Justification, Optimization and Decision-Aiding in Existing Exposure Situations

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The existing ICRP system of radiological protection from 1990 (ICRP Publication 60) can be seen as a binary or dual-line system dealing with protection in exposure situations categorized as either practices or interventions. The distinction between practices and interventions is summarized in the paper with focus on some of the problems experienced in making such a distinction. The protection principles within the existing system of protection are presented with emphasis on the application to de facto or existing exposure situations. Decisions on countermeasures to mitigate the consequences of existing exposure situations such as nuclear or radiological accidents and naturally occurring exposure situations include factors or attributes describing benefits from the countermeasure and those describing harm. Some of these attributes are discussed and the general process of justification of intervention and optimization of protection arriving at generic reference levels for implementing protective measures is presented. In addition, the role of radiological protection professionals and other stakeholders in the decision-making process is discussed. Special attention is given to the question whether radiological protection should form only one of many decision-aiding inputs to a broader societal decision-making process or whether societal aspects should be fully integrated into the radiological protection framework. The concepts of practices and interventions, however logical they are, have created some confusion when applied to protection of the public following a nuclear or radiological accident. These problems may be solved in a new set of general ICRP recommendations on radiological protection, which are anticipated to supersede Publication 60 in 2005. The evolution of the basic ICRP principles for radiological protection in existing exposure situations into a new set of ICRP recommendations is briefly discussed based upon the various material that has been presented by the ICRP during the preparation of these recommendations.

KEY WORDS: ICRP, intervention, justification, optimization, decision-aiding, decision-making, psychological impacts, countermeasures, avertable dose, projected dose, intervention criteria, stakeholder involvement

1 INTRODUCTION

Existing or de facto exposure of the public includes both natural and artificial radiation sources. Prolonged exposure of the public can be defined as adventitious exposures of the public to radiation, which persists for long time periods without any continuing human action to maintain these exposures. Except for the exposure to the external component of the cosmic radiation, all sources of prolonged exposure involve long-lived radionuclides. Some of these radionuclides are naturally occurring while others are man-made. They can be present in the surrounding environment and their radiation can expose people externally or they can also be taken into the body and expose people internally. Examples of existing prolonged exposure are radon in dwellings, residues from past uranium mining and milling operations, residues from nuclear weapons testing and residual contamination following accidental releases of long-lived radionuclides to the environment.

According to the ICRP, the protection of the public in existing exposure situations should follow the system of protection for interventions. There are some exposure situations, which are difficult to categorize as either practices or interventions, an example of which is the situation of re-inhabiting former nuclear weapons test sites. In addition, some confusion arose after the Chernobyl accident where dose limits for practices to some extent were interpreted as action levels and this has resulted in some uncertainty among...
individuals living in the contaminated territories. These issues are discussed in Section 2 where the existing 1990-system of radiological protection is reviewed.

Decisions on countermeasures to mitigate the consequences of existing public exposure include factors describing benefits from the countermeasure and those describing harm. An important aim of protective actions is to reduce the likely numbers of cancers as much and as effectively as reasonably possible and to avoid deterministic effects. To achieve this goal the protective measures should be effective in reducing doses or even avoiding doses. However, the total health consequences of an existing public exposure, and of any countermeasures subsequently implemented, include more than the injuries and increased risks directly attributable to radiation exposure. Perception of the hazard posed by radiation in the environment and enforced changes of lifestyle, may lead to increases in psychological strain in the affected population. Such increases may in turn lead directly or indirectly to increased illness. Therefore, the optimization of the overall health protection, of which radiological protection is only one part, and the decision on the implementation of an overall protection strategy, is complex, and interaction between radiological protection, psychological, social and ethical experts and representatives from the affected population is certainly needed. The role of the radiological protection as a provider of decision-aiding input to a wider decision-making process is discussed in Section 3 and Section 4.

The existing ICRP recommendations from 1990 are under revision and a new set of recommendations is expected to be published in 2005 after extensive consultation around the world.

II SYSTEM OF RADIOLOGICAL PROTECTION

Within the System of Radiological Protection, human activities that involve or could involve exposure to radiation can be dealt with either as practices or as intervention. A practice can be described as:

*any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed*.

In contrast, intervention can be described as:

*any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident*.

The System of Protection deals with the principles for limitation of exposure attributed to practices and the reduction of existing exposures through interventions and it is thus intended to control the addition of exposures by a practice and the reduction of exposures by intervention.

2.1 Practices and dose limitation

The term practice can be interpreted as those human activities, which can be reasonably adopted as a matter of choice to achieve some benefit from the use of ionizing radiation and radioactive materials but which result in some exposure to radiation. For the public exposure resulting from practices, ICRP’s emphasis is on the prospective control of the source. The introduction (and continuation) of a practice may cause prolonged exposure and add to the existing (pre-practice) total annual dose that people are incurring at the time of the introduction of the practice some additional individual annual doses, $\Delta E$, attributable to practices and not with the pre- and post-practice total annual doses.

![Fig. 1](image)

**Fig. 1** The introduction of a practice will add individual doses, $\Delta E$, to the background dose (pre-practice total annual dose) existing before the practice is introduced. The System of Protection for practices is concerned only with limitation of the added annual doses, $\Delta E$, attributed to practices and not with the pre- and post-practice total annual doses.

The concepts applied in the System of Protection for practices include *dose constraints* and *dose limits* for source-related and individual-related protection, respectively. For a single practice the System of Protection requires that individual members of a critical group should not be exposed above a fraction of the dose limit:

$$\text{source-related protection: } \Delta E \leq f \cdot E_{\text{lim}}$$

where $f \cdot E_{\text{lim}}$ is the dose constraint. $E_{\text{lim}}$ is here the dose limit and $f$ is the mentioned specified fraction of the dose limit.

The individual dose to a single member of the public from all practices should not exceed the dose limit:

$$\text{individual-related protection: } \sum_{\text{all practices}} \Delta E \leq f \cdot E_{\text{lim}}$$

The total individual dose, either that existing before the practice was introduced or that remaining after the practice...
has been introduced, is not subject to any limitation other than the limitation of the components of the total dose, $\Delta E$, which are attributable to each contributing practice, $i$.

2.2 Intervention and dose reduction

The term intervention refers to those situations where 'the sources, pathways and exposed individuals are already in place when decisions about control measures are being considered.' The existence of such situations is not a matter of choice. Sources amenable to intervention include natural as well as artificial source, such as radioactive residues from past practices, from other past human activities and events, and from accidents. Interventions are intended to decrease existing exposure, by removing existing sources, modifying pathways, or reducing the number of exposed people. After the implementation of the intervention, the post-intervention residual annual dose is not subject to further consideration as illustrated in Fig. 3.

As well as in practices, the protection in intervention situations includes source-related and individual-related protection as illustrated in Fig. 4.

The concepts applied in the System of Protection for interventions include intervention levels and action levels. The intervention level can be described as the level of avertable dose at which a specific protective action or remedial action is taken in an emergency exposure situation or a chronic exposure situation. The intervention level is expressed by the quantity avertable dose by a specific countermeasure. If the dose expected to be averted by the countermeasure is greater than the intervention level, the countermeasure should be introduced. The condition for introducing an intervention to avert (reduce) individual doses by $-\Delta E$ can be formulated as:

$$-\Delta E \geq \text{the intervention level } IL$$

then introduce the specified countermeasure.

The ICRP System of Radiological Protection is similar to other risk based health protection systems that are focused either on controlling the source of a hazard to individuals or...
on restricting the exposure of individuals to the hazard. It is often necessary to use both approaches.

Source-related assessments make it possible to judge whether a practice or intervention is likely to bring benefits sufficient to outweigh any disadvantages and whether all reasonable steps have been taken to reduce the radiation exposures that a source will cause. They thus facilitate the justification of practices and interventions and the optimization of protection at the source level. Source-related assessments take account of the magnitude (increase or decrease) of the doses attributable to the assessed source, and of the number of individuals exposed, but not of the influence on individuals of other exposure sources.

2.3 Distinguishing practices from interventions

In most situations there is no difficulty in distinguishing practices from interventions. However, there have been some misunderstandings in this distinction and the ICRP5 has re-emphasized some important issues relating to the distinction between practices, interventions and other human activities:

- practices are adopted as a matter of a planned choice in order to gain some individual or societal benefit. There is a conscious decision to adopt a beneficial practice in spite of the exposure, which it will add to the existing exposure;
- an intervention is intended to reduce exposures caused by a de facto situation whose existence is not a matter of choice, although it may be a matter of health concern. In an intervention situation, the source (and/or the exposure) already exists and is usually not tied to any particular societal benefit specifically related to the source;
- the clearest distinction between practices and interventions is the ability to choose a priori whether to accept beneficial sources and the consequent exposures. If a choice is still available, the exposure can usually be said to be due to a practice. The control of annual doses attributable to the practice should be planned in advance. Subsequent steps to reduce the annual doses attributable to the practice are improvements in the practice and not necessarily an intervention. If there is no choice, because the sources already exist, any action taken to reduce exposures is an intervention.

When introducing the concepts of practice and intervention, the ICRP5 did not intend to imply that any human activity that might cause increases in an individual’s exposure is a practice, nor that any human activity that might reduce an individual’s exposure is an intervention. For instance, a move to another part of the country or a change in the type of home should not be treated either as a practice or as an intervention and should not be subject to the System of Protection.

Practices and interventions are in most cases easy to distinguish from each other, although there has been some uncertainty about the introduction and management of a practice and other human activities involving radiation exposure in an area previously subject to intervention. It should be emphasized, however, that decisions on whether or not to introduce an intervention or to suspend an existing intervention should consider the expected exposure from all existing or realistic foreseen use of the area. Consequently, individual doses from the residual exposure after the intervention has been fully withdrawn (or considered but not introduced) are not subject to restrictions, and the post-intervention total annual dose is therefore the new baseline for considering any further human activities, including the introduction of a practice. Introducing a practice into an area with post-intervention residual exposures should be justified and the protection optimized in the exact same way as outside the area. The reason is that all decisions about a new practice should be related only to the individual doses, +ΔE, attributable to that practice which would add to the baseline total annual dose.

2.4 Dose concepts and quantities for intervention

The dose concepts for practices and interventions are different and this has not always been recognized. Because of the different nature of deterministic and stochastic effects, two types of dose quantity are needed to be able to decide on the need for protective actions, namely projected doses and avertable doses.
2.4.1 Projected doses and deterministic effects

The relevant quantity for expressing the risk of deterministic effects is the projected dose, i.e. the total dose received via all pathways over a period of time from the beginning of the accident. Although the projected dose is the total dose to be expected if no protective or remedial action is taken and not entirely related to deterministic effects, it is usually limited to the dose received in a biologically significant time period. To represent the risk of effects in a particular organ, the projected dose to that organ—within a time period that depends on the organ—is required.

When assessing projected individual doses due to an accident, it is important that due consideration is given to both the uncertainty in the assessment and to the distribution of doses in the population under consideration. It should also be recognized that doses already received before the intervention is considered could contribute to the deterministic effects. Intervention shall almost always be introduced to avoid levels of individual dose at which, if received, serious deterministic effects would occur.2

2.4.2 Avertable doses and stochastic effects

The benefit of an intervention that would reduce stochastic risks can be expressed as the dose to individual members of the public that can be averted in the time period for which the countermeasure lasts. The avertable dose is thus defined as the individual dose to be averted by the countermeasure, and it can be assessed as the difference between the dose to be expected without the countermeasure and that to be expected if the countermeasure is implemented. After the intervention has been withdrawn the dose to individual members of the public that has been saved by the countermeasure is named the averted dose.

The concepts of projected and avertable doses are shown in Fig. 5. Protective actions can only influence doses that would
be received in the future. Intervention cannot reduce doses already received, and it is therefore not appropriate to include doses already received when a decision on countermeasures to reduce stochastic risks is considered. It should, however, be recognized that doses already received before the intervention is considered would contribute to the deterministic effects as indicated in Fig. 6. Nevertheless, the optimization process is constrained by the principle of avoiding deterministic effects, so there is an additional condition on the projected dose.

Since protective actions for later phases of an accident will normally be invoked at levels of dose at which the concepts of equivalent and effective dose apply, the avertable dose can be expressed in units of sieverts (Sv). An example on the assessment of avertable doses by relocation is given in the box below.

### Determination of the avertable individual doses by relocation

An inhabited area has been contaminated with $^{137}$Cs from a radiological accident. Within the area, the average outdoor dose rate has been measured to be 20 $\mu$Sv/h above normal background. The time-averaged location factor that accounts for indoor/outdoor occupancy and shielding effects of buildings has been assessed to be about 0.3.

What would be the avertable dose per month if the population were relocated to un-contaminated areas?

The outdoor dose rate of 20 $\mu$Sv/h correspond to a daily effective dose from normal living in the area of:

$$\dot{E} = 0.3 \times 20 \mu\text{Sv/h} \times 24 \text{ h/d} = 140 \mu\text{Sv/d}$$

The dose that can be averted (avertable dose) in a month by relocation will therefore be:

$$E_{\text{avert}} = 140 \mu\text{Sv/d} \times 30 \text{ d/month} = 4 \text{ mSv/month}$$

If the areas to which the populations were relocated also were contaminated by the accident, but to a lesser degree, or, e.g. the radon background was significantly higher, the avertable dose from the relocation would be less.

If the avertable individual doses achieved by relocating the population from the contaminated area are larger than the optimized intervention level for relocation, this measure should be implemented.

### III DECISION-AIDING ON RADIOTHERAPEUTIC PROTECTION IN EXISTING EXPOSURE SITUATIONS

The principles of justification and optimization of intervention each require consideration of the benefit that would be achieved by the intervention and the harm, in its broadest sense, that would also result from it. They therefore require the use of the procedures for reaching decisions. The inputs to justification and optimization procedures include attributes that are related to radiological protection, whereas the final decisions may depend also on other attributes.

The ICRP recommendations should be seen as a provider of decision-aiding recommendations mainly based on scientific considerations on radiological protection. The outcome of its advice could also serve as an input to the final (usually wider) decision-making process, which may include other societal concerns and considerations.

#### 3.1 Justification of intervention

The immediate advantage of intervention is the expectation of obtaining averted (individual and collective) doses, i.e. of reduction in the existing doses, with the consequent reduction in the risk of radiation health effects to individuals and of radiation detriment to the exposed population. The disadvantages introduced by the intervention include the costs of the protective actions and the harm associated with them. If the advantages of intervening offset the disadvantages, the net benefit of intervening will be positive and the intervention is said to be justified. The principle of justification of intervention has been formulated by the ICRP as:

*The proposed intervention should do more good than harm, i.e. the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including social costs, of the intervention.*

Intervention is justified when its net benefit, or balance between attributes before and after intervention, is positive. In quantitative terms this is achieved when the summation of attributes with intervention minus the summation of attributes without intervention is larger than zero. It should be emphasized that it is only the difference between the values of the attributes before and after intervention rather than the absolute values, which is relevant for justifying intervention. For instance, it is the avertable dose, rather than the existing dose, which is the relevant quantity to be used in the justification process.

In summary, the justification of protective measures in intervention situations should be assessed by means of a decision-aiding process requiring a positive balance of all relevant attributes related to radiological protection. The results of such decision-aiding process should be used as an input into a decision-making process, which may encompass other considerations and may involve relevant stakeholders.

#### 3.2 Optimization of protection

Optimization of the protective actions is the process of deciding on the form, scale and duration of the protective actions of the already justified intervention. The aim is to obtain not only a positive net benefit, but also a maximized net benefit. This procedure is no different conceptually from optimizing protection for sources within practices. The principle of optimizing the protection achieved by intervention has been formulated by the ICRP as:

*The form, scale, and duration of the intervention should be optimized so that the net benefit of the reduction of dose, i.e. the benefit of the reduction in radiation detriment, less the detriment associated with the intervention, should be maximized.*

Normally, there would be a range of justified intervention options for which the net benefit is positive. Other options will not be justified because the net benefit is zero or negative. Among the justified options, the optimum protection option would be the combination of form, scale and duration.
of a protective action for which such net benefit is maximized seen from a radiological protection point of view.

In summary, the optimization of protective actions can be performed following the general approach to optimization of protection recommended by ICRP in the context of practices. The optimum form, scale and duration of the protective actions should be selected from the justified options of intervention.

3.3 Generically optimized reference levels for intervention

The ICRP and other international organizations have recommended specific reference levels (intervention levels) in terms of avertable (individual or collective) dose or derived quantities (e.g. Bq/kg) for specific countermeasures as shown in Table 1. The specific reference levels are generally derived from a generic optimization in which the only attributes included are dose reduction and monetary costs.

### IV DECISION-MAKING ON OVERALL HEALTH PROTECTION IN EXISTING EXPOSURE SITUATIONS

In many intervention situations, there are considerations, which may not be objectively related to radiological protection, but which may also need to be taken into account in making decisions about intervention. ICRP considers that these other considerations, which are mainly of a socio-political and cultural nature, may be taken into account in a decision-making process which should be wider than the decision-aiding process for the justification of intervention as all relevant attributes are included, not only radiological protection attributes.

### 4.1 Radiological protection attributes

Radiological protection attributes are defined as those, which are related to the level of radiological protection achieved and they have been used in developing international numerical guidance on intervention levels for implementing countermeasures to reduce doses after a nuclear or radiological emergency. Thus they include those attributes describing the dose distribution averted and those describing the costs and other disadvantages incurred in averting the doses. All these techniques have as their primary objective to clarify, for the people who have to decide on the intervention, the various attributes, to quantify them if this is reasonable and necessary, and to systematize the trade-offs between the various attributes.

### Attributes, which would clearly be radiological protection related, include those describing benefits from the countermeasure and those describing harm:

- The averted individual and collective risks for the members of the public,
- The individual and collective physical risks to the public caused by the countermeasure,
- The individual and collective risks to the workers in carrying out the countermeasure, and
- The monetary cost of the countermeasure.

### 4.2 Non-radiological protection attributes

Non-radiological protection attributes are defined as those, which are not related to the level of radiological protection achieved by protective measures. It is very difficult to generalize about these attributes, although they can have an important or even overriding influence on the decisions to be taken. Most intervention is disruptive to normal social and economic life. Change may cause anxiety, which can be harmful to health and well-being. However, the absence of protective measures can also cause anxiety, which is often exacerbated by a lack of objective information. These effects are non-

<table>
<thead>
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<th>Intervention criteria</th>
<th>ICRP</th>
<th>IAEA</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary relocation</td>
<td>&gt;10 mSv in a month</td>
<td>&gt;30 mSv in first month</td>
<td>&gt;10 mSv in a month</td>
</tr>
<tr>
<td>Permanent resettlement</td>
<td>&gt;1 Sv in lifetime (70 years)</td>
<td>&gt;10 Sv in subsequent months</td>
<td>&gt;1 Sv in lifetime (70 years)</td>
</tr>
<tr>
<td>Foodstuff withdrawal</td>
<td>&gt;10 mSv in 1 year for a single foodstuff</td>
<td>&gt;1,000–10,000 Bq/kg (a)</td>
<td>&gt;10–100 Bq/kg (a)</td>
</tr>
<tr>
<td></td>
<td>&gt;1,000–10,000 Bq/kg (b)</td>
<td>&gt;10,000–100,000 Bq/kg (II)</td>
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<tr>
<td>Agricultural countermeasures</td>
<td>—</td>
<td>generic action levels selected from mid-ranges of optimized intervention levels to be identical to the Codex values</td>
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<tr>
<td>Cleanup of contaminated land</td>
<td>total dose reference level of 10 mSv/a cleanup based on optimized level of avertable dose</td>
<td>total dose reference level of 10 mSv/a cleanup based on optimized level of avertable dose</td>
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radiological, are not easily quantifiable, will vary markedly between countries, and in any case will normally have opposing influences on the choices of intervention levels. They include the following attributes:

- the perception of the hazard posed by the radiation from environmental dispersed radioactive materials,
- psychological impacts,
- the reassurance provided by the implementation of the countermeasure,
- the anxiety caused by its implementation,
- the individual and social disruption resulting from its implementation, and
- political considerations.

Although some of these attributes to a certain extent are related to the level of protection achieved they are all considered to be non-radiological protection attributes. The political input, however, is always deemed to include only non-radiological protection attributes.

4.3 The role of radiological protection in decision-making

Management of protective actions in existing exposure situations is not a radiological protection problem only as has been experienced in the former USSR following the Chernobyl accident. The socio-psychological attributes are important and they may even be the dominating ones. Socio-psychological countermeasures are a new category of action, in the sense that social protection philosophy has not yet been developed to fully include their application in such situations, especially those following nuclear or radiological accidents.

Without the introduction of protective actions, most attributes would quantify disadvantages, e.g. the existing individual and collective doses as shown in Fig. 7. The advantage of intervention is that it may reduce the disadvantageous attributes, for instance averting individual and collective doses, or even get rid of them. Intervention may also introduce advantageous attributes, such as the reassurance produced by the intervention. But intervention will in addition introduce new disadvantageous attributes, e.g. the costs, harm and inconveniences introduced by the protective actions as shown in Fig. 7.

The left-hand picture shows that, without intervention, all key attributes can be considered disadvantageous. The right-hand picture shows that intervention may reduce (or eliminate) some of the disadvantageous attributes, introducing new disadvantageous attributes (e.g. costs) and some advantageous attributes (e.g. reassurance). The factor ‘other’ is intended to cover the disadvantage of social disruption and political problems as well as other less quantifiable components. The attributes costs and reassurance are not shown in the left-hand figure, as their value is zero without intervention.

In analyzing the inputs to the decision, it is necessary to decide on the relative importance of each factor. These judgments have to be applied irrespective of the decision aiding technique used.8-11 In a complete analysis each of the attributes have to be expressed in the same units. These units can be dimensionless quantities (such as used in multi-attribute utility analysis), or values could be expressed in equivalent years of life lost.

Explicit guidance is not provided on how psychological, social and ethical attributes should be included in the optimization of overall health protection. However, the optimization of radiation protection and psychological and social protection should not be carried out independently,10 as the overall health protection would depend on both radiological and non-radiological protection attributes as shown in the right-hand picture in Fig. 8. Combining independent optimization of radiological and non-radiological protection might lead to a sub-optimized overall health protection as shown in the left-hand picture in Fig. 8.

The overall health consequences of a nuclear or radiological emergency include the increased stochastic risks directly attributable to the accident. They also include the perception of the hazard posed by radioactive materials dispersed in the environment and enforced changes of lifestyle, which lead to increases in psychological strain in the affected population. Such increases may in turn lead directly or indirectly to
In situations where a dose-reducing countermeasure has already been implemented, and has been found to create so much strain that a net harm has been the result, i.e. the psychological harm introduced by the countermeasure more than offsets the benefit of the dose reductions, it may be optimal not to reduce doses, or even increase doses, in order to reduce the strain and so provide an overall net benefit. For example, some relocation strategies in the former USSR moved people to areas with elevated radon levels such that their total annual radiation exposure after the countermeasure was greater than if they had remained in the contaminated areas. Such a strategy may result in improved overall health protection, where less emphasis is placed on the collective dose. Other ideas and arguments that according to the ICRP favored a revision were that (1) the existing system is too complex and difficult to explain and contains too many numerical values (around 30 values), (2) the distinction between practices and intervention is difficult to understand, and (3) radiological protection input to the principle of justification normally plays only a minor role as far as practices are concerned.

The new system of protection—as the author sees it—will appear as a single-line system of protection compared to the existing binary system of protection for practices and intervention as indicated in Fig. 9. The new system would be more ‘intervention-like’ than ‘practice-like’ in so far as individual doses should be reduced below the appropriate constraint for the given exposure situation with the requirement to provide supplementary protection beyond that required by the recommended constraint, i.e. that all individual doses from a given source should be as low as reasonably achievable (ALARA). The ranges of constraints for normal and abnormal situations are indicated in Fig. 9.
In existing exposure situations, the constraint represents the level of dose where actions to reduce that dose is almost always justified and should be complemented by the requirement to optimize the level of protection achieved by the protective actions. For abnormal situations like accidents and emergencies constraints should be developed for likely remedial actions, e.g. relocation of people from contaminated areas. These constraints would be in the form of action levels or operational intervention levels acting as trigger levels for
specific protective actions.

In abnormal situations, decisions on the introduction of protective actions should be taken only if the action does more good than harm to the affected group of people or population and the decisions should, in principle, depend on the avertable individual doses and the residual doses after the protective actions have been implemented.

Involvement of stakeholders in the process of optimization of radiological protection

The new recommendations from ICRP will include a requirement to optimize the radiological protection for a given source to achieve the best level of protection that is reasonable (do the most good by the protective measures). Stakeholder involvement in the optimization process and in the process of decision-making has the purpose of e.g. incorporating values into decisions and resolving conflicts among competing interests.

VI DISCUSSION AND CONCLUSION

The present system of radiological protection deals with protection in existing exposure situations. These situations include exposure to naturally occurring radiation sources like e.g. radon in dwellings and gamma radiation emitters in building materials and soil as well as sources from human activities like e.g. nuclear and radiological accidents, past activities and event and military operations and nuclear weapons testing.

The principles of protection in existing exposure situations include the justification of protective measures and optimization of the protection achieved by these measures. The process of justification/optimization has been used by the ICRP to derive generic reference levels for specific protective measures based on avertable doses and monetary costs. It can, however, be argued that issuing generically optimized numerical guidance on intervention is questionable, because the inclusion of other factors in the decision-making process probably would modify the generic levels. Not including all relevant factors in the decision-making process might lead to a sub-optimized overall health protection as discussed in Section 4.

In the decision-making process on protective measures in an existing exposure situation, many complex human, social and economic considerations will have to be taken into account by the responsible authorities. The decisions and protective actions taken may themselves induce social and psychological impacts. From the experience in the former USSR after the Chernobyl accident, countermeasures to mitigate socio-psychological impacts have obviously been needed. It has been suggested that the inclusion of such countermeasures into the intervention framework should be within the radiological protection framework. More generally, the question has been raised if societal aspects should be integrated into radiological protection decisions or if radiation protection should be integrated into societal decisions as shown in the figure below.

ICRP has up until now considered that the justification and optimization of radiological protection should be assessed by means of a decision-aiding process requiring a positive balance of all relevant attributes related to radiological protection. The result of such a decision-aiding process can be used as input into a wider decision-making process (not performed by the radiological protection community), which may encompass other considerations being mainly of a socio-political nature. Integrating societal aspects into the radiological protection framework appears to be wrong, as the radiation protection community has no mandate to make societal decisions.

In order to achieve an optimized overall health protection, non-radiological protection factors would enter the optimization/decision-making process in parallel with radiological protection attributes to form an optimized countermeasure strategy. The optimization of the overall health protection would thus be the responsibility of the decision-maker with guidance from radiological protection experts, from experts in the fields of social and psychological sciences and from stakeholders.

From past experience it is evident that a methodology is needed in which all relevant protection attributes can be included in the decision-making process to reach a final (optimized) decision on countermeasures in post accident management. During more than a decade a number of research projects have been conducted on the role of socio-psychological factors in the implementation of protective actions in the late phase of an accident, but no satisfactory instrument have emerged from these research programs as to how radiological and non-radiological attributes can be weighed and combined to achieve an optimized protection of the populations affected. Therefore, further research on these issues seems to be necessary.

The upcoming ICRP recommendations continue to include principles for protection in existing exposure situations. Maximum values of source-related dose constraints will be recommended for such situations, and these constraints represent the level of individual doses (or risk) where protective measures to reduce (avert) individual doses (or risk) is almost always justified. In addition, there is a requirement that the level of protection achieved by the protective measure should be optimized. Therefore, there seems to be virtually no difference between the existing and the new system with regard to the principles of protection in existing exposure situations, except the change in name from intervention level to dose constraint.

With respect to the principles and processes of stakeholder involvement in the optimization of protection in de facto...
exposure situations the message from ICRP appears to be somewhat vague. The question still stands if societal aspects should be integrated into radiation protection decisions or, vice versa, if radiation protection should be integrated into societal decisions. As already mentioned, integrating societal aspects into the radiological protection framework appears to be wrong, and the opinion of the author is that the opposite is more correct, namely that radiation protection should be integrated into societal decisions, i.e. into the wider decision-making/optimization process. An often overlooked and maybe forgotten issue is the fact that the radiation protection community itself has a role as stakeholder within this wider decision-making process. As such, the radiation protection community has a natural obligation to give advice and guidance on radiation protection matters on a scientific basis.

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