

A STUDY ON ICRP RECOMMENDATIONS

Hengde Wang

China Institute for Radiation Protection, P. O. Box 120 Taiyuan, Shanxi 030006, China

Abstract - This paper reviews briefly the ICRP recommendations published before 1977, in 1977 (ICRP 26), in 1990 (ICRP 60) and in the near future (around 2005) mainly in the philosophy and principles. The great progress is appreciated. A discussion is presented at the end.

INTRODUCTION

The recommendations of the International Commission on Radiological Protection (ICRP) are taken as the fundamental philosophy and usually incorporated in the national regulations of radiation protection in China, as in many other countries. Therefore, studying on ICRP recommendations and other publications is of most importance for Chinese scientists in the field of radiation protection.

DEVELOPMENT OF RECOMMENDATIONS

ICRP was founded in 1928 by the International Society of Radiology (ISR), then it was called the International X-Ray and Radium Protection Committee, and reconstructed to better take account of uses of radiation outside the medical area, and given its present name in 1950.

Now ICRP publishes its recommendations in a period of about every 15 years. Roughly, ICRP recommendations that have been published can be divided into three groups. That is the recommendations before 1977, in 1977, and in 1990. A new issue of recommendations may be issued in about 2005, which shall be the fourth group. Each recommendations improved significantly than previous ones, in radiation protection principles, quantities, dose limits, protected

subjects and applicable scope.

RADIATION PROTECTION PRINCIPLES

In early years, ICRP recommendations[1] did not establish a clear radiation protection system. More emphasis was given to protection of radiation workers exposed to high doses and to avoid acute radiation effects. Protection of members of the public and of the environment was less regarded.

Upon to the year of 1977 when ICRP Publication 26[2] was published, the System of Dose Limitation was formally established. That is:

1. No practice shall be adopted unless its introduction produces a positive net benefit (justification of practice);
2. All exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account (optimization of radiation protection); and
3. The dose equivalent to individuals shall not exceed the limits recommended for the appropriate circumstances by the Commission (individual dose limits).

ICRP publication 26 paid more attention than previous recommendations to protection of members of the public and the environment, and also stochastic effects of radiation in addition to deterministic effects. However, it did not discuss in depth radiation protection in the events of nuclear or radiation emergency. Therefore, it

was essentially dealing with radiation protection for normal operation of nuclear and radioactive facilities. ICRP publication 26 established for the first time a systematic principle for radiation protection, therefore it is important.

ICRP publication 60[3] (1990) put forward a new Radiation Protection System instead of Dose Limitation System recommended by ICRP publication 26. The new system is:

1. No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes. (The justification of a practice);
2. In relation to any particular source within a practice, the magnitude of individual dose, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable, economic and social factors being taken into account. This procedure should be constrained by restrictions on the doses to individuals (dose constraints), so as to limit the inequity likely to result from the inherent economic and social judgments. (The optimization of protection)
3. The exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. These are aimed at ensuring that no individuals is exposed to radiation risks that are judged to be unacceptable from these practices in any normal circumstances. Not all sources are susceptible of control by action at the source and it is necessary to specify the sources to be included as relevant before selecting a dose limit. (Individual dose and risk limits)

In addition, ICRP 60 also recommended the system of radiological protection for intervention. ICRP 60 recommendations changed the name of the system of basic radiation protection principles from Dose Limitation System recommended by ICRP 26 to Radiation Protection System, and divided human activities into practice and intervention. It enlarged its applicable scope from basically normal operation (for exposures in various

practices) to both practices and interventions (for potential exposures). And also ICRP 60 recommendations emphasized the overall benefit to the society from radiation protection, i.e. to reduce the collective doses.

Dr. R. H. Clarke[4] introduced the framework of the new ICRP recommendations to be published around 2005. The new recommendations will shift the emphasis of radiation protection from controlling the detriments to the society as a whole to individuals, especially those at the highest risk no matter arising from what radiation sources, natural or manmade, occupational, public or medical exposures, so long as they are controllable. The new recommendations will no longer divide human activities into practice and intervention, and not distinguish between occupational, public and medical exposures. And ignore the principle of justification of practices from the radiation protection system. The new radiation protection system would be:

1. Control the dose to the representative member of the most highly exposed group (Control), and
2. Ensure that resulting dose is "as low as reasonably practicable" (ALARP).

For the future, ICRP is considering an individual-based philosophy using the concept of controllability of sources.

DOSE LIMITS

Before 1977 (ICRP 26), the limitation of doses was performed in terms of Maximum Permissible Doses for workers, and emphasis was given to protection of critical tissues and organs (mainly gonads and red bone-marrow). The maximum permissible dose limit was set as 5 rem in a year for the critical organs of gonads and red bone-marrow, and for the whole body in the case of uniform exposure. The dose limits for the members of the public were set at about one tenth of the dose limits for workers. "Maximum Permissible Dose" was understood as the upper bound of doses which could be received, obviously this is not correct. The concept of the critical organs or tissues used in this way did not permit the summation of detriment according to the relative radio-sensitivities of the exposed organs or

tissues, therefore it was difficult to estimate the overall detriment if more than one organ or tissue were exposed.

ICRP 26 introduced in 1977 the tissue weighting factor (Wt) and abandoned the concept of critical organs or tissues, so that the difficulty described above was overcome, and set the dose limit for occupational exposures at 50 mSv in a year for whole body at uniform exposure and 5 mSv for individual member of the public. However, dose limit may be misunderstood as the boundary between "safe" and "unsafe", and ICRP 26 recommendations did not set constraints for controlling risks arising from abnormal operation (potential exposures), as it was designed basically for normal operation.

ICRP 60 distinguished human activities into practice and intervention, and stated that the exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. And it reduced the dose limits from 50 mSv to 20 mSv for occupational exposures and from 5 mSv to 1 mSv for members of the public.

The future ICRP recommendations[4] being prepared may be to work toward a single scale of individual dose. A possible single scale with descriptors of the importance of the exposure is shown in Table 1, and a potential regulatory system for controlling individual doses in Table 2.

Table 1 A possible single scale of individual dose with description of the importance of the dose

Individual Dose Scale	
Description	Dose(mSv)
serious	30~300
high	3~30
moderate	0.3~3
low	0.03~0.3
trivial	~0.03

Table 2 A potential regulatory system for the control of

individual doses

	Quantity	Effective dose(mSv)
Action level	Existing dose	~30
Investigation level	Existing dose	~3
Constraint on single source	Additional dose	~0.3
Exemption level	Additional dose	~0.03

DISCUSSION

As described above, ICRP recommendations have been played a leading role especially in radiation protection philosophy and principles. And many countries have incorporated them into their national regulations of radiation protection. Therefore, the world community of radiation protection follows with great interest the development of ICRP recommendations. I appreciate many improvements that ICRP may make in its future recommendations. For instance, the individual-based-philosophy using the concept of controllability of sources, giving up the differentiation between practice and intervention, removing "justification" from the radiation protection system, ignoring the distinction of exposures from manmade and natural sources, and establishing single scale of individual dose. However, more work needs to be done. For instance, "collective dose" or sub-sets of collective dose needs to be redefined for implementing the principle "ALARP", more detailed guidance on how to achieve ALARP, and how to make the new idea of single scale of individual dose instead of individual dose limits understood and accepted by not only radiation protection community but also the members of the public in large. And a note "provided that children and reproductive women are properly protected" may be needed to add to the statement "if the risk of harm to the health of the most exposed individual is acceptable, then the total risk is acceptable, irrespective of how many people are exposed".

Anyway, ICRP philosophy and principles are

changing very fast in the past decades and in the time to come. This reflects improvements in knowledge and ability of radiation protection, however it may result some difficulty in following the fast changing recommendations. For instance, in China the national regulations are being modified now according to ICRP 60 recommendations, and they may be come into effect in a couple of years to come, when a new set of ICRP recommendations is about to issue. A question may arise that what should do at that time, revising the just effected national regulations of radiation protection or showing no consideration for the new ICRP recommendations. Therefore, it may be desirable that the fundamental ICRP philosophy and principles maintain relatively stable and continuative.

REFERENCES

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