Intervention and Action levels (GILs and GALs)**



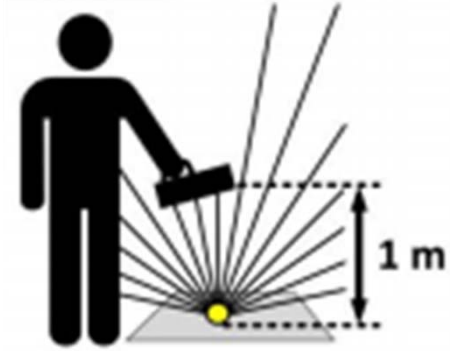
Comparison of the operational concepts
Decision making (cont.)

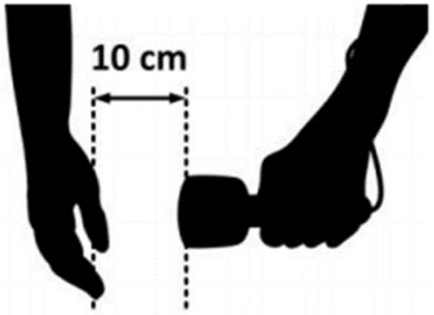
- ***In the very early phase of an emergency, intervention is based on the existing facility conditions.***
- Generic **Emergency Action Levels** (**EALs**) are provided by the IAEA (TecDoc-955, GSG-2).
- In the NREP, **EALs** are required to be determined for the specific NPP types that are to be constructed.
- Nordic Flag book addresses **triggers/EALs** for immediate implementation of the protective actions.
- According to the HERCA-WENRA approach the protective actions shall be based on the three **Judgement Evaluation Factors** (**JEFs**):

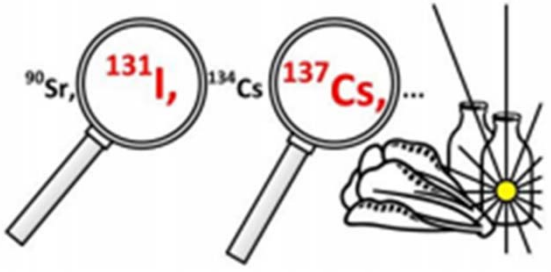
JEF	Description	Possible values of JEF		
1	Is there a risk of core melt?	Yes	No	Unknown
2	Is the containment integrity maintained?	Yes	No	Unknown
3	Is the wind direction:	Steady	Variable	Unknown

Comparison of the operational concepts
Decision making (cont.)

- The **GC** focus on “protection strategies” while the **GILs** and **GALs** were determined ***for each protection action***.
- If the OILs given in **EPR-NPP Public Protection Actions-2013** and the **NREP** are exceeded, ***sets of protection actions*** have to be implemented.
- The OILs given in the **Nordic Flag Book** were derived for each protective action.

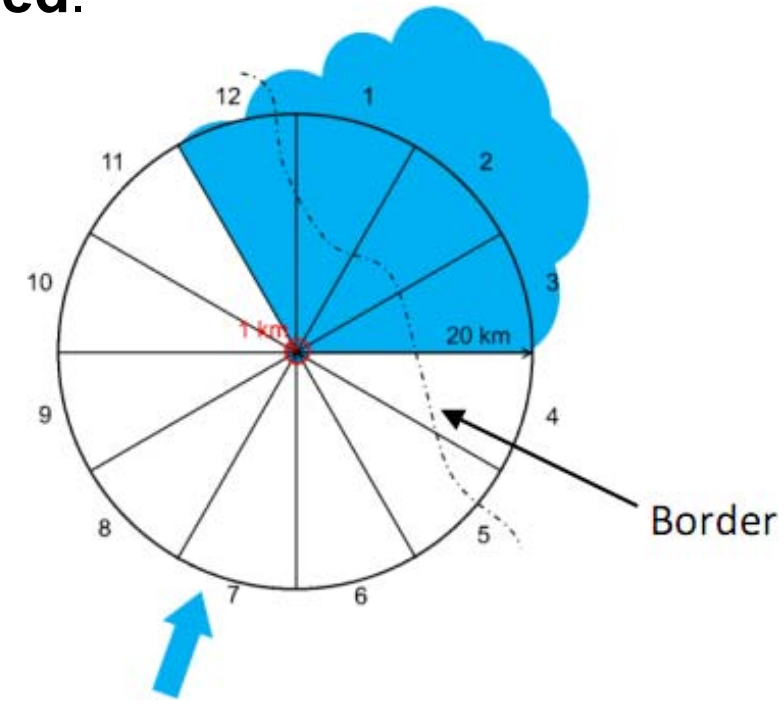






Comparison of the operational concepts *Response*

- The IAEA suggest the protective actions to be applied **in all directions** in the emergency planning zones (PAZ & UPZ).
- According to the HERCA-WENRA Approach, depending on wind condition forecast during the expected period of a large release, the protective actions shall be implemented **only in 30° sectors potentially concerned**.



References

- Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants, Nuclear and Radiation Studies Board, Division on Earth and Life Studies, National Research Council, Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants, The National Academies Press, Washington D.C (2014).
- INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, GSR Part 3, Vienna (2013)
- INTERNATIONAL ATOMIC ENERGY AGENCY, Actions to Protect the Public in an Emergency Due To Severe Conditions at a Light Water Reactor, EPR-NPP-Public Protective Actions-2013, Vienna (2013)
- INTERNATIONAL ATOMIC ENERGY AGENCY, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA General Safety Requirements No. GSR Part 7, Draft DS457 Rev. 10, Vienna
- STUK, Beredskabsstyrelsen, Sundhedsstyrelsen, Geislavarnir Ríkisins, Statens strålevern, Stral säkerhets myndigheten, Protective Measures in Early and Intermediate Phases of a Nuclear or Radiological Emergency, Nordic Guides and Recommendations (2014)
- HERCA, WENRA, HERCA-WENRA Approach in case of a Severe Accident requiring Rapid Decisions for Protective Actions, while very little is known about the Situation, Stockholm (2014)

THANK YOU