



IAEA

International Atomic Energy Agency

Atoms for Peace and Development

Arrangements for the Termination of a Nuclear or Radiological Emergency

Protection Strategy for the Transition Phase

Lecture 05

Introduction.

GSR Part 7, Requirement 5

*“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.”*



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Preparedness and Response for a Nuclear or Radiological Emergency

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General Safety Requirements No. GSR Part 7



Introduction.

GSG-11, Section 3

“The radiological situation should be assessed, as appropriate, against reference levels, generic criteria, operational criteria and dose limits, to determine whether the relevant prerequisites ... have been achieved.”

“Justified and optimized actions have been taken ...”



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General Safety Guide No. GSG-11



Purpose



- Present and describe the concept of the protection strategy for a nuclear or radiological emergency with focus on its application in the transition phase.

Learning objectives

- Recognize the elements of a protection strategy and the role it plays in emergency preparedness and response with particular focus on the transition phase;
- Identify relevant considerations in developing, justifying and optimizing the protection strategy for the transition phase.

Content

- Protection strategy: What it is and why we need it
- Dosimetric concepts in the protection strategy and their role
- Considerations for the development of the protection strategy
- Justification and optimization
- Implementation of the protection strategy

Note: This presentation looks at protection of the public and society in general, while protection of emergency workers and helpers is addressed separately

What is a Protection Strategy?

- Describes in a comprehensive manner:
 - What needs to be achieved in response to a nuclear or radiological emergency:
 - During **all phases of response**: from its declaration until the emergency is terminated;
 - For large scale emergency, the strategy may extend in the longer term within the framework of an existing exposure situation.
 - How this will be achieved:
 - Implementing **a justified and optimized set of protective actions and other response actions**

Discussion



- Is the concept of protection strategy introduced at the national level?
- Have you developed or are you developing a protection strategy for an emergency?

Why elaborate a Protection Strategy?

To effectively **achieve the goals of emergency response** through defining a justified and optimized set of emergency response actions

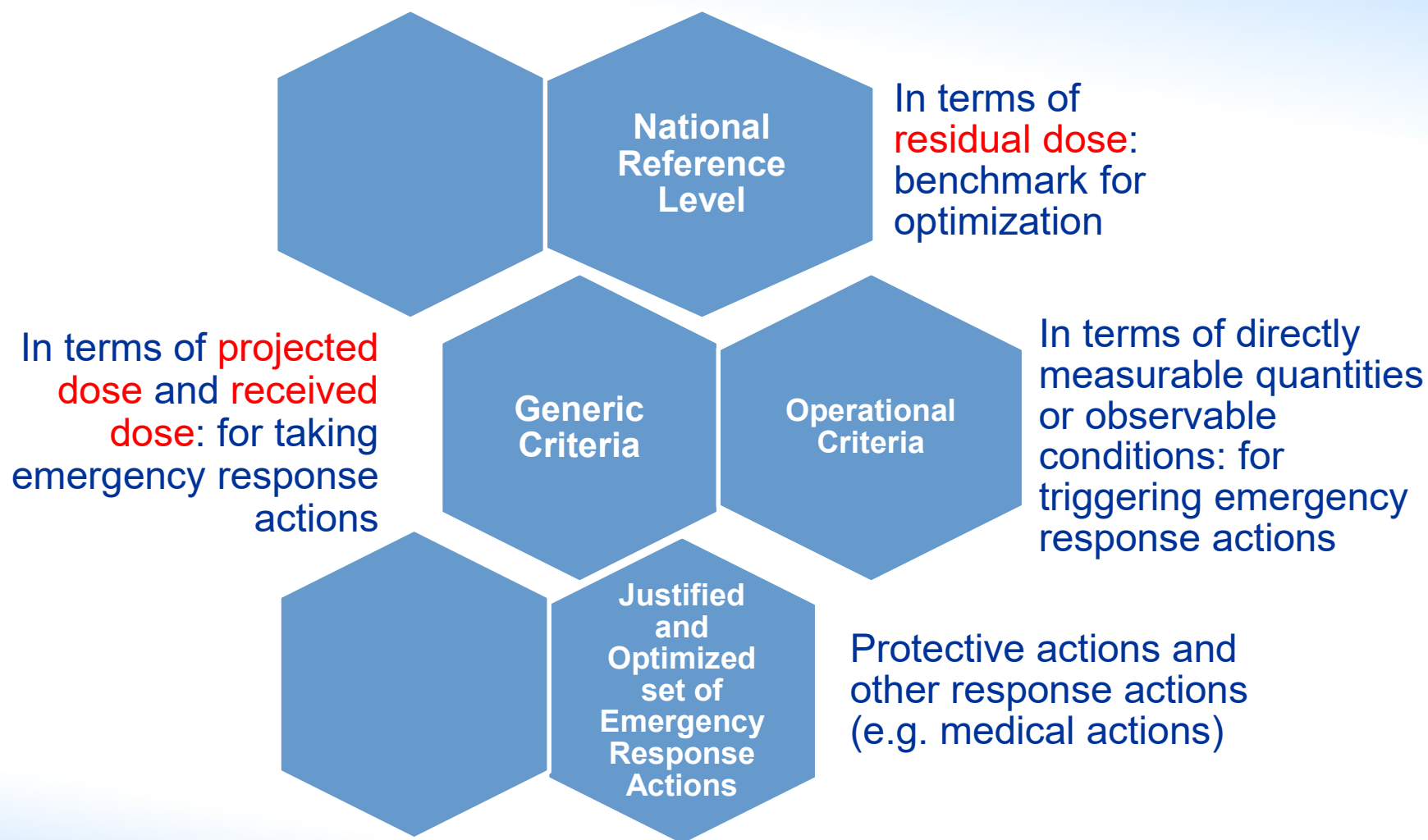
To **guide the establishment of adequate emergency arrangements** at the preparedness stage

- Plans, procedures, equipment, tools, training and exercise programmes, etc.

To **ensure the feasibility, practicability and acceptance** among various response organizations and relevant interested parties

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What should the Protection Strategy include?



Dose Concepts



- **Projected dose**

- The dose that would be expected to be received if planned protective actions were not taken.

- **Residual dose**

- The dose expected to be incurred after protective actions have been terminated (or after a decision has been taken not to take protective actions).

- **Received dose:**

- The dose that is incurred after protective actions have been fully implemented (or after a decision has been taken not to implement any protective actions).

Reference Level

- The level of dose:
 - Above which it is not appropriate to allow exposures to occur;
 - Below which optimization of protection and safety would continue to be implemented.
- Suggested **residual effective dose** in the range:
 - 20 – 100 mSv, acute or annual, via all exposure pathways, for an emergency exposure situation;
 - 1 – 20 mSv, annual, via all exposure pathways, for an existing exposure situation.

Reference Level (cont'd)

- To be used as:
 - Tool for optimization of protection and safety at the preparedness stage and during response;
 - Benchmark for assessment of effectiveness of the protection strategy during the response.
- It allows for:
 - Priorities to be assigned to those most in need (e.g. those expected to be exposed to levels above the reference level);
 - Resources to be allocated to those most in need.

Range and applicability of Reference Level for the transition phase



Range of reference level for residual dose	Applicability	Some considerations
20 – 100 mSv acute or annual effective dose	Emergency exposure situation	Upper end of range not considered appropriate for long-term benchmark
~ 20 mSv annual effective dose	Transition to an existing exposure situation	Basis for the termination of emergency to allow for smooth transition to existing exposure situation Higher level may also be considered in some circumstances provided the residual dose will not exceed levels at which public protective actions may be warranted
1 – 20 mSv annual effective dose	Existing exposure situation	Values towards the lower end can be used as long term objective

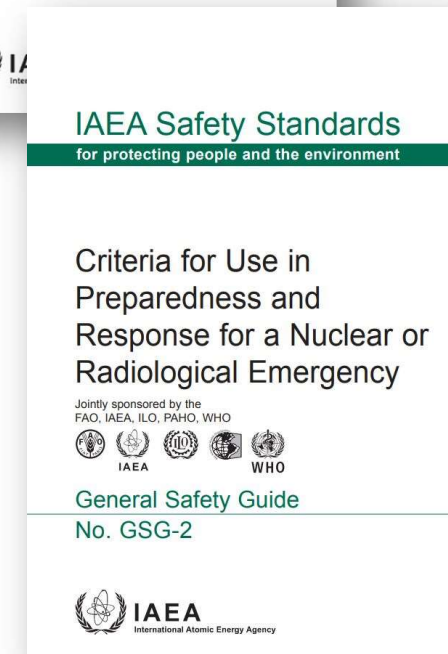
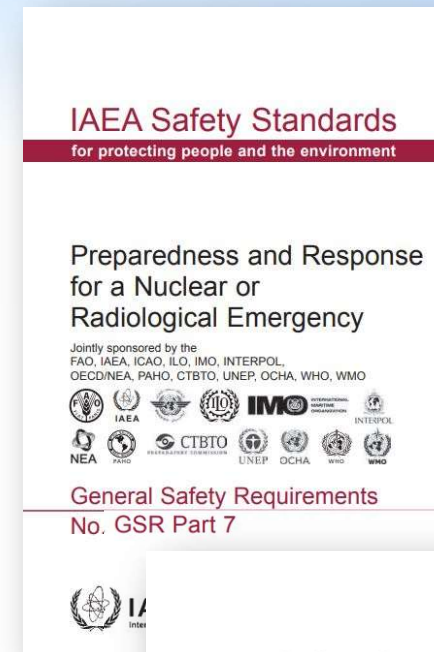
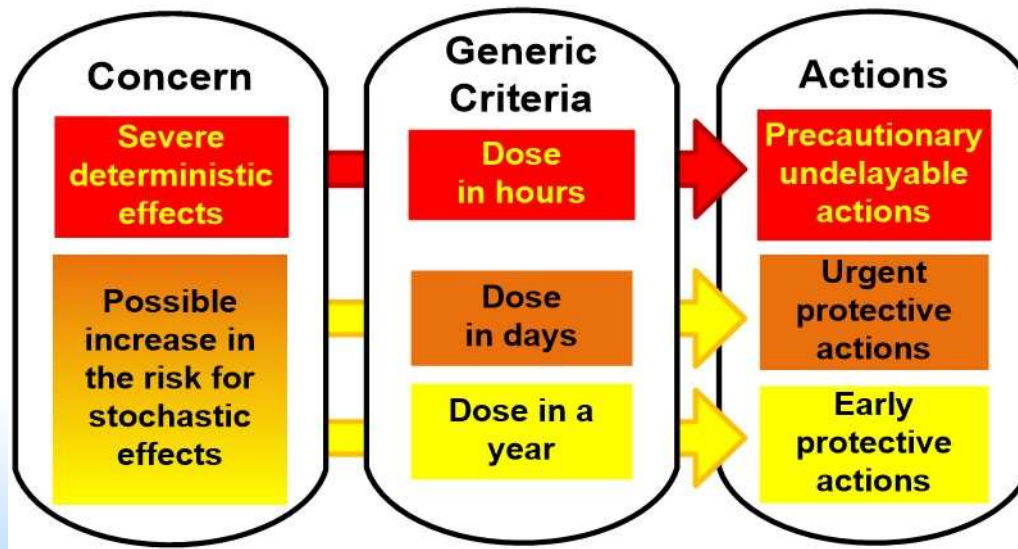
Reference Level: choosing the national value



- Choosing the value for the reference level will depend on **prevailing conditions**;
- Selecting lower levels for the reference level will not necessarily provide for better protection:
 - The best protection is not necessarily the one that results in the lowest dose.
- In a large scale emergency resulting in significant release of radioactive material to the environment, radiological conditions will vary greatly from area to area:
 - What is feasible to achieve in a given time frame will differ from area to area;
 - Different reference levels as benchmarks for optimization and for enabling the transition to an existing exposure situation may be necessary in different geographical areas at the same time.

Generic criteria. General

- Levels for the projected dose, or the dose that has been received, at which protective actions and other response actions are to be taken.



Generic criteria for enabling the transition to existing exposure situation



- GSR Part 7, Appendix II:
 - A projected effective dose of 20 mSv per year;
 - A projected equivalent dose to a fetus of 20 mSv for the full period of in utero development.
- To be used for guiding actions enabling the transition to an existing exposure situation.

Discussion

- Have you defined a reference level within the national EPR framework and how it is used?
- Have you developed criteria for implementing public protective actions?



Operational Criteria.

General

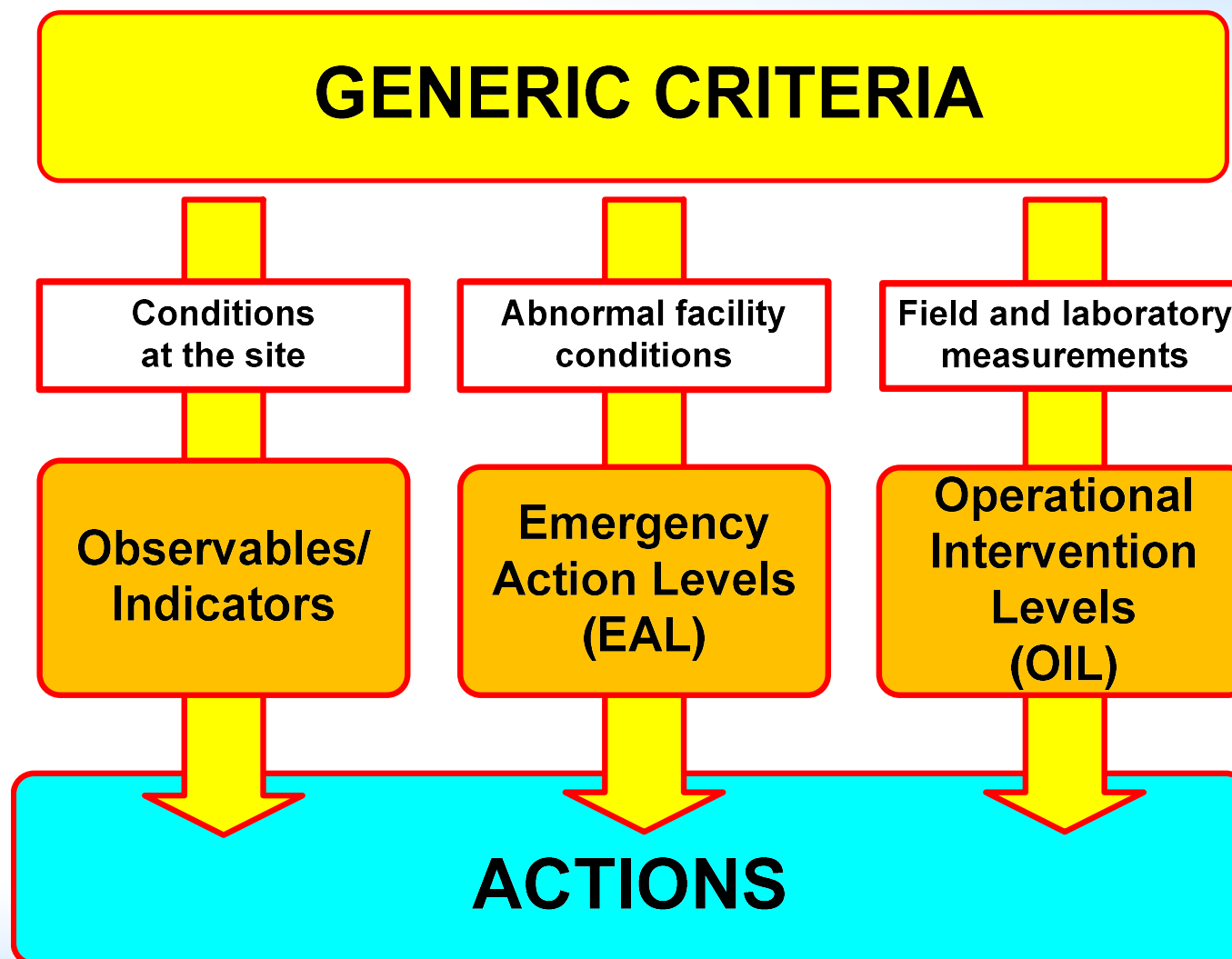
- Generic criteria cannot be used directly in the response:
 - They are based on projected or received dose that needs to be calculated taking into account a large number of considerations and uncertainties;



- Hence, the need to develop, at the preparedness stage, criteria deriving from the generic criteria (i.e. **operational criteria**) that can be used directly in the response (measurable/observable).



Operational Criteria. General (cont'd)



Operational Criteria.

OIL_T



- **OIL_T : OIL for enabling the transition to an existing exposure situation:**
 - Derived on the basis of generic criteria for enabling the transition to existing exposure situation;
 - Methodology for deriving OIL_T provided in GSG-11.
- **OIL_T to be used as a tool to support:**
 - Decision making on lifting or adapting protective actions (what, when, for whom);
 - Implementation of activities to enable the transition to an existing exposure situation by providing a basis to guide simple activities aimed at reducing the residual dose.

Operational Criteria.

Additional OILs for transition phase

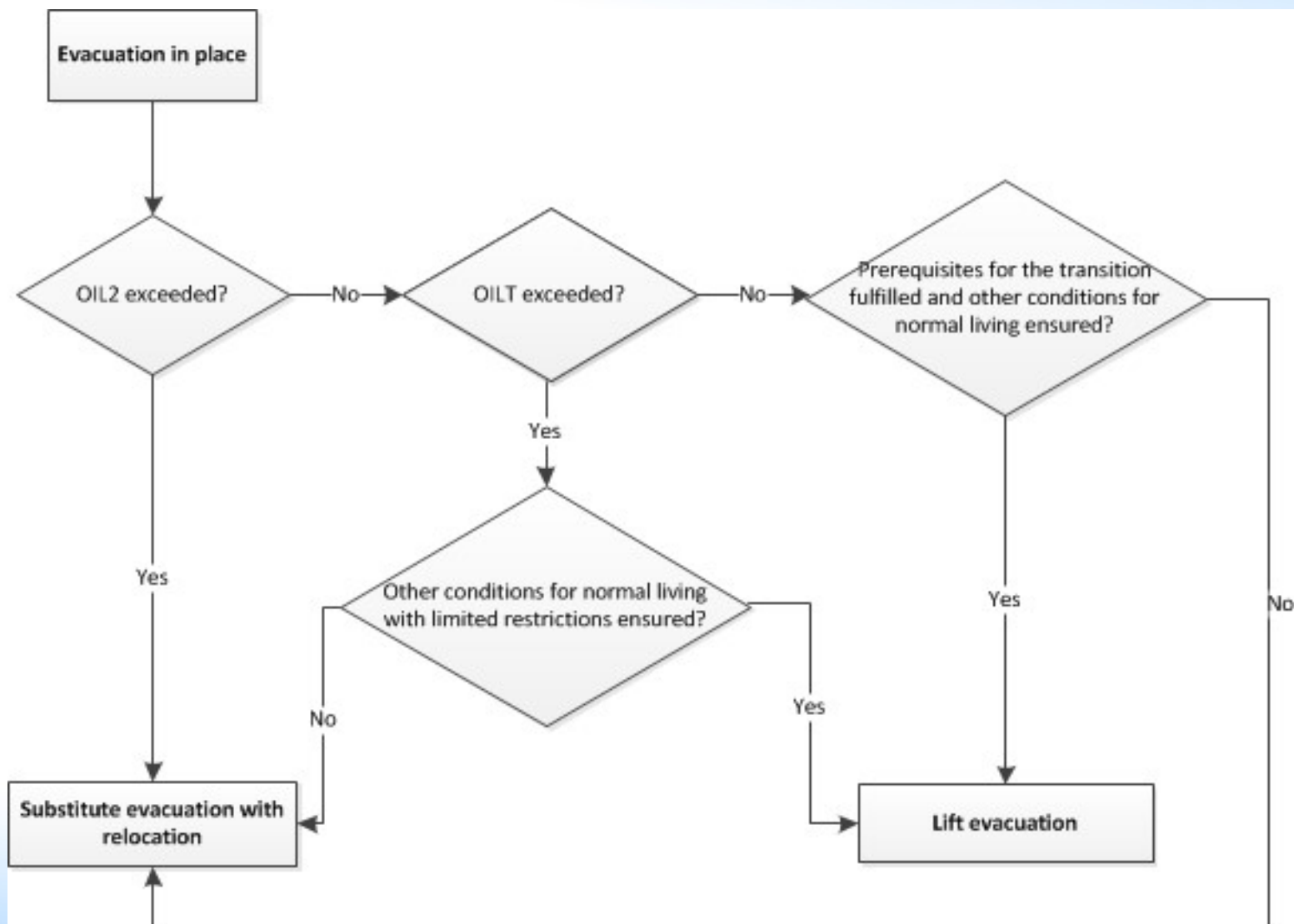


- In addition to OIL_T , other OILs need also to be used during the transition phase to inform lifting or adapting protective actions.
- Example:
 - OIL1 (GSG-2) trigger for evacuation as urgent protective action;
 - OIL2 (GSG-2) ($< OIL1$) trigger for relocation as early protective action;

How can evacuation be adapted if measured values are below OIL1?

Operational Criteria.

Additional OILs for transition phase (cont'd)



Discussion

- What do we need to know/consider to develop a protection strategy for the transition phase?



Basis for the development of the Protection Strategy



- **Planning basis:**
 - Legislation and regulations;
 - Inventory of facilities, activities and sources;
 - Resources available (human, technical, financial) and infrastructure;
 - Other documentation and arrangements in place.
- **Results of the hazard assessment:**
 - Consequences assessment for a wide range of postulated emergencies, including those with very low probability.
- **Driving principles:**
 - Goals of emergency response;
 - Prerequisites for the termination.

Considerations for the development of the Protection Strategy



- Ensuring **coordination** through national coordination mechanism;
- Addressing **whole range of goals of emergency response** and timeframes in which they are to be achieved:
 - From the emergency onset to the time the emergency is declared ended;
 - Taking account prerequisites to be fulfilled during the transition phase.
- Address **priorities** appropriately:
 - Detailed elaborated protective actions for preventing severe deterministic effects and reducing risk for an increase in the incidence of radiation induced cancers;
 - Appropriate level of details in the strategy to achieve remaining goals of emergency response and to facilitate resumption of normal social and economic activity.

Considerations for the development of the Protection Strategy (cont'd)



- Processes to be used for **adjusting the strategy to the actual circumstances** of the emergency:
 - Large uncertainties in the prediction of the long term development of the radiological consequences;
 - The social, economic, political and other factors prevailing at the time of the emergency may not be known with sufficient accuracy;
 - Adaptation, as relevant information becomes available, is essential to provide for the protection and safety of those affected.

Considerations for the development of the Protection Strategy (cont'd)

- Processes to be applied for **justification and optimization** during the transition phase:
 - Processes and methods to be used in the transition phase (e.g. decision aiding tools);
 - Parties to be consulted;
 - Roles and responsibilities.



Considerations for the development of the Protection Strategy (cont'd)



- Influence of actions on subsequent actions;
- Temporal and geographical issues:
 - Need for protective actions may vary both spatially and in time;
 - Important factors: demographic, economic and use of land.
- Dynamic nature of response:
 - Time constraints on decision making and implementation of actions in an effective manner.
- Public self-help programmes;
- Consultation with interested parties;

Discussion

- An essential part of developing the protection strategy is its justification and optimization:
 - Do you have specific processes established for doing so?



Justification. GSR Part 7

“determining ... whether a proposed protective action or remedial action is likely, overall, to be beneficial; i.e. whether the expected benefits to individuals and to society (including the reduction in radiation detriment) from introducing or continuing the protective action or remedial action outweigh the cost of such action and any harm or damage caused by the action”

- The process applies to:
 - The protection strategy and individual protective actions.



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General Safety Requirements No. GSR Part 7



Justification (cont'd)



e.g. reduction in
radiation
detriment



e.g. costs,
disruption,
reduction in life
expectancy and
anxiety

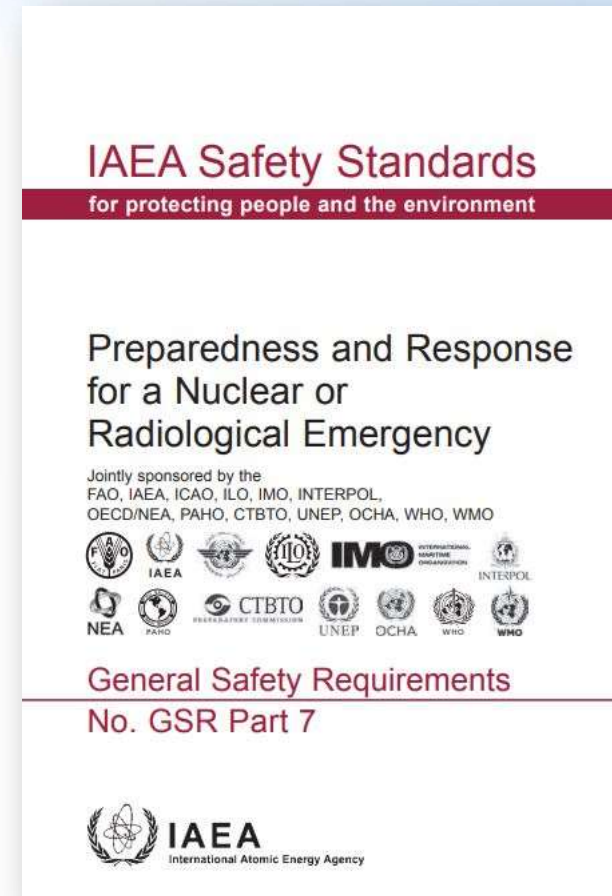


Optimization

“...determining what level of protection and safety would result in the magnitude of individual doses, the number of individuals (workers and members of the public) subject to exposure and the likelihood of exposure being as low as reasonably achievable, economic and social factors being taken into account”

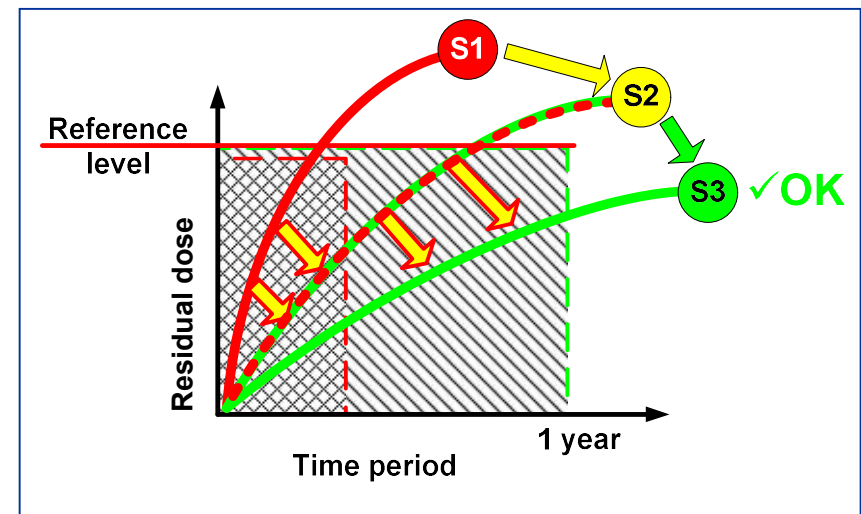
Justification, GSR Part 7

- The level of protection that would be the best possible under the prevailing circumstances, not necessarily that with the lowest dose;
- Optimization applies to protective actions and the protection strategy that have been justified;



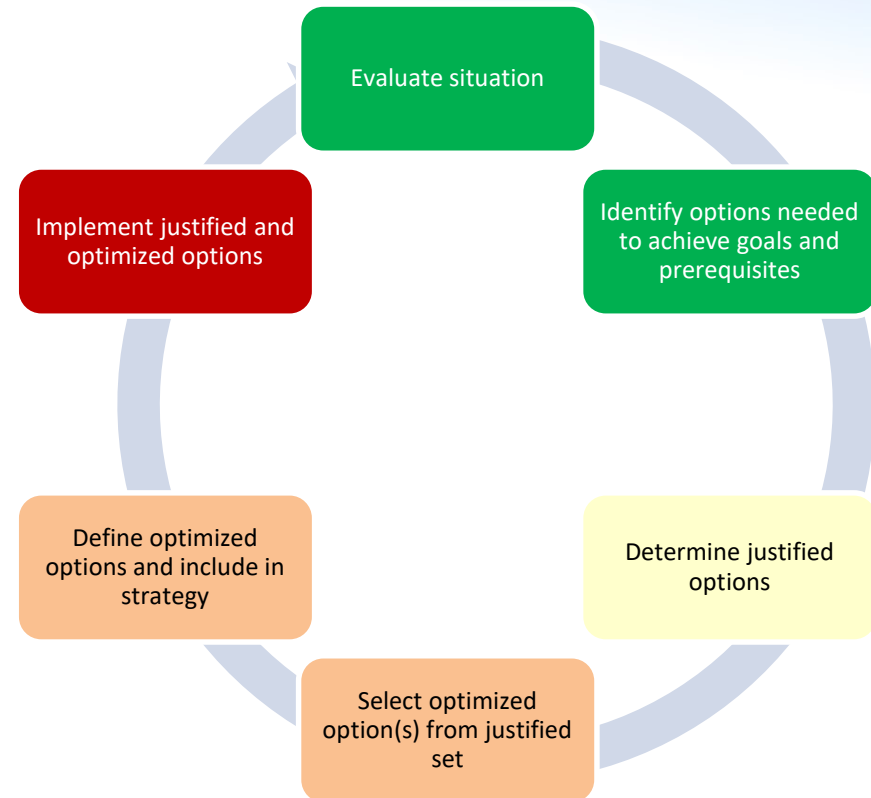
Optimization (cont'd)

- **Constrained optimization** using the reference level:
 - Optimization should generally result in exposures below the reference level and continue below this level as long as this is justified.
- Optimization also applies if initial exposure levels are less than the reference level if actions are justified.



Justification and Optimization

- A forward looking, iterative process that examines available options for protection and adjusts the actions to obtain the best outcome.



Justification and Optimization (cont'd)



- Non-radiological factors become increasingly important in decision making in transition phase:
 - Doses tend to decrease as the effective implementation of the protection strategy advances.
- A range of factors requires **input from various authorities and interested parties**.
- Need to consider **uncertainties** during the preparedness stage and in response:
 - Some factors (e.g. season and weather) will be unknown or inaccurate in preparedness;
 - Adaptation to actual situation needed in response.

Justification and Optimization (cont'd)



Factors to be considered:

- Goals and prerequisites;
- Radiation protection bases and criteria;
- Nature of the emergency exposure situation;
- Timing;
- Efficiency;
- Resources;
- Environmental aspects;
- Economic aspects;
- Social and ethical aspects;
- Waste impacts;

Discussion



- What is your estimate:
 - How long may the development of a protection strategy take?
 - How many organizations and interested parties would need to be involved?

Implementation of the Protection Strategy



- It is probable that actual emergency situations will not match the assumptions from planning:
 - Processes to adapt the protection strategy to meet the actual conditions need to be agreed at preparedness.
- As soon as the emergency has been declared, the prompt implementation of the protection strategy is paramount to provide the best level of protection under the circumstances, even if very little information is available:
 - Calls for detailed strategy for the urgent response phase.

Implementation of the Protection Strategy (cont'd)



- As the emergency progresses, particularly during the transition phase:
 - Better understanding of the exact circumstances;
 - Decisions based on actual conditions rather than pre-planned response;
 - Measurable quantities and observables will trigger discussions, but decision are to be made after consideration of the residual doses and other factors applicable at this stage.
- Adjusting/lifting protective actions:
 - Essential to ensure that protective actions are discontinued when no longer justified;
 - Impact on residual dose has to be assessed:
 - Lifting of protective actions should not significantly change the residual dose.

Implementation of the Protection Strategy (cont'd)



Urgent response phase

- Act quickly
- Follow pre-planned plans
- Use observables/ EALs to initiate actions

Early response phase

- More information available
- Follow pre-planned plans
- Adapt, justify, optimize the strategy if clearly indicated as needed

Transition phase

- Better understanding
- Decisions based on actual conditions rather than pre-planned in detail
- Time to review and discuss adaptation, with account taken of residual doses
- Adapting/lifting protective actions

Implementation of the Protection Strategy (cont'd)

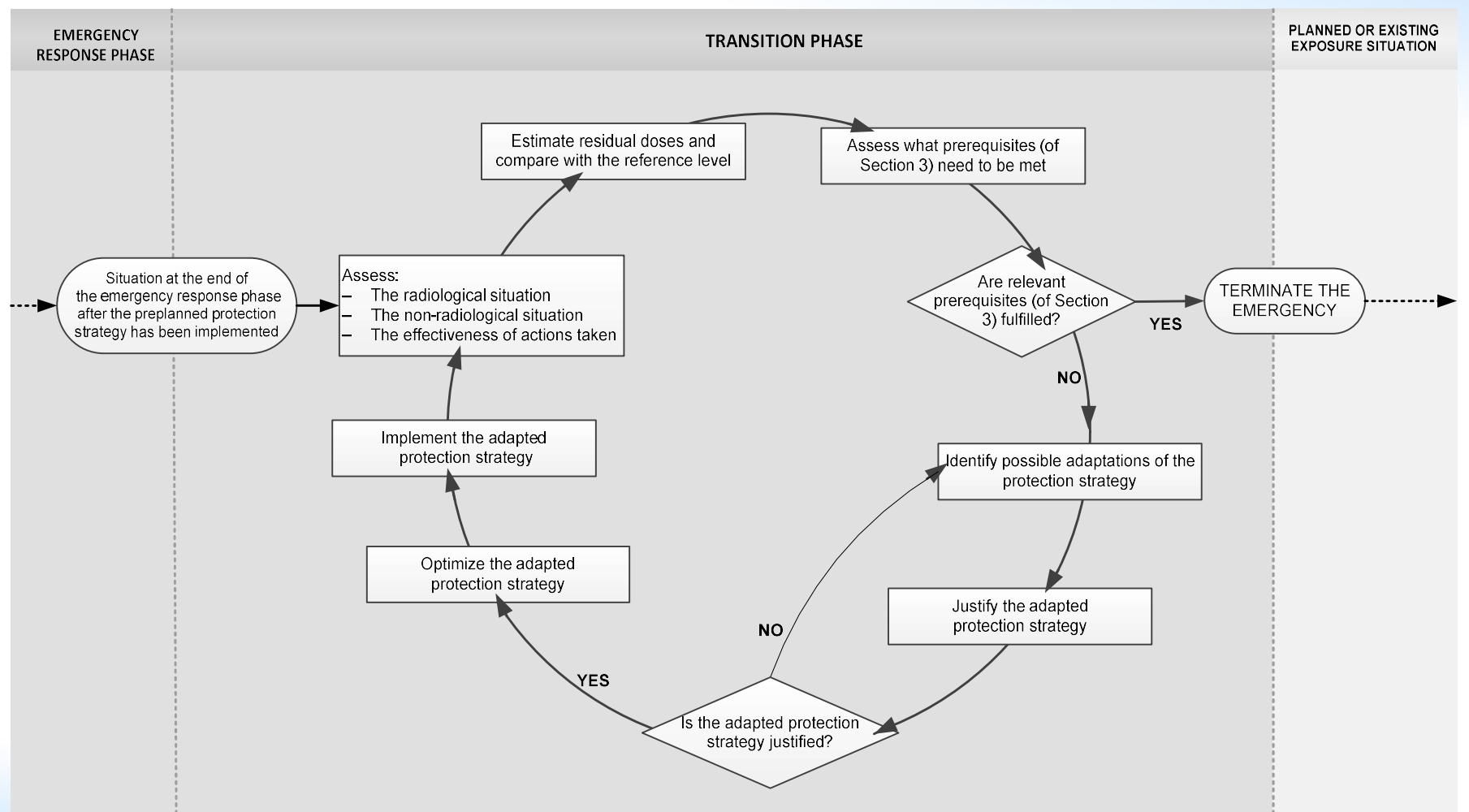
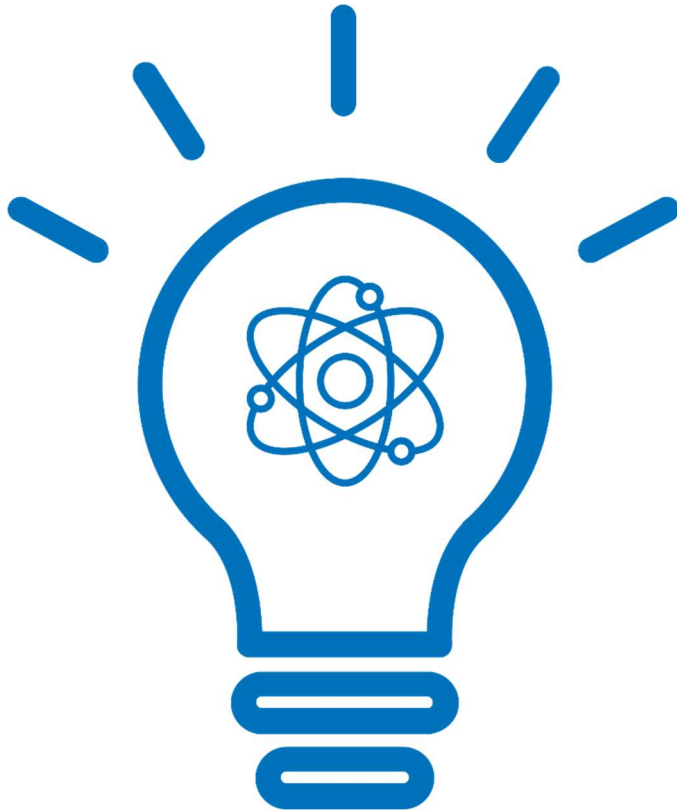


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Summary



- Protection strategies provide for a justified and optimized set of protective actions designed to achieve emergency response goals and work towards resuming normal social and economic activity:
 - With involvement of relevant stakeholders.
- Protection strategies have to be developed at the preparedness stage with account taken of uncertainties and limitations in information available:
 - Strategy for transition phase likely to be less detailed than for urgent/early response phases.
- Protection strategies have to be assessed and adjusted during response to remain justified and optimized in the light of actual circumstances.



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Thank you!