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Ethical Aspects on Nuclear Waste

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Abstract

In an ethical assessment of how we shall deal with nuclear waste, one of the chief questions that arises is how to initiate action while at the same time taking into consideration uncertainties which are unavoidable seen from a longterm perspective.

By means of different formulations and by proceeding from various starting-points, a two edged objective is established vis-a-vis repository facilities: Safety in operation combined with reparability, with controls not necessary, but not impossible. Prerequisites for the realization of this objective are the continued advancement of knowledge and refinement of the qualifications required to deal with nuclear waste.

The ethical considerations above could be the bases for the future legislation in the field of nuclear energy waste.

1. INTRODUCTION

The Swedish Consultative Committee for Nuclear Waste Management (KASAM), with the intention of widening and developing this discussion in collaboration with the National Board for Spent Nuclear Fuel, arranged a seminar in 1987, that encompassed several scientific lines of inquiry. Here, it followed as a logical deduction that the title of the discussion would be "Ethical Action in the Face of Uncertainty". Some thirty-or-so scientists were invited to take part, as well as participants in the public dialogue on social questions, especially those with backgrounds in the humanities, theology, the natural sciences and technology.

The seminar confirmed that as soon as we look at nuclear power from the perspective of its waste products (that is, what to do with them), regardless of how we may continue to use nuclear power, it is both correct and constructive to formulate the fundamental query in terms of "Ethical Action in the Face of Uncertainty". One important reason for this is that we know certain things about the vast chronological dimensions involved in dealing with nuclear waste. We know, for example, the length of the radioactive half-life of different types of nuclear wastes. Therefore, there is an unique and obvious connection between any measures we may take today and their consequences far in the future, for the present and the future are clearly inseparable. Seen from the perspective of its wastes, nuclear power has revealed to us that our responsibility for it projects so far into the future that we, in fact, lack the ability to even imagine that future; and this means that we are forced to accept the factor of uncertainty in our assessment of the long-term consequences of our actions today.

The fact that the borders of our responsibility are not limited to today or tomorrow, but stretch far away into an uncertain future, demands of us a new spirit of solidarity: A solidarity across the years between Now and the Future.

However, many of the seminar's participants thought it important to point out that the long time-perspective is nevertheless not unique to nuclear energy. Indeed, the way in which we approach the question of how to cope with nuclear wastes ought to serve as a model for how we deal with other long-term consequences of "the breakneck progress of our generation, which has not only been bought at the cost of our own welfare, but also poses a threat to the health and environment of thousands of generations to come". Nuclear waste has been the first of these dangers to come under wide scrutiny due to a number of factors, not least among them the fact that the technology of nuclear energy is, in many people's minds, inseparable from the technology of nuclear weaponry.

In an ethical assessment of how we shall deal with nuclear wastes, one of the chief questions that arises is how to initiate action while at the same time taking into consideration uncertainties which are unavoidable seen from a long-term perspective. The seminar, by reason of its having been organized along several lines of scientific inquiry, progressed in the directions indicated in the following summary.

2. Different Types of Uncertainty

Since we are dealing with different types of uncertainty on this issue, it follows that we are also dealing with uncertainty in different dimensions of time: Human, societal, biological and geological. For society, a thousand years is a long time. But geologically speaking, 24 000 years – the half-life of plutonium – is an almost inconsequential time-span, however long it may seem in the biosphere.

2.1. *Mankind's Built-in Limitations*

In a way it's inappropriate to speak of man as being an uncertainty-factor. In fact, man is an unusually well-functioning being, with a powerful potential for development. But at the same time, he has certain built-in limitations, certain imperfections; he is "inherently unfool-proof". Man often attempts to compensate for these innate limitations by technically improving the efficiency of his creations. He believes that with the "perfect" technical system he can thereby make the system itself impervious to human failure.

Considering what we know about how man works as an individual, we can certainly question if this is a feasible ambition. To begin with, when man constructs any system he builds into it the imperfections characteristic of himself. Secondly, man has an incapacity for dealing with monotony. The boredom of passivity diminishes his capacity for action if the unforeseen occurs, and can even tempt him to try, in a foolhardy way, to break the monotony. Thirdly, the human mind's need of stimulation is fundamental, and causes man to want to exert control over things.

If one wishes to lessen the risk of mistakes and faulty action which are inherent in mankind's built-in limitations, one must take individual human qualifications into consideration. The question, then, is how this can be done in the context of final storage of nuclear waste. Isn't one of the built-in features, even of a repository system, that the system's security can be influenced by the risk for faulty human actions, or by the incomplete knowledge which, precisely because of human limitations, characterizes even the most sophisticated expert? Isn't there a danger inherent in the idea that people will be forced to tolerate being cut off from having influence or control over a given situation, as would be the case in the long-term perspective of a repository that is sealed for all time?

Even as it is important to take into consideration the qualifications of the human individual, it is equally important to observe his behaviour in a *group*. Studies show that a group, especially under great pressure from the outside, will strive after unity, with the result that individual and personal critical judgment can easily be eradicated. The group tends to see itself as invulnerable, which can lead to over-optimism and, thence, to risktaking. Its members easily become inured; awareness is deadened. Anxiety resounds before it has been channelled, and the members become blind to criticism from without. Therefore, it is important that the result of the group's activities be exposed to thorough and meticulous scrutiny by "outsiders", that is, people who have not taken part in the group's work.

2.2. *Uncertainty About Society's Development*

Each society has certain tendencies toward reproducing itself, the better to maintain its own stability. These tendencies are especially palpable in three specific societal manifestations: Firstly, in the transference of values and methods of instruction from primary groups of different types to the new generation (socialization). Within these groups a common mentality is fashioned, making it possible for us to predict the behaviour of other people with a reasonable degree of certitude; secondly, in the judicial role of the State, i.e. its laws and the social control they exert. Thirdly, in the social network of economic activity, in which quite different protagonists behave quite similarly because they are steered by parallel interests.

Given these factors as the seminar formulated them, uncertainty about the development of society can be defined as "the experience of a lack of stability in our vision of the future, because the stabilizing factors are either weak or weakened". The analysis arrived at by the seminar concerning development of stabilizing factors in the three areas named above, shows conclusively that varying degrees of certainty or uncertainty are built into our present systems of knowledge. The judicial system, for example, would seem to be the most substantial of the stabilizing factors; but this is true, ultimately, only on the condition that it employ legal coercion. On the other hand, according to the analysis, the weakest of the stabilizing factors is the mentality of ordinary people, such as it has become since the foundations of traditional common Christian values began to fall asunder. At the same time it is obvious that precisely this factor, i.e. consistency in the society's fundamental values, which is the most uncertain of all factors in gauging the stability of a society, is the most important of all if we wish to increase certainty and at the same time maintain and strengthen democracy.

The conclusion to be drawn from this is the following one: Certainty about society's development can only be increased if fundamental values are kept alive through socialization, information, and influencing of opinion; and then, only if these values are inculcated in all groups and each succeeding generation. Thus, the most important steering mechanisms would not be the courts or the police, but the schools and culture itself. This conclusion can also be arrived at if we consider that the fundamental values at issue here are best expressed in terms of a democratic view of society, a humanistic view of mankind, and an enlightened view of the future or the environment.

What will the consequences be in relation to our management of nuclear waste if we accept the idea that the most important stabilizing factors in maintaining the security of a democratic state are consensus and the support of fundamental values? In this case, we can only deduce that the process which led the seminar to certain conclusions played, itself, a central role in the discussions. A few of the questions exemplify this: How do we arrive at consensus on a solution to the problem? Is working out compromises one of the conditions of consensus? Can the bases for decision-making be broadened by allowing even more groups and individuals to be observers, and by considering their assessment of the risks involved? Is this a way to diminish uncertainty? How does one avoid the danger of information being "filtered", and thereby appearing to acquire a manipulative character? How does one expand the capacity and the power to deal with the information? How does one differentiate between facts and values so that the values of which every decision is ultimately an expression, are clearly delineated and thus can be subject to public debate and choice within the democratic process? How do we arrive at common values when our individual ideals may demand certain specific conclusions at any price?

2.3. *Uncertainty About Environmental Development*

The third type of uncertainty which the seminar devoted itself to, regards the development of our environment. We know that the very same scientific and technological progress which has had, in many ways, such a positive effect on mankind's living conditions has also subjected the environment to exploitation and has already caused discernible damage. Besides, if effective measures are not taken against these effects, we can predict even more threatening consequences, for example damage to the ozone layer and genetic abnormity in human and animal life. Both in the short-term perspective, which involves our lives today, and in the long-term perspective, which involves the "life" of nuclear waste, measures against damage and threats to the environment must take into account not only the present situation but the environment of future generations.

Yet and still, the difficulties of predicting the long-term consequences of whatever measures we take today are very great indeed. We are obliged to deal with altogether too many uncertain factors, even as far as mankind's future survival is concerned, to be able to make anything like sure predictions. However, we know with certainty that our actions today, especially if we do not employ effective antidotes, will lead to deterioration of future life-environments. Therefore, our awareness that such a threat is imminent ought to weigh heavier on our scales of ethics than does our uncertainty as to the extent of future damage that might occur.

Taken in the larger context which the environment constitutes, the problem of constructing secure repositories for nuclear waste seems, of course, to be a relatively minor question. However, taken as a model, it can have decisive importance for the very reason that long-term ethical aspects have been consciously considered in approaching it.

As we ponder the fact that our actions with regard to the environment are coloured by uncertainty, the conclusion that seems today to be nearest at hand is that we need time to think out "acceptable" solutions, and thereby attempt to avoid the hasty decisions which could hobble our freedom of action.

3. Systems That Diminish Uncertainty

It has been made plain in this analysis that it is important to identify the particular type of uncertainty one addresses oneself to when assessing the level of certainty that can be achieved; and in the last stages of the assessment-process, the different types of uncertainty must be weighed together. To what degree can increased certainty on one level balance out a lack of certainty on other levels?

It is obvious from this that uncertainties of a scientific and technological nature must be dealt with separately from others at some stage of the assessment-process. The following conclusions were explored in the material laid forth by the seminar.

Two fundamental ideas are of primary importance to any final disposal system. Both of them have to do with the fact that any such system must be constructed with a high tolerance for error, i.e. that it can "pardon mistakes" by virtue of its own built-in security. One of these is the multi-barrier-principle, according to which the wastes would be surrounded by several barriers, none of which would be dependent in its function upon the others, in order to guarantee that the system's security would not be contingent on the function of any single barrier. In order to counteract the basic uncertainty which still arises in any analysis of the barriers' function (due to the long time-frame necessary to the experiment, which makes controlled testing of the barriers a practical impossiblity), a second principle must complement the first: The repository must be constructed as a system in harmony with Nature. In other words, materials found in nature would be sought for construction, and the observations which can be gleaned from the natural world could be held up to comparison with various natural systems to arrive at "natural analogies".

4. Risk

The word "risk" is used primarily in two closely related contexts: It can mean either the appreciable likelihood of something dangerous occurring, or it can mean, generally speaking, a situation in which it is possible but not certain that something dangerous will occur. Thus the term "risk" implies both the likelihood of danger occurring and the character of that likelihood.

In analyses of risk, one must take into account both the likelihood of danger occurring and the consequences of its occurrence.

Furthermore, in decisions about the execution of different practical phases in the process for handling of spent nuclear fuel, a stand must be taken regarding what constitutes a reasonable level of risk from the point of view of society and its members, as well as what the economic and other consequences of such decisions will be. These assessments cannot be made on natural scientific grounds alone.

This is the general background to why one of the seminar's four topics was "risk". The problem was approached in terms of estimated risk, experienced risk and acceptable risk.

Psychological studies were presented for the seminar demonstrating the ways in which human beings experience risk. One result of these studies is the observation that the risk-assessments of informed experts often differed radically from those of laymen. It is interesting to note that there are questions in which the experts assess the risks as being appreciably more innocuous than the general public believes, as well as questions in which laymen feel the risks to be far less than the experts do. An example of this is risks posed by nuclear waste as opposed to the dangers of fire, even though both of these are areas where relatively detailed information has been dispensed to the public. The results of the studies also show that there can be great differences in how risk is perceived among different groups in society depending on age, sex, level of education, etc. Certain studies suggest that men perceive the word "risk" more as the likelihood of some negative occurrence, whereas women to a far greater degree relate the word "risk" to the consequences of a negative occurrence.

In the discussion it was emphasized that the objective of psychological studies surrounding the idea of risk was not that they be used to manipulate people, or to find out how to influence people to accept a particular method of dealing with nuclear waste. Instead, awareness of those factors which influence our conception and assessment of risk should strengthen our ability to defend ourselves against manipulation from various sources.

A special report was devoted to the question of the "philosophy" behind radiation-protective devices and the development of a correlation between this "philosophy" and the train of thought that lies behind construction of protective devices against chemical and other dangerous substances, in other words, general genotoxic protection.

One principle important to this "philosophy of radiation-protection" has been summarized in the acronym ALARA (As Low As Reasonably Achievable). This concept propounds that any exposure to radiation must be kept as low as is reasonably possible in keeping with economic and societal considerations.

In the practical application of this philosophy, radiation-protection officials proceed from the assumption that there is no threshhold below which a dose of radiation has no deleterious effect. This belief is expressed in the hypothesis of the so-called "linear relation", according to which the damage caused by a dose of radiation is proportional to the intensity of the dose. The linear relation is widely discussed among researchers. Some say that the linear relation underestimates the risk of damage caused by a small dose of radiation; others claim that small doses do not cause any damage at all.

However, responsible international agencies and national authorities appraise the linear relation, with its no-threshhold axiom, as a sufficiently reliable measure of the radiation risk, and apply it when they draw up regulations for radiation-protection.

The impression the seminar had was that the linear relation and the ALARA-principle are ethically acceptible guidelines. Similar guidelines should influence our attitude toward exposure to certain dangerous chemicals and other substances as well.

5. Our Responsibility – The Responsibility of Coming Generations and The Need for Controls

One of the central questions posed at the seminar concerned our generation's responsibility to coming generations. According to the dominating view held thus far, it is our generation's responsibility to find a solution to the problem of nuclear waste that allows it, once it is disposed of, to remain secure without surveillance.

Basically two lines of reasoning were presented, both of which led, in principle, to the same conclusion. For the sake of clarity, we shall outline both.

According to the first and more detailed of the two, it is natural to demand two things from any technical product that is meant to be in use for a longer period: It must be safe in operation and, furthermore, reparable. The same qualities can be demanded of a nuclear waste repository. Safety in operation means, in this case, that the waste can be disposed of so that as far as we can predict, coming generations will not be obliged to take measures to protect themselves or their environment from it. Reparability means that coming generations can repair any mistakes we may have made in disposing of the waste.

Thus far safety in operation has been, almost without exception, the central theme of all discussion, research and political decisions regarding nuclear waste. This is the case, of course, because all debate on nuclear waste has arisen from the perspective of nuclear power. We have discussed the disposal of nuclear waste as a problem which can or cannot be solved as an argument for or against nuclear power. From that perspective, it makes sense to concentrate on the demand for safety in operation; thus, the reparability issue has remained in the background.

If, however, we proceed from the perspective of waste, i.e. putting emphasis on what we shall do with the considerable quantities of waste that must be dealt with regardless of how we proceed with nuclear power, the need for reparability becomes far more urgent. From this perspective we are forced to take into consideration factors like the difficulty of getting different experts to agree completely on whether or not various systems can be considered absolutely safe without the possibility of getting inside to repair them, not to speak of the human errors and incorrect calculations that can also occur in the construction of a final repository.

It was pointed out that from this aspect, it is difficult to see how we can decide on a method of final disposal which is "irreversible", irrevocable, in the sense that the need for reparability is not met to any reasonable extent. Then too, it also becomes clear that the demands for safety in operation and reparability are, in part, in conflict with each other. Safety in operation requires, at least in a certain sense, a sealed repository. Reparability requires, in a somewhat different sense, an accessible repository. The technical question of how both these requirements can be met simultaneously is still insufficiently explored.

In the second line of reasoning, predicted advances in knowledge played an important role. On the one hand, today we can hardly guarantee that knowledge of how to dispose of nuclear waste will exist for all time. From that perspective, repositories should be constructed so that they will need no surveillance once they are sealed. Thus, it is our responsibility to come up with a system that will not need active surveillance in order to ensure that safety can be maintained.

On the other hand it is also conceivable that advances in knowledge will be such that coming generations will have the capacity to deal with nuclear waste in a way that increases safety and/or allows the energy-resources latent in the waste to be put to use. The choice of what to do must devolve upon the generation in question and be based upon its own assessment of the advantages and disadvantages to be encountered. Furthermore, this implies that the repository be designed in such a way as to enable future generations to control it.

These lines of reasoning lead to a double conclusion: A repository should be constructed so that it makes controls and corrective measures unnecessary, while at the same time not making controls and corrective measures impossible. In other words, our generation should not put the entire responsibility for maintenance of repositories on coming generations; however, neither should we deny coming generations the possibility of taking control.

By means of different formulations and by proceeding from various starting-points, a two- edged objective was established vis-a-vis repository facilities: Safety in operation combined with reparability, with controls not necessary, but not impossible. Pre-requisites for the realization of this objective are the continued advancement of knowledge and refinement of the qualifications required to deal with nuclear waste.