ENISS
European Nuclear Installation Safety Standards

POSITION PAPER

Avoid Unnecessary Complexity in Radiation Protection

February 2023

Position

The ENISS members, licensees of large nuclear installations in Europe, have reviewed the issue relating to the risk of unnecessarily increasing complexity in Radiation Protection, and a common position has been developed, based on their extensive experience.

It is especially important to account for this position when the Radiation Protection (RP) System is being reviewed, for instance by the International Commission for Radiological Protection (ICRP).

Reviewing the Radiation Protection (RP) system should be carried out considering (among others) the following key principles:

Principle 1: Avoid additional complexity to maintain the current day-to-day practice in the field which is well established and provides satisfactory results.

Principle 2: Before integrating new knowledge into the RP system, consider the implications for national regulation and practical implementation, and weigh these against the benefits of the intended change.

Principle 3: Put forward simplification and/or rationalisation where possible in the system and in its practical application.

The subject of radiation protection is undoubtedly complex, but that is precisely why ICRP recommendations should aim to reduce complexity especially in practical RP.

In the case of planned modifications or extensions of the RP system, it should be checked whether the gain of the change justifies additional complexity in the practice as well as the associated expenditures.

Concerning practical RP, one should first make a distinction between:

(1) the day-to-day practice of RP in nuclear installations, i.e. the handling on-site - and,

(2) other activities in the frame of continuous improvements and PSR, e.g. performing dose assessments for licensing purposes.

In view of the item (1), we consider the practical use of the current RP system as well-established and accepted by important stakeholders such as workers, authorities and contractors. It sufficiently protects and controls exposure of the personnel on site. The principle of dose measurements and dose limits is reasonably simple and convenient to cope with. The workers understand the practical implementation of the system and can check their radiation exposure.

When science generates relevant new knowledge, of course this should be appropriately considered when reviewing the RP system. However, concerning its application in practice, one should ask how the possible changes would actually provide benefits in terms of control of exposures and protection of the staff. The practical implementation should stay simple to keep the system understandable and accepted. New scientific data should be considered for potential changes in the RP system only if they are of significant importance. The consequences on the practical implementation of the potential changes should be carefully evaluated. Nevertheless, it is worth noting that, as far as the ENISS members know, there is currently no new scientific knowledge requiring to adapt the RP system.

The item (2) is even more challenging. For example, when performing dose assessments, in particular concerning the public, some theoritical approaches in the methodologies imply unnecessary complexity. It may require additional resources which should be justified by the benefits.

On one hand it is deemed that a number of changes already implemented in the RP System have not provided a significant gain for workers' protection and safety, and have even introduced complexities, for example:

- The introduction of dose constraints[1]:

  Most industrialised countries have had, for a long time, a well-developed RP system – also in terms of optimisation. The radiation exposure of NPP workers has decreased to very low values. Even the most exposed workers are nowadays only exposed to a few millisieverts per year (at the exception of some rare cases for specific activities for which the exposure can reach up to 10 mSv per year).

  In most of the cases, the enforcement of the dose constraints in the RP system (cf. ICRP Publication 103 [Ref.1]) did not lead to any further dose reduction. Though, it has led to diverse expenditures on the regulatory level and in the practice, for instance education and training, RP instructions, operating manuals and so forth.

- The introduction of categories of *exposure situations* instead of *practices and interventions*:

  Without wanting to doubt that the categories of the three exposure situations are of a more stringent logic compared to the previous approach of process-based protection, working with exposure situation has not shown to lead to lower dose values or better protection in practice. The implementation of these notions into legislation and subsequently into NPP licensees' processes (e.g. instructions, manuals, education/training) implied a lot of work, for ultimately no added value in terms of workers' protection. In fact, it did not imply any change in the day-to-day practice in the NPPs.

- The consideration of six age groups instead of two:

  When assessing the expected radiation exposure of members of the public (for normal operation or for design basis accidents) due to radioactive releases from NPPs, the differences between the age groups are by far lower than most of the inaccuracies arising in the dose assessment, for example concerning lifestyle habits, amounts of ingested food, weather, etc.

  The benefit of increasing the number of age groups to six, as done by ICRP beginning with ICRP Publication 56 [Ref.2], is therefore negligible. So, there was no added value for such a change but it introduced more complexity.

  Nevertheless, ICRP realised that in most cases the consideration of less than six age groups is sufficient. In its Publication 101a [Ref.3], ICRP modified its earlier recommendation: "…It now recommends the use of three age categories…" instead of six. The ICRP justification was based on "the inherent uncertainties usually associated

[1] Dose constraint: prospective, source related value of individual dose, applied in a planned exposure situation, above which it is unlikely that protection is optimised for a given source. The value of the dose constraint takes into account the estimated individual dose distribution, with the objective of identifying exposures that warrant specific attention and facilitate optimisation of protection. ICRP Glossary, 7 March 2019

with estimating dose". This is seen as a good example of reducing the complexity of the existing RP system.

On the other hand, it is deemed that a number of changes currently in discussion would not provide a significant gain for workers' protection and safety, and could even introduce complexities, for example:

- The new dose quantities [Ref.4]:

  It is considered that the new dose quantities applied in NPPs would only lead to marginal differences in dose values, and would have no impact on improving radiation protection or safety. However, if those new dose quantities had to be enforced they would lead to unnecessary implementation of new equipment or upgrading existing one (e.g. dose measurement systems) and additional resources.

- The explicit distinction between genders:

  The same consideration can be made for the distinction between female and male persons in the dose evaluations. Indeed, even if their effective doses are actually different, these differences are much smaller than the accuracy of the usual dose assessments and even of the dose measurements.

All these examples demonstrate the inadequacy of introducing too much complexity and/or a too high level of detail in the RP system.

Interestingly, the specific case of the number of age groups highlights that ICRP has already recognised a case where adding too much detail is not adequate.

Such a development is highly appreciated by ENISS, even though it must be stressed that the IAEA and EU Basic Safety Standards (GSR Part 3, 2014 [Ref. 5] and Council Directive 2013/59/EURATOM [Ref. 6]) still refer to tables with dose coefficients for six age groups, which clearly constitutes a lack of harmonization in the RP practice. This last point illustrates that all stakeholders should appropriately account for the complete picture (from theory to practice) in a harmonised way before considering any change in the requirements and guidance.

Some of the previous examples (e.g. inadequacy to do a distinction between genders, decision to recommend the use of three age groups instead of six) derive from the consideration that many quantities of the RP system cannot be precisely determined in practice. The case of the dose assessment is illustrative. Indeed, there are a lot of uncertain factors that limit the accuracy of dose assessment and then question the high complexity and level of detail of the RP system. Those factors are for instance:

- The influence of the building structures on the NPP site (air flow effects, impact on the exposition path…) for the public exposure;
- The background radiation;
- The differences between individuals regarding body size or radiation sensitivity;
- The actual compliance of the workers with the RP instructions, when too complex.

In conclusion, ICRP should pay attention to the efforts implied by any change in the RP system. Specifically, ICRP should perform risk-informed / cost-benefit analyses regarding, in particular factoring the implementation in practice. ICRP should use the contacts they already have with experts from operators and take their information into account for the benefit of the RP system. The Special Liaison Organisations (SLOs) could be effectively used for this purpose.

In addition, ICRP should consider whether and to what extent simplifications in the practice are conceivable and how they may significantly influence the actual protection. The point here is not to oversimplify the system, but to make its implementation, for planning or licensing procedures for instance, more adequate and practicable. Any change should be done bearing in mind that practically achievable accuracy limits the relevance of an overly complex RP system.

Given the drawbacks of increasing complexity, the uncertain factors inherent to dose assessments and the fact that actual radiation exposures for normal operation are actually low, reductions of complexity in the RP system for practical purposes should be envisaged and would be helpful in many situations.

References

[Ref.1] ICRP Publication 103, “The 2007 recommendations of the International Commission for Radiation Protection”, 2007

[Ref.2] ICRP Publication 56, “Age-dependent Doses to Members of the Public from Intake of Radionuclides - Part 1”, 1990

[Ref.3] ICRP Publication 101a, “Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public”, 2006

[Ref.4] ICRU Report 95, “Operational Quantities for External Radiation Exposure”, 2020

[Ref. 5] IAEA GSR Part 3 “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards”, 2014

[Ref. 6] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation