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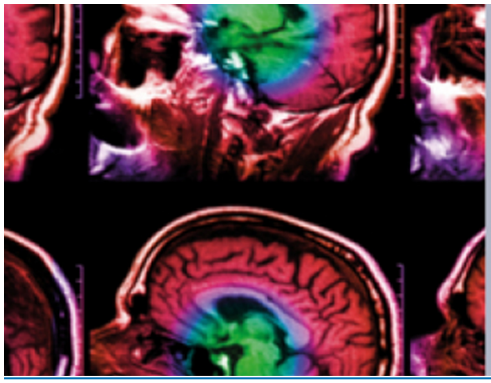

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Memorandum

IRPA Consultation: is the system of protection 'fit for purpose' and can it be readily communicated? Views of the radiation protection professionals

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Abstract

The system of protection, which provides the basic underpinning philosophy and principles for radiation protection, is constantly evolving in the light of developing scientific understanding and practical experience. Over recent times there has been significant learning from experiences relating to the Fukushima accident, and there is also increasing recognition of the importance of enhancing public understanding of radiation and risk. The practical application of radiation protection is undertaken by thousands of practitioners around the world, and it is IRPA's task to ensure that this experience is fed back for the benefit of all. This Memorandum reports the outcome of IRPA's consultation on the system of protection. The principal issues raised in the consultation include general perceptions of the system, risk uncertainties at low dose, the context of natural background exposure, dose limits and limitation, ALARA and reasonableness, and public understanding and communication of radiation and risk.

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Keywords: system of protection, radiation risk, ALARA, dose limits, public understanding, reasonableness

(Some figures may appear in colour only in the online journal)

Executive summary

In 2015 IRPA decided to commence a consultation with the Associate Societies on the broad topic of the effectiveness of the system of protection and its ability to be widely communicated and understood by interested parties. This was aimed both at providing information from the 'user community' to all those parties who are engaged in the ongoing development of the system, and to inform IRPA's considerations on how best to assist the Associate Societies in the communication of radiation and risk to stakeholders outside the profession.

This report identifies the principal issues raised by the consultation. Perhaps as expected, there is considerable overlap regarding views on 'effectiveness' and 'communication'. This is an inevitable consequence of the fact that the system of protection is somewhat detailed and complex, driven by the need to consider a wide range of exposure situations.

The principal conclusions of the consultation fall into several categories as follows:

General perceptions

Whilst the system of protection has proved capable of delivering an adequate level of protection, there is concern that it must integrate better into a more holistic approach which takes account of other risks. A further key concern is the link between the complexity of the system and the resulting challenge to its effective communication. There is a case for rebalancing the system to reduce reliance on 'fine print' explanations which are not easily visible or readily understood during communication with wider stakeholders.

Uncertainty in risk estimates

The important factors are seen as the over-riding importance of honesty in presentation, together with the recognition that, whilst we do not know everything, we do know that at the most relevant exposure levels the risk is bounded and must be quite small. It was noted that by far the overwhelming number of exposure situations in practice involve doses around a few mSv yr^{-1} or less, and it is important to focus on how best to make decisions in this dose range.

The context of natural background exposure

There is wide support for using the typical levels of natural background exposure to which we are all exposed as a means of giving context to our understanding of radiation risk and exposure situations in our communications, especially outside the profession. Whilst an additional exposure cannot be justified, or deemed as acceptable, solely on the basis of it being within the range of such natural exposures, there is evidence from many practitioners' day to day communication experiences that an understanding of natural background and its variability can have a significant influence on an individual's personal perspective and attitude to different exposure situations.

Dose limitation and dose limits

The word 'limit' has a clear connotation in public consciousness as the delineation between safety and danger. In addition, the apparent profile given to dose limits presents communication challenges for existing and emergency exposure situations, resulting in the term 'limit' as used in various contexts being widely regarded as unhelpful. Indeed, the definition of a public dose limit which is less than natural background exposure levels can reinforce a perception that man-made radiation is particularly dangerous, even though there are logical explanations in the 'fine print' of the system of protection.

It would be helpful to have a broader, more comprehensive and more readily available approach to limitation of exposure in all situations. This would aim to bring together limits, constraints and reference levels, ideally in the wider context of optimisation and ALARA. This need for a more flexible approach to limitation was a fundamental message from the IRPA professionals.

Optimisation, ALARA and 'reasonableness'

It is universally accepted that the optimisation principle is the central pillar for the practical implementation of radiation protection and is the dominant factor controlling exposures in any well-developed system of protection. The most widespread concern was in the interpretation of what is 'reasonable' and proportionate, and that an overly-simplistic approach is leading to continuing expectations of ever lower doses. There was a strong desire to seek ways of placing more formal recognition that ALARA does not generally mean consistently lower doses, and that there is a balanced approach to optimisation which results in value to society.

Communication and public understanding of radiation and risk

The importance of enhancing our efforts on public understanding of radiation and risk is recognised both by IRPA and the Associate Societies. There was a strong request for IRPA to assist societies and individual members in providing tools and training to improve our ability to communicate effectively outside of our profession. The consultation has identified many steps which are important for effective communication, and which must be developed into a programme to help the profession meet this very significant challenge.

IRPA believes that it is important that the profession, including the front line practitioners, have had an opportunity to reflect on the fundamental issues within the system of protection. Having distilled these views into this report, we must now seek ways to act on the findings within the relevant communities as follows:

I. Working with those international organisations closely involved in the ongoing development of the system of protection, specifically ICRP and our other international partners.
II. IRPA itself must continue to engage within the radiation protection profession to further explore and develop the issues raised in this report, and also deliver on our work programme to assist the Associate Societies and the individual practitioners to improve our ability to communicate effectively outside of our profession.
III. Encouraging the Associate Societies, and through them the individual radiation protection professionals around the world, to work within their countries and regions in order to seek local improvements where appropriate to address the issues raised in the

report, and to ensure that such experiences are communicated through the IRPA family so that the feedback from the profession is shared.

Introduction and background to the consultation

The System of Protection provides the basic underpinning philosophy and principles for the practice of radiation protection, including the cornerstones of justification, optimisation and limitation. Over recent times there has been widespread international discussion and interest in the challenges currently posed to the system of protection, for example in the light of experiences from the Fukushima accident. These considerations have also included wider issues pertaining to the effective communication and understanding of the system by interested parties, including both the radiological protection profession and the wider public.

There is also increasing recognition of the importance of enhancing public understanding of radiation risks and the control framework, which seeks to secure a balance of risks and benefits. It can be argued that the system of protection is quite complex and presents many challenges in this regard. The International Radiation Protection Association (IRPA), the Associate Societies and individual members have a key role in the public interface and therefore in addressing these challenges. We therefore need to seek a better understanding of the principal issues involved, how these may relate to the system of protection itself, and how we could make appropriate improvement.

Following the Fukushima accident an ICRP Task Group was established to identify the principal issues (Gonzalez *et al* 2013). In an Invited Editorial, the ICRP Scientific Secretary noted the importance of examining each of the issues and recommendations to assess whether the primary difficulties lie in communication and understanding of the system, or in the system itself (Clement 2013). In discussions at the 2014 ICRP Liaison Meeting with our international organisation partners, who all have a role to play in how we collectively address and implement protection, IRPA noted that it was a common task to ensure that the system of protection is fit for purpose, credible and able to be presented to and understood by all those impacted by radiation.

In our world of radiation protection, what is often referred to as 'the system of protection' has many stakeholders. ICRP as the principal owner of the system has the prime responsibility for its development. Many international organisations, including the IAEA, have a key role in formulating standards and guidance supporting implementation of the system. However, the practical implementation of radiation protection is undertaken by thousands of practitioners around the world, including operators, medical personnel, regulators, researchers and specialist advisors, who have this crucial day to day role, including communicating requirements and approaches to a wide range of lay persons. It is IRPA's task to ensure that this practical experience is able to be fed back into the ongoing development of the system so that it can meet the goal of 'fit for purpose and credible' described above.

IRPA's consultation on the system of protection

It is important that these issues related to the system of protection are fully debated by the radiation protection community as we seek to identify how best to proceed. IRPA believes that the views of the professionals and practitioners around the world should be brought to bear on this important challenge.

IRPA therefore decided to engage on a consultation with the Associate Societies to seek the views of our members on the challenges in the implementation and communication of the system of protection. Our intention is that the conclusions of our broad discussion should make a contribution in two general areas as follows. Firstly, the views of the professionals should be shared with all those international organisations who are stakeholders in the system of protection in order to help guide its future development. Secondly, the views should guide IRPA's considerations on public understanding and the communication of radiation and risk.

IRPA's approach to the consultation was to consider, review and, if appropriate, build on the personal views presented in an invited editorial by Vice President (now President) Roger Coates (Coates 2014). Whilst the paper did not represent the views of IRPA or any other organisation, it was noted that it did raise and discuss relevant issues. The Associate Societies were therefore invited to develop views on how best to improve the system of protection and its presentation so that it better meets the challenges of communication and understanding, whilst of course remaining fit for purpose, ethically-based and appropriately comprehensive. Responses were invited on several questions posed in the editorial, and on any other matters that the Associate Societies considered to be relevant.

Eight Associate Societies[4] responded formally to the consultation, together with some individual members of the Strategy and Practice Committee. Whilst this is by no means a majority of the AS, collectively these societies represent almost half of IRPA's individual membership, and this response is therefore considered to be broadly representative of the views of the profession. This report presents the conclusions that can be drawn from the responses, giving particular emphasis to the common themes that emerged. In broad terms, many issues relate to how best to communicate radiation risk, although inevitably there is a strong interaction with the system of protection itself, particularly on the topics of dose limits and optimisation (ALARA).

General current perceptions on the system of protection

There is a general consensus that the system of protection, whilst being seen as becoming increasingly complex in its overall structure, has proved capable of delivering an adequate level of protection to workers, members of the public, patients and the environment. However, this does not preclude looking for improved ways of achieving this objective for the future, and indeed there are strong views that further refinement is needed.

One key and well-recognised outstanding challenge is the need to take an 'integrated risk' perspective. This is particularly so in emergency and post-emergency situations, where perceptions of radiation risk and wider social factors can dominate the actual risk to health, but there is recognition of the need for a more holistic approach across many other aspects of practice. Radiation protection has in some ways been very introverted, enhancing the perception that radiation hazards are in some ways more dangerous than others, and encouraging a fear factor. This is exacerbated by the development of its own lexicon and complexities in the system of control.

A key concern raised in this consultation is the link between the complexity of the system and the resulting challenge to its communication to, and understanding by, a wide range of interested parties, indeed including many radiation protection (RP) practitioners. The system has grown in complexity as it has evolved to address a wide range of situations, and within

[4] Australasia, Belgium, France, German-Swiss, Italy, Japan, Spain and UK, with additional Strategy and Practice Committee member views from Brazil, Japan and the US. Views from relevant professional organisations in liaison with IRPA were also considered.

the system there are many detailed subtleties and caveats, perhaps best described as 'fine print', which are absolutely essential to the logical structure, but which are a particular challenge to easy understanding by the wider community. Some responses expressed the view that the system needs a 'reboot', and that the idea of one all-encompassing system needs to be revisited and reconsidered. Although this is not widely supported, it does illustrate the depth of the challenge.

It was noted that by far the overwhelming number of exposure situations in practice involve doses around a few mSv yr^{-1} or less (although the trend of medical exposures perhaps represents a move towards some higher doses in this sector). Given that these exposures are inevitably in addition to natural background, the resulting total exposure from all sources remains within the normal range of natural background. The consultation identified that it may be helpful to focus on this important context. Concerns were expressed relating to the extent to which we should pursue ever decreasing doses well within the lower end of this range, together with the view that regulatory emphasis on such low doses can give rise to perceptions that these are quite harmful, and this can cause unwarranted anxiety for the public. The importance of further consideration for how best to address the control of such low doses is discussed further below.

Summary—general perceptions

Whilst the system of protection has proved capable of delivering an adequate level of protection, there is concern that it must integrate better into a more holistic approach which takes account of other risks. A further key concern is the link between the complexity of the system and the resulting challenge to its effective communication. There is a case for rebalancing the system to reduce reliance on 'fine print' explanations that are not easily visible or readily understood during communication with wider stakeholders.

Uncertainty in risk estimates at low doses

Despite much scientific research on radiation effects, increasingly focussed on the low dose region, it is clear that there is scientific uncertainty on the level of risk from radiation at low doses and particularly at low dose-rates. This is particularly so at levels around a few mSv yr^{-1} which are important for almost all practical exposure situations. There seems little prospect of any definitive clarification of low dose risk in the foreseeable future. Against this background there is general (but not universal) acceptance of the need for using the linear no threshold (LNT) approach as a basis for protection, with the important caveat that this is recognised as a prudent basis for protection and not as a scientific fact.

The consultation emphasised the importance of honesty in our communication on this topic. We must be clear about what we know and what we do not know. For example, this would include the avoidance of statements such as 'the risk of radiation is 5% per Sv', which would imply an undue level of certainty and would tend to reinforce LNT as a fact, not a hypothesis.

There was strong support for recognising that uncertainty does not mean a total lack of information. At the dose levels of particular interest it means that the risk of radiation, assuming that there is a risk, is sufficiently low that we have not been able to detect it. However, this should be balanced with the concept that 'absence of evidence is not necessarily evidence of absence', and that whilst we have not been able to detect radiation risks around the levels of natural background exposure there are some theoretical reasons to believe

that a risk could be present, although at levels that would generally be regarded as very low and which would be undetectable.

It is also perhaps helpful to note that we do in fact know more about radiation risks than about many other risks that are present in our lives—radiation is not an unknown entity.

In summary, the main factors are seen as the over-riding importance of honesty in presentation, together with the recognition that, whilst we do not know everything, we do know that at the most relevant exposure levels the risk is bounded and must be quite small, otherwise we would be able to detect it. Given that there is unlikely to be significantly greater scientific clarity on low dose risk (especially around a few mSv yr^{-1}) in the foreseeable future, perhaps the emphasis should move a little from 'What is the risk at these very low doses' towards 'What is the best pragmatic framework for making decisions, including how we apply LNT, at these very low doses'? Are there other considerations which should enter the decision framework at these low levels?

It was also pointed out that there are other important sources of uncertainty in our estimations of the risk from radiation. Much of our work involves the measurement or estimation/assessment of exposures in a wide range of situations. Each of these involves uncertainties, and in many cases also involves 'prudent assumptions'. It is the responsibility of those of us in the profession to address and reduce such uncertainties where appropriate and to ensure that the interpretation of prudence and the extent of conservatism are appropriate to the circumstances.

Summary—uncertainty in risk estimates

The important factors are seen as the over-riding importance of honesty in presentation, together with the recognition that, whilst we do not know everything, we do know that at the most relevant exposure levels the risk is bounded and must be quite small. It was noted that by far the overwhelming number of exposure situations in practice involve doses around a few mSv yr^{-1} or less, and it is important to focus on how best to make decisions in this dose range.

The context of natural background exposure

There is wide support for using the typical levels of natural background exposure to which we are all exposed as a means of giving context to our understanding of radiation risk and exposure situations in our communications, especially outside the profession. This is seen as a context and comparison that we should make use of as a help for the public to 'weigh' the risks in their mind (although there is of course always subjectivity). It is noted above that most current radiation exposure situations result in relatively modest additions to this natural background, or at least do not make a vital or significant difference to the picture of total exposure to society or individuals, in that the range of total exposures remains within the broad scope of natural background and its variability.

Reference to natural background exposure also helps to give substance to any explanation of the basic unit of radiation exposure, the mSv.

Such context would reinforce the important concept that there is nothing uniquely risky about man-made exposure—a dose is a dose, and the risks are the same, whatever the origin of the source. There is also no such thing as a radiation-free environment, and there never has been.

Whilst the context of natural background exposure does provide a benchmark which helps understanding of radiation, it is perhaps of limited value in considerations of the

acceptability of exposure from any given source. An additional exposure cannot be justified, or deemed as acceptable, solely on the basis of it being within the range of such natural exposures. Issues of acceptability must be judged both in the context of the wider requirements of the system of protection and in the context of the personal judgements of those persons impacted by the exposure. However, in this latter context there is evidence from many practitioners' day to day communication experiences that an understanding of natural background exposure and its variability can have a significant influence on an individual's personal perspective and attitude to different exposure situations.

It is also accepted that comparisons with natural background exposure must not detract from the principle of ensuring the application of the ALARA principle. This is discussed further below.

Summary—the context of natural background exposure

There is wide support for using the typical levels of natural background exposure to which we are all exposed as a means of giving context to our understanding of radiation risk and exposure situations in our communications, especially outside the profession. Whilst an additional exposure cannot be justified, or deemed as acceptable, solely on the basis of it being within the range of such natural exposures, there is evidence from many practitioners' day to day communication experiences that an understanding of natural background and its variability can have a significant influence on an individual's personal perspective and attitude to different exposure situations.

Dose limitation and dose limits

In the consultation responses by far the biggest concerns over the system of protection relate to the topic of dose limits. There is absolute support for the concept of limitation of doses, in terms of the need to place restrictions on the level of individual doses which should be permissible in various situations. However, numerical dose limits are regarded as problematic and of dubious or questionable value. This is fundamentally because of two reasons:

- The word 'limit' has a clear connotation in public consciousness as the delineation between safety and danger, and hence a demarcation of what is acceptable. This immediately presents an emotive context. An analogy was drawn with the context of speed limits. Exceeding a speed limit by 5% may not present immediate danger, but an excess of say 30% would generally be regarded as approaching to danger. This cannot be said of radiation limits (with the possible exception of limits based on tissue reactions). Whilst in the 'fine print' of radiation texts and standards there are statements that a limit does not represent such a safe/unsafe boundary, like all such fine print it does not enter the real consciousness when engaging in wider discussions and interactions. There remains an over-riding clear impression of 'safety versus danger'. Relying on half-hidden fine print caveats will never be good enough in any public discussion. In addition, the use of concepts such as tolerability does not necessarily make it easier since it still comes close to the concepts of safe/danger, especially when linguistic translation challenges are taken into account.
- Dose limits are usually presented as a high profile component of the system of protection. In fact they have a very limited application—only to non-medical planned exposure situations. Once again this important caveat and subtlety becomes confusing in general discussion, which must inevitably address the concepts of natural background, patient

exposure and emergency exposures—all of which could be well in excess of the public dose limit. Particularly in this latter emergency context, it is exceedingly difficult to convince the public that, when the exposure situation suddenly becomes challenging, it is acceptable to 'move the goalposts' (a perception of changing the rules) and exceed the dose limit.

It is the combination of these two issues that makes discussions and understanding relating to dose limits exceedingly challenging, resulting in the use of the term 'limit' and its context being widely regarded as unhelpful. Indeed, the definition of a public dose limit which is less than natural background exposure levels can reinforce a perception that man-made radiation is particularly dangerous, even though there are logical explanations in the 'fine print' of the system of protection.

Within the limited context to which dose limits apply, it is of course a legal concept which both regulators and operators can readily understand, and from which operators in particular can take some comfort in being seen to operate well within the limit. But given the wider challenges, these may be regarded as narrow benefits that could be delivered in other ways.

Dose Limits were perhaps of greater relevance decades ago when the levels of occupational and public exposure were somewhat higher than at present, but now have little impact in the vast majority of situations. There is, however, an acceptance that numerical dose limits have some relevance as a legal construct and give regulatory clarity. However, given that optimisation (ALARA) should also be a regulatory requirement, and indeed the controlling factor for actual exposures, it may be possible to develop a regulatory approach which, for the relevant exposure situations as identified above, results in exposures exceeding defined restrictions (for example using terminology such as 'control level', 'operational level' or equivalent) being determined as legal breaches of the ALARA principle—i.e. without using the emotive term 'limit'.

A change of approach would be particularly important for the context of the public dose limit, where in practice legal restrictions on exposure are rarely, if ever, based on the defined numerical dose limit. For example, discharge authorisations and other regulatory instruments controlling public exposure are usually linked to lower exposure values. Hence the particularly strong conceptual challenge of the 1 mSv yr^{-1} public dose limit, and its compatibility with other exposure situations, could be avoided or minimised. It is recognised that such a major change of approach would be a significant undertaking for the system of protection, but the strength of concern expressed on this topic by the professional and practitioner community indicates a need for very serious consideration of this issue.

Rather than placing so much emphasis on limits purely for non-medical planned exposures, it would be helpful to have a broader, more comprehensive and more readily available approach to limitation of exposure in all situations. This would aim to bring together limits, constraints and reference levels, ideally in the wider context of optimisation and ALARA, with the need to implement demonstrated good practice, achieve the restriction of inequity and demonstrate fairness. This would help to link the discussion to both the practical and ethical roots of the system.

The fundamental message from the IRPA professionals is therefore a strong request for more flexibility and discretion in the approach to limits and limitation. Whilst limits perhaps have some value from a legal viewpoint, they do not seem relevant for practical protection purposes. Given the major challenge they present for public understanding and perception, there is strong support for exploring alternative approaches to this concept.

One possible approach which consultation responses thought may be helpful would be to develop a scheme based on bands of radiation exposure linked to broad patterns of control. There have been several approaches in this vein developed over time, and an illustrative scheme is attached as an appendix. The extent to which such an approach could form a regulatory basis may be limited, and it would certainly require a level of maturity across the whole RP community that could be challenging. However, it could be helpful as a unifying approach to the different exposure situations and the resulting level of exposures, and could be a significant aid to wider communication.

Summary—dose limitation and dose limits

The word 'limit' has a clear connotation in public consciousness as the delineation between safety and danger. In addition, the high profile given to dose limits presents communication challenges for existing and emergency exposure situations, resulting in the use of the term 'limit' and its context being widely regarded as unhelpful. Indeed, the definition of a public dose limit which is less than natural background exposure levels can reinforce a perception that man-made radiation is particularly dangerous, even though there are logical explanations in the 'fine print' of the system of protection. It would be helpful to have a broader, more comprehensive and more readily available approach to limitation of exposure in all situations. This would aim to bring together limits, constraints and reference levels, ideally in the wider context of optimisation and ALARA. This need for a more flexible approach to limitation was a fundamental message from the IRPA professionals.

Optimisation, ALARA and 'reasonableness'

It is universally accepted that the optimisation principle, including ALARA, is the central pillar for the practical implementation of radiation protection and is the dominant factor controlling exposures in any well-developed system of protection. There may be a few regimes where there is perhaps an over-reliance on limits, but if so these are rare and are likely to mature under wider influences. ALARA is generally more mature in some sectors compared with others—for example it is often the case that it is more developed in the nuclear sector than in the medical field or for small industrial uses, but there is a momentum of change in these sectors and overall there is confidence in the ALARA approach.

There is sufficient interest in this topic for IRPA to support an organised further reflection on 'what is reasonable'. A first workshop was volunteered by the French Society and held in February 2017. Considerations from this workshop and from the wider consultation are included below.

As discussed above, there could be useful improvements in pursuing greater integration with approaches to limitation, which would bring together the factors which place restrictions on the ALARA process, such as limits, constraints, reference levels and related concepts.

ALARA is a potentially complex process, with the major players being the operating organisation or the responsible public authority (as is usually the case in existing or emergency exposure situations), together with the impacted stakeholders, where appropriate under regulatory scrutiny and challenge. It is not always easy to identify how or why particular decisions are made, and it is possible that in some situations improvements in the visibility of decision-making could be helpful.

ALARA is a process with no absolute 'right or wrong', and there is significant reliance on judgement, particularly in the interpretation of what is 'reasonable' and proportionate. Much of this judgement can be subjective, and it is important that all those involved in

making such judgements have a broad understanding of radiation risk and the circumstances and influences impacting the outcome. There are some concerns of a potential over-reliance on cost-benefit analysis, although this approach has had limited impact in practice and, in its favour, it does represent an attempt to align with other risks to society regarding how much resource should be expended in reducing radiation exposures.

The most widespread concern was that an overly-simplistic approach, perhaps plus natural regulatory caution, is leading to continuing expectations of ever lower doses. Put another way, there is more emphasis on 'As Low As' and much less on 'Reasonable'. There is also growing recognition that overuse of conservatism in assessments is contributing to unnecessarily low outcomes in real doses. Questions were raised on whether it is possible to define dose levels or to codify situations where 'enough is enough', where no further efforts to reduce doses are appropriate. Whilst such a 'de minimis' approach, or related wider guidance, may not be feasible because of the wide range of situations, there was a strong desire to seek ways of placing more formal recognition that ALARA does not generally mean continually lower doses. Perhaps this could be assisted by a series of well-established case studies in different fields. It was also noted that in other risk areas such as toxic substances the terminology 'Minimal Risk Level' is used, with no actions expected to be taken at lower levels.

'Stakeholders'—those impacted by the decision—must be engaged in the ALARA decision process. However, the nature of the principal stakeholders (including their identity, perceptions, cohesiveness and alignment with the system under review) seems to have a great impact on the style of the ALARA process and the outcome. It can be argued that ALARA determinations can be considered in two principal types of approaches:

- Practitioner-led ALARA: mostly in occupational and medical exposure, with well-defined stakeholders, who have a reasonable understanding of (or can be informed of) radiation concepts. These ALARA processes are closely aligned with RP/Safety Culture and 'Learning from Experience', and there is a generally agreed importance of focus on the highest doses.
- Perception-led ALARA: involving public exposure, existing exposure situations or responses to emergencies. Here the stakeholders are a much more diffuse group, often with little or no knowledge of radiation or wider societal risks, but who nonetheless have clear concerns and interests. This often leads to a process of minimisation, not optimisation. This is particularly so for environmental issues—which often leave virtually no room for true 'optimisation'. It is concern over this approach to ALARA that drives the initiatives on communication and public understanding of risk, covered in a later section.

There is recognition that there are potentially competing ethical principles in the determination of ALARA which need to be balanced in some way. As well as the principle of dignity in ensuring that those impacted are involved in the decision, there is of course the principle of prudence, giving appropriate attention to the safety of individuals. However, this must be balanced against the principle of beneficence—a value linked to doing the best that can be done with society's resources. This acknowledges that there is an opportunity cost in spending resources on ever decreasing levels of exposure, in that these spent resources cannot therefore be used elsewhere to give better value benefits to society.

Summary—optimisation, alara and 'reasonableness'

It is universally accepted that the optimisation principle is the central pillar for the practical implementation of radiation protection and is the dominant factor controlling exposures in any well-developed system of protection. The most widespread concern was in the interpretation of what is 'reasonable' and proportionate, and that an overly-simplistic approach is leading to continuing expectations of ever lower doses. There was a strong desire to seek ways of placing more formal recognition that ALARA does not generally mean continually lower doses, and that there is a balanced approach to optimisation which results in value to society.

Radiation risk and wider public health

The importance of taking account of wider risks in the determination of the appropriate level of radiation protection is widely recognised. It is particularly important in consideration of emergency and recovery actions, as indicated previously, where other risks have been shown to be significant. It is also important to take account of other impacting risks during the optimisation of protection, where in many cases the risk from radiation would be a relatively minor contribution to total risk.

It can also be helpful to provide the context of our normal background cancer risk and its geographical variation. After the Fukushima accident many radiological protection experts in Japan engaged in various dialogue forums involving residents and evacuees in the affected area, giving fundamental scientific facts and context in relation to radiation risk, using an easy-to-understand manner. Such experiences demonstrated the importance of presenting the magnitude and variation of background lifetime risk of cancer mortality. This lifetime cancer risk shows some geographical variability[5], and this scientific fact allowed consideration of the incremental risk of cancer mortality posed by exposure to radiation in the context of the level of the background lifetime risk of cancer mortality of the exposed population.

There could be value in exploring and understanding how other specific health risks, for example from chemicals, are assessed and regulated. At first sight there is a feeling that there is little consistency across these sectors, but there is relatively low awareness of the approaches used.

Communication and public understanding of radiation and risk

The importance of enhancing our efforts on public understanding of radiation and risk is recognised both by IRPA and in the responses to this consultation. Whilst an alternative perspective can be adopted, whereby radiation protection professionals should restrict their attention to science and practice, and not be engaged in subjective and potentially political issues such as public understanding, this view is not widely supported. Indeed, the formal objectives of many Associate Societies specifically include the promotion of public understanding.

Many of the issues discussed above are largely focussed around public understanding, and will not be repeated in detail in this section. Important points already addressed include the following:

[5] For example in the Japanese case, gender-averaged background lifetime risk of cancer mortality ranges from 23.7% to 28.3% among 47 prefectures, and the arithmetic mean was calculated to be 25.4% using the mortality and population data from national surveys in 2010.

- The need for honesty in discussing the uncertainty of risk estimates at low doses.
- Noting that uncertainty does not mean that there is no relevant information: at low doses the risks are bounded by evidence from natural background exposures.
- The importance of using natural background exposure and its variability as a helpful context for understanding radiation.
- Care is needed in the discussion of dose limits and dose limitation, focussing on a more flexible approach.
- Using a broad 'banded' approach to radiation exposures and risks may be helpful to understanding.
- It can be helpful to discuss radiation in the context of other public health risks, for example including background lifetime risk of cancer mortality and its variability.
- However, we cannot use comparisons with natural background exposure or other public health risks as a justification for accepting radiation risks of a similar magnitude, although there is evidence that an understanding of our radiation environment can lead to lower concerns over radiation exposures generally.

Several consultation responses noted the importance of seeking to ensure that discussions of radiation involve the fundamental concept of balancing risks and benefits. This is the underpinning approach of the radiation protection system—justification and optimisation. Focussing discussion solely on risk looks intrinsically like a losing strategy: 'people do not consider risk per se, they consider trade-offs'. Information about the application of radiation in uses such as medicine may help to provide better comprehension of both the effects and the beneficial uses of low doses. The possible advantage of emphasising the ethical basis of our approach to radiation protection should also be considered.

There was a strong request for IRPA to assist societies and individual members in providing tools and training to improve our ability to communicate effectively outside of our profession. Suggestions ranged from preparing a 'plain language guide' on radiation and risk, to providing advice on the scientific basis and key messages that would need to be considered, together with how these could be communicated and socialised within the target groups of lay persons. This approach would support and recognise the importance of local discussions as the most powerful method of public engagement. The importance of engaging with experts in risk communication and with media experts was emphasised. This reflects the importance of perception and risk acceptance issues, cultural influences and language in addressing effective communication in this challenging environment.

IRPA believes that it is a public duty for RP professionals and the Associate Societies to further their efforts in improving public understanding of radiation and risk. To this end we have re-established our Task Group on Public Understanding, with the objective of assisting the AS and individual professionals to better understand the challenges of communication, and to be better equipped to meet them in all relevant situations including normal activities, emergencies, and post- accident recovery. This topic should also be integrated into the programme of all IRPA Congresses.

As a major presence on the international radiation protection stage we believe that the IRPA website should contain some helpful information for wider stakeholders and the public on radiation and risk. However, given that there is considerable literature on this topic readily available, we are not intending to develop significant new material, and we intend to provide user-friendly information essentially through links to existing documentation.

This is a long term challenge that will take a generation or more to make significant inroads into public perception of radiation. It is important that the overall programme includes

appropriate emphasis on the younger generation through schools outreach and wider education activities.

Summary—communication and public understanding of radiation and risk

The importance of enhancing our efforts on public understanding of radiation and risk is recognised both by IRPA and the Associate Societies. There was a strong request for IRPA to assist societies and individual members in providing tools and training to improve our ability to communicate effectively outside of our profession. The consultation has identified many steps that are important for effective communication, and which must be developed into a programme to help the profession meet this very significant challenge.

Conclusions and way forward

In 2015 IRPA decided to commence a consultation with the Associate Societies on the broad topic of the effectiveness of the system of protection and its ability to be widely communicated and understood by interested parties. This was aimed both at providing information from the 'user community' to all those parties who are engaged in the ongoing development of the system, and to inform IRPA's considerations on how best to assist the Associate Societies in the communication of radiation and risk to stakeholders outside the profession.

This report identifies the principal issues raised by the consultation. Perhaps as expected, there is considerable correlation regarding views on 'effectiveness' and 'communication'. This is an inevitable consequence of the fact that the system of protection is somewhat detailed and complex, driven by the need to consider a wide range of exposure situations.

IRPA believes that it is important that the profession, including the front-line practitioners, have had an opportunity to reflect on the fundamental issues within the system of protection. Having distilled these views into this report, we must now seek ways to act on the findings within the relevant communities as follows.

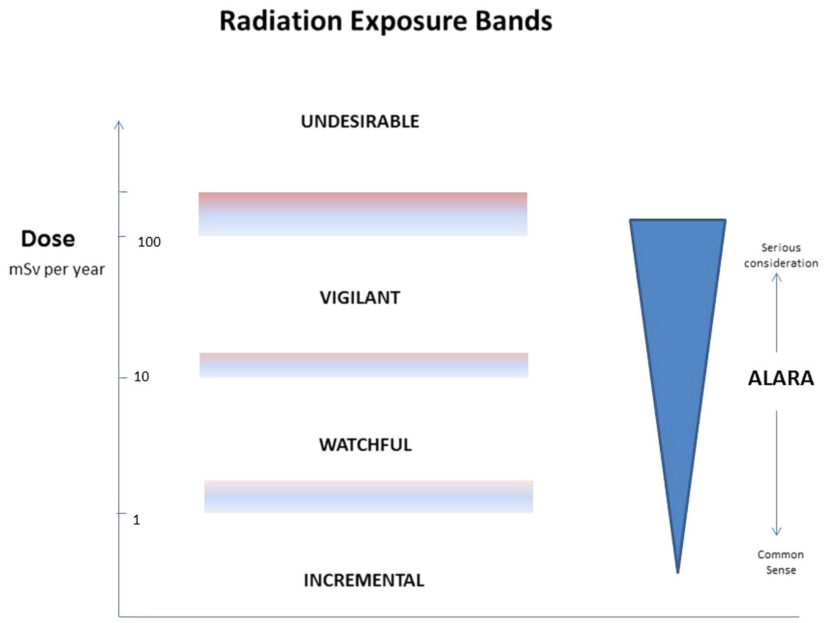
1. The system of protection is constantly evolving and has many stakeholders. Its development is a responsibility shared by many international organisations, with a lead taken by ICRP. IRPA therefore invites ICRP and our other international partners to consider the views expressed in this report, as we move forward collectively to improve the system of protection. IRPA accepts that evolution is a long-term process, and that any changes must be duly considered and discussed by all stakeholders.
2. IRPA itself must continue to engage within the radiation protection profession to further explore and develop the issues raised in this report, and to work constructively with the international organisations. We must also deliver on our work programme to assist the Associate Societies and practitioners to improve our ability to communicate effectively outside of our profession.
3. We strongly encourage the Associate Societies, and through them the individual radiation protection professionals around the world, to work within their countries and regions in order to seek local improvements where appropriate to address the issues raised in this report. It is important to ensure that such experiences are also shared through the IRPA family so that the feedback from the profession into the system of protection is effective and that good practices in the implementation of radiation protection and the communication of radiation and risk are shared.

Approved by the IRPA Executive Council, October 2017.

Appendix. A broad overview of exposure to ionising radiation

Taking account of the various types of radiation exposure, it is possible to distinguish broad patterns of control linked to ranges of exposure as follows (and in the attached figure). The boundaries between the ranges are imprecise and somewhat flexible, deliberately reflecting the imprecision inherent in a risk-based system.

Undesirable	
Doses greater than a few 100 s of mSv (per year or a single exposure)	Risks to health are serious and significant. Such exposures must be avoided, with doses up to 500 mSv only to save life or a significant societal asset during an emergency.
Above ~ 100 mSv	
Vigilant	
Doses greater than a few 10 s of mSv yr^{-1}	Regular exposure at this level should be avoided. Doses may be appropriate in exceptional circumstances: for example in emergency situations or in rare occupational situations with special justification. Doses should be subject to formal review to ensure that they are as low as reasonable. Ongoing exposure to natural background at these levels should be reduced where possible.
Above ~ 20–30 mSv yr^{-1}	
Watchful	
Doses greater than a few mSv yr^{-1}	This includes the majority of the range of natural background exposures, and many occupational exposures. The exposed individuals often receive some direct benefit from the situation, such as medical treatment, employment or housing. Exposures should be kept under review to check for opportunities to reduce them where reasonable, focussing particular attention towards the higher end of this range.
Above ~ 1–3 mSv yr^{-1}	
Incremental	
Additional doses less than a few mSv yr^{-1}	This relates to exposures in addition to natural background. Such exposure will normally be due to man-made sources. These exposures are unlikely to make a material difference to the total radiation dose received by an individual from all sources (including natural background), but because a low level of additional risk cannot be excluded it is appropriate to apply a prudent common-sense review of the exposures to ensure that they are optimised—i.e. 'reasonable'.
Below ~ 1–2 mSv yr^{-1}	



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