Introduction

The World Nuclear Association (WNA) is the international organisation that represents all sections of the global nuclear industry. In 2018, the ICRP launched a pre-consultation, inviting its Special Liaison Organisations (SLOs), including WNA, to comment on the draft update of ICRP Publications 109 and 111, developed by the ICRP Task Group nº 93. We have taken note of the changes between the different drafts, and we welcome this opportunity to provide further comments on the draft report *"Radiological Protection of the People and the Environment in the Event of a Large Nuclear Accident"*.

General comments

One of the main purposes for updating ICRP Publications 109 and 111 was to take *"into account the lessons learned from the experience of the Fukushima nuclear accident"*. In this regard, it should be recalled that following the Fukushima Daiichi accident the ICRP convened a task group (Task Group 84) to compile lessons learned with respect to the ICRP system of radiation protection. A main recommendation of that group was that *"the radiological protection community has the responsibility, if not the ethical duty, to learn from the Fukushima accident and suggest improvements in the system of protection"*. We firmly believe that this report falls short of achieving this aim. We do not see that it takes a holistic approach to risks & hazards and therefore jeopardises the principle of doing more good than harm, and it omits key aspects of emergency response to radiological accidents. We believe that a holistic perspective is required, and indeed this was one of the key lessons learnt from the Chernobyl and Fukushima Daiichi accidents. However, this draft publication fundamentally fails to establish such a perspective.

Overall, we are disappointed to see that the ICRP has focused on its own recommendations rather than utilising the lessons learned from the Fukushima Daiichi accident to properly evaluate the costs and benefits of protective actions in terms of holistic human consequences. It is well-established that the primary health impacts of the Chernobyl and Fukushima Daiichi accidents were psychological (e.g. severe mental health issues) and socio-economic (e.g. stigmatisation), and were not due to radiation exposure. Furthermore, these accidents have served to highlight how disproportionate and unjustified protective actions can have severely detrimental effects. One such example is the mass evacuation of elderly and sick patients around Fukushima, where patients died as a result of evacuation from areas where doses were well below levels that could cause harm. We believe that the proven psychological and socio-economic detriment that can result from protective measures must be considered systematically, and in balance with possible radiation risks.

We believe that the draft publication does not offer sufficient justification for its proposed actions, based on the Linear No-Threshold hypothesis. We fear that the ICRP's application of the ALARA principle throughout the publication prevents the holistic

implications of the proposed guidelines, if implemented, from being fully examined. For optimisation, the ICRP states that its guidelines are the result of an evaluation that carefully balances the detriment from the exposure with the relevant economic, societal and environmental factors. However, the draft report places too much emphasis on dose-related (numerical) criteria, with the use of 'standard' radiological values (1, 10, 20, 100 mSv) giving the impression that the rationale behind the report is still focussed on radiological effects, even though the prior experience demonstrates that psychological and socio-economic impacts are likely to dominate. For example, the report recommends that no emergency responders should receive exposures in excess of 100mSv, due to the very small increased risk of cancer in the distant future. This sends the wrong message to the public, as it perpetuates the notion of radiation as a unique hazard, fuelling "radiophobia".

Additionally, the draft publication is in contradiction with the IAEA GSG-11 on termination of the emergency, where GSG-11 has already established 20mSv effective dose as an adequate level. This draft, without proper justification, attempts to set this level at 10mSv. We believe this is misguided and that the IAEA GSG-11 safety standard, which is in use across the world, is to be used.

Given natural background radiation levels, there is no justification for setting an annual reduction target of 1mSv, as a level of exposure that will inevitably become to be regarded as some form of limit. We therefore believe that the approach in this draft report is strongly reflective of radiological-based reference levels, which is out of balance with the reality of the combined experiences of past accidents. We would therefore strongly support a move away from rigid numerical values for reference levels.

We note, with great concern, the omission of risk communication from this draft report, apart from brief and fleeting references to information needs of affected populations (Para 89). In the aftermath of every large radiological incident that has taken place, one of the perennial conclusions is the need for stronger communication efforts. The repeated failure to adequately, and accurately, communicate radiological risks in context, especially during emergencies, has resulted in considerable and avoidable detrimental effects, including social stigmatisation, fatalistic behaviour, medically unjustified abortions, deaths due to evacuation and widespread mental health issues.

In recognition of this, the importance of effective risk communication in relation to radiological and nuclear accidents has over the past few years increasingly been highlighted. Several high-profile events, such as the IAEA-hosted *International Symposium on Communicating Nuclear and Radiological Emergencies to the Public* (2018) and the OECD Nuclear Energy Agency-hosted *Workshop on Stakeholder Involvement: Risk Communication: Dialogues towards a Shared Understanding of Radiological Risks* (2019), have reaffirmed its importance. The fact that this draft publication has failed to reflect upon the vast literature and efforts post-Fukushima restricts its usefulness.

The report's mention of a "co-expertise approach", whilst laudable, is unlikely to succeed unless trust between authorities, experts and stakeholders is established beforehand. It is therefore regrettable that the ICRP has failed to include any mention of this crucial issue.

We believe that this updated document is not fit for purpose. We therefore strongly recommend that Task Group 93 redrafts this publication. Whilst we recognise that the ICRP's remit is within radiation protection, collaboration with non-radiation experts should be sought, drawing upon the vast risk and hazards expertise that exists outside the radiation protection community. Putting radiation risks in proper context and perspective against other hazards and any socio-psychological impacts is essential, and would be fully in line with the principle of justification and ensuring that actions do more good than harm.

List of specific comments

Comment No.	Line No.	Current/proposed new text	Comment
1	**Document-wide**		Any reference to Chernobyl and/or Fukushima should be referring to the **Chernobyl accident** and/or the **Fukushima Daiichi accident**, to separate the general areas from the specific power stations.
2	**Document-wide**		According to the recently published (2018) IAEA Safety Standard GSG-11 *"Arrangements for the Termination of a Nuclear or Radiological Emergency"*, Para 4.59 an effective dose in the order of 20mSv in a year should be accepted for the termination of the emergency (transition to the existing exposure situation). It is confusing to have different numbers for the same issue (especially for regulators and governments for their decision making process). We recommend adopting 20mSv.
3	Line **40**	"non-radiological impacts"	If this means other hazards, mental health and psychological impacts are missing.
4	Lines **44-47**	For protection of responders and the population during the emergency response, the reference level ~~should not generally exceed~~ be in the order of a few hundred ~~100~~mSv, while recognising that higher values, in the order of 1Sv, may be necessary to save lives and for the prevention of catastrophic conditions.	When put into perspective with the operational risks taken by fire fighters and first responders the radiological risk is small. There is evidence from the many studies conducted in areas with high natural background radiation that even those receiving substantially higher sustained levels of background radiation (up to 100 mSv annually) do not show any health related effects. Therefore we have suggested the rewording provided.
5	Lines **51-55**	Levels should be within or below the Commission's recommended 1–20-mSv band taking into account the actual distribution of	See earlier comments in connection with IAEA GSG-11

		doses in the population and the tolerability of risk for the long-lasting existing exposure situations, and would not generally need to exceed ~~10~~ 20mSv per year.	
6	Line **55-62**	The objective ~~of optimisation~~ of protection could be is a progressive reduction in exposure to levels on the order of 10mSv per year depending on circumstances.	1mSv is too low. There is no proven evidence of detrimental health effects due to radiation below 100mSy. Natural background is at least more than 2mSv/y at most places in the world. 1mSv/y is not optimization but minimisation, and not appropriate.
7	Line **67**	"…unknown character and alarming image"	Sweeping statement which fails to capture the multitude of factors which impacts our relationship with radiation.
8	Lines **86-87**	Radiation exposure is relatively straightforward to reduce although it is impossible to remove it completely.	Sweeping statement, which might not be entirely appropriate in this text.
9	Line **96**	The overall result ~~is~~ must deliver more good than harm for affected people and the environment	Clarification of the justification principle.
10	Lines **107-111**	For protection of responders and the population during the emergency response, the reference level ~~should not generally exceed~~ be in the order of 1Gy ~~100 mSv,~~ while recognising that higher levels may be necessary in exceptional circumstances to save lives and prevent further degradation of the facility leading to catastrophic conditions. The initial reference levels may be applicable for a short period, and should not generally exceed ~~1 year~~ several years.	100mSv will be a wrong signal to rescue workers and it might lead to difficulties to recruit volunteers. 1 year is a completely arbitrary number does not reflect the individual conditions or circumstances.
11	Lines **114-120**	For protection of responders after the urgent emergency response, the reference level should not exceed ~~20~~ 100mSv per year. For	See also comments above. 20mSv is the normal limit for planned exposures. Again, to propose this number is not taking the specific circumstances into account.

		people living in long-term contaminated areas following the emergency response, the reference level should be selected ~~within or below above~~ in the order of the Commission's recommended band of 1–20/year mSv for existing exposure situations, taking into account the actual distribution of doses in the population and the tolerability of risk for the long-lasting existing exposure situations, and there is generally no need for the reference level to exceed 20mSv per year. The objective of optimisation of protection is a progressive reduction in exposure to levels on the order of 10mSv per year.	1mSv/a as a long time goal means restricting a possible return of people and is unnecessary with respect to the existing natural background. Furthermore, the objective of optimisation should be to deliver more good than harm, rather than a fixed numerical value.
12	Lines **141-143**	A nuclear accident is an unexpected event that profoundly destabilises people and society, generates great complexity, and requires mobilisation of considerable human and financial resources.	This is a sweeping statement which fails to recognise that (over)reactions to accidents have at least as destabilising an impact as the accidents themselves.
13	Line **161**	…of the Chernobyl accident in ~~Europe~~ Ukraine	Should be specific.
14	Line **273**	"…unknown character and alarming image"	Sweeping statement which fails to capture the multitude of factors which impacts our relationship with radiation.
15	Lines **279-281**	These situations cannot be managed with radiological protection considerations alone; factors related to psychology, health, geography, environment, education, culture, ethics, political governance, etc. also need to be considered	Some countries have limited geographical space because of size, or are covered with mountainous areas limiting options for evacuation, relocation, etc.
16	Line **291**	…heritable diseases	There is no evidence at all of heritable diseases due to radiation exposure.

17	Lines **303-308**	Acute organ doses up to approximately 100mGy (0.1 Gy) produce no functional impairment of tissues. At higher doses, the risk of tissue reactions becomes ~~increasingly~~ more important and there is increased likelihood of ~~serious~~ damage. As it is prudent to take uncertainties in the current estimates of thresholds for deterministic effects into account, the Commission considers that short-term or annual doses ~~rising towards~~ above some hundreds of ~~100~~mSv for whole body exposure almost always justify the consideration of protective actions.	Clarification and stressing that deterministic effects are not seen below 500mSv.
18	Lines **324-330**	There is reliable scientific evidence that whole-body exposures on the order of ≥100 mSv can increase the probability of cancer occurring in an exposed population. Below 100 mSv, ~~the evidence is less clear~~ there is no clear evidence. The Commission ~~prudently~~ precautionary assumes, for purposes of radiological protection, that even small doses might result in a slight increase in risk.	There is no clear evidence of increased cancer risks below 100mSv – any such risks are inferred.
19	Lines **331-334**	Although heritable (genetic) effects have been seen in animals, there is no ~~direct~~ evidence that exposure of humans to radiation leads to excess heritable disease. However, the Commission ~~prudently~~ precautionary continues to include the risk of heritable effects in its system of radiological protection.	There is no evidence of genetic effects in humans as a result of radiation exposure.

20	Lines **375-376**	The Chernobyl and Fukushima nuclear accidents had similar consequences in terms of societal impact of the presence of radioactive contamination in affected areas.	This statement is untrue. The Chernobyl accident has considerably larger impacts across most of Europe, whereas Fukushima was mostly contained to Japan.
21	Lines **528-530**	Decisions should be based on a reasonably realistic ~~conservative~~ approach to consider the inevitable uncertainties concerning the situation on-site as well as off-site, and bearing their potential negative consequences in mind.	Conservative approach would be appropriate if a robust justification system was in place, as opposed to a desire to always decrease exposure.
22	Lines **553-554**	The Commission considers that the justification of decisions should be re-assessed regularly as the overall situation resulting from the accident evolves.	Whilst it is important to reassess the situation, it is also crucial that this is not too frequent as this would likely have a hampering effect and could undermine public confidence.
23	Lines **615**	…the principle of optimisation, with ~~restrictions~~ on individual exposures.	Should make reference to reference levels, rather than placing limits.
24	Lines **691-695**	A few individuals (particularly responders) may receive high exposures that could induce severe radiation health effects if protective actions are not implemented promptly or adequately. The Commission ~~therefore pays particular attention to equity in the distribution of exposure within the groups of affected people, and~~ recommends that, in the event of an accident, optimisation of protection should be implemented with the aim of reducing the exposure of the most exposed individuals as a priority.	Within the recommended dose restrictions there will be no difference in the health consequences for people.
25	Lines **703-705**	As the best protective option is always specific to the exposure situation, it is not relevant to determine, a priori, a target dose	There is obviously a level of dose when it is inappropriate to reduce doses further. It makes no sense to reduce doses less than some percent of

		level. ~~below which the optimisation process should stop~~	natural background. For workers it makes no sense to reduce their doses at levels below the limit for the public.
26	Lines **759-761**	The objective is to ensure ~~that when implementing protective actions, the range between the highest and lowest individual exposures is reduced, and~~ all exposures are kept as low as reasonably achievable ~~below the reference levels~~, or at least remain in the order of these levels.	To add the demand for evenly distributed doses is unnecessary and makes the situation even more complicated. Aiming to reduce exposures to below 1mSv is entirely unjustifiable due to cost, socio-psychological impacts etc.
27	Lines **796-799**	For the optimisation of protective actions during the emergency response, the Commission recommends that the reference level for restricting exposures of the affected population and the emergency responders should generally not exceed ~~100~~ some hundreds of mSv. This may be applied for a short period, and should not generally exceed ~~1~~ several years ~~year~~. This is because, at doses of the order of a few hundreds of mSv, there ~~is~~ may be an increased likelihood of deterministic effects and a more significant risk of cancer	See earlier comments about emergency responders. Define "short period". Deterministic effects not seen below 500mSv
28	Lines **833-834**	The current recommendation, that the selected reference level would not generally need to exceed ~~10~~20mSv, clarifies this position.	See earlier comments in connection with IAEA GSG-11
29	Lines **839-841**	Therefore, it is not recommended to select reference levels beyond ~~10~~20mSv per year when it is estimated that such exposures could continue for several years,	See earlier comments in connection with IAEA GSG-11
30	Lines **848-851**	The Commission recommends that some	This is entirely disproportionate and unjustifiable

		types of protective actions should be maintained during the recovery process as long as a significant proportion of the affected population receive exposures above 1mSv per year, a level that is close or similar to exposure situations in non-affected areas	from a *do more good than harm* perspective, and should be removed.
31	Line **1240** (Table **3.1**)	Exceptional circumstances	This should be defined, and at levels higher than 100mSv, as per earlier comments.
32	Lines **1256**	…should be guided by a reference level of 100mSv for the duration of the emergency response	This is inappropriate, as per earlier comments.
33	Lines **1731-1733**	However, when protective actions are implemented in areas of lower exposure, such as in public areas, the Commission recommends that the reference level should be within the 1–20-mSv per year band, and would not generally need to exceed ~~10~~20mSv	See earlier comments in connection with IAEA GSG-11
34	Lines **2118** (Table **6.1**)	Existing exposure situation: general public ~~10~~20mSv	See earlier comments in connection with IAEA GSG-11
35	Line **2121-2122**	recognises that the most appropriate reference level may be lower than the corresponding band under some circumstances	This would be disproportionate, especially in regard to the 1-20mSv band and should be removed.