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Ethical Issues in Radiation Protection

– an International Workshop

Statens strålskyddsinstitut

Swedish Radiation Protection Institute

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TITLE: Ethical Issues in Radiation Protection – an International Workshop.

SUMMARY: Ethical theories are relevant to the current recommendations and standards for radiation protection. Radiation protection is not only a matter for science. It is also a problem of philosophy. In order for protection regulations to be respected, it must correspond to widely accepted ethical values among those who are affected by the regulations. The workshop covered the following issues: Problems in Present Protection Policy, ICRP Protection Policy - A Historical Perspective, Radiation Risk - What we know and what we believe, Present ICRP Recommendations, Ethical Values in the Context of ICRP Recommendations, Collective Responsibility for Invisible Harm, Environmental Protection - Ethical Issues, The Global Change of Values, and Procedural Justice and Radiation Protection.

SAMMANFATTNING: De värderingar som finns i samhället – etiska värderingar – är viktiga vid utformandet av strålskyddets principer. Strålskyddet har sin grund inte bara inom medicinen och naturvetenskapen utan även i samhälleliga värderingar såsom i filosofin. Strålskyddets principer måste grundas i allmänt vedertagna värderingar för att accepteras över världen. SSI:s arbetsmöte omfattade områdena: aktuella problem inom strålskyddet, en historisk översikt av ICRP:s strålskyddsrekommendationer , ICRP:s nuvarande strålskyddsrekommendationer, vad vi vet och vad vi tror inom strålskyddet, etiska värderingar inom ICRP:s rekommendationer för strålskydd, det kollektiva ansvaret för osynliga risker, etiska frågor inom miljöskydd för strålning, vad vi vet om värderingsförskjutningar i världen samt strålskydd och processrätt.

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Executive Summary - Ethical Issues in Radiation Protection

Ethical theories are relevant to the current recommendations and standards for radiation protection. Lauriston Taylor, one of the "grand old men" of radiation protection, once wrote 'Radiation protection is not only a matter for science. It is a problem of philosophy, morality, and the utmost wisdom' [ref. 1]. In order for protection legislation to be respected, it must correspond to widely accepted ethical values among those who are affected by the regulations, in addition to other political and social values.

The ICRP principles for radiation protection, as formulated in Publication 60 (Ref. 2), have gained considerable acceptance all over the world as well as among relevant international organizations. However, new directions in radiation protection exist, such as the protection of nature.

In Germany, a second Society for Radiation Protection was established some years ago which opposes the ICRP view of radiation risk. The Society is of the opinion that the radiation risk is far greater than the ICRP estimate. Opposition to the ICRP also comes from the French Science Academy and from some groups of scientists in the USA and Canada as well as from some individual scientists in Poland, Japan, and Sweden. These scientists believe that the ICRP overestimates the radiation risk, which results in radiation protection costs that are too high. Some of these scientists believe that there is a threshold for the radiation risk and some of them also believe that low-dose radiation is beneficial to humans.

Dr Lars-Erik Holm, Director General of SSI, chairman of UNSCEAR and vice chairman of ICRP Main Commission, specified some key ethical issues for future radiation protection:

Protection of humans: Sociologists and economists usually describe the changing trends in values during the 20th century as a shift from individualism to collectivism and back to individualism. Hence, the period of the first three decades of this century was characterized by values focusing on the individual, whereas the 1930s – 1980s bore the stamp of collectivism. This has also been reflected in radiation protection since the 1960s, with the notion that if society is adequately protected, then the individual will also be adequately protected. The present ICRP recommendations emphasize the collective good and harm and apply constraints in optimization to limit the inequity between individuals, while the dose limits prevent unacceptable risks to each individual.

Since the early 1990s there has been an increasing interest of protection of the individual in society as a whole (e.g. litigation, genetic susceptibility of individuals, individual variability etc.). The NIMBY (not in my back-yard) syndrome is another expression of the individualistic perspective in many areas, which is also a common phenomenon in countries in search of a possible site for a repository for spent nuclear fuel.

Therefore, it is clear that societal values change with time, and that the radiation protection philosophy has changed in response to these variations over time. With the increasing focus on the individual, the question of how radiation protection could reflect this renewed interest for the individual must be raised. ICRP is now considering a review of its current recommendations and will have to take the ethical dimensions of radiation protection into consideration within the framework of the societal values of today.

Although the radiation protection terminology consists of a logically structured system, it is at the same time highly technical and theoretical and differs from the terminology used in other areas of protection. This makes it difficult for the public and decision-makers to understand the rationale of the radiation protection philosophy. An important issue today is whether the ICRP should develop an individual-based protection philosophy as outlined in a discussion paper by its chairman, Roger Clarke, on ‘controllable dose’. This paper is now being promulgated for discussion in scientific associations and radiation protection authorities.

According to Clarke [Ref. 3], a controllable is the dose or the sum of the doses to an individual from a particular source that can reasonably be controlled by any means. One effect of such a concept would be to put the primary emphasis for the system of protection on the individual, by adequately restricting the sources that may reasonably be controlled. Clarke believes that it would result in as good a level of protection as exists today for those individuals with any significant level of exposure. It would also provide adequate protection for individuals and society without the present theoretical emphasis on low doses to large numbers of individuals. There may not be a need to distinguish between practices and interventions, nor to distinguish between occupational, public or medical exposures. The same guidance would be equally applicable for the protection of each category.

With the concept of ‘controllable dose’, there would perhaps be no use of collective doses as presently defined, since the concept’s policy of protection ensures that if the most exposed individual is sufficiently protected from a given source, then everyone else is also sufficiently protected from that source. On the other hand, the use of collective doses has many regulatory advantages. The linear, non-threshold hypothesis allows:

*doses within an organ or tissue to be averaged over that organ/tissue,

*doses received at different times to be added, and

*a dose received from one source to be considered independently of the doses received from other sources.

These factors are important in radiation protection since the dose distribution in both time and space are complex.

Protection of the environment: The purpose of the Swedish Radiation Protection Act from 1988 is to protect people, animals and the environment from the harmful effects of radiation. How can animals and the environment be protected? Suffice it to say that it may now be timely and there may now be good scientific reasons to develop an environmental protection policy that is more compatible with those for other environmental agents. It is probably no longer sufficient for radiation protection authorities to state their belief that the standard environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk. Our line of argument should perhaps start with the environment, i.e. if the environment is sufficiently protected, then humans will also be adequately protected.

Professor Bo Lindell, SSI, member emeritus of ICRP, expressed in his speech: Global contamination may expose large numbers of individuals to very small doses but still cause collective doses which are not insignificant. A common argument for cutting off small doses (the *de minimis* argument) is that a situation where the doses are negligible to all exposed individuals must always be acceptable. It is true that the incremental collective dose may be negligible in comparison with collective doses from other sources, *e.g.* natural sources of radiation, but this comparison is not sufficient. The small collective risk should also be related to the *source*. It might be possible, at the source and at low cost, to reduce the collective dose and spare lives. Would this then not be reasonable?

The University of Uppsala Philosopher, Professor Carl-Reinhold Bråkenhielm, who working in the field of research of the future, developed the theme: *Global change of values:* Attitudes to nuclear energy, to reactor safety and nuclear waste management are not formed in a vacuum. They arise against a more general background of beliefs, values and attitudes. When these values change, this change affects the public perception of nuclear technology. If we can predict the future change of values, then we can also predict the change in the attitudes towards nuclear energy. Therefore, knowledge of the global change of values is essential for policy makers and political leadership.

In sum, the global shift of values makes sense of the resistance against nuclear technology - as well as the resistance towards other technologies (such as biotechnology). What is not sufficiently clear on this analysis is why some other technologies - such as IT, space technology, flight technology - get better reviews. Unclear is also why some countries have been more critical than other when it comes to the public discussion.

The American philosopher Professor Kristin Shrader-Frechette of Notre Dame University, Indiana, noted that the science surrounding the linear, non-threshold hypothesis is currently uncertain, and that there is no uncontroversial, factual, substantive way to resolve the difference of opinion. But if the correct position is substantially unclear or uncertain, there are some procedures, which can help to determine what the default rule should be. This solution is appealing because, in general, there are two ways of arriving at a correct social policy. One way, the substantive way, is to know, ahead of time, what the correct policy or outcome is, and then simply implement it because one already knows what is substantively correct. The other way, the procedural way, is useful in situations in which there is no substantive outcome, which is known in advance to be correct. In fact, criteria of pure procedural justice apply when there is no independent criterion for a just decision and when the just decision cannot be specified independently of the procedure for obtaining it. In fact, the practical advantage of procedural criteria for decision-making is that one need not keep track of all circumstances, distributions, and various complexities, in making a decision. Instead one merely specifies procedures for arriving at a just or correct decision, as in a court of law.

In the case of the linear non-threshold hypothesis, there is no independent criterion for whether using it is just, because the science itself is unclear. Therefore, a correct position on the basis of this hypothesis cannot be specified, independently of the procedure for obtaining it.

What would be some hallmarks of a procedurally just decision about the linear, non-threshold hypothesis? First, all of the background conditions would have to be fair. That is, there could be no lying, cheating, or deception in the discussions about the linear, non-threshold hypothesis. Also, the procedurally just decisions would have to be actually carried out or administered by a just series of social institutions. Third, markets would have to be competitive, resources would have to be fully employed, and property and wealth would have to be widely distributed. Fourth, all individuals would have to enjoy the maximum liberty compatible with equal liberty for all, and fifth, all individuals would have equal opportunities. More specifically, to make a procedurally just decision, all the participants in the decision would have to be non-coerced, rational, disinterested, and possessed of equal and full information, and all participants would have to be able to register their considered opinion and be allowed a voice.

First; the only way to insure a non-coerced, disinterested decision, made with full information, and conducted so that everyone has a voice, would be to have persons representing various stakeholders – the public, workers, industry – making the decision about whether to use the linear, non-threshold hypothesis as a default rule. Thus, for example, one procedural condition might be to require that all decision-making or standard-setting? advisory? bodies, dealing with the linear, non-threshold hypothesis, should include representatives of stakeholders, such as labor union personnel, representatives of future generations, representatives of the public, and so on. At present, it is not clear that either the ICRP, the IAEA, or other groups include stakeholders, despite the fact that they are essential for procedurally just decisions and their inclusion has been said to be just as important, by the latest US National Academy of Sciences risk panel, as the inclusion of experts.

Second, in addition to having stakeholder representation in the linear, non-threshold decision, another requirement of procedural justice would be that no member of the decision-making group has information that is not shared and made available to the other members of the group.

There would have to be equal and full information available to all. To the degree that information on radiation risk comes from groups promoting nuclear energy or closely associated with it, it would be necessary to have alternative information, prepared with alternative methodological assumptions, also available, so that the information is balanced.

Third, to the degree that any inequities in property or wealth caused decision-makers to have a particular opinion on the linear, non-threshold hypothesis, then those inequities would have to be compensated, so that the decision is not biased. For example, if there were a body making a recommendation on the linear no threshold hypothesis, then people might need to have their expenses covered, in order to attend the meeting, so that their representative point of view would not go unheard, owing to financial constraints.

Fourth, if a fully free, informed, financially unconstrained, representative body makes a decision on whether to accept the linear, non-threshold hypothesis as the default rule for low-dose exposures, and if this body could not agree on which position to take, then there could be a procedural way to decide about what to do about this indecision. The group itself could decide what amount, if any, would be adequate compensation for special groups, such as workers, who were not given the protection of the linear non-threshold hypothesis. The group could also decide under what conditions people could give their consent to situations in which they are not afforded the protection of the linear, non-threshold hypothesis.

In a review of the ICRP recommendations, *the English radiochemist Dr Deborah Oughton, Department of Chemistry and Biotechnology, Agricultural University of Norway*, underlined her view that the ethical issues are not dealt with explicitly enough. This omission can both cause confusion and result in a risk evaluation policy that simply compares the size of risks and benefits and asks whether dose limits are being exceeded. *The ICRP could promote the ethical evaluation of radiation risks by assigning a more prominent role to ethical principles within its radiation protection framework.*

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Introduction to the Workshop

By Lars Persson

The ICRP principles for radiation protection, as formulated in Publication 60 (1), have gained considerable acceptance all over the world as well as among relevant international organisations. However, some new directions in radiation protection exist, such as the protection of nature, new scientific findings such as the effects of the Auger electron emitters bound to DNA as well as some criticism of the ICRP basic radiation protection principles and their risk estimates.

In Germany, a second Society for Radiation Protection was established which opposes the ICRP view of the radiation risk. The Society is of the opinion that the radiation risk is far greater than the ICRP estimate. The new German Minister for the Environment, Dr Jürgen Trittin, has pronounced some sympathy for their views, which has, however, created a strong reaction from the German-Swiss Radiation Protection Association. Opposition to ICRP also comes from the French Science Academy and from some groups of scientists in the USA and Canada as well as from some individual scientists in Poland, Japan, and Sweden. These scientists believe that the ICRP overestimates the radiation risk, which results in radiation protection costs that are too high. Some of these scientists believe that there is a threshold for the radiation risk and some of them also believe that low-dose radiation is beneficial to humans.

In view of these deliberations, the President of ICRP, Professor Roger Clarke, has sent a discussion paper to IRPA (the International Radiation Protection Association) proposing a radiation protection policy for controllable doses based on the individual. If the individual is sufficiently protected from a single source, this is an adequate criterion for the control of the source. In the past, ICRP has used societal criteria, using the collective dose totalled for all populations and all times in cost-benefit analyses in order to determine the optimum spend on the control of a source. The new approach of Professor Clarke is a totally individual source-related criterion. The proposed principle is: If the risk of harm to the health of the most exposed individual is trivial, then the total risk is trivial - irrespective of how many people are exposed. A copy of Professor Clark’s paper is available to the participants of this meeting.

In the workshop today, the problems that are of an ethical nature in radiation protection will be dealt with from different perspectives. Dr Lars-Erik Holm, DG of SSI and also a member of ICRP Main Commission, will review existing problems in radiation protection. The history of the ICRP Recommendations and the present Recommendations will be described by Professor Lindell, one of the fathers of radiation protection, and Dr Valentin, the Secretary of ICRP. Dr Ulf Bäverstam of SSI will discuss the radiation risk - what we know and what we believe. The new problem of environmental radiation protection will be discussed by Dr Carl-Magnus Larsson, a biologist who has been working for SSI for a few years.

Among us today we have several moral philosophers who have taken time to elaborate philosophical views on the radiation protection policy. Dr Deborah Oughton from Norway and Great Britain will cover the ethical values in radiation protection. She will also propose supplements to the present ICRP policy. Professor Torbjörn Tännsjö, University of Gothenburg will then treat the problem of invisible harm and collective responsibility and Professor Carl-Reinhold Bråkenhielm, Dean of the Theological Faculty of University of Uppsala - the oldest University of Sweden - will lecture on the global change in values which are of importance in establishing new protection principles.

Professor Kristin Shrader-Frechette, Philosopher from the University of Notre Dame in Indiana, USA has, in several books, dealt with different risk factors in this age of nuclear technology such as the nuclear waste problem. She has also recently reviewed, in an article in the American journal, Health Physics, the ethical issues in radiation protection. Today, she will lecture on procedural justice and radiation protection. She has recently received a large NSF grant to study Nuclear Technology and the Ethics of Worker Radiation Risk. I believe that she will receive inspiration and new ideas for her future work today.

At the very end of the day, we will deliberate the new ideas put forward today in a final session under the chairmanship of Dr Lars-Erik Holm. Perhaps, we may reach some preliminary conclusions on the radiation protections principles for the protection of humans in their roles as workers, patients or the members of public and also concerning the problem of the protection of nature.

The discussions at the SSI Workshop today will be very useful for the ICRP in its future work on new recommendations and also for the participant philosophers. Professor K Shrader-Frechette has recently received a grant of 224,000 US$ from the National Science Foundation to study nuclear technology and the ethics of worker radiation risks. Dr Deborah Oughton, now working in Norway, will soon defend a doctoral thesis at the Dep. of Philosophy, Univ. of Oslo with the title: 'Causing cancer? Evaluation of Radiation Risks'.

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Problems in Present Radiation Protection Policy

By Lars-Erik Holm

Ethical theories are relevant to the current recommendations and standards for radiation protection. Lauriston Taylor, one of the nestors of radiation protection, once wrote: Radiation protection is not only a matter for science. It is a problem of philosophy, morality, and the utmost wisdom [1]. In order for protection legislation to be respected, it must correspond to widely accepted ethical values among those who are affected by the regulations, in addition to other political and social values. Some ethical values concerned by protection legislation are that

- the total harm to human health should be minimised,
- the risks should be equitably distributed among the population, and
- sufficient resources should be allocated to the protection of human health.

The values involved may be in conflict with one another and priorities may have to be set as to which values should be given preference.

It is now nearly ten years since the current recommendations of the International Commission on Radiological Protection (ICRP) were published [2]. The starting point of ICRP in its recommendations has not been ethical principles, although they form a conceptual framework for radiation protection based on science and risk assessment as well as on ethics. The primary aim of radiation protection is to provide an appropriate standard of protection and safety for humans without unduly limiting the benefits of practices giving rise to radiation exposure or incurring disproportionate costs in the case of intervention. Three principles are the cornerstones in the radiation protection philosophy

The justification principle requires that the practice should do more good than harm.

The optimisation principle applies to the protection measures applied to each of the sources within a practice, and requires managers to keep radiation exposures as low as reasonably achievable (ALARA), taking into account economic and social factors. The principle of optimisation can be seen as the superior principle of radiation protection. The lowest collective dose could in some instances be achieved if all measures were taken by the same individual, whose radiation dose would then be equal to the collective dose. Optimization could therefore result in high individual doses and dose limits are required to balance protection of the individual against protection of a collective.

The dose-limitation principle limits exposure of individuals to radiation. Doses to individuals must not exceed dose-limits even though the collective dose might be reduced. Because medical exposures are intended to be as low as possible and to provide a direct benefit to the patient, no dose limits are applied to medical exposures.

Radiation protection implicitly uses the concept of **the precautionary principle**. The whole philosophy of protection against radiation-induced stochastic effects is not based on proven harm from radiation, since cancer from radiation at low doses has never been demonstrated conclusively. Rather, it is reasonable to adopt the linear, no-threshold hypothesis if one wishes to take ethical precautions in a situation of uncertainty. Radiation protection also implicitly uses **the substitution principle**, e.g. when recommending the use of ultrasound rather than x rays in diagnostic procedures of the offspring of pregnant women. **The principle of**

protection of future generations means that the foreseeable impact on human health for future generations must not exceed the levels that we accept today.

Structure of radiation protection

The ICRP has established a formal system of radiation protection. It has been developed to allow a complex network of parameters to be treated by a logical system of protection. The structure is as follows

Practices that increase the exposure of people or the number of people exposed
Intervention that decreases the exposures from existing sources
Source-related and individual-related assessments
Classification of types of exposures into occupational, medical and public exposures
Justification of a practice, optimisation of protection, and dose limits
Potential exposure and accident prevention
Emergency planning
Implementation of the recommendations by operating management and regulators.

The ethical principles of the radiation protection philosophy thus deal with different situations of human exposure, i.e. exposure to the general public, medical exposure or occupational exposure. The radiation protection principles sanction higher dose limits for workers than for members of the public (20 mSv per year and 1 mSv per year, respectively). For occupational exposures, the ICRP aims at establishing a level of dose above which the consequences for the individual would be regarded as unacceptable.

As regards medical ethics, the IAEA [3] has argued that the exposure of humans for medical research is not justified unless it is in accordance with the provisions of the Helsinki Declaration and follows the guidelines for its application prepared by the Council for International Organisations of Medical Sciences and the World Health Organisation, and subject to advice of an ethical review committee, or any other institutional body assigned similar functions by national authorities.

Some professional associations have issued a code of professional ethics for their members. This is the case with the American Health Physics Society, and seven of its nine of principles concern factors that could affect radiation protection.

Key Ethical Issues for Future Radiation Protection

Protection of Humans: Sociologists and economists usually describe the changing trends in values during the 20th century as a shift from individualism to collectivism and back to individualism. Hence, the period of the first three decades of this century was characterised by values focusing on the individual, whereas the 1930s B 1980s bore the stamp of collectivism. This has also been reflected in radiation protection since the 1960s, with the notion that if society is adequately protected, then the individual will also be adequately protected. The present ICRP recommendations emphasise the collective good and harm and apply constraints in optimisation to limit the inequity between individuals, while the dose limits prevent unacceptable risks to each individual.

Since the early 1990s there has been an increasing interest of protection of the individual in society as a whole (e.g. litigation, genetic susceptibility of individuals, individual variability etc.). The NIMBY (not in my back-yard syndrome) is another expression of the individualistic perspective in many areas, and which is also a common phenomenon occurring in countries searching for a possible site of a final repository for spent nuclear fuel.

It is thus clear that societal values change with time, and that the radiation protection philosophy has changed in response to these variations over time. With the increasing focus on the individual, the question must be raised how radiation protection could reflect this renewed interest for the individual. ICRP is now considering a review of its current recommendations and shall have to take the ethical dimensions of radiation protection into consideration within the framework of the societal values of today.

Although the radiation protection terminology consists of a logically structured system, it is in the same time highly technical and theoretical and differs from the terminology used in other areas of protection. This makes it difficult for the public and decision makers to understand the rational of the radiation protection philosophy. An important issue today is whether ICRP should develop an individual-based protection philosophy as outlined in a discussion paper by its chairman, Roger Clarke, on “controllable dose”. This paper is now being promulgated for discussion in scientific associations and radiation protection authorities.

According to Clarke [4], a controllable is the dose or the sum of the doses to an individual from a particular source that can reasonably be controlled by whatever means. One effect of such a concept would be to put the primary emphasis for the system of protection on the individual, by adequately restricting the sources that may reasonably be controlled. Clarke believes that it would result in as good a level of protection as today for those individuals with any significant level of exposure. It would also provide adequate protection for individuals and society without the present theoretical emphasis on low doses to large numbers of individuals. There may not be a need to distinguishing between practices and interventions, nor to distinguish between occupational, public or medical exposures. The same guidance would be equally applicable for protection of each category.

With the concept of controllable dose, there would perhaps be no use of collective doses as presently defined, since this concept of policy of protection ensures that if the most exposed individual is sufficiently protected from a given source, then everyone else is also sufficiently protected from that source. On the other hand, the use of collective doses have many regulatory advantages. The linear non-threshold hypothesis allows :

- doses within an organ or tissue to be averaged over that organ/tissue
- doses received at different times to be added
- dose received from one source to be considered independently of the doses received from other sources.

These factors are important in radiation protection since the dose distribution in both time and space are complex.

Protection of the Environment: The purpose of the Swedish Radiation Protection Act from 1988 is to protect people, animals and the environment from harmful effects of radiation. How can animals and the environment be protected? The environmental issue will be discussed by other at this workshop. Suffice it to say that perhaps it is now timely and good scientific reasons to develop an environmental protection policy that is more compatible with those for other environmental agents. It is probably no longer sufficient for radiation protection authorities to state its belief that the standard environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk. We should perhaps instead conduct a line of arguments starting with the environment, i.e. if the environment is sufficiently protected, then humans will also be adequately protected.

The role of economics in radiation protection

The interplay between radiation protection and resources is in general recognised in legislation for the protection of human health. Since many years, any Swedish government authority considering new regulations must also analyse costs, expected benefits and other aspects of the proposed regulations. Direct costs should be stated together with non-quantifiable factors indicated by a valuation of whether their consequences are positive or negative. Applied to radiation protection, this includes discussion of the resources worth spending on preventing a case of serious radiation injury. The optimisation principle and its ALARA concept also take economic and social factors into account.

If a protective measure costs less than 5 million SEK (1 USD=8.4 SEK) per prevented case, the Swedish Radiation Protection Institute considers the measure to be strongly justified. If the cost exceeds 25 million SEK per case, then very strong reasons are required for implementation of the measure. In the intermediate interval, measures are particularly justified if the costs are in the lower end and the total societal cost of the measure is moderately large. The interval 5-25 million SEK per case corresponds to 0.4-2 million SEK per personSv [5].

In poor societies, allocation of large sums of money for specific types of protection may drain resources necessary to sustain life by other means. In such cases, the ethical guideline could be to institute countermeasures if the overall situation for the society concerned is improved, subject to the restrictions of equitable distribution already mentioned. In more affluent societies, resource allocation for radiation protection purposes may entail conflicts with other areas in society. Here, it is reasonable to plead for the largest possible share of the resources to be devoted to protection. Within the overall economic frames given, optimisation would help to get the best protection value for the money, subject again to the constraint of equitable distribution of risks.

Those responsible for planning radiation protection should keep an eye on the expenditures considered reasonable in other areas of protection, and advocate similar expenditures in order to adhere to the ethical values of equity and emphasis on protection. This approach to optimisation must not be at the expense of accepting large individual risks for anyone.

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ICRP Protection Policy — A Historical Perspective

By Bo Lindell

The International Commission on Radiological Protection (ICRP) was established in Stockholm in 1928, although it operated under a different name until 1950. Its first ambition was to prevent radiation injuries to radiologists and nurses who worked with x rays and radium. The injuries that were considered during the first decades were skin damage and destruction of the bloodforming tissues, leading to aplastic anemia, the disease that killed Marie Curie.

In its first publication, ICRP made no statement on dose limitation but recommended working practices that would prevent the feared injuries. These were of the kind that are now called *deterministic* because they inevitably follow the killing of a sufficient number of cells and increase in severity with the radiation dose. However, if the number of cells that are killed is not sufficient, deterministic harm cannot occur. There is therefore a *threshold dose* below which the exposed individuals are safe. Doses below the threshold were called *tolerance doses* and recommendations on dose limitation were first based on a *margin of safety* to the observed threshold doses, a practice which is still common in the protection against toxic substances.

In its recommendations from 1950, published in British Journal of Radiology in 1951, ICRP also recognised the possibility of such deleterious effects as cancer and hereditary harm. The Commission made the following statement: Whilst the values proposed for maximum permissible exposures are such as to involve a risk which is small compared to the other hazards of life, nevertheless in view of the unsatisfactory nature of much of the evidence on which our judgements must be based, coupled with the knowledge that certain radiation effects are irreversible and cumulative, it is strongly recommended that every effort be made to reduce exposures to all types of ionising radiation to the lowest possible level.

The radiation sources to be protected against were still mainly medical x-ray equipment and radium. It is interesting to notice that the Commission wrote about *reduction* rather than *limitation* of exposures; the sources were already there and what could be done for protection was mostly related to the exposed individuals (by protective barriers, shorter exposure time and increased distances). This *individual-related* view of protection is still very common in spite of the fact that the most efficient protection is *source-related*.

It was never assumed that there was a threshold dose for deleterious hereditary effects, which were assumed to occur at random with a probability proportional to the dose in the reproductive organs. In the mid-1950's, epidemiological studies pointed at the possibility that a similar randomness also applied to radiation-induced leukaemia and perhaps even to solid tumours. The recommendation to keep all exposures at the lowest possible level was repeated in ICRP Publications in 1955 (Brit. J. Radiol. Suppl. No. 6), 1959 (ICRP Publication 1) and 1966 (ICRP Publication 9) with slightly changing wording:
1955: "… reduce exposure to all types of ionising radiation to the lowest possible level."
1959: "…that all doses be kept as low as practicable and that any unnecessary exposure be

1966: "…that any unnecessary exposure be avoided and that all doses be kept as low as is readily achievable, economic and social considerations being taken into account."

In its 1955 publication, the Commission for the first time mentioned exposure of the general public after a warning about the possible hereditary consequences from Herman Muller at a meeting in Stockholm in 1952. The Commission recommended that ”in the case of prolonged exposure of a large population, the maximum permissible levels should be reduced by a factor of ten below those accepted for occupational exposure.”

After the demonstration of world-wide radioactive contamination from nuclear weapons tests, it was obvious that the nuclear age would not limit radiation risks to doctors and nurses. In 1956 ICRP adopted more detailed recommendations for protection of the public and now restricted the 1/10 level to those living near nuclear installations. For the entire population a ”genetic dose limit” was envisaged but not yet specified. In 1966 (Publication 1) a provisional limit of 5 rem (50 mSv) per generation was suggested for the genetic dose to the whole population, corresponding to an average of about 1,7 mSv per year, at a time when the most exposed members of the public were protected by an annual dose limit of 5 mSv.

Up to then, when a dose threshold had been taken for granted, it had been possible to describe the situation in ”black and white”. Below the dose limit complete safety had been assumed. Now, Publication 1 introduced paragraphs discussing ”t
Commission made the assumption that there is no ”wholly safe dose of radiation” and that ”in the absence of positive knowledge, the Commission believes that the policy of assuming a risk of injury at low doses is the most reasonable basis for radiation protection”.

This meant a radical policy change. The ”black and white” situation changed into a greyish region where harm could not be absolutely ruled out even though doses were well below thresholds for deterministic effects. Until then workers had been expected to work up to the dose limit without hesitation. The policy of handling waste and releases of radioactive material had been based on the principle of ”dilute and disperse”. High chimneys and long pipelines had made it possible to increase releases without anticipating undue risks to those most exposed, the "critical groups" near an installation. But the number of persons exposed then increased and so did their collective dose and — with the new assumptions — the expected biological detriment.

But if the old limits were not safe, how far should they be reduced? At any level there might be a risk, how far should one go? The recommendation given in paragraph 52 of Publication 9 ("as low as is readily achievable, economic and social considerations being taken into account") did not give sufficient guidance. For this reason the Commission appointed a task group, which in 1973 gave recommendations published in ICRP Publication 22. These recommendations were the basis for the new system of dose limitation adopted in ICRP Publication 26 in 1977.

In Publication 26, three basic principles were recommended:
(a) No practice shall be adopted unless its introduction produces a positive net benefit (justification of practice);
(b) all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account (optimisation of protection);
(c) the dose (…) to individuals shall not exceed the limits recommended for the appropriate circumstances by the Commission (individual dose limitation).

Principle (b) implies maximising the net benefit of the practice. The task group had suggested that this could be done by means of differential cost benefit analysis, minimising the sum of protection costs and the radiation detriment expressed in monetary terms. Since the detriment was assumed to be proportional to the collective dose, this implied a monetary equivalent to the collective dose. Maximising the net benefit may also be seen as an application of *utilitarian* ethics.

The purpose of principle (c) was to prevent that optimisation of protection would be achieved at the cost of undue risks to the most exposed individuals. This dose and risk limitation may be seen as an application of *deontological* ethics.

Optimisation of protection as described in Publication 26 called for *source-related* protection. This was now achievable because the main problem was no longer existing installations but new installations for which radiation protection could be considered already at the stages of planning and design.

Using cost-benefit analysis for the purposes of protection optimisation implies a monetary ”value” of a human life. In 1983 this caused concern in the Vatican, since the costing of collective doses, and hence also of lives, seemed to be questionable from the ethical point of view. However, a Study Croup appointed by the Pontifical Academy of Sciences draw the conclusion that

…it has nothing to do with valuation of human lives. It must be stressed that the net result of optimisation is to reduce doses *below* the dose limits. It is the responsibility of the protection authorities to seek society’s acceptance of a level of radiation protection which is the highest possible without conflict with other legitimate needs and duties of society.

In other words: the group found that the ethical issue is related to the allocation of money for protection rather than to the *method* for optimisation, which they considered acceptable.

The basic policy behind the ICRP system of dose limitation was maintained in the preparation of the present recommendations in ICRP Publication 60 from 1991, but the dose limits were somewhat reduced. What is not always appreciated is that the magnitude of the ICRP dose limits does not reflect the protection ambition. That is rather reflected by *source-related authorised limits* usually much lower than the primary dose limits, recognising also the requirements indicated by protection optimisation. In the old days the dose limit was operative. At present the primary dose limit — which is individual-related — only indicates the border-line to doses which, under normal circumstances, can never be acceptable. But doses below the dose limit are no longer automatically acceptable, the situation is not acceptable unless protection has been optimised and special source-related limits, called dose constraints, are respected.

The occupational and public dose limits recommended by ICRP are different. This fact has caused questions about the ethical justification: why should workers be permitted higher doses than members of the public? But the historical development has been the opposite, starting with limits for workers, so an equally relevant question could be: why should workers also be permitted an additional, equally high dose as members of the public? For clarity, ICRP now avoids talking about ”workers” and ”members of the public” as two different groups. Most adult people are workers *and* members of the public. It is more appropriate to say that anybody, during a life-time, may be subject to both occupational and public exposures and that there is no obvious logical reason why these two exposures should be equal.

Differential cost-benefit analysis based on reduction of the collective dose is not synonymous with optimisation of protection but only *one* of the possible methods to provide the necessary input. The use of the collective dose implies the assumption of a linear, non-threshold relation between the radiation dose and the probability of stochastic harm. At low doses this assumption can never be proved and it has therefore often been challenged. However, ICRP considers it to be the most likely assumption; furthermore the precautionary principle makes it appropriate.

Global contamination may expose large numbers of individuals to very small doses but still cause collective doses which are not insignificant. A common argument for cutting off small doses (the *de minimis* argument) is that a situation where the doses are negligible to all exposed individuals must always be acceptable. It is true that the incremental collective dose may be negligible in comparison with collective doses from other sources, *e.g.* natural sources of radiation, but this comparison is not sufficient. The small collective risk should also be related to the *source*. It might be possible, at the source and at low cost, to reduce the collective dose and spare lives. Would this then not be reasonable?

Present ICRP recommendations

By Jack Valentin

ICRP, the International Commission on Radiological Protection, is an advisory body providing recommendations and guidance on radiation protection. It was founded in 1928 in Stockholm by the International Society of Radiology (ISR), with Rolf Sievert as one of the Founder Members of what was then called the ‘International X-ray and Radium Protection Committee’. In 1950, it was restructured to better take account of uses of radiation outside the medical area, and given its present name. It is an Independent Registered Charity in the United Kingdom, where its funds are held, and currently has its small Scientific Secretariat in Sweden.

According to its constitution, ICRP is established to advance for the public benefit the science of Radiological Protection, in particular by providing Recommendations and guidance on all aspects of radiation protection. In preparing its recommendations, ICRP considers the fundamental principles and quantitative bases upon which appropriate radiation protection measures can be established, while leaving to the various national protection bodies the responsibility of formulating the specific advice, codes of practice, or regulations that are best suited to the needs of their individual countries.

The activities of ICRP are financed mainly by voluntary contributions from national and international bodies with an interest in radiological protection. Some additional funds accrue from royalties on ICRP publications.

ICRP has always been an advisory body, offering its recommendations to regulatory and advisory agencies. In addition, ICRP hopes that its advice is of help to management and professional staff with responsibilities for radiological protection. No international organisation and no country is obliged to follow the recommendations of ICRP; that most organisations and countries do follow them shows that they find the recommendations suitable.

ICRP is composed of a Main Commission and four standing Committees on Radiation effects, on Doses from radiation exposure, on Protection in medicine, and on the Application of ICRP recommendations. The Main Commission consists of twelve members and a Chairman (currently Professor R H Clarke, UK).

Like other scientific academies, the Commission elects its own members, under rules that are subject to the approval of ISR. Renewal is assured in that 3 to 5 members must be changed every fourth year. Committees typically comprise 15-20 members. Biologists and medical doctors dominate the current membership; physicists are also well represented.

ICRP uses Task Groups (performing defined tasks) and Working Parties (developing ideas) to prepare its reports. A Task Group usually contains a majority of specialists from outside the ICRP membership.

Thus, ICRP is an independent international network of specialists in various fields of radiological protection. At any one time, about one hundred eminent scientists are actively involved in the work of ICRP.

Ionising radiation

There are many different sources of ionising radiation. For members of the general public, by far the most important sources are natural ones (cosmic rays and naturally occurring radioisotopes) and technologically enhanced natural sources (e.g. radon in dwellings).

There are also many different kinds of ionising radiation. One type consists of particles, such as α, β, or neutrons. Another type of ionising radiation consists of electromagnetic wave motions, or photons, such as γ or x rays. Different kinds of radiation cause similar biological endpoints, but they may have vastly differing biological efficiencies.

Furthermore, different parts of the body react in different ways to ionising radiation, and different tissues have differing sensitivities.

Therefore, measurements of absorbed radiation energy alone are not sufficient to evaluate biomedical risks of radiation. ICRP has defined a protection quantity, the *effective dose*, which is weighted for the type of radiation involved and for tissue or organ sensitivity of the exposed parts of the irradiated organism. For intakes of radionuclides, the physiology and retention time in the body are also taken into account.

For radioactive substances, there are two types of radiation measurement. *Activity*, measured in becquerels, describes the size of the source. *Effective dose*, measured in sieverts, describes the effect on the irradiated organism. The dose is not a simple function of activity. One needs to know the radioactive substance, the distance from source to irradiated organism (or the intake route), the time of the irradiation, the presence or otherwise of shielding objects, etc. The becquerel is a very small unit. In other words, trivial amounts of radioactive substance must sometimes be described by what appears to a layman to be a very large number.

The average annual effective dose to members of the public is usually in the order of 4 millisievert (mSv), of which about 2.5 mSv natural background and radon, 1-2 mSv medical diagnosis and treatment (less in developing countries), and less than 0.1 mSv all other sources combined. Radiation workers would typically be exposed to between a fraction of a mSv and a few mSv in addition to that from their occupation.

Risks of late harm

Through its genotoxic action of producing DNA mutations, radiation can cause cancer and genetic damage with a probability that depends on the dose. In addition, high doses can cause other, more immediate types of harm, which are inevitable if the dose is high enough to cause massive cell killing. However, such high doses occur only in accidents and in radiotherapy (where it is desired to kill tumour cells).

Classically, no one is affected by low doses of a noxious agent, but above a threshold that may vary slightly between individuals, everybody is affected. This relationship applies to high dose effects of radiation, such as skin burns.

Genotoxically induced late harm due to radiation does not follow this pattern. Instead, the excess probability of contracting cancer after irradiation is more or less proportional to dose, at least at moderate doses. At quite low doses, below, say, 50 mSv, i.e. in the ranges encountered by the public or in normal work with radiation, inherent limitations of resolution mean that epidemiological investigations are unlikely to ever prove the exact shape of the dose-response relationship. Instead, such conclusions must be based on analogies and laboratory experiments.

ICRP considers that a linear, no threshold dose response relationship is likely to be a good approximation of the true conditions at low doses. In other words, not even the smallest dose of radiation is regarded as entirely ‘safe’.

That interpretation is rather hotly questioned by a number of scientists who would like to see a threshold and a zero risk (or even a beneficial effect) at very low doses. Those scientists fear that much effort and funds are spent unnecessarily on non-existing problems. However, ICRP feels that the evidence in favour of risks in proportion to the dose even at very low doses is convincing.

There are also proponents of the opposite position, claiming that radiation could be more dangerous per unit dose at very small doses than at moderate doses. ICRP does not find the arguments in favour of that position very compelling. Epidemiological evidence also sets an upper limit on the total risk that could possibly exist, not very far above present estimates.

For members of the public, ICRP currently assesses the probability of fatal cancer due to radiation to be in the order of 5 % per 1 000 person mSv (assuming a collective dose comprising low individual doses to many persons). In addition, ICRP suggests that non-fatal cancers and genetic disease should be taken into account in risk assessments. For such diseases, the severity must be taken into account - it is obviously less traumatic to survive a cancer than to die from one.

Any system of weighting for severity must involve a subjective component. With the ICRP weighting, non-fatal cancers and genetic effects are regarded as corresponding to a further 2.3 % deaths per personSv, and therefore the total detriment from all cancers and genetic disease to be 7.3 % per personSv. For radiation workers, a somewhat smaller detriment coefficient of 5.6 % is assumed (primarily because there are no children among radiation workers).

Protection against radiation risks

Since no dose is regarded as safe, dose limits cannot delineate dangerous from safe and are not efficient as tools to minimise radiation risks. Instead, ICRP has devised an ethically based three-tier system of radiation protection. According to this, no additional dose should be tolerated unless justified in that there is an associated benefit that outweighs the risk. Doses are to be kept *as low as reasonably achievable*; i.e. it is not enough that doses are below legal limits, instead optimised protection normally leads to doses much below the dose limits. Limits are needed to ensure equitable distribution of risk, and may be useful as a regulatory instrument, but they are not the primary means to reduce risks.

The principles of justification and optimisation aim at doing more good than harm and at maximising the margin of good over harm. They therefore satisfy the utilitarian principle of ethics, whereby actions are judged by their consequences.

The aim of dose limitation is to ensure that no individual is exposed to undue harm. That principle therefore satisfies the deontological principle of ethics, according to which some duties are imperative.

The ICRP principles of radiological protection have evolved considerably with time. The first, 1928, general Recommendations of ICRP were only devised in order to prevent high dose effects. After several successive updates and shifted priorities, in 1977 ICRP Recommendations drew the full consequences of the linear, no-threshold model, and observed that dose limits are not a means to keep doses low but simply values that should not be exceeded. The actual mechanism to keep doses low is optimisation, to as low doses as reasonably achievable.

The current, 1990, Recommendations, *ICRP Publication 60*, reflected new data that indicated a probably higher risk of stochastic late harm per unit dose than previously assumed. Because of that increased risk estimate, the 1990 Recommendations also reduced the dose limits from 50 to 20 mSv for workers and from 5 to 1 mSv for members of the public (both as 5 year averages). It is important that reduced dose limits were not regarded as a tool to reduce doses in general; it just meant that the borderline between barely tolerable and always unacceptable moved down. Instead, reduction of doses in general (much below the dose limits) came about because of the increased risk figures. They meant that measures that had previously appeared disproportionately expensive now became reasonable alternatives in optimisation.

The 1990 Recommendations also clarified some other matters. One was the clear distinction between practices, where usually radiation from artificial sources is added, and interventions, where radiation (often from natural sources) is removed. The Recommendations also discussed potential exposures from accidents, as opposed to those exposures that are nearly certain to occur.

Plans for the future

The possible need for a Consolidated and Recapitulated set of new Recommendations is currently being contemplated by ICRP. If such a project materialises as a Task Group, a possible target date might be in 2005.

We are all continuously exposed to inevitable radiation, and therefore only a part of the dose to a person is controllable. In practices, the added dose can be constrained or the practice might never be permitted to start. In interventions, only a certain amount of dose can be averted by means of the intervention.

Persons debating dose limits for members of the public sometimes overlook these facts. In fact, the dose limit for the public is not a particularly useful tool. Since members of the public are exposed to a sum of small dose contributions from many sources, superimposed on background and medical doses, it would not do for any operation, practice or licensee to cause exposures by more than a small fraction of the dose limit. Instead, only national regulatory bodies could use dose limits for the public, as an input to set source-related dose constraints that would apply to a specific operation or practice. Perhaps if a 2005 set of new Recommendations is arranged, that may address these topics in order to elucidate practical applications of the ICRP principles for the protection of the general public.

Furthermore, ICRP continues to regularly issue guidance on the application of its recommendations. Reports on Genetic susceptibility to cancer and on Doses from new radiopharmaceuticals are currently being printed.

Some eight ongoing tasks are expected to be completed during the next two years. One project, very close to completion, concerns the possible influence of radiation on the incidence of multifactorial hereditary diseases. Two projects aim to compile age-dependent doses to members of the public from intakes of radionuclides. One of those tasks concerns 'doses to *i.e.* effective dose to the offspring from radionuclides ingested or inhaled by the mother before and during pregnancy. Another task is intended to provide a discussion of general values of effective dose coefficients for populations and their reliability.

Another project is intended to update and extend the data on 'Reference Man' given in *ICRP Publication 23* on parameters for use in dosimetry and on biokinetic models for the metabolism and excretion of incorporated radionuclides. A first report on the skeleton, *ICRP Publication 70*, was published in 1995. A report on Anatomy, physiology, and elemental composition is under way. A third report on the Digestive system is expected to follow later. A project on the Respiratory Tract Model of ICRP is intended to produce a Technical Document serving as a

User Guide offering advice on the application of the Human respiratory tract model described in *ICRP Publication 66* from 1994.

The aim of a project on ‘chronic’ (persistent) exposure is to develop recommendations concerning the application and withdrawal of countermeasures in exposure situations arising from the long-term presence of radioactive materials in the environment, and the management of the residual exposures after the withdrawal of countermeasures. A further project aims to review existing recommendations on radiological protection for disposal of long-lived solid radioactive waste, such as spent nuclear fuel. Previous advice (in *ICRP Publication 46* from 1985) is still regarded as valid, but there is a need to consider its overall usefulness to decision-makers.

In addition, a number of new projects were started in 1998. These include Cancer risk at low doses, Radiation risks to the embryo/foetus, Quality factors and RBE, further Doses from radiopharmaceuticals, Dose coefficients for external radiation, Pregnancy in medical practice, Patient safety in radiotherapy, and Interventional procedures. Other areas are constantly being monitored for possible later inclusion into the ICRP work programme.

Ethical Values in the Context of ICRP Recommendations

By Deborah H. Oughton

It is widely acknowledged that authorities need to pay attention to economic and social factors in the management of radiation risks. Since science cannot identify a «safe» level of exposure, radiation protection is based on the question of what exposures are «acceptable», a decision that will also depend on ethical issues. ICRP has noted the ethical complexities of risk evaluation, noting, for example, that the problem of risk and benefit "distributed over different populations at different times is complex, at least from an ethical viewpoint" [ICRP 37, p 21, §98] and stressing the need to be aware of the ethical implications of value-judgements and decision-making methods in radiological protection [ICRP, 1993a, §16]. But, at present, recommendations are rather vague as to what these ethical values might represent or how they might be incorporated in the management of radiation risks. This omission can both cause confusion and result in a risk evaluation policy which simply compares the size of risks and benefits and asks whether dose limits are being exceeded. ICRP could promote ethical evaluation of radiation risks by assigning a more prominent role to ethical principles within its radiation protection framework. One can identify three questions for policy:

- What issues are relevant to an ethical evaluation of risk?
- To what extent are these issues are incorporated in current radiation protection policy?
- How might they be promoted or made more transparent in decision making?

Ethically Relevant Factors in Risk Evaluation

An ethical evaluation of radiation risks should ask questions in addition to what the size of the dose or risk is. Many facts about radiation risks reflect values that are ethically relevant to decisions about the acceptability of risk. Such questions might include:

- Do the benefits outweigh the costs?
- Is the distribution of risk and benefit equitable?
- Has the person given consent to the risk?

- Have people been involved in the decision making process?
- Is there a viable alternative to the imposition of risk?
- Does the person have control over the risk?
- Has the person been compensated for the risk?

Although a future policy revision might lead to a change from the existing three stage philosophy of radiation protection, a useful point of departure is to consider the extent to which the three existing principles address these issues.

The Justification Principle

The justification principle calls that risk evaluation needs to balance benefits against cost, which is line with the ethical principle that one should «do more good than harm». However, it should be made clear that a practice that does produce sufficient benefit to offset the radiation detriment might be justified, net benefit is not usually adequate grounds in itself to deem a practice ethically justifiable. The main problems with justification include the following:

- The principle can be misinterpreted to mean that all actions having an expected net benefit can be justified.
- The difficulties in showing that benefits outweigh the costs. Risk and benefit prognoses are often associated with large uncertainties and errors.
- There is little guidance as to who should make the decision (stakeholder participation or expert judgement) and where the burden of proof to show that benefits outweigh risks should lie.

The Principle of Optimisation

Criticisms of the optimisation and ALARA principles range from allegations that the economic clause results in authorities putting a «price on a life» to concern that the as-low-as-reasonably-achievable criteria is responsible for the investment of excessive funds to reduce trivial risks. Both these can be traced to misinterpretation of the principle, rather than a direct consequence. There are strong ethical grounds for retaining the notion of «doing much good as possible» in radiation protection policy. A problem is that authorities often appear to pursue cost-effectiveness in favour of an equitable distribution of risks and benefits. The distribution of dose, risk and benefits, can vary both vary over populations, between countries, and as a function of time. Ethically justifiable policies need to evaluate both cost-effectiveness and the distribution of risks and benefits. When exposures are deemed too costly to reduce, this need not preclude the importance of compensation, consent and due process to redress any remaining imbalance.

Dose and Risk Limits

Dose limits are a central part of radiation protection, and are necessary both for practical purposes and public reassurance. They are, however, open to attack both from parties who feel the limits are too low, and factions who claim they are too high. This can, in part, be traced to the apparent inconsistency in dose limits in under different circumstances. For example, there are variable limits for workers and the public; for nuclear power, medicine and radon, and for accidental and routine situations. Other issues that must be kept in mind is the fact that equal dose does not necessarily entail equal risk, that legally-binding limits should be based on measurable quantities and that limits are usually only related to humans and not to other species.

From the point of ethics, distinctions in dose limits between workers and the general public should be grounded in ethically relevant factors such as personal benefit, consent, control and compensation. There are ethical grounds for distinctions between practice and intervention situations (the former reflecting imposed exposure of individuals receiving no direct personal benefit from the action), but coherent and stronger limits should exist for all intervention situations, natural and anthropogenic.

The Global Change of Values

By Carl Reinhold Bråkenhielm

Attitudes to nuclear energy, to reactor safety and nuclear waste management are not formed in a vacuum. They arise against a more general background of beliefs, values and attitudes. When these values change, this change affects the public perception of nuclear technology. If we can predict the future change of values, then we can also predict the change in the attitudes towards nuclear energy. Therefore, knowledge of the global change of values is essential for policy makers and political leadership.

This may be the reason - or one of the reasons - for giving attention to a theme such as The Global Change of Values at this Workshop on Ethical Issues in Radiation Protection. It is, however, a reason which I think it is necessary to question; at least necessary to discuss. My general thesis would be that perception of risks, let alone radiation risks from nuclear reactors or nuclear waste are shaped by a combination of factors. Running the risk of cutting the branch upon which I'm sitting, it is still necessary to remind you of what social psychologist label the *fundamental attribution error* (Lippa 1994). This is the tendency to overemphasise internal and underemphasise external causes. Situational setting and social roles usually affect behaviour and attitudes stronger than we are ready to admit. In short: situational factors, social, political and cultural, are - besides changing values - of central significance for understanding the public perception of nuclear technology.

This does not imply that internal values - and the change of such values - are without importance for the understanding of risk-perception. But we need to give values a proper place in the dynamic of attitude-formation. Needless to say, this is a difficult task, and for some very obvious *conceptual* reasons. What is a ”value”? What is it to ”evaluate something”? In what way do values ”change”?

My easy way out is to say that people express judgements about values they *either* express their preferences, the goals, ideals or things they desire. *Or* they say something about that which *ought to* be desired. There is an obvious tension here, i.e. a tension between individual or socially shared preferences on the one hand and moral judgements on the other. In moral judgement *we take a stand about our preferences* (Harding, Phillips & Fogarty 1986, introduction).

Inglehart´s analysis of contemporary culture shift

These judgements change and affect our attitudes and actions in a certain way. If you think that scientific advances will help rather than harm mankind, then it is more likely that you will find the problems of nuclear waste technically manageable. Similarly, value shift may have certain consequences. Ronald Inglehart is a scholar and sociologist, who has studied cultural change on the international level through the World Values Surveys, a data-base that provides insight into valuestructures in a wide range of countries around the world. In an earlier study he concluded that there is a change from Materialist to Post-materialist values. Post-materialists believe in ideas and celebrate personal relationships, want a say in their jobs, freedom of speech, beautiful cities and a society in harmony with nature. Materialists favour law and order, economic growth and strong defence forces. Inglehart previous studies (e.g. Inglehart 1990) has demonstrated that (1) there is a global shift from Materialist to Post-materialist values, (2) this shift is strongly related to the emergence of democracy and (3) Post-materialist values are even negatively linked to emphasis on economic growth (Inglehart 1997, p. 224).

In his earlier studies, Inglehart has claimed that in this perspective, the struggle over nuclear power is ”a clash of worldviews”. And he continues: For materialists, the use of nuclear energy is viewed as desirable insofar as it seems linked to economic growth and full employment. For them, highly developed science and industry symbolise progress and prosperity. Among postmaterialists, nuclear power tends to be rejected *not only because of its potential dangers but because it is linked with big business, big science and big government-bureaucratic organisations that are evaluated negatively because they are inherently impersonal and hierarchical, minimising individual self-expression and human contact.* The ideologues of the antinuclear movement argue for a return to a simpler, more human society in which energy is used sparingly and what is needed comes directly from nature - symbolised by solar power…(Inglehart 1990, p. 268 f., my italics)

In his new book, *Modernisation and Postmodernization* (1997), Inglehart argues that the trend towards postmaterialism is a part of a larger trend towards post-modern values.

Postmaterialists values belong to a larger complex of values among which a high estimation of personal well-being, health and life-satisfaction. This complex of values stand in sharp contrast to survival values where hard work, money, trust in science and technology are essential. The move away from these survival values towards the values of individual well-being is what Inglehart labels p*ostmodernization*.

There is no doubt that this global change of values illuminates certain aspects of the public perception of nuclear energy. Still, I would argue that this analysis must be complemented with two other perspectives, namely other larger contexts such as the decline of utopian visions, the end of the cold war period and disenchantment with expertise, and other more restricted contexts - such as, for example, the Swedish case - which account for the unique impact of public debate on political-technological decision-making.

The first perspective provides a larger picture; the second is concerned with contextually significant factors for the understanding of attitudes towards nuclear energy. Let me (inspired by Bauer 1995) comment on each of them.

Larger contexts affecting public perception of nuclear technology

Besides shift in cultural values Bauer points to three other features of the post war period (latter half of 20th century) which may explain attitudes to different technologies, for example nuclear technology.

Decline of utopian visions. The last waves of utopianism that motivated the 1968 protests have calmed down. The equation of progress and new technology is not taken for granted. In a survey 1997 among the general adult public in Sweden over 60 percent agreed with the proposition that technological development in the long run will *harm* humanity (n=1336). Women are a little more pessimistic than men. Interestingly, nearly 70 % affirmed that development goes forward in spite of temporary set backs. Belief in progress prevails, but it is not a belief in progress *through technology*. This links up with Inglehart´s analysis of postmodernization. There is a global tendency to look for other forms of improvements than technological and economic progress. Inglehart explains this in the following way:

It reflects the fact that, as given nations become advanced industrial societies, they reach a point of demising marginal utility at which maximising economic gains (for the individual) or economic growth (for society) no longer results in higher levels of subjective well-being…From this perspective, it is perfectly rational to cease making economic efficiency and economic growth top priorities, and give increasing emphasis to quality of life concerns. (Inglehart 1998, p. 87).

Similarly, technological progress has also reached a point of diminishing marginal utility. The utility of the latest computer software is small in comparison to the introduction of the first word processing programme. In a similar vein, the interest of the general public to pay the costs and take the risk for a new generation of nuclear reactors can also be expected to diminish.

End of the Cold War. The mobilisation of science and technology to ensure a balance between military forces framed the public debates in the public debates of many Western countries (less so in Sweden). National security could be used as a means to whitewash mismanagement and technological failures. Research programmes could be conducted secretly in a way that is not possible any longer. The lack of democratic decision-making on grounds of national security is no longer credible; the end of the cold war strengthens the aspirations of many groups to have a say (Bauer 1995, p. 11).

Disenchantment with expertise. Bauer writes: Technocracy is not a socially acceptable form of government. The idea of technocracy is a modern idea, and equally the struggle against technocracy is part of modernity; resistance is part of this parallel process to secure freedom of choice. (Bauer 1995, p. 12).

Resistance against nuclear energy is not the only form of resistance. It can be compared to the resistance against biotechnology. Both these forms of resistance are important in many ”green” parties through Europe. Worth noticing in this context is two things: (1) it is not mainly the product or the service that is the focus of criticism. It is rather the process of technological development and the political decisionmaking involved: deceits and lies; manipulation and exclusion; pollution and exploitation; expert conspiracy; the unequal distribution of risks. (2) Some forms of technology seem largely exempted from criticism. Compare, for example, the strong resistance against nuclear energy with the acceptance, even devotion, of information technology. (Writes Dorothy Nelkin).

Many years ago, George Orwell predicted that the information technologies would bring about an era of mind-control; but the symbolic year, 1984, came and went as if his scenario were only a science fiction plot. While there have been many critiques of information technologies, they mainly come from an elite, sociologists, ethicists and others professionally concerned about the problematic legal, social and political implications of electronic technologies. (Bauer 1995, p. 380).

Compare this to the public opposition against biotechnology, let alone nuclear energy! The positive benefits of these technologies has been overshadowed by their risks and political fears.

Local contexts of significance for public perception of nuclear technology

Resistance to nuclear energy may be interpreted against the background of global value shifts and other larger trends. But the particular social and political context is also of importance, even if it is hard to assess its relative weight. Kristine Bruland - a Norwegian historian - has given a special analysis of the history of resistance to nuclear technology in Sweden (see Bauer 1995, p. 139-143). It is not possible to go into all the details of her analysis, but one thing might be interesting to consider. Bruland notes that Sweden had the world's largest nuclear programme by the early 1970s (in terms of per capita expenditure). The nuclear system did not come under serious public debate until the mid 1970s. What changed the public perception of risks? Bruland argues that one factor was the failure of the Marviken project in 1970. The overall technocratic confidence in nuclear power was shaken. In a sense the discussion was rapidly ”re-technicized”, because much of the risks (reactor risks as well as the risk of nuclear waste disposal) required technical assessments based on engineering expertise. But now ”the cat was out of the hat” and the legitimacy of nuclear engineers was not readily accepted. Moreover, they contradicted each other! The Swedish actor Tage Danielsson´s famous satire 1979 on the probability of a nuclear melt-down was like the last nail in the coffin of technological optimism. So within a decade there was in Sweden a shift in the public perception of nuclear energy - and the incident at Harrisburg made this shift even more convincing.

In sum, the global shift of values makes sense of the resistance against nuclear technology - as well as the resistance towards other technologies (such as biotechnology). What is not sufficiently clear on this analysis is why some other technologies - such as IT, space technology, flight technology - get better reviews. Unclear is also why some countries have been more critical than other when it comes to the public discussion. Sweden is a unique case of a major industrial society making a major technology decision via public debate and a national referendum. If Karen Bruland is correct, ”local” factors are at work, which seems to work in the same direction as the effects of a global change of values.

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Procedural Justice and Radiation Protection

By Kristin Shrader-Frechette

Radiation protection is a difficult undertaking, in part because contemporary people are so balkanized, so organized into extreme positions regarding ionizing radiation. Environmental hypochondriacs, on the one hand, fear all radiation, even the radiation that is necessary for medical and industrial processes, even radiation that is, on balance, beneficial. Environmental hypochondriacs, for example, might oppose mammogram screening or any dental X-rays. Industrial cannibals, on the other hand, have a laissez-faire attitude to radiation, even though carelessness with radiation can cause needless cancer risks. Environmental cannibals seek to maximize profits, regardless of the human costs or risks associated with their profiteering. Several years ago, for example, when I took our daughter to have sinus x-rays, I discovered that one hospital in town took twice as many pictures, with double and head exposure, as every other hospital in town, when all hospitals used the same prescription? My conclusion was that this hospital was guilty of industrial cannibalism. It took only patients with insurance, collected more insurance for more x-rays, and therefore took more x-rays in order to maximize profits.

Everyone knows that environmental hypochondriacs and industrial cannibals are extremists (see Shrader-Frechette 1994; Shrader-Frechette and Persson 1997; and Persson 1996). The question is how to develop a reasonable, middle position that avoids these extreme responses to radiation protection.

The Battle over Low-Dose Radiation

An analogous battle is arising today over default rules for cases of uncertainty in regulating low-dose ionizing radiation. Should one presuppose that the linear, no-threshold hypothesis is the default rule, or that some threshold hypothesis should be the default rule? Of course, one can debate this issue on scientific grounds, but if there were a conclusive scientific answer to questions of low-dose exposure, hormesis, and possible repair after minimal exposures, there would be no controversy. Hence the need for a default rule. The current conflict over low-dose exposures also is characterized by extreme positions that make it difficult to resolve. One important battle is between the anarchists and the autocrats.

Anarchists contribute to societal disorder because they rebel against any way of standardizing behavior or establishing government regulations, such as regulations about the environment. They paralyze society and make it impossible for government or industry to act. Autocrats, on the other hand, cause societal dissensus because they claim unlimited authority over others, even in cases where citizens have rights to self determination. Their presumption of absolute authority causes conflict in a democracy.

In the case of radiation protection, anarchists believe that no one should have the right to make radiation regulations that affect them, unless they individually have consented to the regulations. Hence they attempt, for example, to block or shut down food-irradiation facilities even though they themselves need not buy irradiated food. The anarchists presuppose that regulation, in a democracy, never requires compromise. They hold society hostage to their individual whims and beliefs. Even though no radiation remains in irradiated food, and even though there are zero or negligible exposures associated with food irradiation, anarchists want to prevent food irradiation for everyone. The anarchist position, on default rules for low-dose irradiation, is that unless everyone in society agrees to particular low-dose exposures, no one ought to be subjected to low-dose radiation, beyond background exposures, without consent.

Autocrats, on the other hand, believe that they have the right to set radiation standards in such a way that they define all low-dose exposures as negligible. They presume that they have the right to decide what risks may be imposed on others without their consent, precisely because the risks are allegedly negligible.

Given these two extreme positions, those of the anarchists and the autocrats, how is one to come to a reasonable and ethical decision about radiation protection, particularly in the case of low-dose exposures? I have two suggestions. The first is to survey what goes wrong in each of the extreme positions, that of the anarchists and that of the autocrats. The second suggestion is to attempt to solve the problem of low-dose exposure by <u>procedural</u> means since there is a substantive impasse blocking resolution of the conflict.

Let us begin to investigate the first suggestion by seeing where the arguments of the anarchists and the autocrats go wrong on the low-dose question. Consider first two of the flawed arguments of the anarchists. I call them, respectively, the Zero-Tolerance Argument and the Vested-Interests Argument.

How the Anarchists Go Wrong

When anarchists use the Zero-Tolerance Argument, they claim that no one, anywhere, should be able to impose on them any level of avoidable risk without their explicit, individual consent. On these grounds, they reject any additional low-dose exposures to ionizing radiation on the grounds that they have not consented to them, and they draw no personal benefits from them. The major flaw in their argument, of course, is that anarchists forget that in a democracy, not everyone's opinion can be conclusive, although everyone's interests ought to be considered. If everyone reserved the right to control all societal decisions, no decisions could ever be made. If the anarchists were right about societal consent, then there would be no solution to the problem of social choice, because there would be no way to resolve societal conflicts. As a result, democracy would be impossible, and society would be paralyzed, unable to act. Obviously all these negative consequences would make any society impossible. And if so, then such consequences are enough to show that the anarchists do not have to give their personal consent to societal low-dose exposures. Zero tolerance for radiation risks is an impossible and unrealistic goal.

When anarchists use the Vested-Interests Argument, they claim that they ought not be exposed to any allegedly trivial amount of ionizing radiation, because allowing such exposures benefits those who profit from, and use, radiation. Moreover, they claim that no nuclear expert and no industry scientist ought to be believed in his argument, that low-dose ionizing radiation can be negligible, because all such persons have vested interests. While anarchists are right to be concerned about different motives of various people, one can never confirm motives, and it is as assumption to attribute motives to anyone. Likewise it is an assumption that all radiation experts are biased. To the degree that it employs such incorrect assumptions, the argument amounts to an ad hominem. That is, the very assumption of bias on the part of others is itself biased insofar as it is not always the case, and it cannot be proved. Thus the anarchists fall victim to the very vested interests that they attribute to radiation experts. Anarchists also err in committing the genetic fallacy, in assuming that the origin of a position or an argument therefore determines the validity of the argument. The error, of course, is in not evaluating the argument itself and instead attempting to evaluate the person who gives the argument. This attempt is always dangerous because sometimes even dull people have good arguments, and sometimes even brilliant people say stupid things. And if so, then it makes no sense for anarchists to support the linear, no-threshold hypothesis, merely on the grounds that those with alleged vested interests reject it.

How the Autocrats Go Wrong

Just as the anarchists often have logically flawed arguments in accepting the linear, no-threshold position, as a default rule, so also the autocrats often err in rejecting the linear, no-threshold argument. Consider two of their common arguments. I call them the Paternalistic Argument and the Comparative Risk Argument.

When autocrats make the Paternalistic Argument, they attach popular acceptance of the linear, no-threshold hypothesis on the grounds that, because the public does not understand radiation and is often needlessly fearful, very likely the public is wrong about low doses of ionizing radiation. Therefore, they say, the public ought not make decisions about radiation. This Paternalistic Argument errs because it presupposes that, if people are misinformed about a societal decision, the solution is to take societal power away from them. Thomas Jefferson, at least, believed that the solution was to inform their discretion, not to take away power from the people. Otherwise, democracy would never improve (Shrader-Frechette 1991, esp. p. 99). The Paternalistic Argument also errs because it falls victim to the naturalistic fallacy. As the British ethicist G.E. Moore (1951, pp. viii-ix; 23-40, 60-63, 108, 146) explained, people commit the naturalistic fallacy whenever they reduce ethical decisionmaking to purely factual or scientific decisionmaking. As he noted, one cannot logically reduce an ought to an is. Proponents of the Paternalistic Argument forget that accepting or rejecting the linear, no-threshold hypothesis is not a matter merely (or even mainly) of affirming a scientific hypothesis. Because the situation is one of scientific uncertainty, the issue is one of choosing appropriate behavior under uncertainty, and this choice is an ethical, not only a scientific, one, although science obviously is relevant to the decision. To assume that experts alone ought to make the decision thus commits the naturalistic fallacy and subverts democracy. The fundamental insight is that, although the public may be wrong in its fear of radiation, and even irrational, nevertheless the public has the right to be wrong, at least to some degree, in a democracy. The situation is like that of a person purchasing a mortgage. People who do not understand interest rates and their effects may erroneously choose a higher mortgage rate, with no points assessed, even though, over the long term, it is more costly than a lower mortgage rate, with several points initially assessed. Irrationally, they make the decision based on the amount of money they appear to be saving, up front. Rationally, if they don't have that money, then they have made the best choice they can. Just as people have the right to be wrong in their mortgage preferences, so also they have the right to be wrong in their radiation preferences. In both cases, they bear the costs of their actions. To the degree that they alone neither bear the costs nor receive the benefits of their actions, of course others have a right to representation in their decision. All those affected by the decision have the right to representation in the decision, even though they have the right to be wrong about their decision. Moreover, although the man who doesn't understand compound interest may be just as wrong as the man who does not understand effects of low-dose ionizing radiation, their decisions, at best, are scientifically wrong, but not ethically wrong. I may be wrong in how I assess the costs and benefits of mortgages and of radiation, but I have the right to make the decision about how I assess those costs and benefits, and I may weigh them differently than someone else. That is why Thomas Jefferson was right to recognize that, in a democracy, the people ought to have the power. Autocrats also go wrong when they make the Comparative Risk Argument. One version of this argument is that people should accept low-dose ionizing radiation exposures from waste disposal or reactors because, for example, they receive more radiation from a year of frequent airline flights, cross country, than from living next to a nuclear reactor. Just as with the previous argument, autocrats go wrong in committing the naturalistic fallacy, in assuming that they have the right to tell citizens which tradeoffs, airplane radiation risks and nuclear radiation risks, are acceptable, even thought the tradeoff decision is fundamentally an ethical, not a scientific, decision (Cohen and Lee 1979). Autocrats presuppose that there are no ethical differences between involuntary risks like those from a nuclear reprocessing center, and voluntary risks, like those from flying cross country. Indeed the voluntary-versus-involuntary distinction is crucial because people often do not accept involuntary risks if they believe that the benefits are not worth the risks, or if they believe that experts are not telling them the truth about the risks. The people were told that irradiating feet, to determine shoe size, posed a negligible risk, but this was wrong. They were told that irradiating women's breasts to relieve mastitus posed a negligible risk, but this also was wrong. They were told that portable, as opposed to hospital-based x-rays, in the nineteen sixties, posed a negligible, incremental risk, but this too was wrong. U.S. citizens know what happened to the 500,000 downwinders and atomic veterans, even though the U.S. government says they were not seriously harmed by radiation. They also know that, through the years, radiation standards have been becoming stricter, not more lenient, as scientists discover more about the nature of ionizing radiation. For all these reasons, members of the public may not believe those who tell them that a particular exposure is negligible. Moreover, even if allowable exposure is negligible, people may not believe that the actual exposure is really as small as people allege. After all, at least in the US, there are well documented cases of radiation exposures, especially among downwinders and atomic veterans, being much higher than reported or alleged by government officials (U.S. Congress 1986, 1987, 1994; US DOE 1995). If no one is independently able to check a particular exposure, and if people in the past have been overexposed and misled about their doses, then it may be reasonable for others to be wary of alleged negligible doses. For all these reasons, comparative-risk arguments may be suspect, if the compared risks have important disanalogies or if in fact, there are grounds for not trusting the dosimetry of the supposedly negligible risk

Using Procedural Justice to Resolve the Impasse

As the preceding summaries illustrate, the science surrounding the linear, no-threshold hypothesis is uncertain, and there is no uncontroversial, factual, substantive way to resolve the difference of opinion. But if the correct position is substantively unclear or uncertain, nevertheless there are some procedural ways to help determine what the default rule should be. This procedural solution is appealing because, in general, there are two ways of arriving at correct social policy. One way, the substantive way, is to know, ahead of time, what the correct policy or outcome is, and then simply implement it because one already knows what is substantively correct. The other way, the procedural way, is useful in situations in which there is no substantive outcome, known ahead of time as correct. In fact, as Harvard philosopher John Rawls (1971, pp. 83-90) notes, criteria of pure procedural justice obtain when there is no independent criterion for a just decision and when the just decision cannot be specified independently of the procedure for obtaining it. The practical advantage of procedural criteria for decisionmaking is that one need not keep track of all circumstances, distributions, and various complexities, in making a decision. Instead one need merely specify procedures for arriving at a just or correct decision, as in a court of law. That is, often juries do not know which decision is substantively correct. Nevertheless, they can follow procedurally correct criteria to reach the best decision possible.

In the case of the linear, no-threshold hypothesis, there is no independent criterion for whether using it is just, because the science itself is unclear. And the correct position on this hypothesis cannot be specified, independently of the procedure for obtaining it.

What would be some hallmarks of a procedurally just decision about the linear, no-threshold hypothesis? First, all the background conditions would have to be fair. That is, there could be no lying, cheating, or deception in the evidence accepted regarding the linear, no-threshold hypothesis. Also, the procedurally just decision would have to be actually carried out or administered by a just series of social institutions. Third, markets would have to be competitive, resources would have to be fully employed, and property and wealth would have to be widely distributed. Fourth, all individuals would have to enjoy the maximum liberty compatible with equal liberty for all. Fifth, all individuals would have to enjoy equal opportunity (Rawls 1971, p. 87). More specifically, to make a procedurally just decision, all the participants in it would have to be noncoered, rational, disinterested, and possessed of equal and full information, and all participants would have to be able to register their considered opinion and be allowed a voice (Care 1978).

The only way to insure a noncoerced, disinterested decision, made with full information, and conducted so that everyone had a voice, would be to have persons representing various stakeholders the public, workers, industry making the decision about whether to use the linear, no-threshold hypothesis as a default rule. Thus, for example, one procedural condition might be to require that all decisionmaking or recommending bodies, dealing with the linear, no-threshold hypothesis, include representatives of stakeholders, such as labor union personnel, representatives of future generations, representatives of the public, and so on. At present, it is not clear that either the ICRP, the IAEA, or other groups include stakeholders, despite the fact that their presence is essential for procedurally just decisions, and experts say their inclusion is just as important, according to the latest US National Academy of Sciences risk panel, as inclusion of scientific experts (US National Research Council 1996).

In addition to having stakeholder representation in the linear, no-threshold decision, another requirement of procedural justice would be that no member of the decisionmaking group had information that was not shared and made available to all members of the group. There would have to be equal and full information available to all. To the degree that some information on radiation risk came from groups either promoting or rejecting nuclear energy, it would be necessary to have alternative information, prepared with alternative methodological assumptions, also available, so that the information was balanced and so that everyone had full access to all data.

Moreover, to the degree that any inequities in property or wealth caused decisionmakers to have a vested interest or a particular opinion on the linear, no-threshold hypothesis, then those inequities would have to be compensated, so that the decision was not biased. For example, if there were a body making a recommendation on the linear, no-threshold hypothesis, then citizens or radiation workers might need to have their expenses covered, in order to attend the meeting, so that their representative point of view would not go unheard, purely because of financial constraints.

If a fully free, informed, financially unconstrained, representative body made a decision on whether to accept the linear, no-threshold hypothesis as the default rule for low-dose exposures, and if this body could not agree on which position to take, then there also might be a procedural way to decide what to do about this indecision. The group itself might determine, for example, what amount would be adequate compensation, if at all, for special groups, such as workers, who were not given the protection of the linear, no-threshold hypothesis. The group also might decide under what conditions people could give or withhold their consent to situations in which they were not afforded the protection of the linear, no-threshold hypothesis.

Conclusion

If these criticisms of the flawed arguments of the anarchists and the autocrats are correct, and if it is right to try to resolve a substantive, scientific impasse, over radiation protection, by means of criteria for procedural justice, then several conclusions follow. (1) Both the anarchists and the autocrats likely err in their views on radiation protection. (2) If experts dictate that the linear, no-threshold hypothesis is or is not reasonable, even though the science is uncertain, then they may violate procedural justice if they do not include representatives of stakeholder groups or if they attempt to influence an ethical decision without insuring full representation of stakeholder groups. (3) If experts alone claim the right to make largely ethical decisions on default rules under uncertainty, then they may violate procedural justice and fall victim to the naturalistic fallacy. (4) If anyone wants to convince others of the reasonableness of his position on the linear, no-threshold position, then he should begin by attempting to satisfy the criteria for pure procedural justice in making a decision about this hypothesis, precisely because it is a decision under uncertainty and therefore a largely ethical decision.

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Annex 1

Workshop: Ethical Issues in Radiation Protection - Programme

Wednesday 16th June, 1999

The workshop was held in the Sievert Room at the Swedish Radiation Protection Institute, SSI, Stockholm, Sweden

PROGRAMME

09.00 Introduction	Lars Persson
09.15 Problems in Present Protection Policy	Lars-Erik Holm
09.45 ICRP Protection Policy - A Historical Perspective	Bo Lindell
10.15 Radiation Risk - What we know and what we believe	Ulf Bäverstam
11.00 Present ICRP Recommendations	Jack Valentin
11.30 Ethical Values in the Context of ICRP Recommendations	Deborah Oughton
12.00 Collective Responsibility for Invisible Harm	Torbjörn Tännsjö
12.30 Environmental Protection - Ethical Issues	Carl-Magnus Larsson
14.00 The Global Change of Values	Carl-Reinhold Bråkenhielm
14.30 Procedural Justice and Radiation Protection	Kristin Shrader-Frechette
15.15 Discussion chaired by L-E Holm	
16.15 End	

Annex 2

Workshop: Ethical Issues in Radiation Protection (Wednesday, June 16th 1999) at SSI, Stockholm

List of Participants

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SSI-rapporter 2000

SSI reports 2000

2000:01 Isotopkommittérapporter 1997
Avdelningen för personal- och patientstrålskydd.
Mauricio Alvarez 60 SEK

2000:02 Personalstrålskydd inom kärnkraftindustrin under 1998.
Avdelningen för personal- och patientstrålskydd.
Thommy Godås, Ann-Christin Hägg, Peter Hofvander, Ingemar Lund, Lars Malmqvist och Erik Welleman

2000:03 Radon removal equipment based on aeration: A literature study of tests performed in Sweden between 1981 and 1996.
Avdelningen för miljöövervakning och mätning.
Lars Mjönäs 100 SEK

2000:04 Utsläpps- och omgivningskontroll vid de kärntekniska anläggningarna 1997 och 1998.
Avdelningen för Avfall och Miljö. 100 SEK

2000:05 Doskoefficienter för beräkning av interna doser.
Avdelningen för personal- och patientstrålskydd. 70 SEK

2000:06 Tanning and risk perception in adolescents
Lennart Sjöberg, Lars-Erik Holm, Henrik Ullén och Yvonne Brandberg 80 SEK

2000:07 Strålskydd vid kärnkraftverk i Frankrike – en reserapport.
Avdelningen för patient- och personalstrålskydd.
Thommy Godås, Ingemar Lund och Lars Malmqvist 60 SEK

2000:08 Ethical Issues in Radiation Protection – an International Workshop.
Editor Lars Persson 60 SEK

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SSI sätter gränser för stråldoser till allmänheten och till dem som arbetar med strålning, utfärdar föreskrifter och kontrollerar att de efterlevs, bland annat genom inspektioner. Myndigheten informerar, utbildar och ger råd för att öka kunskaperna om strålning. SSI bedriver också egen forskning och stöder forskning vid universitet och högskolor.

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SSI har idag ca 120 anställda och är beläget i Stockholm.

the swedish radiation protection institute (ssi) is a government authority with the task of protecting mankind and the living environment from the harmful effects of radiation. SSI ensures that the risks and benefits inherent to radiation and its use are compared and evaluated, and that knowledge regarding radiation continues to develop, so that the risk to individuals is minimised.

SSI decides the dose limits for the public and for workers exposed to radiation, and issues regulations that, through inspections, it ensures are being followed. SSI provides information, education, and advice, carries out research and administers external research projects.

SSI participates on a national and international level in the field of radiation protection. As a part of that participation, SSI contributes towards improvements in radiation protection standards in the former Soviet states.

SSI is responsible for co-ordinating activities in Sweden should an accident involving radiation occur. Its resources can be called upon at any time of the day or night. If an accident occurs, a special emergency preparedness organisation is activated. Early notification of emergencies is obtained from automatic alarm monitoring stations in Sweden and abroad, and through international and bilateral agreements on early warning and information.

SSI has 120 employees and is situated in Stockholm.

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