The system of radiation protection, a framework for radioactive waste management

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The European Atomic Energy Community (EURATOM) has wide-ranging competences under Chapter 3 "Health and Safety" of the Euratom Treaty (1957). While these provisions have been implemented directly (e.g. Article 37 on the impact of planned disposal of radioactive waste) and through an important body of secondary legislation (in particular the Basic Safety Standards, currently Council Directive 96/29/EURATOM) for the protection of the health of workers and members of the public, the disposal of radioactive waste has essentially remained a national responsibility.

This can be explained by the fact that the choice of disposal options and of suitable sites has societal dimensions, as well as technological challenges, beyond the remit of radiation protection. The EURATOM Community has played an important role in research in this area under the RTD Framework Programmes. So far no specific legislation on waste management has been adopted.

The principles of radiation protection as laid down in the BSS nevertheless apply, not only to waste management involving immediate exposure of members of the public through discharges of radioactive effluent, but also to disposal or storage options over very long time scales. Basic Safety Standards are being revised along the lines of the new (2007) recommendations of ICRP. It will be discussed to what extent the new ICRP concepts allow a more transparent and effective implementation of radiation protection with regard to waste management. It will be examined in particular how the principles apply to current challenges ranging from clearance of slightly contaminated materials to the long-term disposal of high-level waste.

The key principle of radiation protection remains optimisation, and the European Commission will continue to foster ALARA networks such as the European ALARA Network (EAN), but also those established for the NORM and NDT sectors of activity.

The new ICRP recommendations and the revised Basic Safety Standards should allow a coherent set of requirements for natural radiation sources and for artificial sources. There should be a common framework to deal for example with materials arising from dismantling of nuclear installations and for residues of NORM-industries with regard to the options of concentration and containment versus dispersion and dilution.

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1. WASTE MANAGEMENT AND RADIATION PROTECTION

This paper examines the issue of waste management from the point of view of radiation protection. Radiation protection services in general, and in particular the unit dealing with such matters in the European Commission, are in charge of the management of radioactive effluent and the assessment of their impact on the exposure of members of the public. The processing and disposal of solid radioactive waste, however, receives much less attention, with the possible exception where processing of residues for waste disposal is an option in competition with discharge of effluent. Thus current Community radiation protection legislation, in particular Council Directive 96/29/EURATOM, laying down the basic safety standards for the protection of workers and the population, includes provisions on establishing discharge authorisations, but not on the management of radioactive waste *per se*.

There is one borderline case that the European Commission has tackled from a radiation protection point of view, i.e. the release of slightly contaminated materials arising from the dismantling of nuclear installations, applying the concept of clearance (as provided for in Article 5 of the basic safety standards Directive). The Commission has published guidance on the establishment of clearance levels for the recycling or reuse of metals, for the recycling of building rubble or the reuse of buildings, as well as default levels for any type of material from any origin or to any destination (Publications 89, 113, 112 respectively). The perspective of the EC on this option in comparison with the management of "very low level radioactive waste" was given at an IAEA conference in 2005 [1] and at one of the first ALARA Workshops, in Saclay, France, ("ALARA and Decommissioning", 1997), a presentation was made on different policy options for the recycling of contaminated scrap metal.

Little or no attention has been given to the actual disposal of radioactive waste, from a radiation protection point of view. The disposal of radioactive waste in principle is within the remit of radiation protection, and under Council Directive 96/29/EURATOM the disposal of radioactive waste is subject to prior authorisation. In general, however, it is felt that the issue is not radiation protection but the safety of the storage or disposal sites. Technical options are discussed far more than exposures to workers or members of the public. The cost of disposal and the financing provisions are also important issues, but the overall societal implications and dimension are much broader, especially with regard to the choice of appropriate locations for near-surface or geological disposal. The Commission has been very actively engaged in research on waste management technologies, as well as on the governance of waste management (COWAM network), under the research Framework Programme.

At a political level, however, the technological and societal dimensions of the issue caused it to be considered a national matter, with little room for Community competences. A Court of Justice ruling (in case C-29/99) nevertheless made it clear that the distinction between radiation protection and safety is artificial, and that both the safety of nuclear installations and the management of radioactive waste could be dealt with under chapter 3, Health and Safety, of the EURATOM Treaty.

This paper will thus explore how radiation protection philosophy and legal requirements should be applied to the disposal of radioactive waste. This application is not straightforward, and one must allow for the specific features of waste disposal. These include, in the first place, the consideration that the disposal of radioactive waste is liable to affect future generations, rather than people currently living in the proximity of the site (except for the transport of waste conveyances to the site and possible effluents from on-site processing or conditioning of the waste). In addition, future populations need to be considered over a very long timescale, in particular for geological disposal.

The assessment of population exposure is thus by nature of disposal operations fully prospective. It is not possible to assess retrospectively whether dose constraints or dose limits are complied with. If any problem were to arise in future, it would not be possible in practice to intervene in order to reduce the population exposure. Geological exposure relies on passive safety features and not on any active

controls. The prospective assessment of population exposures cannot proceed through deterministic models. The expectation is that the waste will remain well contained in the geological strata, and the exposure of future populations is likely to be zero. However, one must allow for scenarios that invalidate this assumption and for the associated uncertainties. In part such scenarios can be investigated using probabilistic tools and the radiation protection concept of "potential exposure" can be applied. Certain events must be allowed for while being unpredictable, e.g., the intrusion scenario, or the features of a future ice age.

The location and design of a disposal site are determined by natural features (site geology) and engineering aspects (multiple barrier, safety functions). The options and choices are only in part a matter of science and engineering, however. The societal aspects of decision making, whether or not a participative approach through, e.g., stakeholder involvement is pursued, are by far the most important. In addition to the usual principles of radiation protection the ethical principle of not unduly burdening future generations is equally important, as well as preserving choices available to future generations leading, for example, to the concept of retrievability.

One should also bear in mind the societal implications, not only of a decision for the disposal of radioactive waste, but also of any delays in such decision making. The current widespread hesitation in making a positive decision may negatively affect the public's perception of the safety of the nuclear energy option on the one hand, on the other hand may increase financial liabilities.

2. ICRP RECOMMENDATIONS

The rationale for the management of radioactive waste from the perspective of health protection against ionising radiation is laid down by the International Commission for Radiological Protection (ICRP) through a series of recommendations and publications. The most recent publications relating to the disposal of radioactive waste date from 1998 (Publication 77 on the overall radiological protection policy and Publication 81 as applied to the disposal of long-lived solid radioactive waste). These publications refer to the framework laid down in the 1990 Recommendation of ICRP (Publication 60). Meanwhile, ICRP has adopted new Recommendations (2007, Publication 103). This section of the paper examines the extent to which the new Recommendations shed new light on the issue and to which degree they necessitate a revision of the earlier publications.

2.1. The system of radiological protection

The fundamental change in the revised recommendations of ICRP is that (quote from the abstract of Publication 103):

"The Recommendations evolve from the previous process-based protection approach using practices and interventions by moving to an approach based on the exposure situation. They recognise planned, emergency, and existing exposure situations, and apply the fundamental principles of justification and optimisation of protection to all of these situations."

There is hence no change in the fundamental principles, but the new framework of *exposure situations* will have an impact on how these principles are interpreted and applied.

The management and disposal of radioactive waste are a planned exposure situation (cf. ICRP Glossary):

"Planned exposure situations: everyday situations involving the planned operation of sources including decommissioning, disposal of radioactive waste and rehabilitation of the previously occupied land. Practices in operation are planned exposure situations."

The transposition of the definitions of the exposure situations in terms of legal requirements is less straightforward. In particular, the word "planned" has given rise to some confusion. For instance, an emergency exposure situation in general arises from planned operations with a potential for accidental releases of radioactivity to the environment. The management of such a situation must be "planned" even before the start of the operation of a nuclear installation. In the long term, the environmental contamination resulting from such an accident will be managed as an existing exposure situation, and, to the extent intervention is still warranted, this will be planned for by the responsible organisation. Finally, activities which in most countries have been considered part of an existing exposure situation, such as the processing of materials with naturally occurring radioactive materials (NORM), are now being considered as part of planned exposure situations.

The distinction between exposure situations has an impact on the limitation of doses. As before (for practices), dose limits apply only to the sum of exposures (in one of the categories: occupational or public) to an individual (or the "representative person" in case of public exposure), in a planned exposure situation. This principle of dose limitation has been maintained, even if in practice the exposures are controlled through the application of the principle of optimisation, with a new emphasis on the role of source-related constraints on individual exposure. The principle of optimisation remains the cornerstone of the system of protection, in all exposure situations.

The distinction between exposure situations has also an impact on the principle of justification. Justification is:

"The process of determining whether either (1) a planned activity involving radiation is, overall, beneficial, i.e. whether the benefits to individuals and to society from introducing or continuing the activity outweigh the harm (including radiation detriment) resulting from the activity; or (2) a proposed remedial action in an emergency or existing exposure situation is likely, overall, to be beneficial, i.e., whether the benefits to individuals and to society (including the reduction in radiation detriment) from introducing or continuing the remedial action outweigh its cost and any harm or damage it causes."

The decision on whether a planned activity is beneficial should be taken before the start of the operations, in particular if the practice would cause the production of radioactive materials, in general by fission of nuclear materials or by activation of structural materials, as in a nuclear reactor. This is an irreversible process, hence the management of these radionuclides, whether as radioactive waste or as a new source for use in further practices, needs to be considered, together with the practice, in the process of justification.

This has been clearly formulated in Publication 77:

"(15) Waste management and disposal operations are an integral part of the practice generating the waste. It is wrong to regard them as a free standing practice, needing its own justification. If the national waste disposal policy changes and the practice is continuing, it may be necessary to reassess the justification of the practice. If the practice has ceased, it may be necessary to carry out intervention.

(16) The justification of a practice has a defined and limited meaning in ICRP Recommendations. The Commission's definition of the justification of a practice requires only that the net benefit of the practice, including the waste management, be positive. The selection of the most appropriate justified practice goes beyond the scope of the Commission's recommendations. Nevertheless, the term is frequently used outside the Commission in this wider sense of selecting the best option. This use of the term justification is of course legitimate, provided that all aspects of the practice are considered, not merely those concerned with

radiological protection. Nevertheless, it causes a confusion, which the Commission has been at pains to avoid, between the justification of a practice and the optimisation of protection within a practice."

It is interesting to note that in 1998 ICRP had already recognised the possible confusion between justification and optimisation, which, however, Publication 103 still does not fully resolve either, in particular with regard to the justification in existing and emergency exposure situations. The main point made here is that the disposal of radioactive waste does not need to be justified in its own right. The choice of the management option, including processing, storage and eventual disposal, is a matter of optimisation of the means to ensure adequate disposal at a reasonable cost, as well as allowing for the exposure of the current generation (workers and members of the public) and for broader societal aspects, preferences and ethics.

2.2. Potential Exposures

Potential exposures are those that are *"not expected to be delivered with certainty but that may result from an accident at a source or an event or sequence of events of a probabilistic nature"* (ICRP 103 Glossary). Such exposure can be expressed as a *"two-dimensional quantity comprising the probability of occurrence of a dose and the considered probability of occurrence of the consequences, given that the dose occurs"* (Publication 77, paragraph (60)).

Potential exposures are a key feature of radioactive waste disposal. Indeed, while optimising the management of radioactive waste for the current generation, and even if by design the exposure of future generations is meant to be prevented, allowance must be made for potential exposures. This concept is essential with regard to the choice of management strategy, i.e. *"dilute and disperse, or concentrate and contain"*. See Publication 77:

"(61) Considerations of potential exposure have a marked effect on the use of the two waste disposal strategies Dilute and Disperse, and Concentrate and Retain. The dispersal strategy has of course to take account of environmental re-concentration processes, but then has the merit of ensuring that individuals in critical groups are adequately protected and that other individuals are at even lower risk. It largely ignores potential exposure. The retention strategy has often ignored the long-term consequences of deterioration or failure of the retention facilities. Apart from that, it reduces both individual and collective doses to the public. If only normal exposures are considered, it appears to be the more protective of the two strategies. Considerations of potential exposure, particularly potential individual exposure, from the concentrated retained waste, make that judgement less definitive.

(62) Most waste management decisions include a choice between various options for the treatment or conditioning of waste. It is thus possible to make choices between dispersal and retention. These choices also influence the form in which the waste is presented for disposal. For example, filtering a gaseous effluent reduces the activity in the effluent but creates a solid waste.

(63) In summary, the Commission recommends that waste disposal policies should be influenced by the interaction of potential and normal exposures, and that the dispersal of radioactive waste should not be automatically regarded as less suitable than retention. Both strategies are necessary and a suitable balance between the two should be sought."

In Publication 103, paragraph (265), a distinction is made between different types of events, among which:

"Events in which the potential exposures could occur far in the future, and the doses be delivered over long time periods, e.g., in the case of solid waste disposal in deep repositories: Considerable uncertainties surround exposures taking place in the far future. Thus dose

estimates should not be regarded as measures of health detriment beyond times of around several hundreds of years into the future. Rather, they represent indicators of the protection afforded by the disposal system. The Commission has given specific guidance for the disposal of long-lived solid radioactive waste in Publication 81 (ICRP, 1998b). This guidance remains valid."

Publication 81 indeed puts emphasis on the fact that the application of the concept of potential exposures to the disposal of long-lived radioactive waste is not so much a matter of quantification of probabilities (see Publication 77, paragraph (60) quoted above) but rather of addressing uncertainties which are difficult to express in terms of probabilities, or which are essentially unpredictable, e.g., the scenario of intrusion or the occurrence and features of a future ice age.

ICRP (Publication 103, paragraph (267)) distinguishes between two approaches, one making separate allowance for the probability of occurrence and the magnitude of the exposure, another considering the individual probability of radiation-induced death:

"(267) Decisions on the acceptability of potential exposures should take account of both the probability of occurrence of the exposure and its magnitude. In some circumstances, decisions can be made by separate consideration of these two factors. In other circumstances, it is useful to consider the individual probability of radiation-related death, rather than the effective dose. For this purpose, the probability is defined as the product of the probability of incurring the dose in a year and the lifetime probability of radiation-related death from the dose conditional on the dose being incurred. The resulting probability can then be compared with a risk constraint. If the probability is lower than the risk constraint, it may be tolerated. Both of these approaches are discussed in the Commission's Recommendations for the disposal of long-lived solid radioactive waste in Publication 81 (ICRP, 1998b)."

The specific recommendations and guidance in Publication 81 are indeed still fully valid, and nothing in Publication 77 and 81 is in contradiction with Publication 103 (even though the terminology has changed a little); indeed the publications in 1998 seem to have anticipated the later developments.

Among the scenarios considered for the potential exposures associated with waste disposal one distinguishes between normal evolution and intrusion. The normal evolution of a geological stratum and of the migration of radionuclides through the containment and in the geosphere is predictable, however with increasing uncertainties at very long timescales. As for involuntary intrusion, one must allow for this possibility, but it is hardly possible to put a figure on the probability of such an event. Nevertheless, one must put reasonable effort into reducing the possibility or plausibility of such a scenario, e.g., through the depth of the disposal site and engineered barriers and warning signs. The benefit of any such measures in terms of averted potential exposure is, again, very difficult to quantify, so a formal and objective cost-benefit optimisation is not possible. Common sense optimisation (answering the question whether one has done enough in terms of protection) is nevertheless warranted as well as the application of the principle of "defence-in-depth" as part of an overall safety culture.

It would lead too far to discuss these probabilistic approaches and scenarios in any further detail. It must nevertheless be borne in mind that the complexity of these approaches is a factor to be taken into account in its own right. It is not sufficient for the expert to understand his methodology and its mathematical formulation, the approach and underlying assumptions must be fully understood by all stakeholders. People have great difficulty in understanding probabilities. In particular, the distinction between the (annual) probability of exposure for an undefined individual at any future point in time, and the probability for the occurrence of a scenario at any time and resulting life-long exposure of the individuals affected by this event, is

difficult to express. The means of expression of potential exposure are liable to affect its perception and thus the acceptance of the expert point of view. Other parameters may be equally important, such as the duration and extent of the exposure.

2.3. Exposure situations

The disposal of radioactive waste is a planned activity, hence dose limits apply. However, the scope for their application is very limited, since, initially, after closure of the disposal site, public exposure is essentially zero (certainty for geological disposal). The envisaged period of institutional control of the disposal site, including environmental monitoring where appropriate, will almost certainly be short, compared to the timescale by which there is a potential for the dose limit to be exceeded (or even a fraction of the dose limit if one would like to allow for other practices affecting the same individual). Even if this were to happen, there is, despite designs incorporating retrievability or reversibility, little scope for intervention (passive protection rather than active control) in the design of the disposal site, nor for correcting the practice that has given rise to the radioactive waste (most often the practice will have been terminated).

Thus retrospective application of dose limits is rather meaningless. The prospective application of dose and risk constraints is nevertheless possible. In Publication 103, paragraph (260), the Commission confirms a dose constraint of 0.3 mSv per year for the control of public exposure from waste disposal, which was already elaborated upon in Publication 81. This value for the dose constraint is largely based on the consideration that allowance must be made for multiple sources for compliance with the individual-related dose limit. This is not the main purpose of the constraint, but still, for practical purposes, the value is just as good as any other value.

The value for the risk constraint, presented in an aggregated way, which corresponds to 0.3 mSv is of the order of 10^{-5} per year. Bearing in mind the uncertainties on any probabilistic risk figures this is again a figure that one could apply in practice.

In the longer term, it is no longer appropriate to manage the situation as a planned exposure situation. This was already recognised in Publication 77, even though at the time the terms "practice" and "intervention" were used rather than planned versus emergency or existing exposure situations:

"(26) In the context of waste disposal, it is not always easy to distinguish between practices and intervention, even for radionuclides of moderate half-life. A change in the environment or in the use of the environment may open new or enhanced pathways from the source to man. An existing, but overlooked, pathway may become apparent. If the introduction or modification of the pathways is a matter of choice, it can sometimes be regarded as a new practice in its own right. Alternatively, and always if the change is involuntary, the change modifies the conditions of the current practice and may require a reconsideration of the justification of the whole practice generating the waste. If modifications in the practice are impracticable, the change may call for intervention in the environment or in the behaviour of the critical group."

Whenever radionuclides migrate from the geosphere to the biosphere this might give rise to elevated exposures such as may arise in a nuclear emergency. However, it is not meaningful to plan the management of such an emergency over such timescales. The memory of the site may even have been lost and it may take time before the contamination is discovered (if the society is still capable of detecting radiation), hence the concept of an existing exposure situation would apply. Whether an emergency or an existing situation, a reference level could be applied. The concept of reference level, similar to the one of constraint, has been thoroughly developed in Publication 103.

It clarifies the older concept of generic level for the "existing annual dose" below which (e.g., 10 mSv) "intervention is not likely to be justified" or above which (e.g., 100 mSv) "intervention should be considered almost always justifiable" (Publication 21, paragraph (64)). In Publication 103 bands of constraints or reference levels have been introduced (see Table 5) in the ranges 0 to 1 mSv, 1 to 20 mSv, 20 to 100 mSv. This approach, with the societal criteria associated with each band, is much more transparent than before.

3. EC INITIATIVES

3.1. Radiation Protection

The remit for actions related to radiation protection is laid down in Title II, chapter 3 (Health and Safety) of the EURATOM Treaty. The main provisions are those in Articles 30-33 on the basic safety standards for the health of workers and members of the public. Developments in this area are discussed further in chapter 3.3.

Articles 35-38 of the Treaty lay down obligations in primary law with regard to monitoring and assessing levels of radioactivity in the environment. In particular, Article 37 requires general data to be submitted relating to "*any plan for the disposal of radioactive waste in whatever form as will make it possible to determine whether the implementation of such plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State*."

Under the terms of the Commission Recommendation 1999/829/EURATOM, the *"disposal of radioactive waste"* covers *"any planned disposal or accidental release of radioactive substance, in gaseous, liquid or solid form, in or to the environment"*. Operations listed for the application of Article 37 are, amongst other operations (e.g., nuclear power plant), those concerned with the management of (solid) radioactive waste: the storage of irradiated nuclear fuel (6), the processing or storage of radioactive waste (8) and the "*emplacement above or under the ground of radioactive wastes without the intention of retrieval*" (10). It should be noted that, while such operations are in the Commission's view within the remit of Article 37, their impact on other Member States through discharges of radioactive effluents is, in general, negligibly small.

The European Commission is not only concerned with the application of primary law (in the Treaty) and with the establishment of secondary legislation (e.g., Directives) but also with checking their correct transposition in national law (under Article 33 of the EURATOM Treaty) and adequate operational implementation. For this purpose the Commission has issued many guidance documents (published in the Radiation Protection – RP- series, to a large extent endorsed by the Group of Experts). The services also answered numerous questions of the users of the legislation (regulators and operators). This has become increasingly difficult with the enlargement of the European Union, hence a decentralised approach is needed, by which the stakeholders share experience and offer solutions to common problems. The best examples of such networks are those established under the acronym ALARA. Originally funded by the EC, under the framework programmes of EC research, the main "network" has become self-sustaining. Building upon this success, the Commission has launched initiatives for setting up specific networks, for instance on non-destructive testing and NORM industries, possibly also in the medical area, in all areas of protection: occupational, public and medical exposure.

3.2. Waste Management

At the summit of 8-9 March 2007 the European Council noted the Commission's assessment of the contribution of nuclear energy in ensuring security of supply and the reduction of CO_2 emissions. However, the European Council also stressed that nuclear safety and the management of radioactive waste, especially the most hazardous ones, have to be further improved as an

important pre-condition for the further use of nuclear energy. Indeed, the implementation of demonstrated solutions for the long-term management of high-level waste should now be accelerated.

In its conclusions of 8 May 2007 on nuclear safety and safe management of spent nuclear fuel and radioactive waste, the Council stipulates that each EU Member State should be urged *"to establish and keep updated a national programme for the safe management of radioactive waste and spent fuel that includes all radioactive waste under its jurisdiction and covers all stages of management"* which is fully in line with the policy of the European Commission.

The Commission considers that, concerning radioactive waste management, no burden should be put on future generations and "wait and see" approaches must be ruled out.

However, while geological disposal is internationally recognized as the safest and most sustainable option for the long term management of high level radioactive waste, no repository is implemented yet in Europe, for technical, economical or societal (public acceptance) reasons. High level wastes have been produced in the Community for over half a century – and they are all still being temporarily stored on the surface. Even if the feasibility of geological disposal has been demonstrated, progress towards the implementation of such a solution is noted only in a few Member States.

European citizens attach great importance to the issue of radioactive waste management, as has been highlighted in successive Eurobarometer surveys. The 2007 Eurobarometer on nuclear safety confirmed that the unresolved question of radioactive waste is among the European citizens' concerns connected with nuclear energy. As well the Eurobarometer on waste management organised in 2005 by the Commission has shown that 91% of the citizens in the European Union wish to see radioactive waste solutions implemented now. A new Eurobarometer on radioactive waste is in progress, the results of which will be published in April 2008. One of the main purposes of this poll is to analyse the evolution of the European citizen's opinion on radioactive waste management, integrating the results of all the polls performed in 1999, 2002, 2005 and 2008.

At this stage, there is little binding Community legislation specifically concerning radioactive waste management. Efforts are directed towards addressing these issues within the framework of further development of common instruments for nuclear energy by means of extensive consultations at EU level. The European Council of 8-9 March 2007 endorsed the Commission's proposals for:

- the creation of the European High Level Group (HLG) on Nuclear Safety and Waste Management. The Group, composed of senior officials from national regulatory or nuclear safety authorities, should develop a common understanding that will help the Commission identify priority safety issues, as well as advise the Commission on progressively developing European rules regarding the safety of nuclear installations and the safe management of spent fuel and radioactive waste. The objective is to find a way forward and start to fill the existing legislative gap in nuclear safety and waste. The HLG will be assisted by three expert groups covering Waste Management, Nuclear Safety and Financing of Decommissioning;
- the organisation of a broad discussion among all relevant stakeholders on the contribution of nuclear energy in meeting the energy challenges of sustainability, security of supply and competitiveness: the European Nuclear Energy Forum. The Forum brings together, for structured and open debate, high level representatives from the nuclear industry, power companies, energy intensive consumers, finance and civil society, as well as other key decision makers and organizations at national and EU level. During the first meeting in Bratislava, three working groups "Opportunities", "Risks" and "Transparency" have been established to discuss respectively "How can the opportunities of nuclear energy be better

exploited in the EU?", "How can nuclear safety, security and waste management be further improved within the EU?" and "How better inform the public in objective and factual terms about all aspects of nuclear?"

3.3. Basic Safety Standards

Ever since the first Basic Safety Standards Directive was adopted in 1959 these Directives have been amended to allow for the publication of new recommendations by ICRP. The current Directive 96/29/EURATOM reflects ICRP Publication 60 (1990). The new recommendations (Publication 103, 2007) do not imply important changes in the system of protection or in the definition of effective dose. Nevertheless, as explained in chapter 1, the introduction of three exposure situations (planned, emergency and existing), rather than the earlier confusing distinction between practices and interventions, calls for a thorough restructuring of the Directive. For a variety of reasons, including ICRP Publication 103, the Inter-Agency Basic Safety Standards (co-sponsored by IAEA, WHO, PAHO, NEA, ILO, FAO) have been reviewed also and the revision process will soon yield a first draft for discussion in the IAEA Committees. The European Atomic Energy Community so far did not sponsor the International Standards, as a result of the difficulty of committing to a text without limiting the competences of the European institutions involved in the decision-making process. The Commission is now firmly engaged in the revision of the Inter-Agency Basic Safety Standards, with a view to a possible co-sponsorship. The latter should proceed in the same way as for the Safety Fundamentals endorsed in 2007.

The Commission has undertaken a revision of the EURATOM Basic Safety Standards, not only to allow for ICRP and IAEA, but also in the light of experience with the current Directive. The Group of Experts established under Article 31 of the EURATOM Treaty confirmed that there was a need to strengthen the requirements on natural radiation sources and on the procedure and values for exemption and clearance, as well as to enhance cooperation between Member States for emergency preparedness and response.

There was also felt to be a need for introducing a graded approach to regulatory control, commensurate with the risk associated with the regulated practice and with the potential effectiveness of regulations or specific licensing requirements.

The current system of regulatory control in Directive 96/29/EURATOM is built on requirements of reporting and prior authorisation. Article 3 of the Directive lists types of practices subject to prior authorisation, however without explanation as to why these are listed, whether for the management of radioactive waste, or control of discharges, protection of patients, placing on the market of sources, apparatus or consumer goods, etc. Neither does the current Directive specify any licensing requirements, with the exception of the discharge authorisations which are dealt with under Title VIII, on public exposure.

The Directive also allows for the authorisation of practices "*in cases of a limited risk, in accordance with conditions laid down in legislation*". This option is used by some Member States, but its full potential is seldom understood. It is now envisaged to adjust to the terms in the international BSS: notification, registration and licensing, in order to promote the graded approach more effectively and in a more harmonised way. In the same context, it is considered useful to allow the possibility for the regulatory body to exempt notified practices from all or part of further requirements, if the general criteria for exemption are met or if exemption is demonstrated to be the best option.

The current set of exemption values (Annex 1) will be maintained for the exempt quantities (Bq), but for the activity concentrations (Bq/g) replaced by the values that are suitable for clearance. While exemption and clearance are conceptually different, there is merit in having a single set of

values. Moreover, experience shows that there is no need for the somewhat higher exemption values for any consumer goods currently on the market.

For the sake of international harmonisation the European Commission is ready to endorse the values proposed by IAEA in RS-G-1.7. These values are in general identical to, or close to (within one order of magnitude) the values proposed earlier in Community guidance as default values for any type of material, for any pathway of disposal, recycling or reuse (Radiation Protection 122, part I). It remains, however, to be verified whether the differences can be explained and whether, for those radionuclides that matter, a correction is warranted (both in the international standards and in the EURATOM Directive).

The European Commission still advocates the use of specific clearance levels (e.g., for metals, building rubble) on which guidance was provided (Radiation Protection 89, 103) in addition to the general clearance levels. Such values are important for the decommissioning of nuclear installations and higher values are beneficial for reducing the volume of radioactive waste. While allowing for clearance levels higher than the exemption values, the Directive needs to be carefully drafted in order to avoid loopholes in the control system.

Also for naturally occurring radioactive materials (NORM) it is considered to endorse the values in RS-G-1.7 (1 Bq/g for the decay families of Ra-226 and Th-232, 10 Bq/g for K-40). In RP 122, part II, values two times lower were recommended. A relaxation is possible only if accompanied by a stricter control of the recycling of NORM residues, in particular in building materials. It is worth noting that for the recycling of NORM residues, mixing with less active inert materials or ores is considered as restoring the concentrations prevailing in the earth's crust, rather than as dilution of radioactive waste.

The mission of the Basic Safety Standards will coincide with a major consolidation of all Community legislation in radiation protection, or at least of the following Directives:
- BSS Directive 96/29
- Directive 97/43 (MED)
- Directive 89/618 (Public Information)
- Directive 90/641 (Outside Workers)
- Directive 2003/122 (HASS)

A further Directive, on the quality of drinking water with regard to the presence of artificial or natural radionuclides, might also be part of this recast process. This Directive should replace the indicative parameters currently laid down in EC Directive 98/83/EC.

The recast process goes beyond mere "codification" but still requires that any amendment to the consolidated acts be justified and such changes be kept to a minimum. For a major consolidation of very different Directives, together with a revision of the main Directive, this is a very complex task. It requires a thorough restructuring of the Directive, which will be undertaken along the three exposure situations defined by ICRP.

4. CONCLUSIONS

The revision and recast of EURATOM legislation is a major undertaking. While the building blocks for the revision are to a large extent completed (natural radiation sources, regulatory control) the actual recast takes up a lot of resources. In addition the Commission is actively involved in the revision of the Inter-Agency Basic Safety Standards. Allowance for the ICRP recommendations and the full integration of natural radiation sources are very challenging. The revised Basic Safety Standards are also an opportunity for more explicit requirements on safety and on the management and disposal of radioactive waste.

The basis for radiation protection requirements on radioactive waste disposal should be the recommendations published by ICRP. The guidance offered in 1998 in Publication 77 and RP 81 is found to be still very useful and fully in conformity with the new general recommendations in Publication 103. The concept of potential exposures needs to be applied with caution, and risk constraints or any other numerical values are to be used as indicators rather than as binding criteria.

5. REFERENCES

[1] "Disposal of Low Activity Radioactive Waste", in Proceedings of an international conference, Cordoba, Spain, 13-17 December 2004, IAEA, Vienna, 2005.