Justification in emergency situations

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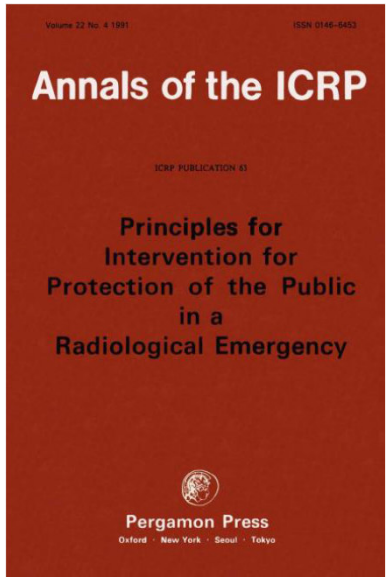
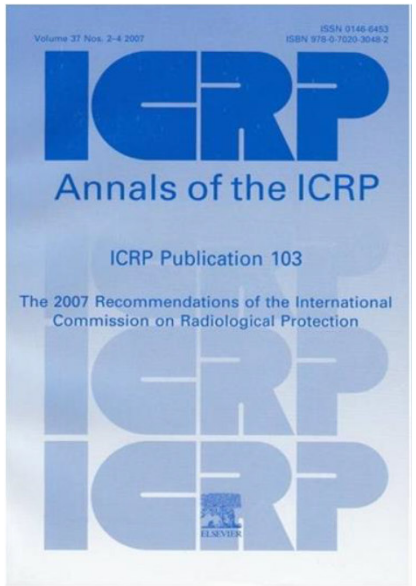
ICRP Development





Justify and optimize individual protective actions according to the averted dose (the dose prevented or avoided by the application of a protective action)

Focus for justifaction and optimization is the overall protection strategy, comprising protective actions, in combination where appropriate.

Reference levels introduced expressed as residual dose

Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations

ICRP PUBLICATION 109

(c) … While each individual protective measure must be justified by itself in the context of an overall protection strategy, the full protection strategy must also be justified, resulting in more good than harm.

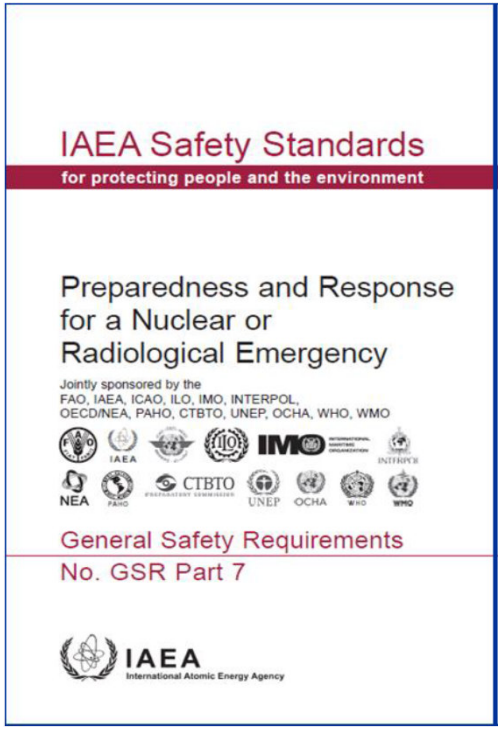
(g) … To the extent possible, the overall protection strategy and its constituent individual protective measures should be worked through and agreed with all those potentially exposed or affected.

(o) The resources required to implement protective measures are not the only factors that might interact within an overall protection strategy. Other such factors include individual and social disruption, anxiety and reassurance, and indirect economic consequences.

Justification (IAEA)

Requirement 5: Protection strategy for an emergency

The government shall ensure that protection strategies are developed, justified and optimized at the preparedness stage for taking protective actions and other response actions effectively in a nuclear or radiological emergency.


IAEA Safety Standards
for protecting people and the environment

Preparedness and Response for a Nuclear or Radiological Emergency

Jointly sponsored by the
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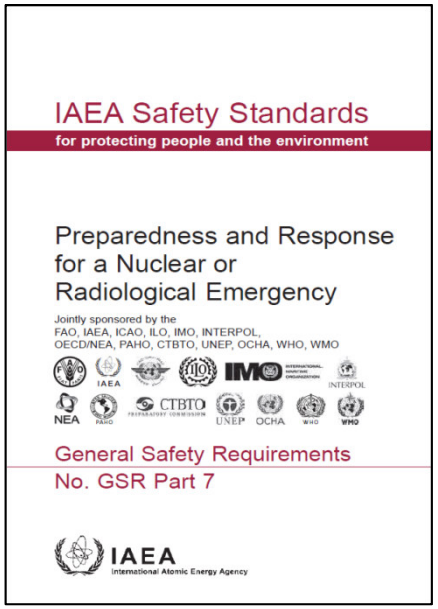
General Safety Requirements
No. GSR Part 7

IAEA
International Atomic Energy Agency

EPR Goals

a) Regain control of the situation and mitigate consequences;
b) Save lives;
c) Avoid or Minimize severe deterministic effects;
d) Render first aid, provide critical medical treatment and manage the treatment of radiation injuries;
e) Reduce the risk of stochastic effects;
f) …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No. GSR Part 7

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Justification

At high doses:

- Radiological considerations prevail the non-radiological aspects in the decision-making process
- Those situations in which the dose thresholds for severe deterministic injuries could be exceeded should always require action
- Those situation in which the doses approach the level at which an increase in the incidence of cancers may be expected should also require action

At low doses:

- Non-radiological considerations may prevail the radiological consequences
- Careful consideration is required with account taken of different radiological and non-radiological factors when making decisions to ensure actions taken do more good than harm

Dosimetric basis

Avoid or minimize stochastic effects

Dosimetric quantity	Take urgent protective actions if the projected dose is greater than the following generic criteria:	Examples of urgent protective actions
Effective dose (E)	100 mSv in the first 7 days	Sheltering, evacuation, decontamination, restriction of consumption of food
Equivalent dose to the fetus (H_{fetus})	100 mSv in the first 7 days	
Equivalent dose to the thyroid ($H_{thyroid}$)	50 mSv in the first 7 days	ITB

Justification and optimization

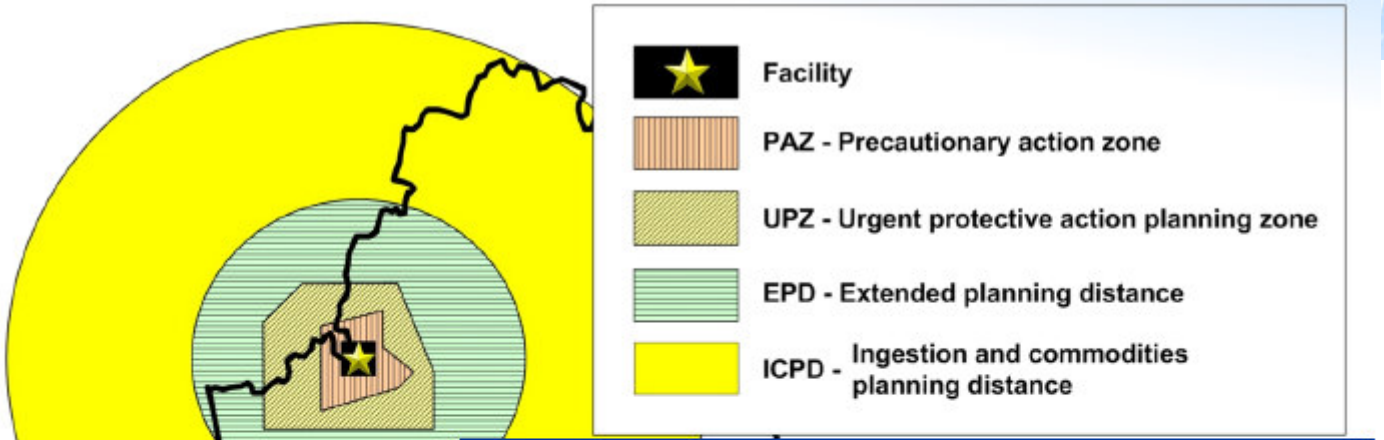
Emergency planning zones and distances are derived based on hazard assessment and dosimetric basis

Thus the emergency planning zones and distances are generically justified and optimized on radiation protection grounds.

HOWEVER

- Further justification and optimization within the overall protection strategy may be necessary to account for local and national conditions.
- Local conditions need to be considered. For example:
  - Available resources
  - Evacuation times
  - Non-radiological hazards
  - Local and national response arrangements
  - Affected population

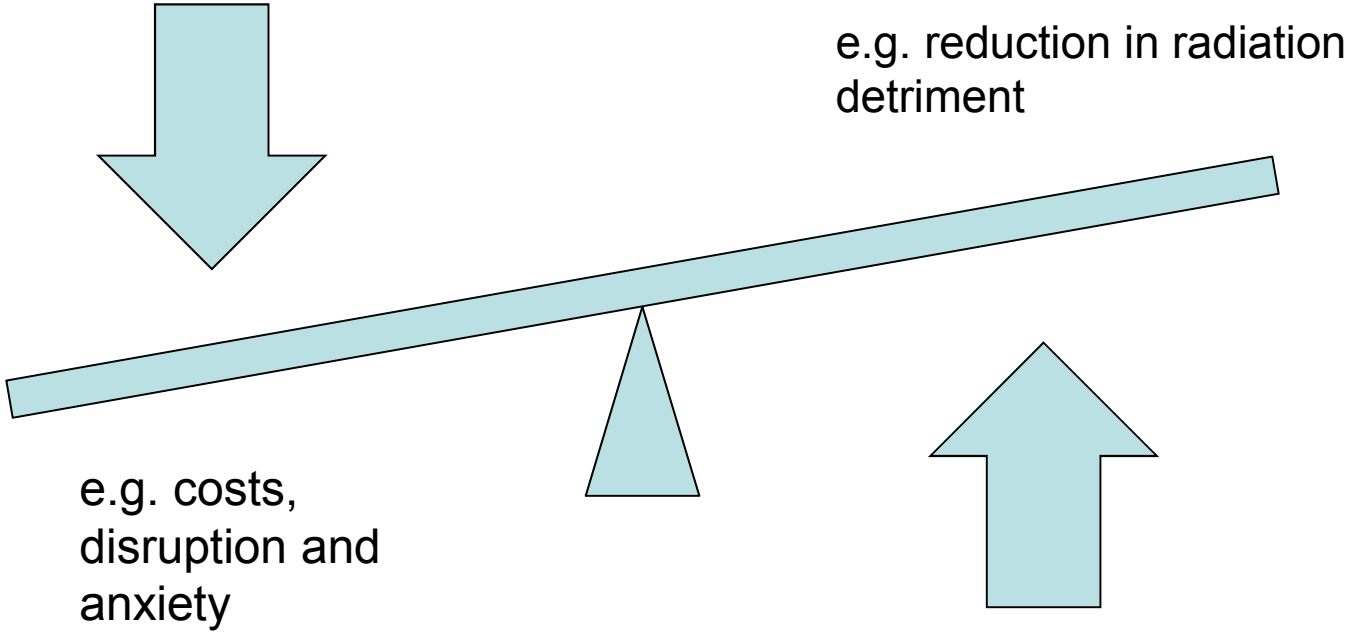
Emergency planning zones for severe NPP accidents



Example EPC I and V

	Power MW(th)	
	≥ 1000 MW(th)	100 to 1000 MW(th)
PAZ	3 to 5 km	
UPZ	15 to 30 km	
EPD	100 km	50 km
ICPD	300 km	100 km

Justification of protective actions



Factors in decision making

Factors effecting choice of protective measures especially in the intermediate phase

Efficiency
- reducing exposure and contamination
- time of year and weather conditions
- optimized use of resources
- limitations (technical, social, environmental, economical)
- acceptability of protective measures (supports the implementation)

Nature of the event
- cause of radiation hazard and radionuclides
- magnitude of deposition and activity levels
- paths of radiation exposure
- location and size of area
- amount of exposed people
- protective measures carried out in earlier phase of the emergency

Legislation, agreements and guidance
- international
- national
- local

Waste containing radioactive substances
- minimizing amount of waste (e.g. recycling or concentration)
- type of waste
- amount of radioactive substances in waste
- treatment of waste (e.g. methods and disposal)
- exposure during treatment of waste

Timing
- urgency priority in protective measures (magnitude of doses)
- time passed from contamination
- feasibility of measures (time of year and weather conditions)
- time needed for implementation of measures
- duration of protective measures

Social and ethical aspects

Disturbance to normal life conditions
- possibility of self help
- creation of feeling safe (e.g. information received)
- sovereignty (e.g. following given guidance)
- allocation of advantages / disadvantages
- participation of stakeholders (population, various groups of interest)in decision-making
- socioeconomic aspects e.g. uncertainty about future, suspicions concerning safety

Radiation protection
- doses to people; protective measures and possibilities and effectiveness of measures
- protection of emergency workers (protective equipment, dose monitoring, training)
- food safety: contamination of foodstuffs and feeding stuffs

Economical and political aspects
- direct costs
- indirect costs
- compensation issues
- aspects of international relations e.g. trade
- political decisions

Aspects concerning environment of the area
- type of area: residential, industrial, recreational, agricultural, forests, natural etc
- geographical location of area (e.g. coast, mountain) and geology (e.g. rock, clay)
- types of surfaces (e.g. surfaces of buildings, roads, land areas)
- indirect effects e.g. use of area for other purposes

Availability of resources
- Workers and availability of their skills; training
- Infrastructure neede protective measures relocation of people management, chang production sectors) logistics
- tools (e.g. iodine tab machinery and uten needed in decontam

Social and ethical factors

- Disrupted living conditions
  - Reduction in life expectancy due to stress (e.g. associated with resettlement)
  - Psycho-social effects
  - Possibility of public self-help
  - Feedback from interested parties on their concerns
  - Socioeconomic aspects, including issues associated with public trust and credibility of authorities

- Need for routine public services (transport, shops, medical care, education etc.)

Justification in preparedness and response

Preparedness

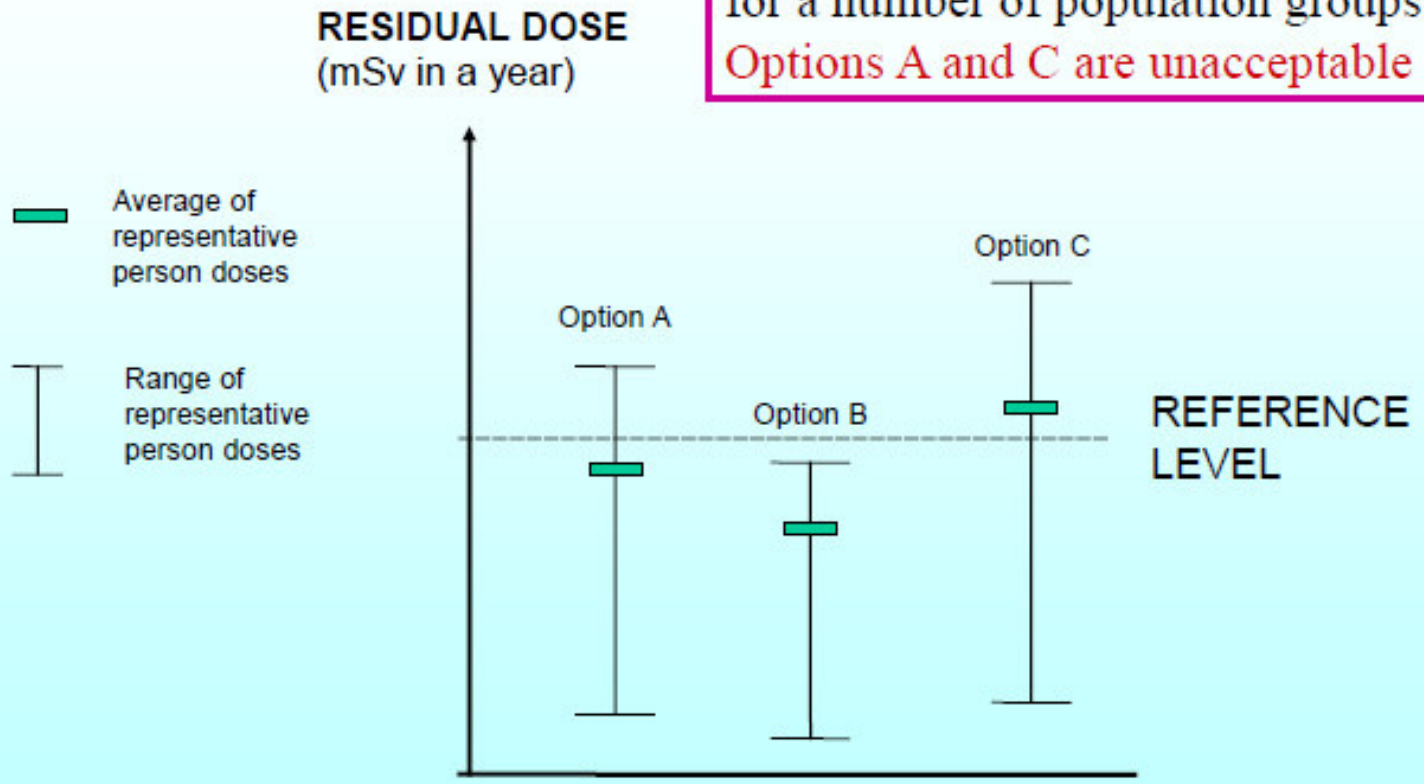
- Applied to develop strategies for a range of postulated emergencies(for range of sites)
- Generic process with significant uncertainties
- Involves coordination among relevant organizations and consultation with interested parties

Response

- Applied to a given emergency situation
- Initial implementation of pre-planned (urgent) actions
- Increasingly greater time, amount of information and involvement of interested parties in decision-making
- Periodic review to ensure strategy still justified (reference level!)

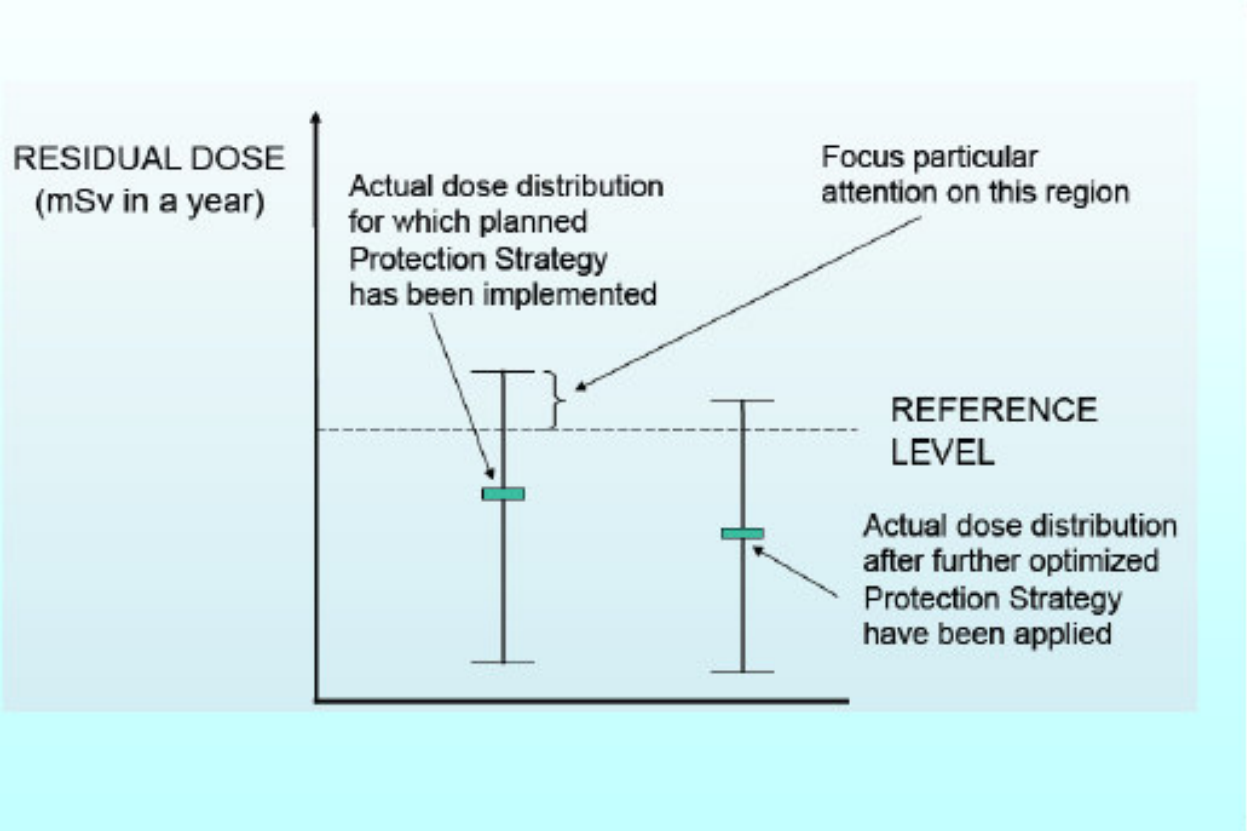
Reference levels in planning

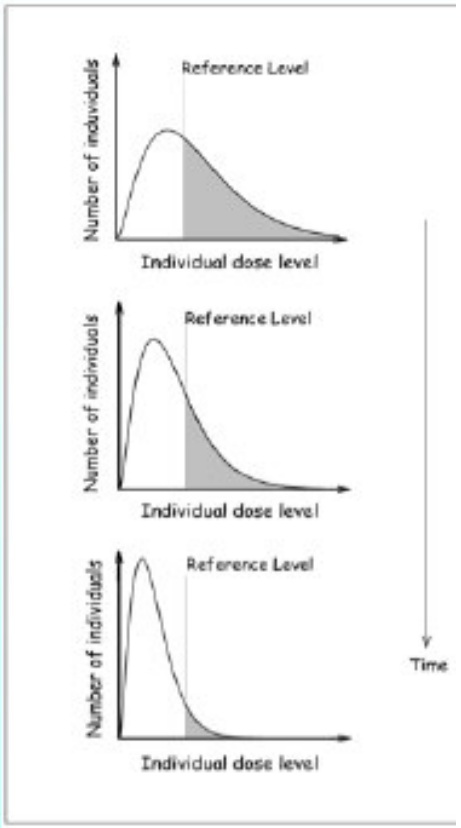
The application of dose reference levels in planning protective actions for a number of population groups: Options A and C are unacceptable



(Wolfgang Weiss, „Application of ICRP recommendations 103/109“, 2015)

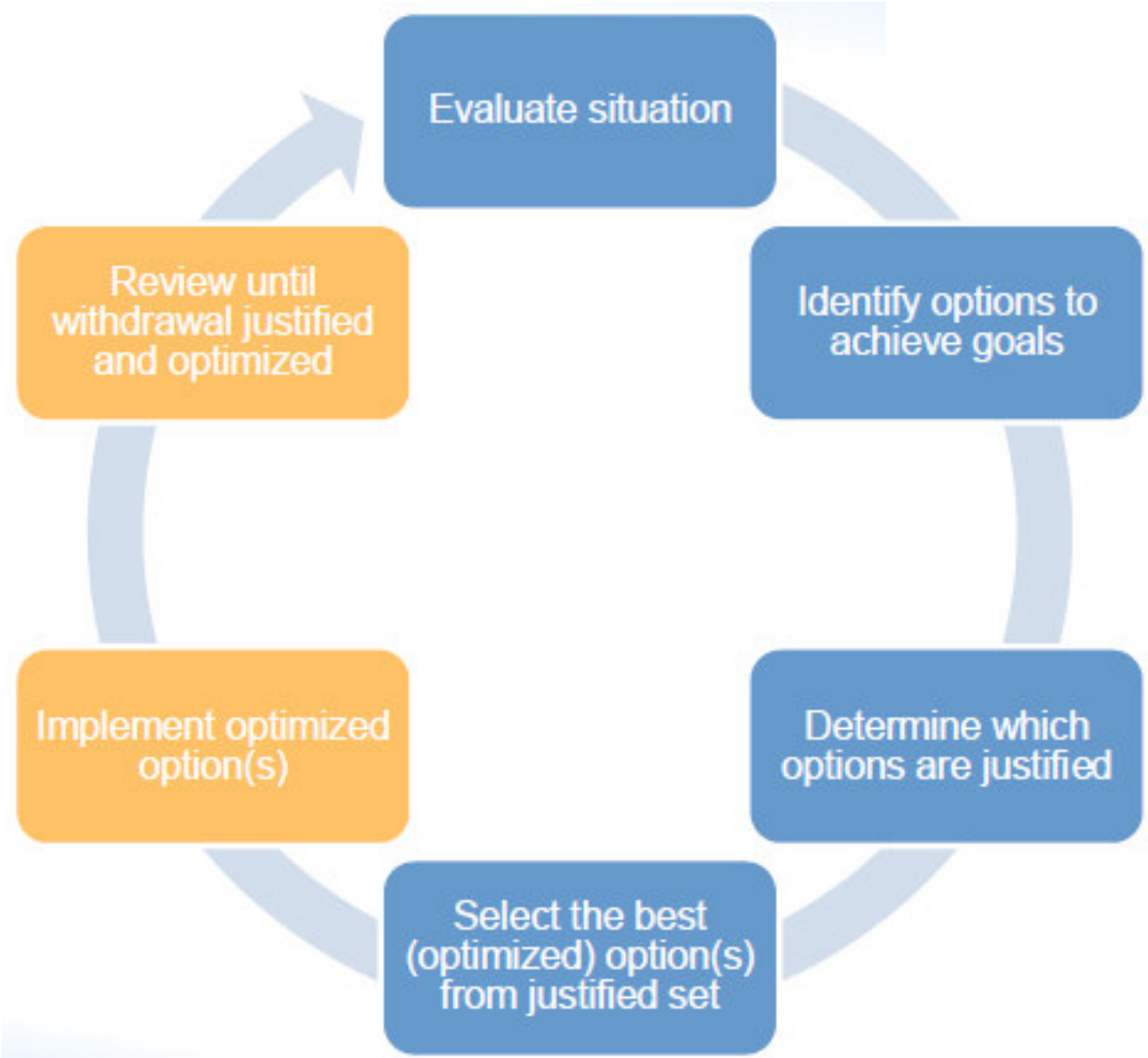
Reference levels in response





(Wolfgang Weiss, „Application of ICRP recommendations 103/109“, 2015)

Decision making process



Changing focus of justification and optimization

Information and time available for decisions increases

Urgent response phase

Limited information, urgent mitigatory and urgent public protective actions.
Justification and optimization in planning

Early response phase

Radiological situation characterized to identify need for early protective actions and other response actions and to implement them
Limited justification and optimization possible

Transition phase

Situation under control; detailed characterization of radiological situation carried out.
Activities planned and implemented to allow termination of emergency
Full application of justification and optimization, including consultation with interested parties

Protection of infants and children

The protection of children has been of particular concern in Japan. Parents are suspicious that the levels of the protection of the population as a whole do not provide sufficient safety for their children.

UNSCEAR (2013)
The notion that children might be two–three times more sensitive to radiation than adults is true for some health effects but certainly not for all.

Specific protective actions for infants and children justified?

Justification of disruptive protective actions

The justification of intervening with disruptive protective measures like mass evacuation in the aftermath of an major accident as well as the question of a comprehensive risk benefit analysis of the available options to protect the population against radiation-related health risks requires further thinking (ICRP, IAEA, WHO).

At least 30-40 persons died due to unplanned evacuation of hospitals and elderly care centres after the Fukushima accident.

Evacuation needs special consideration and arrangements for groups of people requiring special care or equipment, e.g. hospitals, prison!

Justification of disruptive protective actions

But there is another aspect:

The mortality rate among residents of nursing homes that evacuated increased up to 3.9 times (after the Fukushima accident).

- Lower risk due to exposure
- Higher risk for harm caused by protective action

- Higher risk due to exposure
- Lower risk for harm cause by protective action

How to decide about justification of e.g. evacuation?

Justification of health screening

Fukushima Medical Health Survey:
about 2 million residents in the Fukushima Prefecture
including about 360,000 children
(ultrasaound thyroid screening)

More than 99 % within limits;
Remaining cases are higher than the numbers of normal health care. This is a source of considerable anxiety.

Thank you for your attention!