Arrangements for the Termination of a Nuclear or Radiological Emergency

Lecture: 05. Protection Strategy for the Transition Phase

Purpose of the Presentation:

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

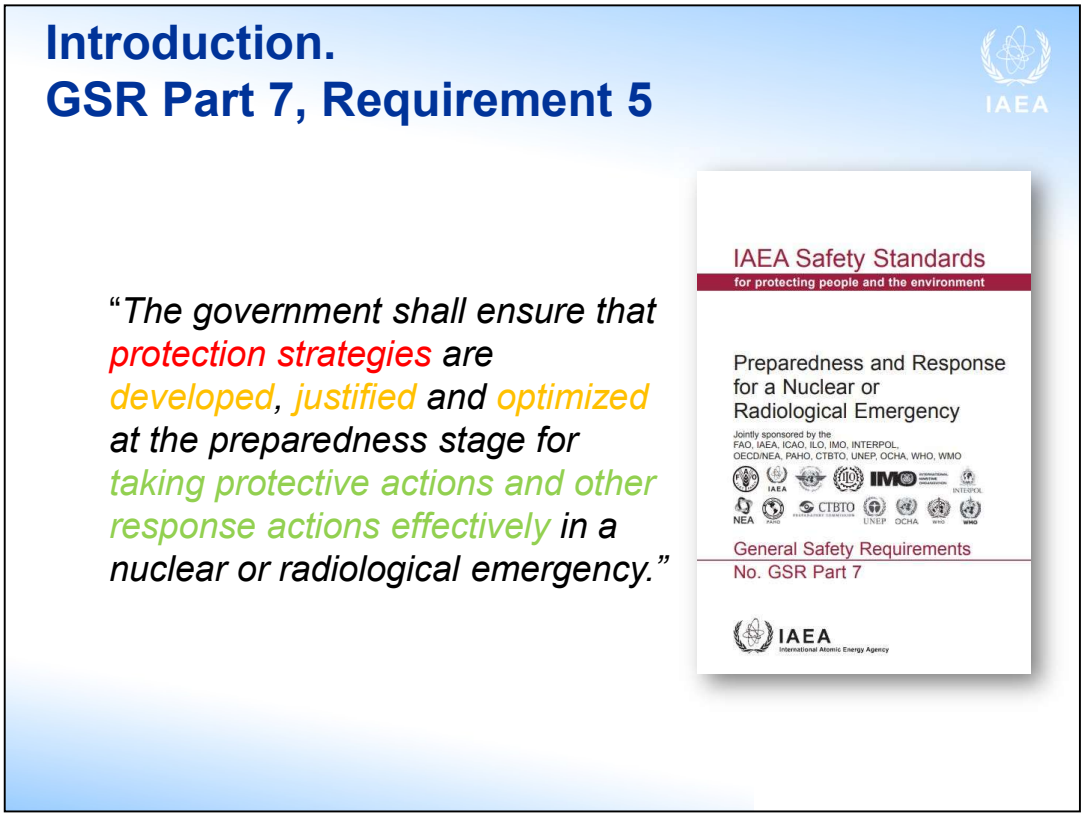
Learning Objectives:

- 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

Duration: 60 minutes

References:

1. International Atomic Energy Agency, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).
2. International Atomic Energy Agency, Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-11, IAEA, Vienna (2018).
3. International Atomic Energy Agency, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2007).
4. International Atomic Energy Agency, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011).

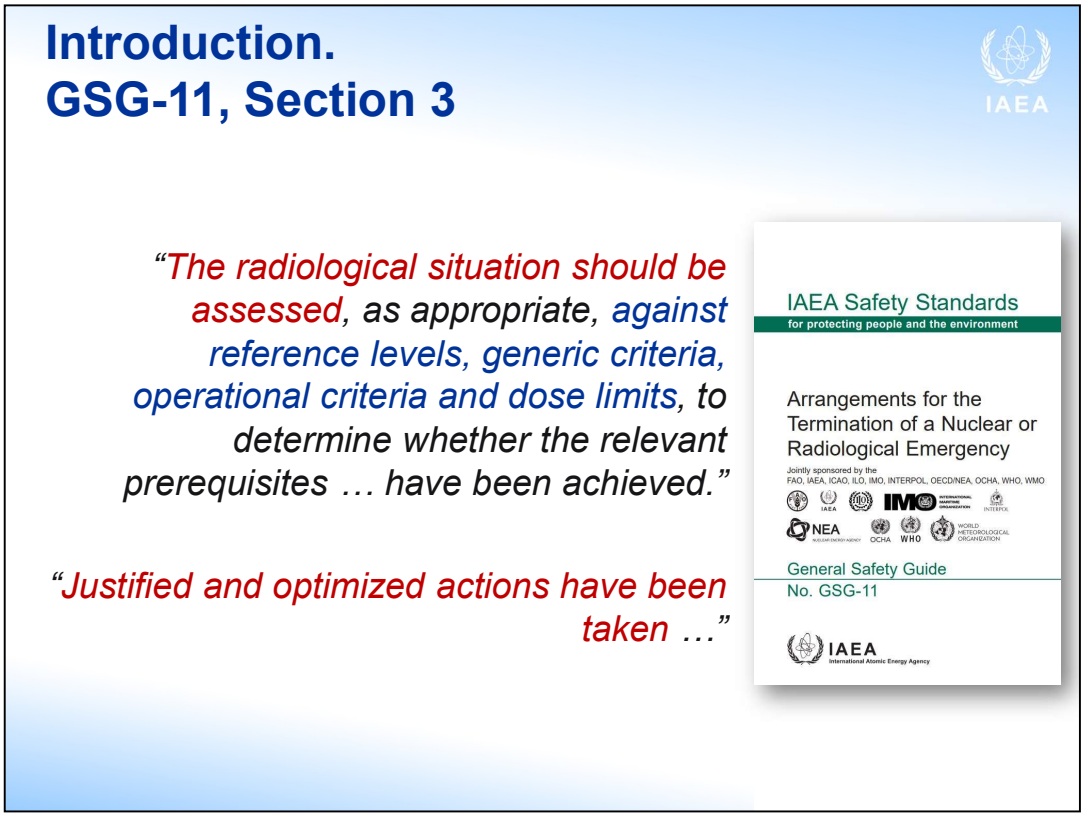


Lecture notes:

Requirement 5 of GSR Part 7 requires governments to develop justified and optimized protection strategies for nuclear or radiological emergencies. The aim is to respond effectively by achieving all the goals of emergency response (given in para. 3.2 of GSR Part 7). The requirement applies to all phases of the emergency (including the transition phase).

Reference:

1. International Atomic Energy Agency, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).



Lecture notes:

Section 3, GSG-11:

General prerequisites:

The radiological situation should be assessed, as appropriate, against reference levels, generic criteria, operational criteria and dose limits, to determine whether the relevant prerequisites for the transition to either an existing exposure situation or a planned exposure situation, as appropriate, have been achieved.

Specific prerequisites for transition to an existing exposure situation:

Justified and optimized actions have been taken to meet the national generic criteria established to enable the transition to an existing exposure situation, with account taken of the generic criteria provided in appendix II to GSR Part 7, and it has been verified that the assessed residual doses approach the lower bound of the reference level for an emergency exposure situation.

Reference:

1. International Atomic Energy Agency, Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-11, IAEA, Vienna (2018).

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.

Lecture notes:

In this presentation, we will be looking at what the protection strategy comprises and some specific aspects of its development and use for 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.

Lecture notes:

Although focus will be on the transition phase, most aspects apply to any phase of a nuclear or radiological emergency.

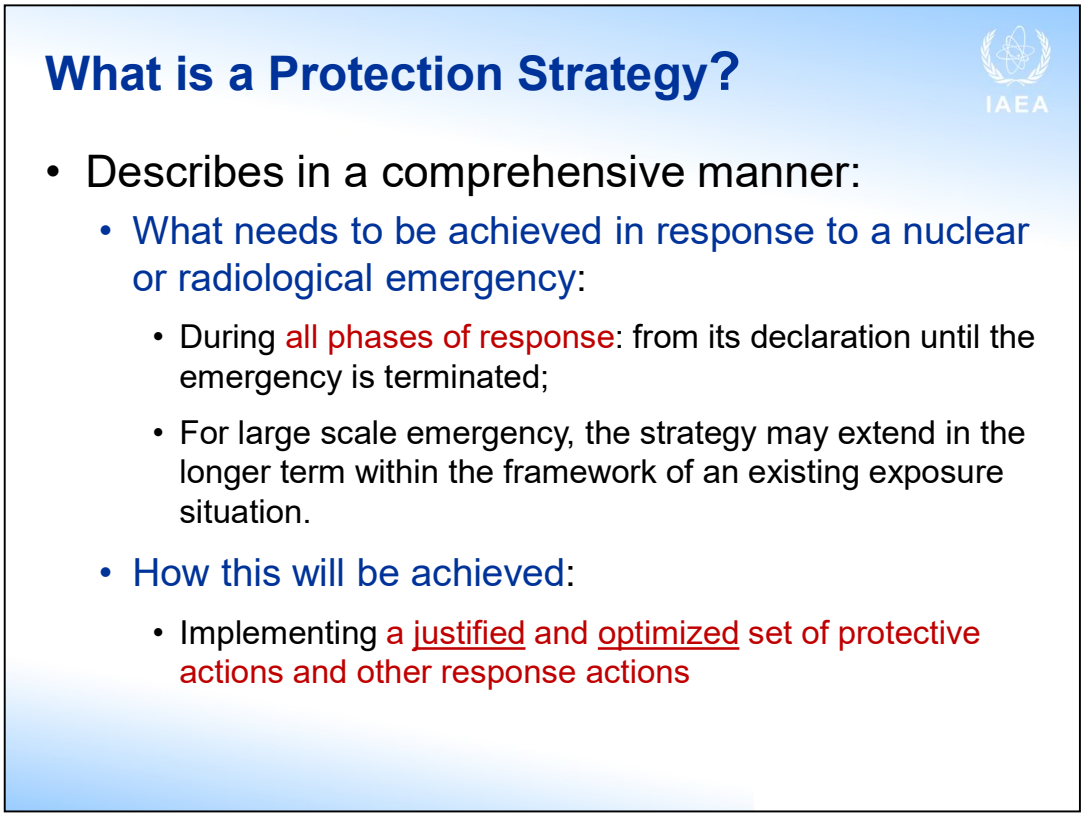
Content

- 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

Lecture notes:

There is a separate presentation on the protection of emergency workers and helpers; therefore, this presentation will concentrate on the use of the protection strategy for protection of the public.



Lecture notes:

A protection strategy (as addressed in GSG-11) describes in a comprehensive manner what needs to be achieved in response to a nuclear or radiological emergency in all its phases and how this strategy will be achieved through the implementation of a justified and optimized set of protective actions and other response actions. In this presentation, particular emphasis is placed on the protection strategy in the transition phase.

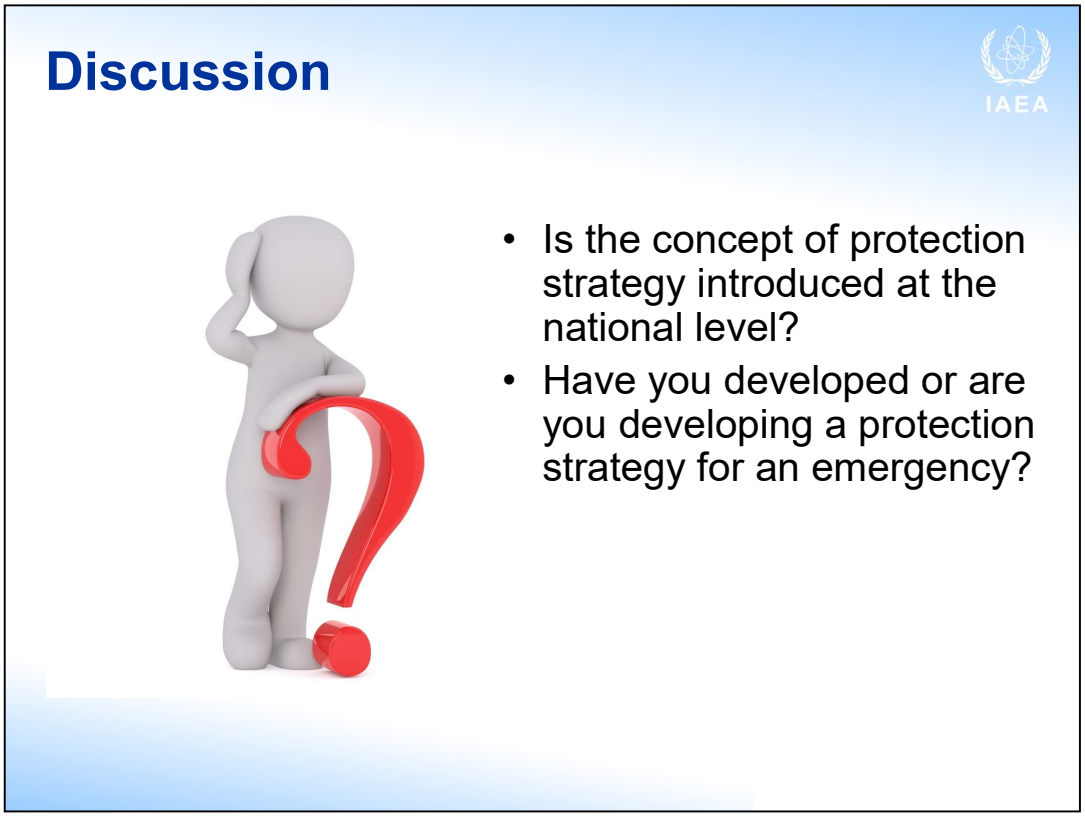
The protection strategy should cover, at least, the period from the emergency onset until the termination of the emergency to support the achievement of all the goals of emergency response (stated in para. 3.2 of GSR Part 7). The primary objective and the prerequisites for the termination of the emergency stated in Section 3 of GSG-11 should be the main drivers for the development of the protection strategy for the transition phase, with account taken of the situation to be inherited at the end of the emergency response phase.

The need for a protection strategy may extend beyond termination of the emergency where residual contamination remains as a result of the emergency (transition to existing exposure situation).

Lecture notes:

The level of detail at which it is possible to pre-plan in preparedness will likely vary from the urgent response phase (need to have clear and detailed actions ready to implement upon declaration of the emergency class) to the transition phase (the exact actions chosen and how they are implemented will depend on the details of the emergency and effectiveness of the implementation of the initial set of protective actions). Thus, the protection strategy for the transition phase developed at the preparedness stage might not be as detailed as the protection strategy for the emergency response phase. This lack of detail is often due to large uncertainties in the prediction of the long - term development of the radiological situation for postulated nuclear or radiological emergencies. Other uncertainties are related to social, economic, political and other aspects prevailing at the time of the emergency and the increasing importance of these non-radiological factors later in the response. Thus, the protection strategy for the transition phase should be further elaborated and adapted during the transition phase itself, as relevant information becomes increasingly available. The process for adapting the protection strategy during the emergency response should be agreed, at the preparedness stage, with all relevant authorities and interested parties and should be included in the protection strategy.

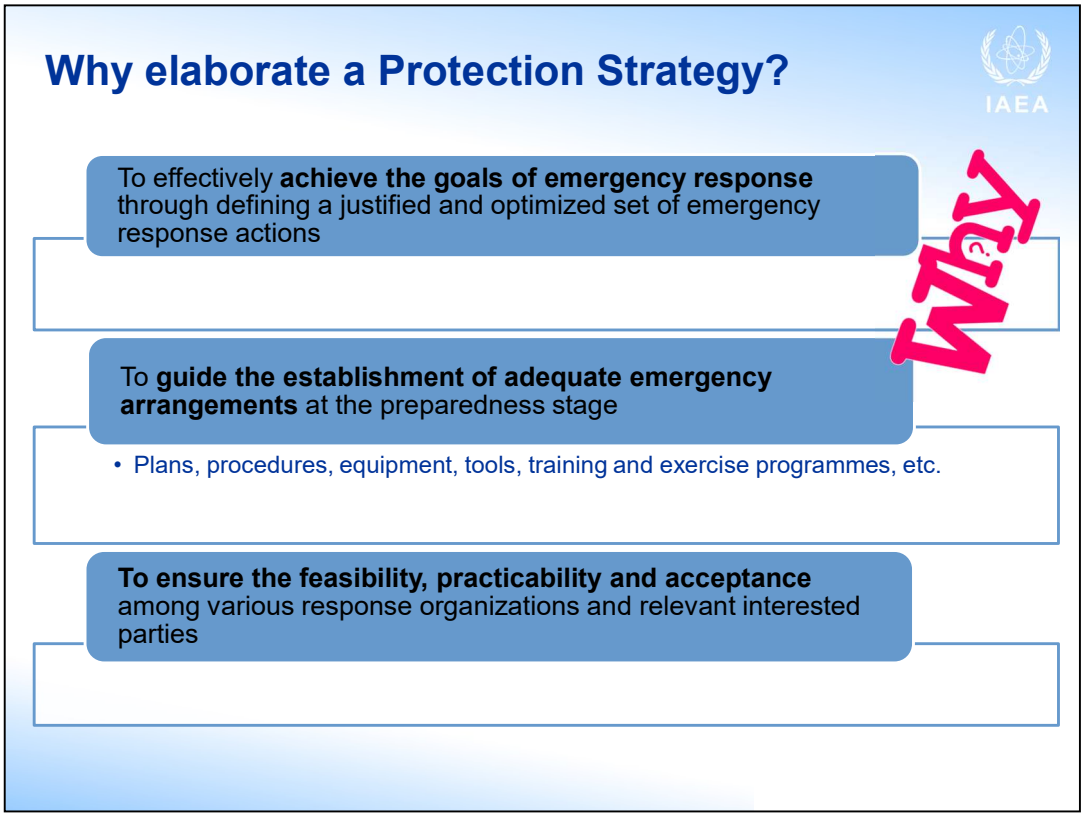
Later in the lecture, we will look at the concepts of justification and optimization as applied to the protection strategy.



Lecture notes:

Allow for about 3 mins. of discussion.

Use this to find out the participants' understanding and knowledge of the protection strategy concept. The next slide looks at the overarching reasons of why we should elaborate a protection strategy.



Lecture notes:

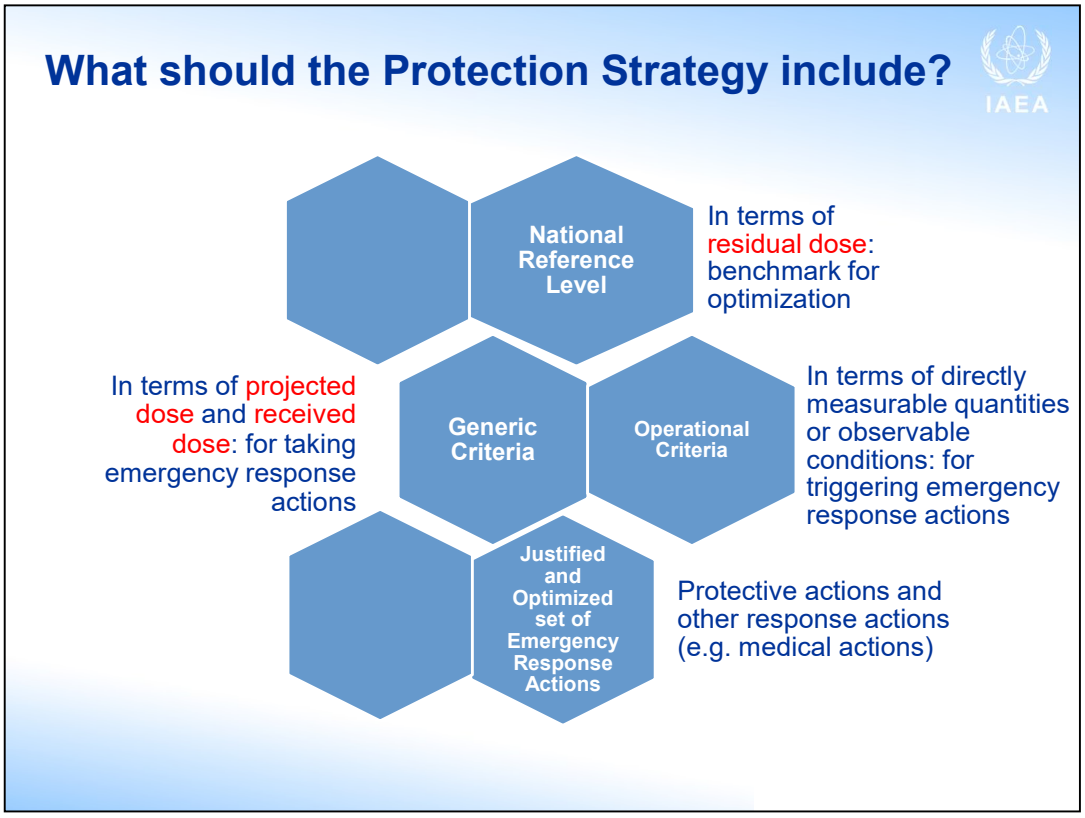
The protection strategy sets out how the set goals of the response are planned to be achieved. The main drivers of the protection strategy in the transition phase should be the achievement of the primary objective and prerequisites for the termination of the emergency. The strategy ensures a consistent response to emergencies.

The strategy should be developed at the preparedness stage, with the involvement of all relevant response organizations and other interested parties. The protection strategy should be used at the preparedness stage as a framework to guide the establishment of adequate emergency arrangements by all response organizations. The plans and procedures provide the details of exactly how the strategy will be implemented. Through execution of these plans, procedures and other arrangements, the strategy is actually implemented in response.

Through involvement of all relevant organizations and interested parties, the development of the protection strategy allows for sharing a common understanding and enhancing the acceptability, feasibility and any associated practicalities of the proposed protection strategy.

Lecture notes:

There may be synergies or conflicts between planned protective actions at different phases, which can be identified in the development of the strategy (e.g., advice to farmers to remove cattle from pasture to protect the food-chain may conflict with advice to the population generally to stay indoors – recognizing this can allow special messaging for farmers or alternative actions to be taken).



Lecture notes:

The main elements of the protection strategy are presented on this slide in line with Requirement 5 of GSR Part 7, Section 4 of GSR Part 3, GSG-2 and GSG-11.

Each protection strategy should include:

- A national reference level, expressed in terms of residual dose from all exposure pathways, to be used as a benchmark for the optimization of protection and safety;
- Generic criteria for taking protective actions and other response actions; and
- Pre-established operational criteria for initiating the different emergency response actions.

The following slides look briefly at each of these elements as a reminder of the different dosimetric concepts, the purpose they serve and what the requirements and recommendations in the Safety Standards are.

Dose Concepts

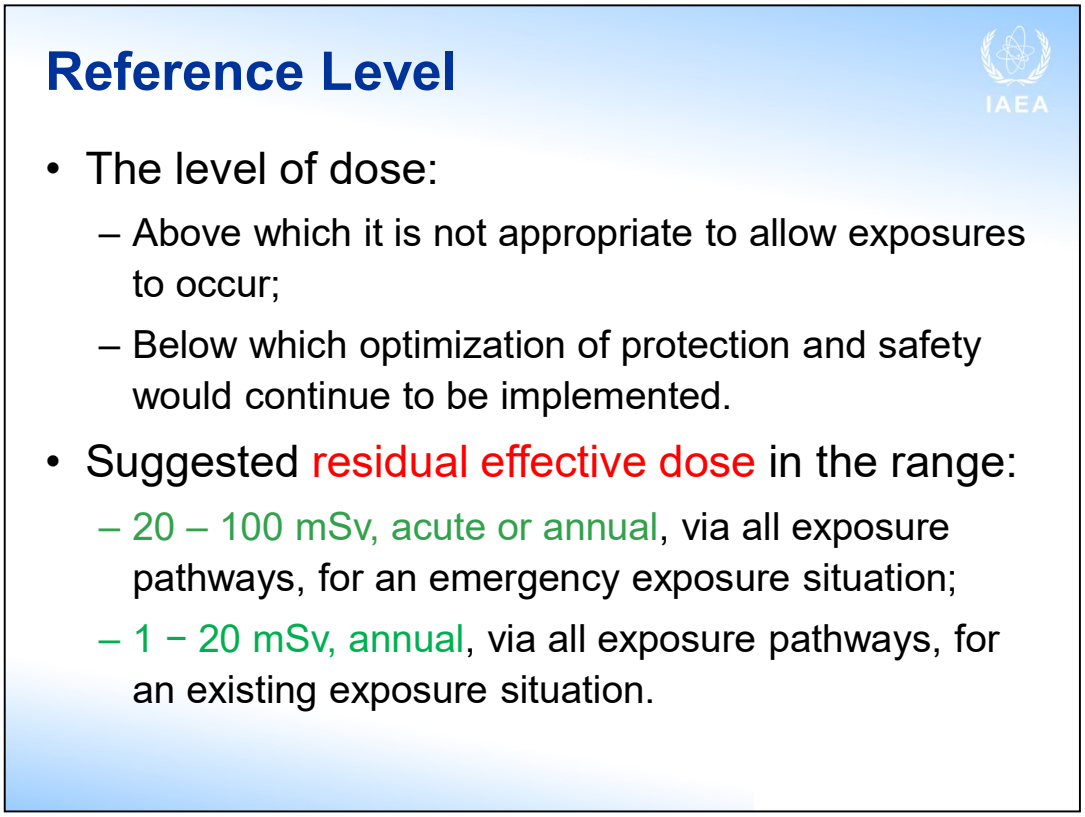
- Projected dose
  - The dose that would be expected to be received if planned protective actions were not taken.
- Residual dose
  - The dose expected to be incurred after protective actions have been terminated (or after a decision has been taken not to take protective actions).
- Received dose:
  - 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).

Lecture notes:

The projected dose is an estimate of the expected dose if no protective actions are taken (used in preparedness and for deciding on actions during an emergency: forward-looking).

The residual dose is an estimate of the expected dose if the planned protective actions are taken or they have been lifted (used in preparedness and for deciding on actions during an emergency: forward looking). The residual dose is concept that is used in planning for what the actual received doses are expected to be.

The received dose is the dose actually received (can determined by measurement or calculation).



Lecture notes:

Each protection strategy should include a national reference level, expressed in terms of residual dose from all exposure pathways, to be used as a benchmark for the optimization of protection and safety.

The reference level is not a limit and should be used as a level against which to benchmark the effectiveness of the planned or actual response.

Based on ICRP recommendations, a range of suitable reference levels for an emergency exposure situation and for an existing exposure situation are suggested in GSR Part 3, GSR Part 7 and GSG-11 to be considered at the national level.

For emergency exposure situations, the typical reference level expressed in terms of residual dose is to be set, typically as an effective dose in the range 20 to 100 mSv, acute or annual, which includes dose contributions via all exposure pathways. Above this level, it is judged to be inappropriate to allow exposures to occur as a result of the exposure situation (i.e. an upper constraint on optimization).

Lecture notes:

The residual dose expresses the accumulated exposure from the initiation of the event through a specified period of time, with account taken of the implementation of the protection strategy, if any. In general, a reference level of the magnitude used in an emergency exposure situation will not be acceptable as a long term benchmark for an existing exposure situation. Thus, termination of an emergency should not be considered if the annual effective dose (residual dose) to the affected population who remain living in an area that is under an emergency exposure situation would be close to the upper end of the range of the reference level for the emergency exposure situation.

For emergency exposure situations that may result in doses over a period of less than one year, the residual dose will be the total dose from all exposure pathways for the entire duration of the emergency. For a large scale emergency resulting in longer term exposures due to residual radioactive material in the environment, the residual dose will encompass the total dose from all exposure pathways over one year from the onset of the emergency. For residual doses to be used during the response, the total residual dose includes the doses received from all exposure pathways (received dose) and the doses expected to be received in future (projected residual dose), with account taken of the implementation of the protection strategy, if any.

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.

Lecture notes:

During the response, assessment of the appropriateness and effectiveness of the response should include a comparison of the residual doses among affected populations against the chosen reference level. Such use of reference the level will help prioritizing protection of those whose residual dose (or received dose) is above the reference level. However, optimization even below the preselected reference level still applies as long as justified protective or other response actions for those whose doses are below the reference level are available.

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

Lecture notes:

This table summarizes the suggested ranges of reference levels (residual dose) for the different exposure situations, including the transition from an emergency to an existing exposure situation.

Approaching the residual effective dose of 20 mSv per year is suggested as a suitable reference level for termination of the emergency when transitioning to an existing exposure situation.

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.

Lecture notes:

The decision to select specific numerical values for the national reference level remains the responsibility of the relevant national authority. This selection will depend on a range of circumstances, including national and local conditions (e.g. the prevailing economic and societal circumstances, and the available national, regional and local resources and capabilities), the phase of the emergency under consideration, the practicality of reducing or preventing exposures and the availability of options to reduce or prevent exposures. The process of selecting specific numerical values for the national reference level should be based on the results of the hazard assessment and consideration of the urgent protective actions, early protective actions and other response actions implemented, as well as the projected long term development of the exposures.

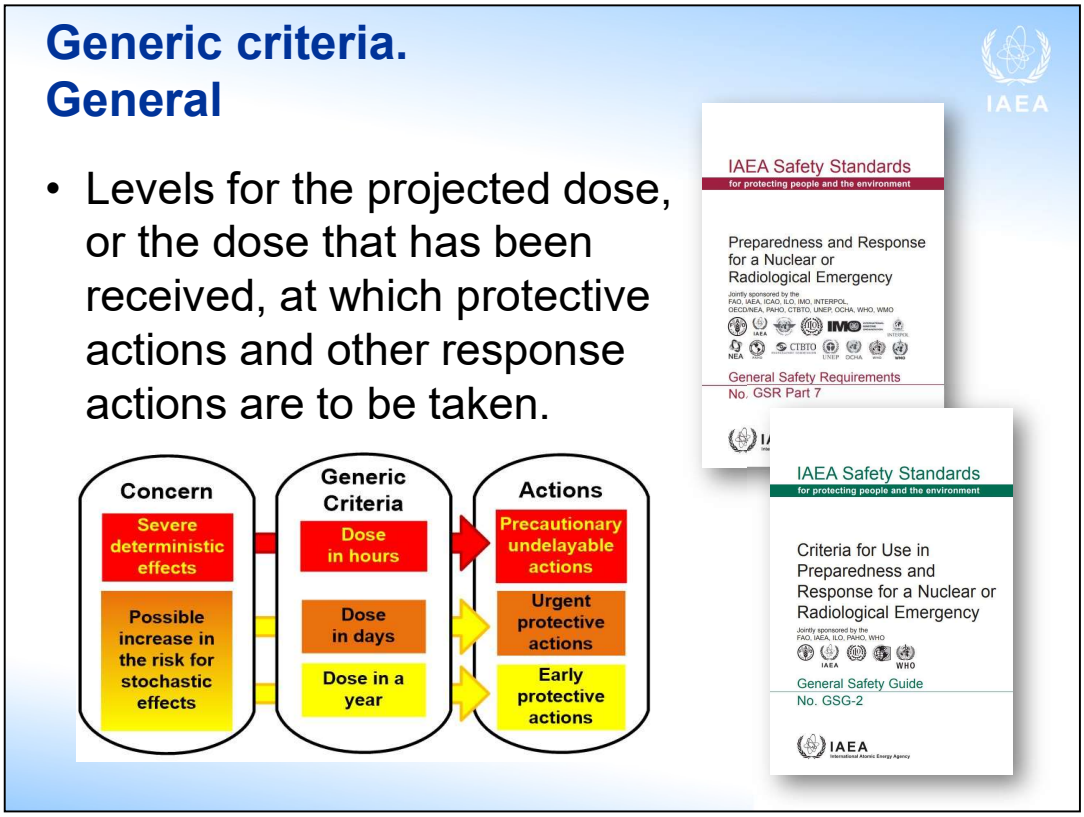
When selecting the values for reference levels, it should be considered that selecting a value close to the lower bound for emergency exposure situation will not necessarily provide for better protection when other factors are also considered in the overall processes of justification and optimization. Selecting low levels for the national reference level may also result in the need of increasing the reference level in case of an actual emergency and the loss of public trust.

Lecture notes:

Selecting lower levels for the reference level will not necessarily provide for better protection when other factors are considered (justification and optimization).

It is recommended that the reference levels for the various exposure situations (including for termination of the emergency) be agreed during preparedness – this will allow discussion and mutual understanding of the issues and real risks involved (or not) with a particular choice. This process should consider factors other on radiological factors as far as possible.

It is important that the affected populations be engaged and informed on the reasons for different doses being 'deemed acceptable' for the same activities in different locations.



Lecture notes:

In addition to a reference level, the national protection strategy should include generic criteria. They are levels for the projected dose, or the dose that has been received, at which protective actions and other response actions are to be taken. If the projected dose or the dose that has been received in an emergency exceeds the generic criteria, then protective actions and other response actions, either individually or in combination, need to be implemented.

GSR Part 7 (Appendix II) and GSG-2 provide generic criteria that are generically justified and optimized for taking protective actions and other response actions. These criteria address specific concern and translate to specific sets of actions to be considered:

- For severe deterministic effects, the generic criteria are established in dose projected/received in hours. Where projected doses exceed these generic criteria precautionary protective actions should be implemented promptly. If doses are received, this should prompt medical actions.

Lecture notes:

- For possible increase in the risk for stochastic effects, the generic criteria are expressed as doses in days (for urgent protective actions) or doses in a year (for early protective actions). If doses are received, this will prompt health screening and, if indicated, subjecting an individual to a longer term medical follow-up.

  For the transition phase, the precautionary protective actions are not relevant; the urgent and early protective actions should have been implemented already (prerequisite for termination). But some of them may be considered for adaptation or lifting during the transition phase, and others may remain in place for a longer term.

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.

Lecture notes:

As well as for introducing protective actions and other response actions, generic criteria should be adopted for the transition of the emergency exposure situation to an existing exposure situation and for adapting/lifting protective actions. GSR Part 7 and GSG-11 provide values for the generic criteria 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?

Lecture notes:

Discussion based on reference level and criteria. Allow for about 3 mins. of discussion.

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).

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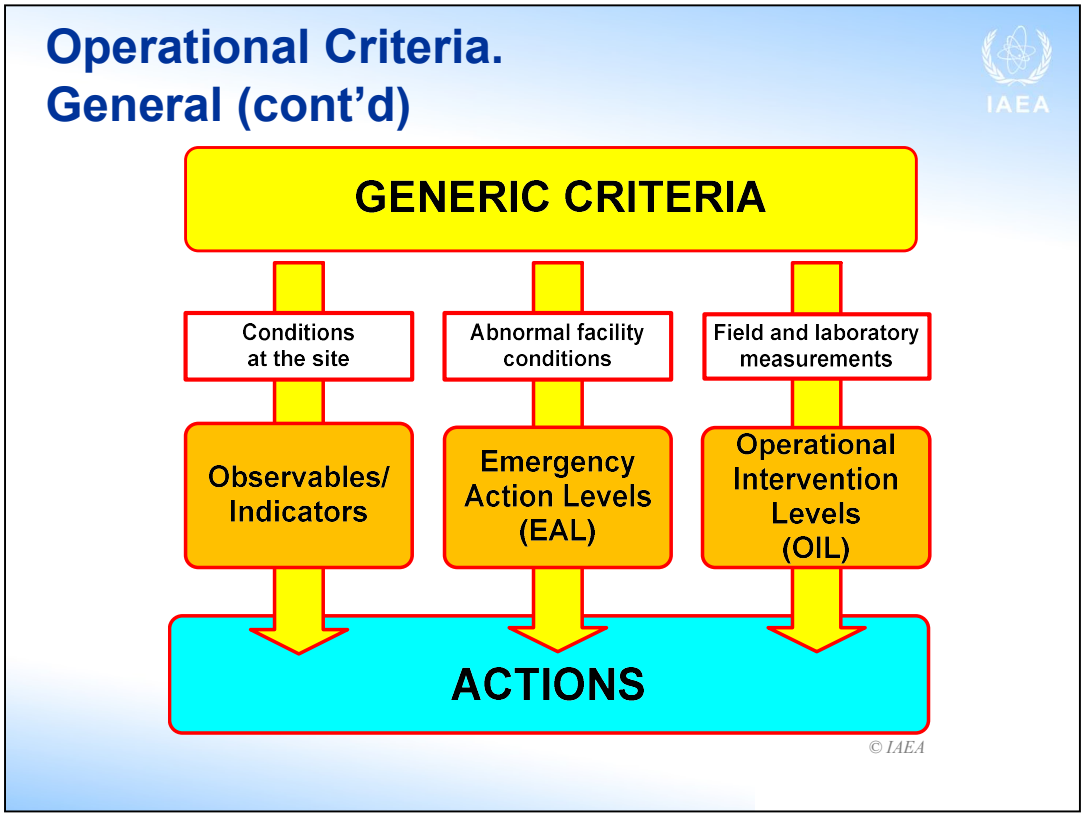
Lecture notes:

If an emergency occurs, prompt decision making is needed to allow the necessary emergency response actions to be implemented effectively. It will not be feasible to spend time calculating the projected doses or making estimates for the received dose in order to decide what to do. Therefore, operational criteria (measurable or observable criteria) need to be developed from the generic criteria to trigger specific emergency response actions, without the need for further assessments.

FIG.: Courtesy of International Atomic Energy Agency

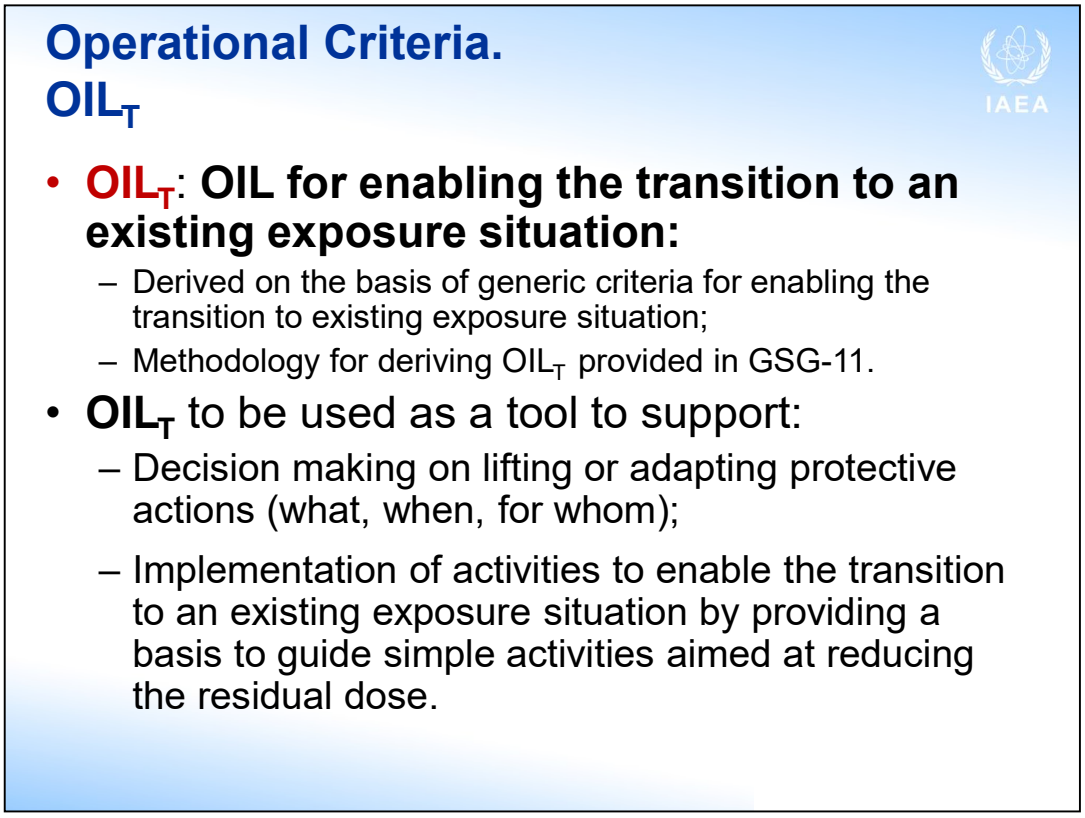


Lecture notes:

The operational criteria for the emergency response phase include observable conditions at the site, emergency action levels (EAL) and operational intervention levels (OIL). OILs have relevance during the transition phase as well, and they will be discussed in another lecture. Further guidance on the operational criteria is given in GSG-2 and GSG-11. Observing a condition or making a measurements should be a direct trigger for initiating protective actions and other response actions:

- Examples of observables/indicators include: fire, earthquake, unshielded source;
- Examples of emergency action levels include: temperature above X, dose rate in the controlled area above Y μSv/hour;
- Examples of OILs include the measured dose rate (μSv/h) at 1-metre from the ground or radionuclide concentrations in food (Bq/kg).

FIG.: Courtesy of International Atomic Energy Agency



Lecture notes:

OIL$_T$ is to be used as a tool to support:

- Decision making on lifting or adapting protective actions, including the determination of what protective actions may need to be lifted or adapted, when the protective actions may need to be lifted or adapted and to whom the decision may apply;
- Implementation of activities to enable the transition from an emergency exposure situation to an existing exposure situation by providing a basis to guide simple activities aimed at reducing the residual dose. Examples of such activities include: decontamination of area, restricting access to certain areas or restricting certain outdoor activities.

Decisions on the adaptation of urgent protective actions and the implementation of early protective actions are taken on the basis of increasingly more detailed information and better knowledge of the exposure situation. Unlike in the urgent response phase where OILs are required to automatically trigger agreed actions, in the interests of urgency, in the transition phase the OILs can be used to aid making decisions to lift or adapt certain protective actions (along with non-radiological criteria).

Lecture notes:

They can still enable local decisions to be taken without the need to refer every decision to a radiological protection experts.

Actual adaptation or lifting of actions should be taken on the basis of an assessment of the residual dose from all exposure pathways against the pre-set reference level, taking into account additional considerations.

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?

Lecture notes:

OIL_s during the transition phase are to be implemented not as a trigger (such as the application of OILs during emergency response phase) but for screening and informing decisions on adapting or lifting of protective actions. In addition to OIL_T, other OIL_S need also to be used during the transition phase to inform lifting or adapting protective actions taking into account those applied to initiate the protective actions in place.

Example:

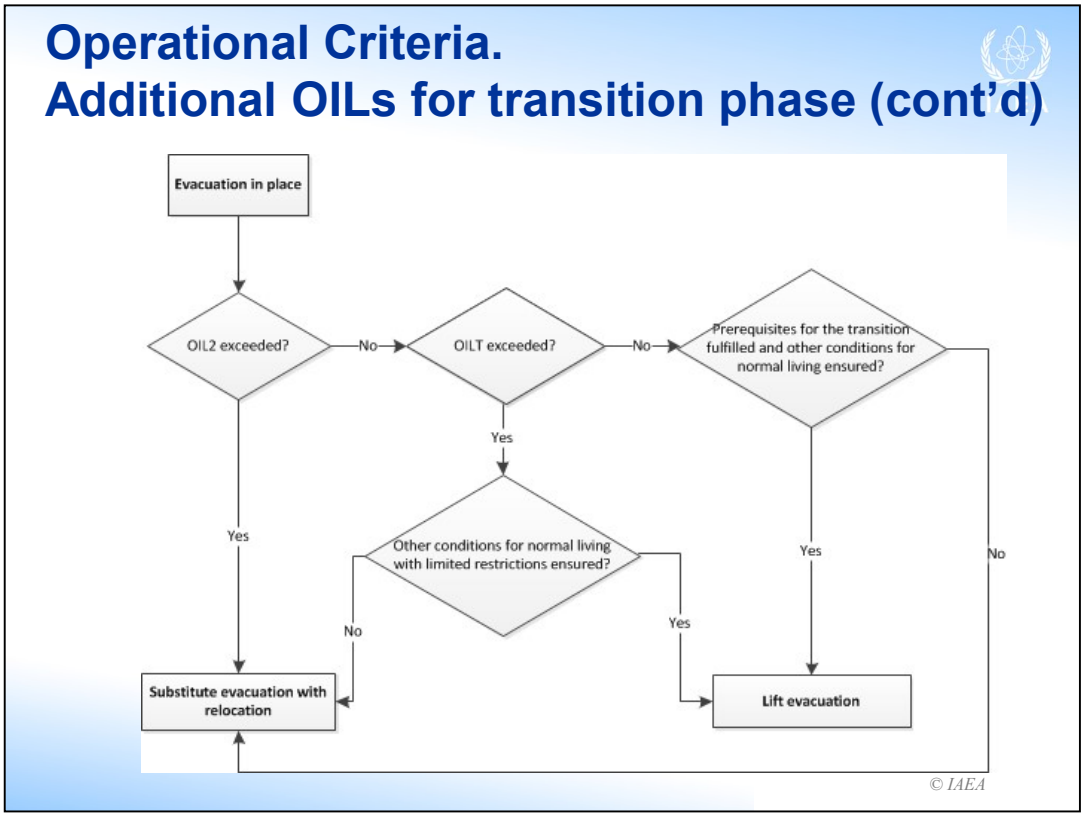
- Evacuation is to be implemented when the generic criteria of 100 mSv (effective dose or equivalent dose to an organ or a tissue) in the first 7 days are exceeded:

  $OIL_{Evacuation}$ (OIL1) > 1000 µSv/h at 1 m from surface or a source.
- Relocation is to be implemented when the generic criteria of 100 mSv (effective dose or equivalent dose to an organ or a tissue) in the first year are exceeded:

  $OIL_{Relocation}$ (OIL2) > 100 µSv/h at 1 m from surface or a source.

Lecture notes:

Thus, relocation is taken after the evacuation, at a point in time when the possibility of lifting the evacuation is being considered. What options do we have when considering adaptation of the evacuation in cases where the measured values are below OIL1?



Lecture notes:

Here we look at the use of the OILs for relocation (OIL2) and for the transition phase (OIL_T) when considering lifting the evacuation during the transition phase.

- Where the population has been evacuated, we need to decide if the evacuation order can be lifted and people can return home. In cases where the measured values are above the OIL2 for relocation, the evacuation should be substituted with evacuation.
- Where the OIL2 for relocation is not exceeded, the decision will depend on the OIL for termination of evacuation (OIL_T) and other (non-radiological) criteria.

Non-radiological criteria: "If people are allowed to return to an area, their well-being should not be endangered, and it should be possible for them to carry out their routine social and economic activities. However, limited restrictions on normal living habits may still need to be observed and might possibly extend into the longer term. Some basic criteria should be met to allow the return of people" [GSG-11, Para. 4.101].

This will later be discussed in detail. Here, it is used only to illustrate the need for various OILs to be used during the transition phase and the relation to those already used to trigger the actions in place.

FIG: Courtesy of International Atomic Energy Agency

Discussion

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

Lecture notes:

Discussion relates to what will be covered on the next slides.

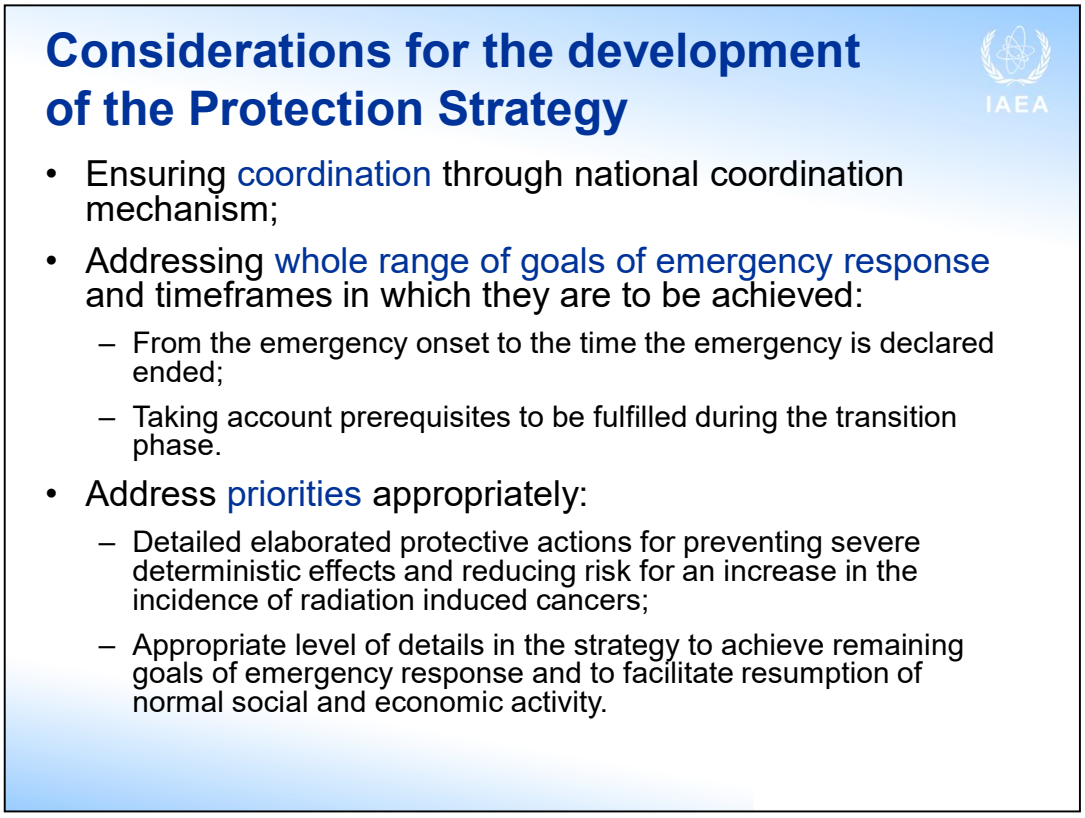
Allow for about 3 mins. of discussion.

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.

Lecture notes:

Many factors, both radiological and non-radiological, influence the choice of protective actions and other response actions within a protection strategy for a nuclear or radiological emergency. For each of these factors, it may be necessary for different organizations and bodies to contribute to the decision making processes. This slide provides a list of some of the key inputs into the protection strategy.



Lecture notes:

Given the wide range of factors relevant to the protection strategy (particularly for the transition phase), a strong coordination mechanism will be required to consider the input of all organizations/disciplines in order to address the goals of response (including the primary objective and prerequisites for termination associated with the last goal of emergency response stipulated in para. 3.2 of GSR Part 7). It is of outmost importance that the strategy addresses the priorities appropriately.

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.

Lecture notes:

The protection strategy for the transition phase developed at the preparedness stage might not be as detailed as the protection strategy for the emergency response phase. This lack of detail is often due to large uncertainties in the prediction of the long - term development of the radiological situation for postulated nuclear or radiological emergencies. Other uncertainties are related to social, economic, political and other aspects prevailing at the time of the emergency and the increasing importance of these non-radiological factors later in the response.

The effectiveness of the protection strategy in the transition phase should be assessed against the pre-established prerequisites for the termination of the emergency.

The protective actions and the protection strategy should be periodically reassessed in the transition phase to ensure they continue to do more good than harm, with account taken of any new information that becomes available.

Lecture notes:

The rationale for adapting the protection strategy should be transparent with respect to the criteria and conditions considered (including radiological factors and other factors) and should be documented and communicated to relevant authorities and relevant interested parties.

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.

Lecture notes:

As part of the protection strategy, the processes of justification and optimization to cope with the prevailing conditions as the emergency evolves should be agreed on. In general, this agreement should include at least the following elements:

- The processes and methods to be used in the transition phase, including the designation of any necessary decision aiding tools;
- The parties that will need to be consulted on the inputs necessary for the justification and optimization processes;
- Clearly defined roles and responsibilities for the justification and optimization processes.

Lecture notes:

The slide gives an overview of additional considerations for developing the protection strategy.

What is feasible and appropriate for the protection strategy in the transition phase will be heavily influenced by the actions taken (or not) in the urgent and early response phases (e.g., decisions to ban large numbers of foodstuffs will have created large quantities of waste, which will have to be managed).

Inhomogeneous contamination patterns, as well as the impact of different habits in different areas, will lead to differing residual doses, and hence the need for different strategies for these areas.

The longer time available for decision making in the transition phase means that the protection strategy can be more easily adapted to optimize it in this phase – however, with this additional time comes a higher expectation of consultation/involvement by interested parties and increasing demand for access to information. These take time to do properly, and so some degree of detailed planning for the transition phase is warranted.

Lecture notes:

The support of self-help programmes (e.g., monitoring equipment for the public, clean-up by volunteers, education on radiation and doses) can empower those affected by the emergency: this supports communities psychologically and also frees up some demand for available radiation protection experts.

Discussion

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

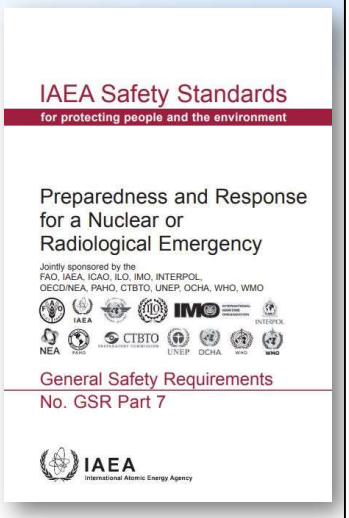
Lecture notes:

Discussion relates to what will be covered on the next slides.

Allow for about 3 mins. of discussion.

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"



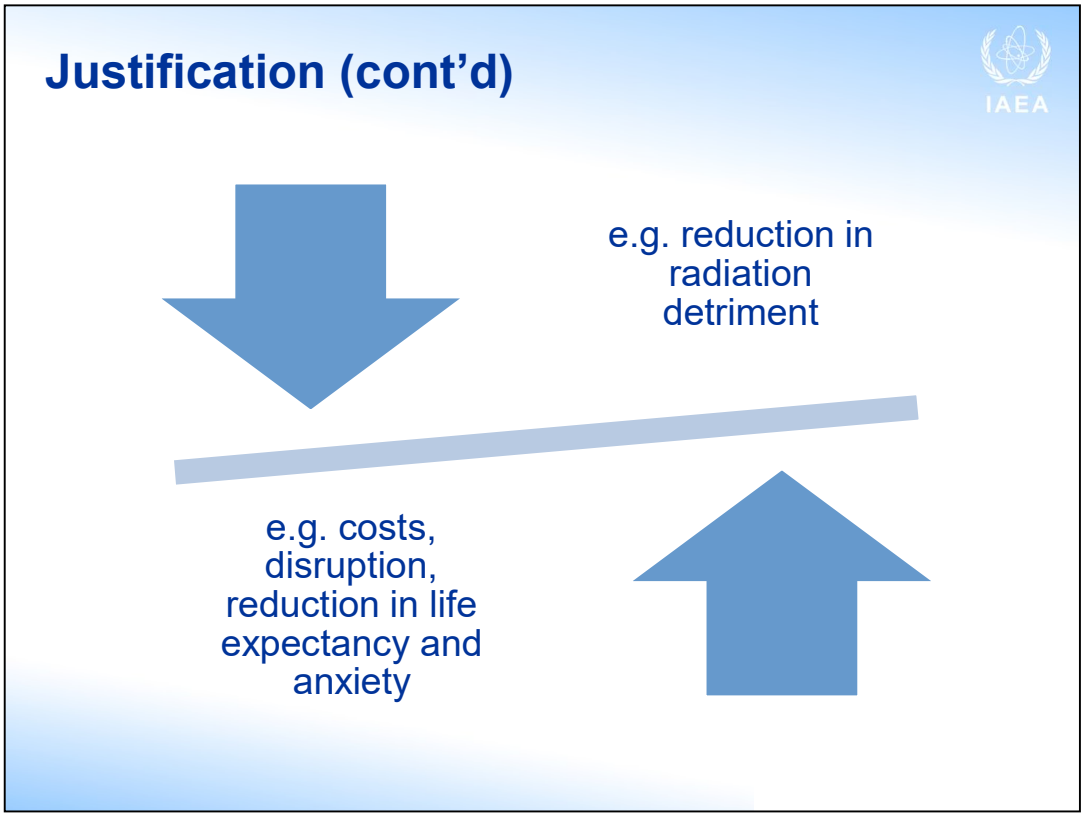
- The process applies to:
  - The protection strategy and individual protective actions.

Lecture notes:

- People are generally familiar with the concept of justification for decisions on whether to permit certain activities (e.g., the use of tritium lights for safety lamps may be justified but their use for decorative purposes may not).
- We also have to ensure that actions to protect people or otherwise respond to an emergency do more good than harm (i.e., are justified).
- Both the individual protective actions and the protection strategy as a whole should be justified.

Reference:

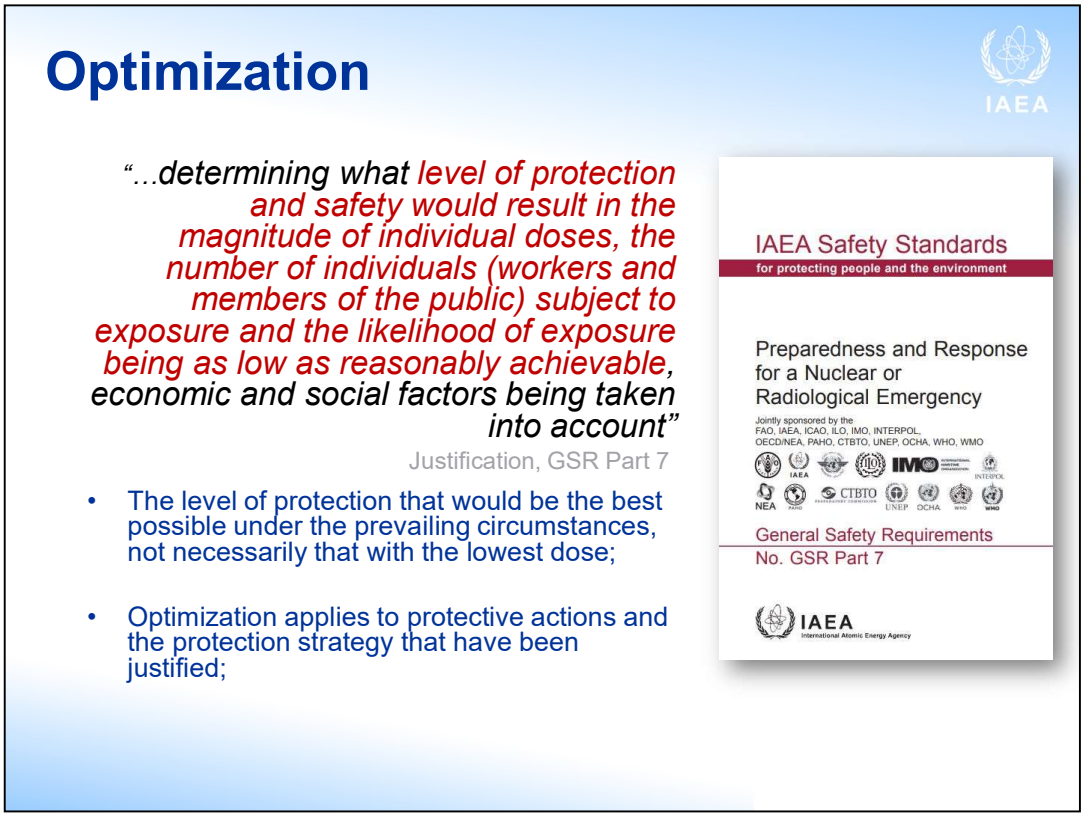
1. International Atomic Energy Agency, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).



Lecture notes:

Every protective action or other response action should do more good than harm. We have to balance the reduction in radiation risks with the increased impacts in financial costs, social disruption or stress to people resulting from the actions being taken.

Actions that may be justified in the short term, may not be in the longer term: for example, restrictions on the consumption of particular food or the use of a particular area may bring about an important reduction in dose for the first days or weeks, but, in the long term, the dose reduction may be less substantial or the negative impact of the restriction may outweigh benefits of the dose reduction. The food/land may be of particular importance economically or culturally, and not having access to it may cause sufficient stress/anxiety and hardship, so that the potential psychological health impacts would be greater than the radiation detriment.



Lecture notes:

Once actions are justified, the aim is to achieve the best level of protection under the prevailing circumstances:

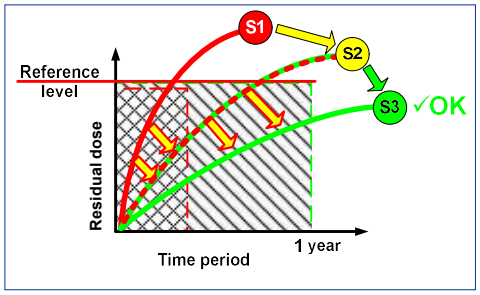
- It is important to remember that this will not necessarily be the option with the lowest dose;
- The process for optimization should allow for all relevant factors – radiological and non-radiological;
- The next few slides look at the area of optimization.

Reference:

1. International Atomic Energy Agency, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

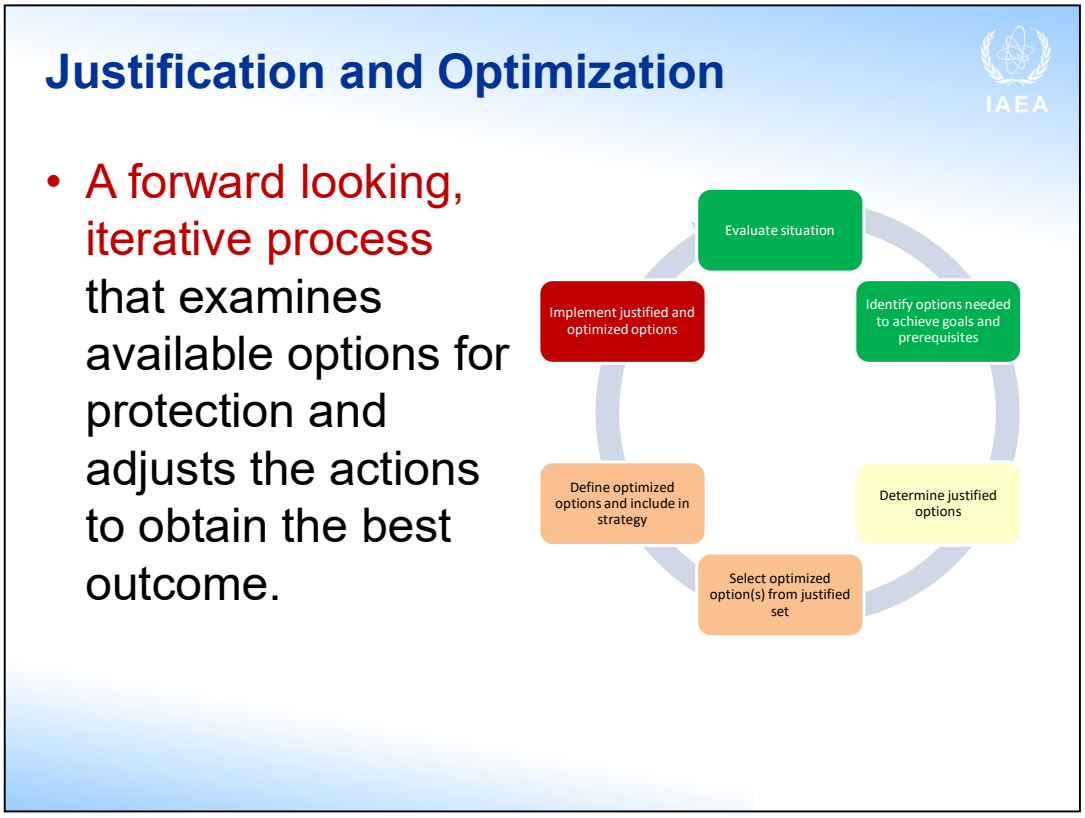
Optimization (cont'd)

- 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.



Lecture notes:

This figure illustrates the use of the reference level in optimizing the protection strategy. The strategy (S1) still leaves a significant number of people with doses above the reference level. Optimizing this strategy (S2) reduces doses generally, and fewer people have doses above the reference level. Finally, with further optimization of the implementation of the strategy (S3), reduction of doses below the reference level are achieved for all groups. Countries need to assess residual doses based on their strategy to see what is achievable and appropriate to further optimize the strategy.



Lecture notes:

Justification and optimization is an iterative process – not a once-through process. The general steps are illustrated in the figure here. Starting with evaluation of the situation, through identification of options for meeting the goals/prerequisites, determining if these are justified (weighing up benefits and detriments), selecting and optimizing the implementation of the chosen justified options as part of the strategy. Then evaluating the new situation which exists once the options have been implemented to see what further actions can or should be taken (or lifted if appropriate).

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.

Lecture notes:

Assuming that the appropriate actions have been implemented properly, the doses should be decreasing as we implement the protection strategy. As this occurs, the balance between the importance of radiological (dose) aspects and non-radiological (psycho-social, economic, waste, cultural, etc.) factors will change: non-radiological factors becomes increasingly important. The input of expertise and views from other areas (other than radiological/public safety) will be more and more important – we need to plan for this input in preparedness. We also need to allow for the many unknowns that we cannot predict in preparedness – our strategy and plans need to be flexible enough to allow for these uncertainties to be factored in.

Lecture notes:

Some examples of the types of factors we have to consider in justifying/optimizing our strategy and protective actions are given here. They are documented in Annex II of GSG-11.

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?

Lecture notes:

Allow for about 3 mins. of discussion.

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.

Lecture notes:

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, as may be the case during the urgent response phase.

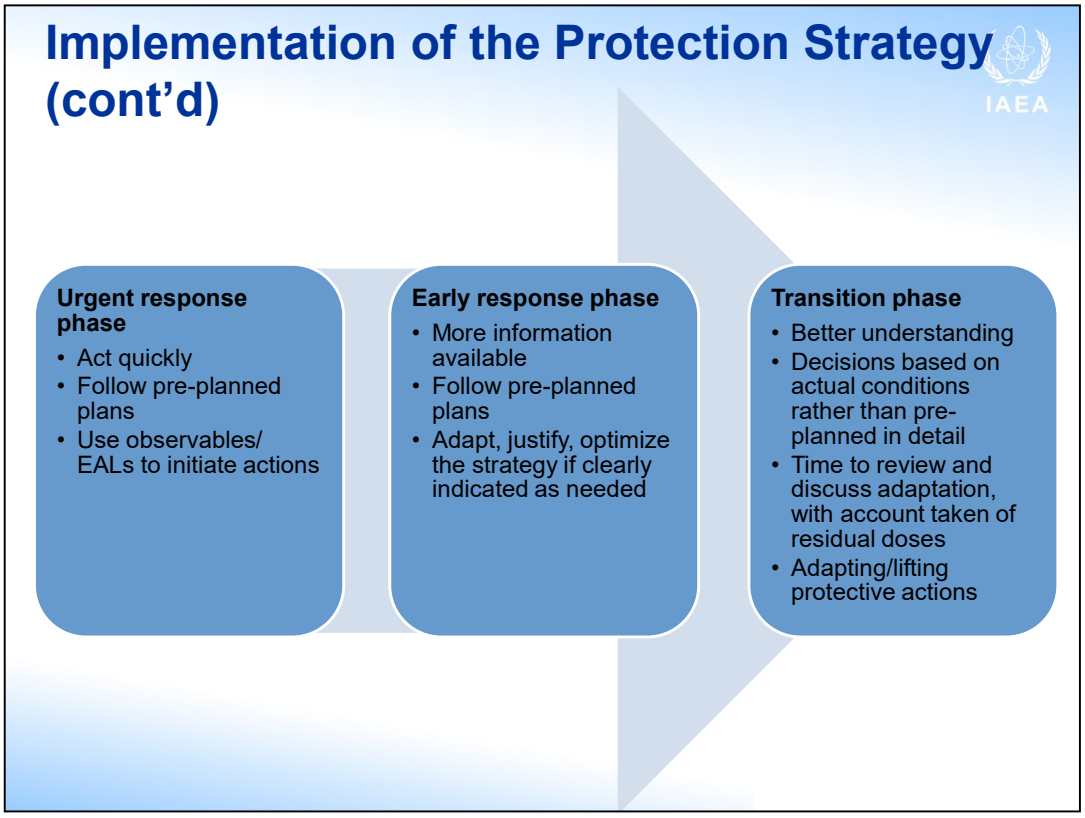
The need to take urgent action to avoid deterministic effects (and reduce stochastic effects) as soon as the emergency is declared means that the protection strategy (and accompanying plans) need to be sufficiently detailed to allow immediate implementation of the planned protective actions early after the emergency onset. It is likely that little information will be available at this stage and little or no time to discuss and agree on the actions to take. Therefore, sufficient work has to have been done in preparedness so that appropriate actions can be taken promptly.

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.

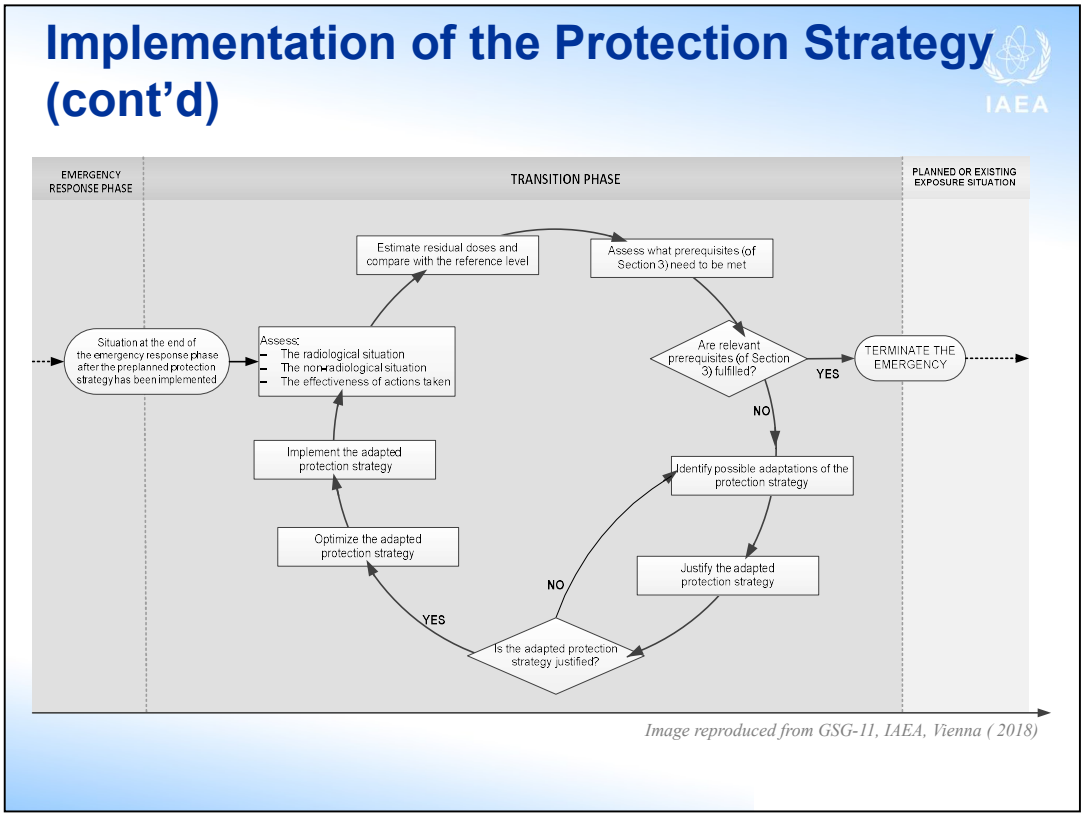
Lecture notes:

As the emergency evolves, and particularly during the transition phase, more information on the circumstances that led to the emergency and its consequences will become available. The implementation of the protection strategy should be continually reassessed, and the protection strategy should be adapted on the basis of the prevailing conditions. This will include consideration of what protective actions and when can be adapted or lifted and to whom these decisions apply. In doing so, we need to consider the impact on the residual dose as well as other (non-radiological) impacts.



Lecture notes:

This slide summarises the three phases in terms of the timescales we are working under, the use of pre-prepared plans, and the factors we need to consider.



Lecture notes:

The slide illustrates the cycle of implementing the protection strategy in the transition phase – with the overall goal of meeting the primary objective (timely resumption of social and economic activity) and the prerequisites (including the reference level):

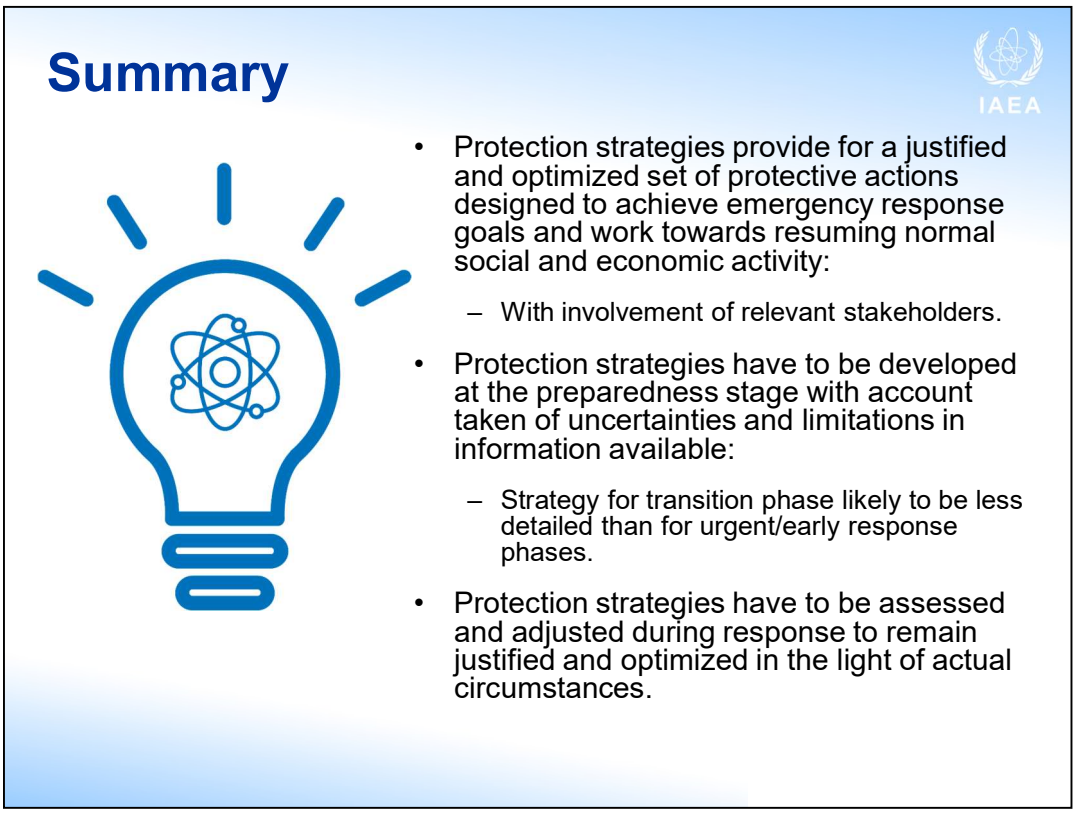
- The cycle starts at the end of the emergency response phase after the pre-planned strategy has been implemented;
- The current situation should be assessed as to the radiological (based on dose) and non-radiological situation (considering issues such as psychological health, economic impact, social disruption, etc.) and the effectiveness of the actions taken to date;
- The residual doses should be estimated and compared to the adopted reference level for enabling the transition;
- Each of the prerequisites (general and appropriate specific) should be assessed – to see if they have been met yet;
- Based on these assessments, we identify possible adaptations of the strategy that will allow the reduction of doses below the reference level and for meeting other prerequisites;

Lecture notes:

- We consider if the proposed adapted strategy is justified;
- If it is, we optimize it before implementation and further assessment;
- If not justified, we reconsider adaptations to the strategy until justified options are identified, if any.

Section 3 on this slide refers to Section 3 of GSG-11.

FIG.: The iterative process of assessing the implementation and adaptation of the protection strategy in the transition phase, International Atomic Energy Agency, Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-11, IAEA, Vienna (2018)



Lecture notes:

Summarize the key messages from the presentation.

Lecture notes:

Thank you!