Protection against the health detriment caused by exposure to ionizing radiation is a very peculiar discipline among other areas of occupational hygiene and public health policies. The radiation detriment is comparatively well understood, but further research programs on radiation biology should allow to better explain the mechanism by which the detriment is caused. More precise estimates of the risk factors are pursued through epidemiology programs. Nevertheless, there will always remain a large uncertainty as to the risk factor for exposure at low doses and dose-rates. Indeed, in general, doses are so low that they will never yield a statistically observable health detriment. In situations where doses are not negligible the size of the affected population is so small that all epidemiological studies are prone to very large statistical uncertainties and possible confounding factors. Hence the success of radiation protection in keeping doses very low prevents a more accurate estimate of the associated risk.

On the one hand we feel concerned with such low doses because there is no biological basis for ignoring them. There is almost certainly no dose threshold to radiation detriment. On the other hand most exposures cannot be fully avoided. For instance, shielding against penetrating radiation reduces the exposure but does not eliminate it. There is no zero exposure, and according to the radiation protection paradigm there is no zero risk. Exposures to man-made radiation sources are in general small compared to those to natural radiation sources however. The detriment of exposure does not depend on its origin, but aversion to any risk that is imposed by a third party yields a widespread perception that any exposure to radiation of man-made origin should be rejected. The natural radiation sources are generally ignored. It is possible to do so because radiation is so easy to measure and the analysis of radiation energy spectra so easily allows to determine its origin.

This may explain that public and political concerns relate disproportionally to low doses in occupational and public exposure, rather than to medical exposures where doses can be comparatively high in some types of radiological imaging (CT, interventional imaging) and of course in radiation therapy. High doses may also be suffered by emergency workers, in particular those involved in on-site intervention in order to prevent catastrophic deterioration of the nuclear emergency. In such case the radiation health detriment is real and can be accepted only if the benefit of the medical treatment or of the emergency intervention outweighs the health detriment.

ICRP developed a rational basis for radiation protection. The philosophy is based on a distinction between three situations: planned, existing and emergency exposure situations. The distinction relates essentially to just one of the principles of radiation protection, the Justification Principle. The Optimization Principle applies very much in the same way in all exposure situations. ICRP did not thoroughly analyze the meaning and merit of dose limits in different exposure situations, and merely advocates that the Limitation Principle be applied only to non-medical exposures in planned exposure situations, i. e. when a conflict with the other two Principles is not likely. For other exposure situations Reference Levels are believed to be a more effective tool to allow for equity considerations within the framework of Optimisation.

The principle of Dose Limitation was originally going to be dismissed in the new ICRP Recommendations, and was reintroduced only because stakeholders (industry, regulators) advocated at the Lanzarote Conference that limits should be maintained. ICRP believed that in planned exposure situations Dose Constraints would play a role similar to that of the Reference Levels, hence no dose limits would be needed.

The ideal Radiation Protection system, fully understood and endorsed by all stakeholders, would indeed allow optimization under constraints or reference levels to define an acceptable level of exposure. Regulators however believe such a comprehensive stakeholder involvement is not realistic; there is a huge deficit in the understanding of radiation effects and consultations would be too costly or time-consuming. Hence the regulator needs to take up its societal responsibilities and ensure that with limited resources for regulatory control adequate protection is offered in most situations, irrespective of the application of Optimization.

Regulatory control is based on the pillars of authorization and inspection. The NEA introduced the idea of a Graded Approach to regulation, which has found its way in the international standards (IAEA, EC), distinguishing between types of justified practices
that are exempted from notification, or that should be notified, registered or licensed. For licensed practices the undertaking may be required to establish a documented procedure for optimization. In other cases, regulatory control will be based on the inspection, on-site or through transmitted information, of compliance with strict enforceable requirements, such as authorizations for discharging radioactive effluent and of course compliance with occupational dose limits.

The new ICRP Recommendations have prompted the international organizations to lay down a comprehensive set of requirements, covering all exposure situations. Ever since the signature of the Treaty establishing the European Atomic Energy Community in 1957, Euratom has established Basic Safety Standards in line with the international standards, and now for the first time co-sponsored both the Safety Fundamentals and the international BSS. The new Euratom BSS result from the consolidation of five earlier Directives and now cover all categories of exposure (occupational, medical and public exposures) and exposure situations. The Euratom BSS now include binding requirements (to be transposed in national legislations) on protection against indoor radon exposure, at work and at home, and on the manufacture and use of building materials. No distinction is made between practices involving man-made radiation sources (nuclear industry, medical applications) and those industries processing naturally occurring radioactive materials (NORM). In addition, while the exposure to radon at work is in general an existing exposure situation, it has been agreed that high occupational exposures should be managed in the same way as occupational exposures in practices, and occupational dose limits apply to all exposures including to radon at work, irrespective of the exposure situation.

The new BSS are expected to be the cornerstone of good radiation protection for the next decades. The role of the regulatory authority is strengthened, and national or regional bodies will need to build up the resources and competences to manage a broader range of exposure situations and to make good judgments on the level of authorization and inspection that is appropriate for different types of industries.

At the same time, the new BSS fully acknowledge the need for optimization and stakeholder involvement in existing exposure situations. This is in particular important for post-accidental situations. The new Euratom BSS require preparation for such situations, through programs such as CODIRPA in France. The crucial importance of this aspect was dramatically highlighted by the accident in Fukushima. The remediation of contaminated land and the restoration of living conditions in the evacuated territories will benefit to a better understanding of the radiation protection principles applicable to such a situation along the recommendations of ICRP Publication 111. The international community will be indebted to Japan for sharing this experience.

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