VALUE ISSUES IN DECISION-MAKING ABOUT NUCLEAR POWER GENERATION: AN ETHICAL ANALYSIS

Report drawn up for Afrosearch

by

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EXECUTIVE SUMMARY

This report gives an overview of the value and ethical issues relevant to decision-making about nuclear power generation in general.

An historical overview of the emergence of these value issues as they respectively related to the USA, Western Europe and South Africa was traced in Section 4.

Questions with regards to the ambivalence towards nuclear power generation (i.e. strong opposition versus strong support) that emerged from this historical overview were analyzed in Section 5 and 6, where they were placed within the context of a social-cultural as well as an analysis of ideology. In this regard it was found that nuclear science and technology has brought modernism to its peak, but exactly this has also raised problems that cannot be overcome from within the framework of conventional responses of modernism itself.

Section 6 of this report has been devoted to a close analysis of particular arguments pro- and contra nuclear power generation as they relate to value issues with regards to nuclear power generation in general. Particular attention was given to issues of:

- Clean energy
- Safety
- Nuclear energy and nuclear weapons
- The cost of nuclear energy.

The recommendations for decision-making that we make, have been based on the principles and contents of common morality, the contours of which are discussed in Section 3. These recommendations are stated in the report within the context from which they have emerged. All of these recommendations have been consolidated in a separate list at the end of this report (see Addendum 1). It is important to note that these recommendations should be read in conjunction with one another, and not in isolation from one another.

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Since the nature, methodology, importance and implications of an ethical analysis of the value issues pertaining to nuclear power generation is not evident from the outset, these themes were discussed in Addendum 2 in which the following questions were addressed:

- Why is it important to focus on values in a process of decision-making on nuclear?
- What is the nature of an ethical analysis of the value issues involved?
- What is the difference that such an ethical analysis can make to decision-making?

1. INTRODUCTION

This report gives an overview of the value and ethical issues relevant to decision-making about nuclear power generation in general. The brief for this study was to do a desktop study in which the value issues are identified that are related to the use of nuclear power generation (in general), to analyze these issues from an ethical point of view, to show what the implications of these issues are for decision-making, and to make recommendations about appropriate responses to these value issues.

The terms of reference of this study also required an overview and critical analysis of the main arguments for and against nuclear power generation. This analysis of pro- and anti-nuclear positions will endeavour to bring rational understanding to a terrain where informed debate seems to have made way for "an anarchy of values, interests, and perspectives" (Barrie 1994: 173), adversarial confrontation, and ideological posturing. Part of the aim of this overview is to identify strategies to come to grips with this situation.

It should be borne in mind that the context of this study is the process of decision-making about the proposed siting of a demonstration model pebblebed modular nuclear reactor (PBMR) in South Africa, either at Koeberg near Cape Town, or at Pelindaba near Pretoria. Associated with this proposal, but subject to different assessments in their own right are proposals about a fuel manufacturing plant for the PBMR at Pelindaba, as well as the importation and transportation of raw material and manufactured fuel along certain routes. However, in terms of our brief, it falls outside the terms of reference for this study to address the particular value issues pertaining to the complex of proposals pertaining to the siting of a PBMR in South Africa. The results of this study, though, will be used to alert decision-makers to the value issues related to the PBMR proposals that may require in depth attention.

In the study that we have conducted, the methodology of which is described below, the following have been identified as the main areas about which the pro- and anti-nuclear positions differ deeply and fundamentally.

- The question of the health hazards of radioactivity
- The problem of the disposal of nuclear waste
- The problem of the risk of catastrophic reactor accidents
- The problem of external costs and affordability
- Nuclear proliferation.
- Terrorism
- Sabotage

For the purpose of our investigation, we have distinguished between stronger and weaker variants in the anti- and pro-nuclear positions, and have identified the main reasons why these differences occur. As we will show in the course of our study, these differences have to do with different sets of opposing, and in some instances, incommensurable assumptions that are adopted on a variety of issues - which explains why the divide between the stronger variants of the pro- and anti-nuclear positions appears to be unbridgeable, and why it is virtually impossible to negotiate one's way in the nuclear debate without facing strong counter-arguments and even deep-seated emotions.

We acknowledge that all of the problem areas listed above clearly cannot be divorced from involved technical and scientific considerations, which raises the problem of the vast difference in the levels of knowledge between experts working in the nuclear field and the public that is expected to comment on proposals in this regard, as well as that of effective public participation. However, the focus of this report will fall on the value dimensions of these problems and the ethical issues that are brought forward by them. For the purposes of this report, it is assumed that the facts with regards to technical aspects of nuclear power generation are known and well understood.

It should also be stated at the outset that his report is written against the background of an emerging international trend in risk decision-making, namely to acknowledge and incorporate value and ethical issues in the whole of the process, from feasibility studies, scoping studies, impact assessments, generation and consideration of alternatives, right up to the final decision-making and implementation phase (see Nye 1986; Brown 1995; Lemons 1995; Cothern 1996, Newton and Dillingham 1996; Harris, Pritchard and Rabins 2000; Reason in Practice 2001, Shrader-Frechette 1991, 1993a, 1993b, 1994, 2000). Since not everyone involved in the process of risk decision-making is aware of, or in agreement with this emerging trend, a brief overview of what is entailed here is given in Addendum 2 attached to this study.

Before we proceed with the analysis of the value and ethical issues pertaining to decision-making about nuclear power generation, it is important to first provide an overview of the historical and socio-political context within which the nuclear debate is currently situated - internationally, as well as locally within South Africa. In this regard we will give a brief overview of the

- Historical emergence of the nuclear debate in the USA, Western Europe and South Africa
- The deeper cultural and socio-political assumptions informing the nuclear debate.

The rationale of this study is to determine what the implications of an ethical analysis of the value issues involved are for public decision-making about nuclear power generation. These recommendations will be identified during the course of this report at the places where they arise. A full articulation and a consolidated list of these recommendations will be given at the end of this study.

2. METHODOLOGY

In order to execute this brief, a survey of local and international publications about the history of the socio-political debate about nuclear energy was undertaken. In this regard, the focus fell particularly on literature devoted to the values that are at issue in this debate. Literature from the subject fields of philosophy and ethics were of great help in this regard. In the main part of this report, a close analysis of the arguments for and against nuclear power generation is given, focusing on different variants of the pro- and anti-positions in this debate, and concentrating in particular on the different assumptions informing each variant. On the basis of this analysis, a number of value issues (or ethical risk areas) were identified that should receive due consideration in any public decision-making on nuclear power generation. What these ethical risk areas entail, and what an appropriate ethical response to it could entail, was captured in a number of recommendations that are consolidated at the end of our study.

A number of interviews with specialists on the scientific and technical aspects of nuclear power generation have also been conducted. Since some of them have instructed us not to mention their names in this report, we withhold all names in this regard for the sake of consistency.

3. THE BASIS AND STRUCTURE OF THE RECOMMENDATIONS

In order to overcome the problem of casting our recommendations in a prescriptive, moralistic tone that could be easily dismissed as biased or subjective (cf. Stout 1993: 215), we have opted to formulate them either in terms of ethical risk areas, or in terms of issues about which decision-makers will need to have clarity if they wish to make any ethically defensible decision at all. These ethical risk areas or issues have been identified on the basis of what is generally known in the literature as "common morality" (cf. Outka and Reeder 1993; Reeder 1993; Stout 1993). This common morality comprises a cluster of values and assumptions that a substantive majority in society adhere to in their daily lives, setting the parameters of what one can reasonably expect of human behaviour within society, in particular within the public domain.

It is assumed within this study that common morality is based on the notion of acknowledging and respecting certain common traits shared to a large degree by all human beings (Harris, Pritchard, Rabins 2000: 32-33). These common traits include:

- Vulnerability (The ability to suffer and to experience pain and unhappiness; the limitations of bodily existence and susceptibility to diseases and disability; the fact of growing old and dying.)
- Autonomy (All humans share to some degree the ability of thinking for themselves and making their own decisions.)
- Interdependency (All humans depend on others to help them get what they want, through co-operative endeavour and division of labour. Our well-being also depends on others refraining from harming us.)
- Shared expectations and goals (Besides wanting things for ourselves as individuals, we may want things together, as groups working toward shared ends. These groups may range from caring relationships between two or more individuals to larger groups, such as a particular profession, religious institution, nation, or even an international organization as the United Nations.)
- Common moral traits (Humans typically display shared moral traits such as fair-mindedness, self-respect, respect for others, compassion, benevolence etc. Despite individual differences in the strength, scope, and constancy of these traits, they are found to some degree in all humans.)

It is not claimed here that this list is complete, but it does give us a reasonable basis for understanding why common morality would include general moral rules or principles about duties such as (Harris, Pritchard, Rabins 2000: 33; Rachels 1997: 10):

- Not to harm others.
- To make reparations for harms done to others.
- Not to lie or cheat.
- To keep our promises.
- Not to interfere with the freedom of others.
- To respect others' capacity to make rational decisions about matters affecting their lives.
- To treat others fairly.
- To help those in need.
- To be open and honest in one's dealing with others.
- To take special care when one can cause great harm to others.

It is furthermore important to know that different standard approaches exist to prioritize these duties and obligations, or to cluster them around a more general principle. Utilitarianism, for instance, in one of its versions, would support the principle of maximizing human well-being

(i.e. ensuring satisfaction of human welfare for the greatest number of people for the longest time). Certain rule-based approaches, on the other hand, will relate these core duties and obligations of humankind to a morality of respect for persons. For the purposes of this overview, these different approaches are important in so far as they make use of different argumentative channels to arrive at a decision about what should be done. However, in spite of the differences in "logic" that they display, substantive overlap exists in the conclusions that they reach. Utilitarian morality (typically focusing on a close analysis of consequences in terms of costs and benefits: the morally acceptable option is the one with the best consequences) and a respect-for-persons morality (typically making use of respect for human autonomy as point of departure, or emphasizing the importance of special obligations, justice and human rights) may indeed differ in terms of what they appeal to, and accordingly what they offer as reasons for or against a certain course of action. However, despite different approaches to justify moral choices, often these different approaches arrive at remarkable similarities in what they support as morally acceptable and what they reject as morally unacceptable. Both approaches also have fairly well developed strategies to overcome differences if they find that they make diverging recommendations (Harris, Pritchard, Rabins 2000: 60, 93; cf. also Jonsen and Toulmin 1988: 1-20).

That such a thing as common morality exists, is evident from the fact that the gist of the duties and obligations listed above is informally codified in strong societal notions of what constitutes the difference between acceptable and unacceptable behaviour. Similarly, much of the "spirit" of these duties and obligations form the basis of formal instruments within society, for example legislation and acts. The Bill of Rights in South Africa's Constitution, for example, is one possible codification of common morality - conceptualized as a set of shared norms and principles that the majority of reasonable and thinking people in society would like to see realized. The same can be said of about every act of Parliament that has been passed since the transformation to democracy in 1994, and about many others that have been passed before that. They all, to a greater or lesser degree, codify some aspect of common morality - thereby setting standards below which we would not like people to go in their choices and actions.

As such, common morality entails a "thin" layer of consensus among people in a society where a line is drawn below which no-one is allowed to venture without a very good justification. This observation highlights the phenomenon that any deviation from the minimum standards of common morality are frowned upon by society, and that such deviations are only allowed if very good reasons exist to do so. For example: to respect freedom of movement is one of the instances of respecting the autonomy of persons, but one would be foolish if one insists on this freedom if it will interfere with government rendering assistance to people

suffering from a natural disaster such as a flood. In such a case, it is apparent that good reasons exist to temporarily restrict the right of the public to move freely in certain areas.

Another important point to bear in mind, is that the standards of *individual morality* may differ from that of common morality. Many individuals ascribe to moral standards that are much higher than that of common morality. These could be referred to as *moral ideals*, and as such, it would not be reasonable for society to expect everyone to adhere to the same standards. An apt example would be the self-sacrifice of Mother Theresa in her humanitarian service to the poor and destitute of society. We all may admire her for her courage and heroism, but we cannot blame others if they do not follow the same path in their lives. We can only legitimately start to blame someone for unacceptable behaviour and take him/her to task about it if the minimum standards of common morality are transgressed.

Similar observations can be made about *professional conduct*, with the difference that we sometimes can hold professionals accountable at a higher level of morality for unacceptable behaviour. Professional morality often sets standards that are higher than that of common morality, and professional bodies are created to ensure that these standards are adhered to. Accordingly, we can take professionals to task if their actions fall below the standards that they have set for themselves. However, if they act in areas where no professional standards exists, the minimum standards of common morality apply in the same manner as in the case of individuals acting in public.

The implications of the points mentioned above for public decision-making follow from the fact that a core set of duties and obligations related to common morality can always be identified at any given time in any society. If common morality is not encoded in laws, structures and standard operational procedures, common practice amongst reasonable, thinking people will always yield ample pointers to the contents and basis of such a common morality. As such, common morality will always be available as a *point of reference* in public decision-making. Similarly, common morality will also always be available as *basis for the evaluation* of any public decision-making. In fact, where society may to some extent still tolerate individuals who fall below the minimum standards of common morality, less room for tolerance is given to bodies who have to make decisions where the common good and the welfare of the public are at stake. However, if public decisions are made in areas where there is no clear guidance from existing laws, statutes and standard operational procedures, the minimum standards of common morality will be applied.

With this in mind, an *ethical risk area* can in the first place be defined as an actual or a potential course of action in which the letter and the spirit of the *minimum standards of*

common morality are ignored, undermined, or transgressed. The ethical risk factor lies in the fact that society would not easily allow anyone to go below the minimum standards of common morality, or forgive them for that matter if they in fact do so. The frequent occurrence of public scandals (and the victimization of transgressors) is more than enough evidence of this phenomenon. An ethical risk area can further be described as an actual or a potential course of action in which the letter and the spirit of *the standards in relevant legislation and regulatory procedures* are ignored, undermined, or transgressed. In such cases it is not only a standard operational procedure that is ignored, or a law that is broken; what is compromised is public trust in agencies and officials who, beyond their duties and obligations as individuals, individually and collectively also have special duties and obligations to obey the law, and follow standard procedures to ensure that the interests of the common good and public welfare are well-served.

Within the context of decision-making about nuclear power generation, a third level of ethical risk has to do with the fact that the development and application of nuclear technology places *extraordinary duties and obligations* on those responsible for its management and control - since the potential exists within this context for "acute exposures" and "catastrophic accidents" (DME 1998: 62). This follows from the reasonable expectations of the public that officials have a *duty of due care* correlative to the actual or potential dangers related to the processes and procedures that they manage. This injunction is based on the tenet of common morality, which states as follows: Other things being equal, one should exercise due care to avoid contributing to significantly harming others. However, if the dangers or risks involved are extreme, then common morality dictates that we have a correlatively extreme duty to take due care to safeguard the public from such dangers. In literature on professional ethics, this is referred to as *the corollary of proportionate care*, and it reads as follows: When one is in a position to contribute to greater harm or when one is in a position to play a more critical part in producing harm than is another person, one must exercise greater care to avoid doing so (Harris, Pritchard and Rabins 1998: 63; cf. also Alpern 1991: 189).

In the case of decision-making about nuclear power generation, this exposes officials, regulators and decision-makers to ethical risks if they fail to demonstrate to what extent they indeed can, and in future will be able to meet the reasonable expectations of the public to be protected from disasters or harm to their best interests.

Accordingly, the recommendations in this overview are structured in such a manner that they highlight those areas in which a course of action (in this case a decision about nuclear power generation) exposes decision-makers to the three levels of ethical risks mentioned above. Conversely, the recommendations in this report are structured to show which kinds and which

levels of justifications would be required to legitimately digress, if at all, from the reasonable expectations and minimum standards of common morality.

Recommendation 1

General formulation

Decision-makers and those commissioned to inform decision-making (e.g. scientists, engineers and environmental assessors) should clearly state which values they are using, and how they are using their values to make their choices and formulate their recommendations.

Application

This recommendation applies to all of the phases of the scientific and technical studies commissioned to inform decision-making. This also applies to all of the phases of decision-making.

Note

This could be done without falling into the traps of subjectivity and relativism by referring back to the minimum standards set by common morality.

4. A HISTORICAL OVERVIEW OF THE EMERGENCE OF VALUE ISSUES RELATED TO NUCLEAR POWER GENERATION

For the purposes of this study, the history of the emergence of value issues with regards to nuclear technology in the USA, Western Europe and South Africa will be used as point of departure. This history is fairly well-documented, but it is important to pay attention to it in broad overview to form an understanding of the long period of the sensitization of public opinion against nuclear technology (Piller 1991; Dunlap, Kraft and Rosa 1993; Gerrard 1995). Although there is a substantive overlap in the value issues that have been raised in the nuclear debates in the USA, Western Europe and South Africa respectively (see Mink 1981; Patterson 1982; Welsh 2000), it should be borne in mind that similar kinds of value issues have been responded to differently in different countries. For instance, in France where about 75% of its electricity is generated by nuclear power plants, a predominantly positive attitude towards nuclear technology exists that is steadily growing (Koopmans and Duyvendak 1994). This difference, we believe, should not be ascribed to the existence of different value issues,

but rather to the fact that virtually the same value issues can be responded to in different ways by different societies and communities.

It should also be borne in mind that the history of the emergence of value issues regarding nuclear technology the world over should not be seen as one single and coherent phenomenon. As it will be shown in the sections below, this history differs from country to country, depending on numerous national and international factors impacting on the public consciousness of the broad population of a particular country or region. Where some countries (for instance Germany) have experienced a progressive growth in public opposition towards nuclear technology, as well as an increase in levels of mistrust in the institutions responsible for the management and regulation of it, other countries (for example France) have little, if any resistance movement against nuclear technology left to speak of.

Recommendation 2

General formulation

Decision-makers about nuclear technology should duely acknowledge and respect the differences in the articulations and interpretations of value issues brought forward by any use of nuclear technology. Special attention should be given to the sharp divide between those opposed to nuclear technology, and those that support it.

Particular formulation

In order, to enable themselves to make up their minds in a rational and reasonable manner in a situation of such differences, decision-makers about nuclear technology should familiarize themselves thoroughly with the nature and structure of these differences, as well as the grounds and the justifications for the different positions that are defended.

Application

If a decision is made for or against any proposal about nuclear technology, a strong obligation rests on decision-makers to clearly spell out what the grounds and justifications for their choices are, and why these grounds and justifications should be accepted above others.

4.1 The nuclear debate in the USA

4.1.1 Value issues in the early history of nuclear technology in the USA

A review of relevant literature shows that the early history of the utilization of nuclear technology in the 1940s and 1950s in the USA, whether for the purpose of weapons manufacturing or for the generation of electricity, was characterized by an atmosphere of technological euphoria and optimism (Dunlap et al 1993: 33, 34). At this time, the completion of the Manhattan Project was seen as the "most remarkable scientific and engineering feat in the history of the human race" (Dunlap et al 1993: 33), and accordingly, everything that was required to establish and promote the fledgling nuclear industry on a commercial basis in the USA was done.

The most famous and often quoted articulation of this optimism is found in the words of Lewis Strauss, then Chairman of the US Atomic Energy Commission who spoke of "unlimited power", and of electricity "too cheap to meter". He also referred to an era in which famines would be remembered only as matters of history. Strauss further argued that people would "travel effortlessly over the seas and under them and through the air with a minimum of danger and at great speeds and [would] experience a life span far longer than ours". In his view, atomic power promised "an age of peace" (quoted in Dunlap et al: 1993: 35-36).

Since the era after the Second World War was also characterized by the Cold War and an accelerating arms race between East and West, the development of nuclear technology was, for understandable reasons of security, covered by a blanket of official secrecy. This secrecy also applied to commercial nuclear facilities, which made it very difficult for the public to gain access to data about potential safety problems of plants. This, in turn, made it virtually impossible for the public to influence either the development of the nuclear industry in the USA, or its regulation. In fact, legislation about atomic energy in the fifties made it possible for the US Atomic Energy Commission to leave it largely to the nuclear industry to regulate itself, while the right of the public to hold the industry liable for damages in cases of a major nuclear accident was for all practical purposes suspended. The net result of this was that the industry was provided with a great deal of protection and support, while the ability of the public to scrutinize and intervene in the industry's development was effectively curtailed (Dunlap et al 1993: 34 - 38). It was only during the early 70s after new legislation has been passed that a new approach to regulation was developed in which the public received a greater ability to influence regulatory decisions. Until then, the development of the nuclear industry was very much a foregone conclusion, with little hope for the public to be able to intervene in the direction or momentum of this development process.

The central issues that were put on the table from the side of the nuclear industry at this time, were commercial in nature, and had to do with

- patent rights
- ownership of fissionable materials, and
- free competition in private enterprise.

From the side of the industry, public health and safety received less attention than the difficulties of establishing a viable commercial enterprise. "Public interests, insofar as it was considered at all, was singularly defined as providing consumers with limitless supplies of cheap electricity …" (Dunlap et al 1993: 34). From the side of the public though, health, safety and security were central value issues that manifested in concerns about:

- The siting of nuclear facilities
- Reactor safety and the risk of catastrophic accidents
- Weapons proliferation.

What is clear from the literature is that the problem of nuclear waste storage was of little concern during this time, since the volume of it involved was relatively small. The question whether the use of nuclear technology was really necessary or not, was also not seriously considered in public debates. Both of these questions only moved to centre stage during the 1980s.

Recommendation 3

General formulation

With the scenario of a new generation civilian nuclear industry being established in South Africa, the temptation may be to promote the industry by protecting it from effective public scrutiny, thereby blocking the ability of the public to influence development and regulatory decisions in this regard. Decision-makers as well as the proponents of nuclear technology should avoid this at all costs.

Specific formulation

Because nuclear based energy generation has become a sensitive issue, the ability of the public to participate and influence the process of decision-making should rather be actively promoted and developed.

Explanatory note 1

The central value assumption on which this recommendation rests, is that effective public participation in the process of decision-making about nuclear power plants is essential to ensure (a) the health and safety of the public, and (b) to establish trust in both the nuclear industry and the institutions responsible for its regulation on the one hand, and the process of decision-making about it on the other hand.

Explanatory note 2

Effective public participation within this context entails at least (a) access to adequate information about nuclear technology and its applications that will enable interested and affected parties to make up their own minds about the value issues (e.g. health and safety issues) involved; (b) reasonable time allocations for interested and affected parties to digest and understand the information; (c) reasonable time and opportunities for interested and affected parties to convey their views to decision-makers; (d) reasonable time and opportunities for interested and affected parties to explain their views to decision-makers and to answer questions about these views.

Recommendation 4

Introductory note

The introduction of any new-generation nuclear technology in a country rests on the hidden assumption that it is indeed *necessary* to establish such a new generation of nuclear technology.

General formulation

In order to ensure that the development of new-generation nuclear technology in South Africa is not seen as a foregone conclusion that cannot be changed or influenced by the public, a strong burden of proof rests on the proponents of such technology to make it clear whether they see the development of this technology as necessary or not, what the grounds for this view is, and how these grounds can be justified.

Application

Such grounds and justifications given by the proponents should subsequently be made available for public review in a process of effective public participation, and eventually proponents should be able to demonstrate if, how and why these grounds and justifications should be upheld in the face of criticism.

4.1.2 Value issues during the era of the proliferation of nuclear power plants: 1960s and 70s

Since the erection of the first nuclear power plant at Shippingsport, Pennsylvania in 1957, the era roughly spanning the 1960s and 70s, until the accident at Three Mile Island in 1978 can, on the one hand, be characterized as that of the proliferation of nuclear power plants, while on the other hand it can be characterized as the era of the consolidation of ambivalence towards nuclear technology. As it was in the era before, the central concerns about nuclear technology in the mind of the public were the siting of nuclear facilities, reactor safety and the risk of catastrophic accidents, and given the Cold War, the dangers of weapons proliferation. These concerns were based on a greater emphasis placed by the public on health, safety, and the effective management of technological hazards. On the other hand, the nuclear industry was preoccupied with delivery, since utilities finally started to place commercial orders for nuclear reactors after the mid-sixties. This preoccupation was clearly vindicated retrospectively by the oil crisis of 1973, which opened the eyes of the world to its vulnerability if it only depended on oil as its source of energy.

During this time, public participation in decision-making about the siting and regulation of nuclear power plants was virtually non-existent. In terms of the rules of the Atomic Energy Commission (AEC), AEC staff and utilities worked out their differences behind closed doors, while the public was not even permitted access to the agency's data about potential safety problems of the plants. Notwithstanding these conditions, the public raised several safety issues in public hearings on proposed reactors that the AEC was not able to resolve. Rosa and Freudenburg (in Dunlap et al 1993: 37) pointed out that

> "… the AEC's response scarcely indicated 'excessive sensitivity' to public concern. Rather than holding up the issuance of permits until the questions could be answered, the AEC decided that if a question covered several plants, it no longer needed to be decided in an individual licensing case. Instead, it would be treated as a 'generic' safety issue, the resolution of which would be sought through the ongoing research of the AEC and the industry. In the meantime, the plant could be built and operated."

This meant that the AEC effectively treated safety issues as irrelevant to the licensing of nuclear reactors. The perception was therefore created that the AEC only paid attention to issues that itself found legitimate, and that public opinion was not taken seriously in decision-making about nuclear technology. If one further takes into account that the AEC at the time only had minimal safety standards, leaving safety issues largely in the realm of the industry's

own responsibility, and add to this that the industry was not accustomed to the intensity of management required, sometimes showing indifferent compliance to the minimal AEC procedures at the time, it is no wonder that public trust was lost in the ability of the AEC to effectively regulate the nuclear industry and that an active anti-nuclear movement started to emerge. In 1973 an evaluation of the AEC licensing process funded by the National Science Foundation concluded: "The whole process as it now stands is nothing more than a charade, the outcome of which is, for all intents and purposes, pre-determined" (quoted in Dunlap et al 1993: 37).

In her characterization of this trend as a *crisis of participation*, political philosopher Robyn Eckersley (1992: 8-11) points out the basic value issue involved here is that of justice. On the one hand, administrative justice requires that people are not only adequately informed about any imminent public decisions that may impact on their lives, whether these impacts are positive or negative, but also that they are given a reasonable opportunity to participate in the process of making that decision. At the same time, the requirements of distributive justice state that the benefits and burdens of any public decision ought to be distributed fairly among the population. The ideal would, from an ethical point of view be that, if there are burdens, that the population enjoying the benefits completely overlap with the population bearing the burdens. Since this cannot be achieved in all cases, the next issue is raised, namely fair compensation. Since these questions require careful deliberation about siting, management and regulatory decisions, the public value of justice in all of the meanings listed above is seriously compromised if the process of public participation about siting, management and/or regulation has deteriorated into a charade.

Recommendation 5

General formulation

Decision-makers about any proposed development or application of nuclear technology should be able to clearly demonstrate that public opinion expressed in the process of public participation has been taken seriously, and that concerted efforts have been made to understand and accommodate public opinion in the process of decision-making.

Application

In order to do this, decision-makers will have to do much more than merely provide a list of concerns and views that have been raised in the process of public participation. They will have to provide in the first place clear and coherent reasons and justifications for their decisions, and show, in the second place with proper arguments why certain concerns and

views were dismissed in the process of decision-making, and why others were taken into account.

Explanatory note
Given the technicalities of the issues related to decision-making about nuclear technology, and given the fact that public concerns can easily be swept off the table by experts in the field as unfounded, a real danger exists that the public can lose its trust in the ability and willingness of decision-makers and regulators to take their concerns seriously. This clearly can happen if the concerns of interested and affected parties are dismissed as unimportant without providing explicit reasons why this is done. Similarly, trust in decision-makers and regulators would be severely underminded if the concerns or views of interested and affected parties were reduced to merely technical or management problems - as challenges that can be addressed by public relations programmes, or information and education campaigns.

4.1.3 Value issues in an era of profound skepticism about nuclear technology

During the 80s and early 90s, the ambivalence towards nuclear energy in the USA deepened to the point that virtually no reconciliation between the pro- and the anti-nuclear groups seem possible. During the 80s a profound skepticism emerged about the ability of institutions in the nuclear industry to ensure nuclear safety, in particular the safe storage of nuclear waste. With about 112 commercial nuclear reactors in operation in the USA alone, the problem of a large volume of high level radioactive waste emerged as the most problematic policy challenge that the nuclear industry has ever faced. With public opinion fueled by images of catastrophe after the Chernobyl disaster of April 26, 1986, all of the efforts of the DOE to find a single geological repository for high level nuclear waste storage proved to be unsuccessful.

In fact, the studies that were done in order to determine the feasibility of the proposed Yucca Mountain geological storage site rather concentrated the focus of public opinion, turning it into a general rejection of continuing with any further development of nuclear technology at all. However, in the light of concerns about climate change and the alleged links to high levels of CO_2 emissions, a resurgence of interest in nuclear power occurred in the late 80s and early nineties. The first Bush administration, for instance boosted this interest when it stated in its National Energy Strategy of 1991 that the USA's capacity for electricity generation should be increased from its levels of 99.5 gigawatts in December 1990 to between 190 (double) and 290 (triple) gigawatts.

With the advantage of hindsight, after what transpired at the Kyoto Conference on Climate Change in 1997 - the USA chose not to sign the multi-lateral agreement on the curtailment of CO_2 emissions - critical observers around the world started to question the very basis of the extremely high levels of energy consumption that is found in the USA. With some basing their questions on concern for fairness toward future generations, and with some basing their questions on concern for fairness towards other nations living on the planet now, it is asked more and more these days to what extent such high levels of energy consumption can be reconciled with the ideals of inter- and intra-generational justice.

According to Robyn Eckersley (1993: 17-21), questions like these confronts us with a *crisis of culture and character*. It confronts us with large, all-encompassing questions about who we are, what kinds of lives we are living, and how we shape our own future and that of the planet by the choices we make now in the present. This in turn not only confronts us with a further set of questions, like: Do we really need this kind of energy and at this level? Do we really need this kind of transport; and this level of consumption in our lives? What does it mean to live a rich and full life? It also confronts us with the question of how we go about settling these questions: on the basis of which considerations, on the basis of which reasons and which justifications? In short, these questions require of us to make explicit what kinds of lives we can justifiably live in the face of scarce resources and global injustices. It furthermore requires of us to make explicit what kinds of institutions and organizations and states we justifiably support in order to realize public values such as justice and fairness.

This line of thinking clearly brings us into the realm of a radical questioning of the current social ideals that we support, and structures that we live in, as well as the question whether they should be continued in their present form, or substantively transformed. As Eckersley (1993) sees it, the environmental crisis has created an opportunity for us to emancipate ourselves from the assumptions, ideals, structures and institutional forms that have become problematic in our time. Apparently this seems to be a long way off from the question of how decisions should be made about the development of nuclear technology in a developing country such as South Africa. It seems as if questions like these take us into the area of idealism, utopianism and aspirational thinking, and that they therefore should not be taken seriously in deliberations about nuclear technology.

Our argument in this regard, however, is that these questions cannot be ignored in public decision-making about nuclear energy in South Africa today. They form part of an essential framework of considerations that fundamentally shape the way in which we think about nuclear power and its management and regulation. This framework has to do with our basic ideas about science and technology, about what we can know, what we ought to do, and what

we can hope to achieve in the future. This general framework of cultural ideals has to do with what we think of ourselves as human beings, and even what a meaningful life on this earth is, or could entail. As such, this framework provides us with a long-term vision against the background of which we articulate our aspirations and make our plans for the future of ourselves and our children. Without an explicit awareness and a constant critical questioning of this broad framework of cultural ideals, humankind would be like a ship on the open seas that has lost its orientation, drifting aimlessly going nowhere. It is therefore essential that the content and the substance of this framework of deep cultural assumptions is also explicated in decision-making about nuclear technology - albeit in a rudimentary form.

Recommendation 6

General formulation

Decision-makers about nuclear technology should familiarize themselves with the different answers and kinds of answers that have been given in the socio-political debate about nuclear technology on the radical questions with which the development and application of nuclear technology confronts us (such as: who are we as humans and where are we going in this world with our knowledge and technology).

Specific formulation

Decision-makers should familiarize themselves with the reasons and justifications given for the different answers provided in the socio-political debate about nuclear technology on the radical framework questions conjured up by the development and application of nuclear technology.

Application

When decision-makers decide about any development or application of nuclear energy, they should be able to explain in public why they give precedence to a certain position in the broad socio-political debate on the radical framework questions referred to above, and why that particular position is better than another.

Recommendation 7

Granted that the conversation of humankind about the radical framework questions referred to above is incomplete and unending, and that we therefore cannot postpone decision-making about a particular proposal about nuclear technology indefinitely, decision-makers at least have the obligation to show that (a) they are aware of the existence of this conversation, (b) that they are aware that they are implicitly contributing to the substance of this conversation

by the choice that they will make, and (c) that they, in the choice that they make, do not foreclose the outcome of that conversation or undermine the conditions for its continuation.

4.2 The nuclear debate in Western Europe

It would be difficult to give an overview of the nuclear debate in Western Europe in terms of distinct historical phases (as it has been done in the case of the USA, and as it will be done in the case of South Africa). The reason for this is that different countries in Western Europe have had different exposures to, and therefore different responses to nuclear technology and its applications. However, what is similar in Europe to the history of the nuclear debate in the USA, is that the capacity for nuclear power generation for civilian purposes was developed during the 1950s, and that most of it was established, albeit against certain levels of public opposition and protest, during the 1960s. In this history, the same issues of official secrecy and government imposition were also experienced (Welsh 2000: 13-15). During the late 1960s and the early 1970s, strong and vocal opposition to nuclear power swept through the whole of Europe, coinciding with the New Left revolution on university campuses, although this didn't represent the attitudes of the majority of the population in most of the West European countries. In some countries, this opposition succeeded to halt any further development of nuclear power generation capacity (for example in the Netherlands in 1974); or to prevent any nuclear power generation capacity to be established at all (Denmark). In some, for instance in the United Kingdom, the anti-nuclear movement only really got off the ground in the late 1970s and early 1980s. In other countries such as France and Belgium, this opposition proved to have no effect at all on the respective country's nuclear power programme.

An important fact in the interpretation of the nuclear debate in Europe, is that its intensity, which is much higher than that in the USA, can be linked to the Europeans' direct experience of warfare in their continent, and to the fact that nuclear weapon installations were deployed throughout Western Europe in close proximity to large masses of population in the era after the Second World War (Snow and Benford 1988: 209). With the constant threat of nuclear war, a strong anti-nuclear movement that is not only opposed to nuclear weapons but also to nuclear power generation emerged in Western Europe, although its history and success differs from country to country. In the Netherlands and Denmark, the position of the anti-nuclear movement was that nuclear energy is both dangerous and unnecessary, and this view has become the dominant viewpoint among the general public, the news media, and a majority of the political parties. In Germany, however, no clear winner has emerged from the debate between pro-nuclear and anti-nuclear positions - the fight for supremacy continues.

On the other hand, France is the best example in Europe of a country in which the anti-nuclear movement has lost the debate and has been marginalized by a discourse that emphasizes the safety of the national nuclear industry and the necessity of nuclear power as a guarantee for economic independence and as a source of national grandeur (Koopmans and Duyvendak 1994: 11; Welsh 2000: 18, 21).

It is furthermore significant to note that public opposition to nuclear energy in Europe (recorded in attitude surveys in distinction from open protest behaviour) significantly increased throughout Europe after the Chernobyl disaster of April 1986, with the exception of France and Belgium where opposition decreased. In countries such as the United Kingdom, Italy and Denmark in which a majority of people in 1978 thought that nuclear energy was worthwhile to pursue, significant shifts of opinion took place when the figures of 1987 just after the Chernobyl disaster are taken into account. In the United Kingdom, Italy and Denmark, a majority of the public assumed an anti-nuclear energy stance in 1987. In the UK, the shift in opinion was 33%, while in Italy a massive 70% shift was registered, while the shift in Denmark was a substantive 52% (Koopmans and Duyvendak 1994: 12).

The Chernobyl disaster of April 1986 also led to a very interesting pattern in the revival of anti-nuclear protest in Western Europe. In a study completed by Koopmans in 1992, it was found that only Germany experienced a spectacular rise in the number of anti-nuclear protest events. In France and Switzerland only a small increase took place, and in the Netherlands no change was detectable. The same pattern emerged when the volume of participation in these events was taken into account. Where Germany saw a substantive increase in the number of protesters, no increases on this level was experienced in the Netherlands and France. A significant increase in the number of protesters was registered in Switzerland though, although not as high as that of Germany (Koopmans en Duyvendak 1994: 4-6).

The reaction of politicians and the general public (in distinction from protesters) affirm how wide definitions and interpretations of similar events can differ. For example, in Germany, several state and local governments prohibited the consumption of fresh vegetables, closed children's playgrounds and swimming pools and even cancelled sports events. None of this happened in France:

> On one side of a Rhine Bridge, at Kehl, in West Germany, the children were forbidden to play on the grass and the lettuces sat uneaten in the ground. On the French side of the bridge, around Strassbourg, very similar lettuces were declared harmless (Hawkes et al: 1986: 154, quoted in Koopmans and Duyvendak 1994: 7).

How can this be explained? According to Koopmans and Duyvendak (1994) these differences have to do with differences in the level of mobilization of protest against nuclear power in a country, and pursuant to that differences in the public image of nuclear power in the public

consciousness of a country. In Germany for instance, the Chernobyl disaster occurred within a period in which public protest against nuclear power was already at a high level and well organized. Public protest was already mobilized during 1985 against a nuclear reprocessing plant in Wackersdorf, Bavaria, so that the Chernobyl disaster only provided further impetus to a movement that was already up and running. This impetus was further supported by the anti-nuclear stance of a number of German political parties. In the Netherlands however, the anti-nuclear movement almost came to a standstill after its campaign to close its two existing nuclear power plants failed in 1981. Similarly, the anti-nuclear movement in France was reduced to marginal proportions after the Socialists took office in 1981 (Koopmans and Duyvendak 1994: 7-8).

The significance of these observations for public decision-making on the development and application of nuclear science and technology lies on different levels: In the first place, it highlights the fact that real differences can exist between objective reality (for instance levels of radiation that can be scientifically measured at a specific time and place) and the interpretations and perceptions of people in that same place at that same time. This difference between objective facts and subjective perceptions is significant for any process of public decision-making, but it is highly important, in the second place, to note that this very distinction itself is contested in the nuclear debate. It is not always clear exactly what the distinction is between objective facts and subjective perceptions, since different *definitions* of concepts will lead to different sets of facts - and these different sets of facts can then be interpreted differently (i.e. they can be given different meanings and weights) depending on different definitions used for words such as "risk", "danger", "safety", "health" etc. From this perspective then it should be borne in mind that straightforward scientific measurement would often be of no value in efforts to settle the differences between pro- and anti-nuclear groups. They often do not differ on what the facts are, but on what counts as facts - on what is accepted as facts. This is another way to say that the nuclear debate, as many other debates in life, is predominantly driven by values (that provide the framework within which "the facts" for the "content" of the debate are constructed along the lines of the fundamental assumptions informing that framework).

In the third instance, this implies that decision-makers should exercise a healthy skepticism about any facts that are introduced in the nuclear debate - until they are satisfied that the *definitions of concepts* on the basis of which these facts are presented are clear, and that the *assumptions* and *implications* of these definitions are well-understood. In practical terms, this would require that decision-makers take due cognisance of the definitions used to frame facts, and the definitions used to allocate a meaning, a weight or significance to these facts. If this is not done, decision-makers can easily dismiss a point of view as a "subjective

interpretation" that is not worthy of further investigation, while it may contain important considerations that should not be ignored in decision-making about the development and application of nuclear science and technology.

A further important point to note in this regard, is that large changes in public opinion in favour or in opposition to nuclear power generation does not say anything about the resolution of any of the substantive issues within the debate itself. A major shift in attitude in a country towards or away from support of nuclear energy only serves as an indication that a discursive battle has been decided one way or the other. Any shift in any direction in public attitude towards nuclear energy therefore still leaves the task to decision-makers to determine for themselves how they would respond to the substantive issues about which people differ in the nuclear debate. Another way to formulate this point, is to say that any sensitivity of decision-makers to public opinion about nuclear energy, amounts to just that: a sensitivity to public opinion. Important as such a sensitivity may be on a political level, it does not amount to addressing the substantive issues related to nuclear energy on a practical level.

Recommendation 8

General formulation

Decision-makers should bear in mind that factual disputes in the nuclear debate can often not be settled by merely falling back on science "to objectively determine what the facts really are". Facts do not speak for themselves. Facts are always determined, and given meaning within a framework of value assumptions

Specific formulation

To come to grips with diverging factual claims in the nuclear debate decision-makers will have have to familiarize themselves thoroughly with the different definitions and investigative frameworks used to establish these diverging factual claims, as well as the different definitions and interpretive frameworks used to give meaning to these factual claims (i.e. to determine their weight and their significance).

Application

This recommendation places a strong requirement on the proponents of any proposal about the development and application of nuclear energy to clearly explicate the definitions of the concepts that they have used in making their factual claims, and to clearly explicate the value assumptions of the investigative framework within which they formulated their factual claims. The same requirement applies to those opposing the proposal.

Recommendation 9

General formulation

Decision-makers about nuclear technology and its applications should take due cognisance of the difference between responding to public opinion about nuclear energy (or the absence of it) and addressing the content of the issues related to nuclear energy. To respond adequately to one (e.g. public opinion) does not necessarily imply that the other one (content issues) has also been addressed adequately. The converse is also true.

Specific formulation

Decision-makers about nuclear technology and its applications should make explicit if, and also how they have taken the difference between public opinion issues and content issues into account in their decision-making.

Application

Decision-makers about nuclear technology and its applications should be able to explain if they have made a distinction between public opinion issues and content issues, and how they have arrived at that distinction (by making use of which concepts with which definitions, working within which investigative framework).

4.3 The nuclear debate in South Africa

The history of the nuclear debate in South Africa can be divided into two distinct contexts, more or less following one another in chronological order. The first context is that of "strategic" decision-making about nuclear issues as it has been defined by the Nationalist Government in the era from the early 1950s to the early 1990s, and the second context is that of "commercial" decision-making since the 1990s (Venter and Fouché 1994: 79; Williams 1994: 73). Taking a closer look at the context of strategic decision-making, a further division can be made between an earlier phase spanning the 1950s and early 1960s, and a later phase spanning the 1970s and 1980s that was characterized by a siege economy following the international boycott of South African minerals and embargoes on technology transfers to South Africa. Similarly, the context of commercial decision-making of the 1990s is embedded within a wider context of political transformation within which the emphasis shifted to that of reconstruction and development with a view to satisfy the basic needs of the majority of South Africa's citizens. As it will be shown in the analysis below, the nuclear debate in the 1990s

highlighted many of the tensions between commercial decision-making about nuclear technology and development oriented decision-making.

4.3.1 The early history of strategic decision-making

The first formal evidence of the early history of strategic decision-making about nuclear technology in South Africa emerges with the formation of the Atomic Energy Board in 1948. It was set up under the leadership of Prime Minister Smuts to exercise control over and trade in uranium in South Africa, following the interest that was expressed by the USA and Britain to procure uranium for their nuclear weapons programmes (Fig 1994: 20). Uranium mining in South Africa commenced in 1952 when a uranium production plant was opened at Wes Rand Consolidated Mine to supply uranium to the Combined Development Agencies, the official procurement organizations of the British and United States governments. By 1959 26 mines in South Africa were feeding material to 17 production plants which supplied almost 6 000 mt of uranium per annum for delivery to the Combined Development Agencies. However, from 1960, the demand for material for military purposes declined, and with it so too did the production of uranium in South Africa (Williams 1994: 73; Eberhard 1994: 40).

During this time, uranium production in South Africa was considered to be a strategic, military-associated business (Williams 1973: 74), and accordingly it was operated under a blanket of official secrecy. The freedom to publish and discuss information about the production and sales of uranium simply didn't exist, so an uninformed public was created that could not engage in a meaningful public debate about nuclear issues by raising concerns, objections and opposition to it, or holding government officials and politicians accountable for their policies.

4.3.2 The later history of strategic decision-making

The later history of strategic decision-making about nuclear fuel and/or energy in South Africa more or less coincided with the 1970s and 1980s, although earlier indications of the trends of this era can be traced back to the early 1960s.[1] The oil crisis in the early 1970s brought about a swing in favour of nuclear power in industrialized countries, and this in turn led to a dramatic surge in the demand for uranium in the industrialized countries of the world. Where South Africa's uranium production was at about 1 865 mt in the mid-1960s, production soared to a

[1] The secret laboratory for uranium enrichment that was set up in the early 1960s behind the façade of a motor-spares shop in Du Toit Street in Pretoria is a case in point (Eberhard 1994: 41).

record level of 6 156 mt of uranium in 1980. At this stage, South African uranium accounted for 14% of production in the Western world (Williams 1994: 73).

Along with the oil crisis, international pressures against the apartheid regime in South Africa from the early 1970s started to create a siege economy in South Africa. This led to a number of strategic choices that for the first time led to heated public debates in South Africa about the military and civilian use of nuclear power. In 1976, construction started on South Africa's first civilian nuclear power plant at the Koeberg site, some 30 km away from Cape Town. Following the same pattern of secrecy about nuclear technology that was established in the earlier phases of the installation of nuclear power plants in the rest of the world, the consultative process with the people of Cape Town on the building of Koeberg, and with the people of Namaqualand on the siting of Vaalputs, was done in what many described as a high-handed and derisory manner (Fig 1994: 21; Cape Town Ecology Group 1994: 189; Komaggas Community Namaqualand 1994: 209). During the phases of its construction and in the first years of its operation, public resistance was mounted against Koeberg from a widely based alliance known as Koeberg Alert, but this made little impact on the decision to go ahead with the power station. Eventually, public debate subsided, although none of the issues driving it (for instance safety, radiation risks, disaster management, and waste storage) were really resolved. In fact, these issues have remained latent, hidden just below the surface of public debate, and can, and in fact, have surfaced again, the moment new proposals about nuclear power generation have been formulated (which is the case with the proposals for the demonstration PBMR plant).

Where the commissioning and installation of Koeberg (construction was completed in March 1984) led to a public debate of some sort about the safety and other substantive issues related to such an installation, another strategic choice was made by the apartheid government in 1971 (Albright 1994: 153), namely to secretly develop a nuclear weapons capability by making use of sufficiently enriched uranium.

It is still unclear exactly how this weapons capability was developed and funded (Christie 1994; Fig 1998), but it clearly coincided with the decision of the Atomic Energy Board of South Africa in the late 1970s to become self sufficient as far as nuclear fuel supplies were concerned. Since sanctions prevented South Africa from buying enriched uranium on the world market, it led to the erection of a number of small plants, including the so-called Z-plant at Pelindaba, in which uranium could be taken through all of the stages of conversion, enrichment and fuel fabrication (Venter and Fouché 1994: 79, 83, 84).

Of these latter developments, the public initially knew very little, but slowly it was eventually realized locally as well as internationally, that South Africa has indeed developed nuclear weapons, so that issues regarding nuclear proliferation also entered the public debate. The so-called Kalahari Incident in 1977 when surveillance satellites of both the USSR and the USA detected the construction of deep shafts for underground nuclear weapons testing, an unaccounted for nuclear explosion in the Southern Ocean, off-shore of the Prince Edward Islands which is a South African possession (Fig 1998: 173),[2] and speculations that international pressure was put on to South Africa to dismantle its nuclear weapons before the political transition of April 1994, all contributed to the image of a very close association between civilian use of nuclear energy and nuclear weapons.

A further characteristic of the development of strategic nuclear capabilities during this time, was that the state guaranteed the loans through which South Africa's nuclear facilities were financed. It was clear from the outset that uranium conversion and enrichment facilities would never be able to recover its capital costs by sales revenue. In fact, until the early 1990s the full responsibility for servicing loans in this regard was carried by the South African government. During 1994, the servicing costs of these loans (interest plus capital) were estimated at between R150 million and R200 million annually (Venter and Fouché 1994: 83). Others indicate that the nuclear sector received generous state subsidies from the Department of Mineral and Energy Affairs' budget that peaked at R705 million (or 92% of the Department's budget) in 1987/88 (Auf der Heyde 1994: 97). During 1994, it was estimated that South Africa's nuclear fuel production capability was being subsidized by the state at almost R300 million per year, with income generated from it only amounting to R10 million from export contracts, and about R80 million from contracts with Eskom at prices that were much higher than spot prices in the international nuclear fuel market (Auf der Heyde 1994: 98).

While these figures have only become known during the 1990s, the general ethical concern that was raised since then about such subsidies in the face of commercial losses, is that it constitutes a substantive drain on the country's resources (Auf der Heyde 1994: 98). From an ethical point of view, it can be pointed out that this was public money that was utilized to serve the agenda of a morally unacceptable regime. While this regime justified the use of this money on the basis of strategic reasons, this justification has clearly fallen away in an era where the government is democratically elected and accountable to the whole of the population.

[2] According to Fig (1998: 174) "the unofficial view is that South Africa, perhaps with Taiwanese support, provided the vessel to support testing of an Israeli tactical nuclear weapon".

4.3.3 The era of commercial decision-making, transparency and open dialogue on nuclear power

Although some indicators to this effect were present at earlier stages, for example in the founding of Nufcor[3] by a consortium of mines in 1967 to produce uranium, it was during the early 1990s that the emphasis explicitly shifted from strategic to commercial decision-making in the nuclear energy field in South Africa. During this time it was realized that South Africa could not afford to continue its decision-making on nuclear issues on an ideological basis; and that the basis for decision-making should rather shift to "rational analysis derived through integrated energy planning within a policy framework which seeks to advance social equity, economic competitiveness and environmental sustainability" (Eberhard 1994: 48). This entails a major paradigm shift in which an optimal energy balance is sought to meet social needs (The Nuclear Debate 1994: 199; DME[4] 1998: 6).

The Management of the Atomic Energy Corporation (AEC, which replaced the earlier Atomic Energy Board), for instance, determined that its uranium enrichment capability was not commercially viable, generally due to the small size of the enrichment plants, but also because of the depressed and oversupplied nuclear fuel market. The AEC Management subsequently made the decision to close some of its enrichment plants down, or to convert to a wide spectrum of other market-driven production capabilities with civilian applications (as opposed to technology driven products with military applications) (Venter and Fouché 1994: 79, 84, 85, 87-88; Albright 1994: 152; cf. also Stumpf 1994).

In addition, it should be borne in mind that this shift has taken place within a political context within which the emphasis strongly moved to that of ensuring social equity, environmental sustainability (Eberhard 1994: 40), and greater openness, transparency and flexibility in decision-making. Within such a context it became evident that the nuclear industry will only survive if it can clearly demonstrate that it is economically competitive, not an unnecessary drain on the country's financial resources when there are pressing social priorities, that it in fact contributes to the economic development of the country, and contributes, or at least is not incompatible with the national policy goal of environmental sustainability (cf. Eberhard 1994: 40).

Evidence of this shift towards social goals, openness and dialogue can be found in the fact that during the early 1990s South Africa has become a signatory to the Nuclear Non-Proliferation Treaty (on July 8, 1991) and pursuant to that opened its uranium enrichment

[3] Nuclear Fuels Corporation of South Africa.
[4] Department of Minerals and Energy.

facilities for inspection by the International Atomic Energy Agency. During this time, South Africa also became a significant supporter of the OAU's declaration of Africa as a nuclear weapons-free zone. This ideal was formalized as the Treaty of Pelindaba, signed in Cairo in April 1996 (Fig 1998: 175). South Africa also played a brokering role in the Review and Extension Conference of the Non-Proliferation Treaty in New York in April-May 1995, and slowly started to resume its activities in the International Atomic Energy Agency.

Further impetus to this trend of openness and dialogue was given on March 24, 1993 when president F.W. de Klerk confirmed in a speech in Parliament the world's suspicion (cf. Moore 1987) that South Africa was engaged in a nuclear weapons programme. The full extent of his announcement was that in 1990 South Africa gave final effect to decisions made in 1989 after the fall of the Berlin wall that all nuclear devices should be dismantled and destroyed. At that stage, South Africa had six nuclear explosive devices, and was working on a seventh when the decision was made to stop the programme (Barrie 1994: 164-165; Amuah 1994: 177). The first move in this process was to close down the R210 million pilot enrichment plant - the so-called Y-plant in February 1990, followed by a systematic dismantling of the nuclear weapons themselves at Armscor's Advena warehouse. The process included decontamination of the buildings, safe storage of about 400 kg[5] highly enriched uranium at Pelindaba, and a number of inspections by the IAEA to verify that the process of dismantling was complete. The documentation of the process of weapon-making was also destroyed (Fig 1998: 174-176). According to Barrie (1994: 171), this dismantling demonstrated South Africa's willingness to co-operate with international bodies on the matter of nuclear weapons proliferation, and "speaks volumes for this country's good faith".

However, the fact of this announcement by F.W. de Klerk underlines the very close link that has existed until very recently within South Africa between commercial and military applications of nuclear technology. It underlines the fact that if the political will to do so exists, overt commercial applications of nuclear technology can be used very effectively as a smokescreen to hide military applications of it. Accordingly, as Barrie (1994: 171) points out, any commercial nuclear capacity will have to live permanently under the cloud of latent nuclear weapons proliferation. Given the South African history in this regard, as well as the secrecy within which it is shrouded, fear of proliferation is deeply ingrained in the political consciousness of many thinking South Africans. As such, this fear constitutes a major political reality that will have to be taken seriously in any decision, or attempted decision, to apply new developments in nuclear technology within the commercial sector.

[5] For security reasons this figure was never publicly confirmed. Some speculations put the amount at about 300 kg (Fig 1998: 176).

During an unprecedented conference on the nuclear debate in South Africa that was held in Cape Town from 11-13 February 1994, it was mentioned that one possible response to this fear of proliferation would be to renounce civilian nuclear technology altogether - but it was pointed out that this would be a very difficult decision to justify since there are many other applications of nuclear technology besides that of electricity generation (for example that of radio-isotopes used in research on, or the treatment of cancer). It was also argued that South Africa would be losing highly skilled personnel and substantive technological capacity if the indigenous nuclear industry were unraveled (Eberhard 1994: 50; cf. also Fig 1994). Another response that was mentioned, was to only approve of nuclear technology that was diversion proof, and to put in place an elaborate machinery of surveillance and verification (Barrie 1994: 171; Albright 1994: 143).

However, to generate public trust in civilian applications of nuclear technology, as well as in such a surveillance and verification machinery, may prove to be very difficult, if not impossible - given the fact that surveillance and verification imply levels of access to and openness about nuclear technology that may be in conflict with current standards and practices regarding the safety of that technology. Barrie (1994: 171), therefore, makes a very important point when he draws attention to the link between commercial and military nuclear power: "The link is a close one and an inconvenient reality for those who would deny it."

Another important value issue that has emerged in the era of commercial decision-making and open dialogue about nuclear power in South Africa, is the fact that taxpayer's money has been used to develop a uranium enrichment capability in South Africa that not only provided some fuel to the Koeberg nuclear power plant, but also highly enriched uranium for nuclear weapons. Besides the serious value issue of allowing South African scientists and technologists to develop weapons of mass destruction, the dismantling of these nuclear weapons and the closure of South Africa's uranium enrichment plants towards the middle of the 1990s have raised equally serious ethical issues about the efficient utilization of the taxpayer's money, and pursuant to that, about social justice issues and the sustainable utilization of the country's natural resources. While some argued that the millions invested in South Africa's nuclear industry was an investment in an "exciting development" that resulted in an "immense achievement" that should not be wasted (Barrie 1994: 172), others characterized it as "a costly mistake" (Fig 1994: 22), or an "excessive investment in a highly protective industry" (Stumpf 1994: 27).

The same problem emerges with regards to the question of the storage of nuclear waste, as well as the decommissioning of nuclear reactors that have reached the end of their productive lives. Although South Africa still does not have an official Nuclear Waste Management Policy

fully in place yet, current thinking about nuclear waste storage is that the state is the appropriate agent to ultimately ensure safe storage, since it can guarantee institutional and organizational continuance. But this implies a burden on the public in the form of taxpayer's money that will be used to pay for it - even if provision is made in the cost-structure of electricity to pay for the storage of nuclear waste and decommissioning. Many argue that the state will eventually have to foot the bill for storage and decommissioning, since the price structure of electricity cannot fully internalize the costs of these externalities (i.e. the decommissioning of nuclear plants and the building and management of nuclear waste storage sites).

For many commentators then, these observations point in the direction of a very cautious approach that should be followed when it comes to the use of taxpayers' money to subsidize the development or application of nuclear technology until it becomes profitable in the long-term. The ethical question that surfaces here is whether South Africa as a developing country with vast backlogs in social development can afford to subsidize the nuclear industry until it becomes profitable (Barrie 1994: 173).

Furthermore it is important to note within this era of commercial decision-making and open dialogue about nuclear technology that market forces alone may prove not to be adequate to address all of the issues that may emerge. The nature of the nuclear fuel cycle presupposes, due to its organizational and technological complexity, a degree of centralized co-ordination that only the state is able to offer (Barrie 1994: 174). The possible motives for a state to become involved with nuclear technology could be one of two:

- Either for its perceived contribution to external security (through nuclear weapons);
- Or for the contribution it can make to economic growth that relies on scientific and technological innovation, and a centralized energy system (Barrie 1994: 174).

Having given up its interest in nuclear weapons for external security, it is evident that the era of commercial decision-making and dialogue squarely stands within the framework of the latter interest in the contribution that nuclear technology can make to economic growth, scientific and technological innovation, and a centralized energy system. Commercial decision-making, however, cannot be done in isolation from social and political issues, which explains why this third era is also characterized by open social and political debates on the question whether South Africa really needs nuclear power in its portfolio of electricity generation options. This has been emphasized throughout the 1990s with reference to the fact that Koeberg only supplies about 6% of South Africa's energy needs, but also by the fact that coal fired power stations have their own problems with regards to the emission of climate changing pollutants.

In order to address these wider political and social considerations in decision-making about nuclear technology, the South African government has embarked on a process of integrated energy planning, the first result of which was a comprehensive White Paper on the Energy Policy of the Republic of South Africa that was published by the Department of Mineral and Energy Affairs in 1998. This laid the foundation for an Integrated Energy Plan for South Africa which, at the time of writing of this report, is under discussion, but was not launched yet. No specific date has been set for its launch. However, it is interesting and important to note that the White Paper states with regards to the future role of nuclear power in South Africa that "it would not be prudent to exclude nuclear power as a supply option. Decisions on the role of nuclear power, as with any other supply option, need to be taken within the context of an integrated resource planning process" (DME 1998: 62). With regards to possible future expansion of South Africa's nuclear energy capability, the White Paper makes two important statements. Firstly it states:

> Expansion will depend on factors such as economic growth, public attitudes and approaches by decision-makers in assessing the macro-economic, health and environmental aspects of the different options available for electricity generation (DME 1998: 60).

In the second place, with direct reference to ESKOM's feasibility studies (at that time) on the possibility of constructing a pebble bed modular nuclear reactor power station, it states the following:

> Government will ensure that decisions to construct new nuclear power stations are taken within the context of an integrated energy policy planning process with due consideration given to all relevant legislation, and the process subject to structured participation and consultation with all stakeholders (DME 1998: 63).

In summary then, it can be said that a whole new set of challenges emerged during the 1990s in the South African nuclear debate. Besides the central issues characteristic of all debates about nuclear technology (safety and health issues, radiation risks, disaster management, proliferation, nuclear waste storage and cost efficiency) a number of serious framework issues emerged during the 1990s that have to do either with the *mechanisms of policy and decision-making* on nuclear issues, or with public trust in the structures and institutions responsible to control the nuclear industry. In these two areas, a number of unresolved issues still exist which can be captured in the following questions, starting with issues of mechanisms and procedures:

1. What exactly should the role of public participation be in the process of developing nuclear policy, albeit that decision-making on nuclear issues entail technical detail that is inaccessible to the lay public (Amuah 1994)?

2. How should the tension between demands for open dialogue and transparency about nuclear issues for the sake of public control (on the one hand) and the demand for secrecy about nuclear issues for security reasons (on the other hand) be addressed?
3. What should the appropriate mix of energy options for South Africa be in terms of an integrated energy plan, and what should the place in this mix be, if any, for nuclear power generation? What exactly do we mean when we say that we should choose "the best option in terms of suitability and the lowest price for our immediate and future needs" (Stott 1994: 53)?
4. Can the nuclear industry make a positive contribution to the processes of economic, social and political reconstruction and development in South Africa (Fig 1994: 19)?

Questions related to public trust in the structures and institutions responsible to control the nuclear technology include the following:

5. How can we ensure public scrutiny of the powers that allocate resources for research and development of science and technology in SA (Fig 1994: 22)?
6. How can we ensure that "South Africa … never again allows its resources, scientists and engineers to produce weapons of mass destruction" (Nelson Mandela, quoted in the Washington Times, 4 Dec. 1993)?
7. Was everything revealed about the South African nuclear weapons programme? (Albright 1994: 142). Why was South Africa's nuclear weapons programme not subjected to a TRC hearing?
8. Did South Africa contribute to the development of Israel's and China's nuclear capacity, and if so, to what extent (Albright 1994: 142, 147-148)?
9. As the industry had concealed and denied so much in the past, could people believe them now (The Nuclear Debate 1994: 140)?

Before we proceed with our analysis, it is necessary to take a closer look at the origins and parameters of the socio-political debate about the utilization of nuclear technology. This will enable us to gain a better understanding of the ideological character of this debate, but will also help to identify strategies through which this ideological character can be recognized and unmasked.

5. THE ORIGINS, PARAMETERS AND IDEOLOGICAL CHARACTER OF THE SOCIO-POLITICAL DEBATE ABOUT NUCLEAR TECHNOLOGY

5.1 Cultural origins and parameters of the socio-political debate about nuclear energy

In this section a brief look will be taken at social and cultural factors that can explain the intensity and fierceness of the public debate over nuclear technology. According to the British sociologist Ian Welsh (2000: 31), drawing on the work of Beck, Giddens and Lash's theories of reflexive modernization,[6] the rise of nuclear science and technology can be seen as part of the culmination of the social movement of modernism. Reflexive modernization can be distinguished from modernism in so far as the first entails a self-critical awareness of the shortcomings and boundaries of scientific reason and technology. Reflexive modernization does not take the claims of science and technology on face value, but rather investigate the conditions under which these claims can be legitimately made, and the manner in which these claims circulate and function in society. Reflexive modernization also leaves room for differences and diversity, acknowledging numerous legitimate ways to approach an issue, and encouraging dialogue between different points of view.

Modernism, on the other hand, is an ideology that displays a desire to control reality fully and completely through science and technology, and tends to dismiss everything that cannot be expressed in the objective thing- or it-language of science as subjective and/or irrational, and therefore unimportant. Modernism is also characterized by a desire for both security and progress, both of which can be achieved through increasing our rational control over more and more aspects of nature and society. On a conceptual level this is achieved by efforts to explain the whole of the universe and everything in it in terms of a limited number, or even a single explanatory principle. One of the founders of modernism, the 17th century French philosopher René Descartes, for example, reduced everything to the certainty and clarity that can be achieved by mathematical reasoning. What cannot be expressed in this mode, Descartes argued, should be dismissed as unimportant. As such, modernism can be seen as a reductionist framework that tends to fall into a monologue with itself.

Now, with these distinctions in mind, Welsh points out that nuclear science and technology is not only embedded within the cultural movement of modernism and therefore is an advanced product of it, but also is a mobilization of modernism, i.e. a driving force within modernism, bringing it to a peak. This mobilization (or driving force) is characterized by a scientific and technological euphoria (experienced as "desire") that brings together a whole number of

[6] See Glossary for explanation.

cultural "registers", the most important of which are a blind faith in instrumental rationality, scientific reason, expertise and technical progress. This supposedly made rational control of nature and the management of society possible, and in turn, was seen as the prerequisite for the self-realization of humankind in history. Accordingly, these cultural registers established a discourse within which the parameters were set for the form and content of knowledge formation, the definition of the goals of society, and what it means to be human and act as a civilized being.

Formulated in practical terms, this means that since the Enlightenment in the 1700s, science and technology was given an enormous authority to define a development trajectory for society - something which explains the presence of scientists in the governing elite of the modern state, while people educated in the humanities are typically conspicuous in their absence from the circles of the governing elite. The apparent objectivity of science has been quoted to be the sole means of delivering such development, since social, political, and cultural differences would always preclude agreement. Welsh (2000: 32) points out that this model "assumed that some set of universal (scientifically valid) technologies and techniques could be developed which would solve social and cultural problems the world over". This assumption partly explains the phenomenon of globalization that, on one level entails the formation of a scientifically and technically based monoculture that spans the whole of the world. However, it is precisely this monoculture that is currently challenged by the effervescence of diversity, difference and hybridity that is, ironically enough, brought to consciousness by the processes of globalization itself. In so far as this monoculture is thin and reduced with many gaps in it that are often not visible to (or acknowledged by) those preoccupied by its maintenance and continuation (based as it is on a formal, mathematical rationality), these challenges typically come from cultures or groups standing on the margins, or even outside that of modernism.

Now, the fierce and widespread opposition to nuclear science and technology can be seen, from a sociological point of view, as a challenge to the dominance and authoritarianism of modernism, conceived of as a blind faith in progress brought about by science and technology. What is challenged today in a wide range of cultural movements, is the mastery and the progress promised by science; what is rejected is the sole right of science and technology, or the experts who speak on their behalf, to define the future of society.

According to Welsh (2000) this is the kind of challenge that is typical of reflexive modernity in which people reclaim the right to think for themselves, having discovered numerous reasons why the project of high modernism and its concomitant knowledge claims, imperatives and discursive strategies have become incredulous.

Space does not allow us to elaborate on these discursive strategies, except to list them as follows and to briefly indicate how this can be linked to claims about nuclear science and technology. It should be pointed out at this point though, that discursive strategies such as these are not exclusive to nuclear science and technology. They rather form part of the discourse of modernism itself, characterized as it is by its blind faith in progress and scientific method. However, and this is Welsh's point, nuclear science and technology have brought these discursive strategies into sharp focus, and ironically enough has provided good reasons to start to challenge them. In a sense, then, it can be said that nuclear science and technology is not only the culmination and peak of modernity; it also marks its end.

Here now follows a short list of the typical knowledge claims, imperatives and discursive strategies of modernism and how they can typically be linked to an almost unqualified support for nuclear technology:

- *Freezing time by claiming the future.* This discursive strategy points to claims often made by those *strongly in favour* of nuclear power that in spite of current uncertainties nuclear science and technology should be further developed because it will bring positive outcomes for humankind in future. By directing attention towards distant time horizons, which will realize positive outcomes, attention is drawn away from more immediate time frames inhabited by scientific and technological uncertainty (Welsh 2000: 6).
- *Locating the future on a new frontier.* This discursive strategy points to claims often made by pro-nuclear groups that nuclear science and technology move towards and expand the frontiers of civilization. Through the image of frontier activity, nuclear science and technology is not only placed at the forefront of endeavours where only the brave and the intrepid venture, it also renders a certain measure of risk-taking as justified, and invokes promises of vast riches that can be unlocked by the brave pioneers and explorers (Welsh 2000: 6).
- *Asserting superior knowledge claims.* This points to claims often made by pro-nuclear groups that insurmountable knowledge deficits - i.e. uncertainties - will be overcome, given the experience of past successes of scientific endeavour in doing so.
- *Asserting imperatives* (such as that *there is no alternative*). This points to claims often made by pro-nuclear groups that there is no alternative to further development of nuclear science and technology. The claim that there is no alternative to nuclear science and technology is often invoked within the context of references to an energy crisis, and as such it is played as a trump card capable of dismissing any counter-argument (Welsh 2000: 7)

- *Discounting residual difficulties into the future.* This discursive strategy entails the practice of discounting current difficulties - for instance the storage of high level nuclear waste - on the basis that they will be readily overcome in the future. Although this optimism encompasses the difficulties experienced both within basic physics and in engineering design, materials science and operational procedure, Welsh (2000: 7-8) points out that there is no necessary link between advances in basic physics and the other terrains mentioned. Advances in basic physics can often be the beginning of operational and engineering difficulties that can prove even more intractable and contested.

On the basis of these observations then, it is evident that the socio-political debate about nuclear technology is not merely about contested knowledge and the legitimate grounds on which such contestation can be based. It is not merely about different and contested factual claims about the health or safety hazards that are associated with certain level of radiation; or about the safety record of the industry, or whether it is technically possible or not to safely store high level nuclear waste for periods longer than 10 000 years. The debate about nuclear science and technology is one going far deeper than this: it has to do with a cultural and societal battle about different ways to define and safeguard the future, about different ways to define who we are, what knowledge is, what we ought to do in the world, what we can hope to achieve with our knowledge and technological capabilities, and how we should go about to ensure a future for ourselves and our children's children.

5.2 Ideological dimensions of the nuclear debate

A further dimension of the nuclear debate that should be borne in mind, is that it can assume an ideological character. Numerous definitions of "ideology" exist - ranging from the neutral definition of a mere set of ideas shared by members of a group or a community, cementing them together, to those critical definitions which state that an ideology entails a distortion of reality, false consciousness, or the justification of vested interests at the cost of others. For the purposes of this discussion, we will make use of the critical conception of Thompson (1990) who has defined ideology as the mobilization of meaning in the service power - or formulated in more detail: meaning in the service of asymmetrical power relations that are characterized by domination and/or exploitation (Thompson 1990: 7).

For the purposes of our discussion of the nuclear debate, it is important to note that an asymmetrical power relationship can be established through language within the context of written or verbal exchanges, and/or adversarial debate. This occurs when one party to a debate claims exclusively for himself the right to define the nature of problems and what

counts as solutions to them, while others are denied that right (i.e. are silenced and not allowed to speak, rendering it impossible or very difficult for them to be heard or taken seriously in the debate at all). This often happens without making this ideological claim explicitly, but rather by utilizing language in a clever way so that the opponent is paralyzed and literally left speechless. As such, "ideological effects" (e.g. preventing questions to be asked, or criticisms to be raised, or claiming the sole right to set an agenda or determine goals) are often achieved in a very subtle manner by using language to appeal to what is portrayed as universal truths, while in fact references to that "universal truth" are used to hide or gloss over sectoral interests which are not shared universally by all in society. Similarly, ideological effects can be achieved with language strategies such as rationalization, narrativization, dissimulation, unification, fragmentation and reification (Thompson 1990: 60-67).

In the case of *rationalization*, a speaker constructs a chain of reasoning which seeks to defend or justify a set of social relations or institutions, and thereby to persuade an audience that it is worthy of support (Thompson 1990: 61). In the case of the nuclear debate, those strongly in support of nuclear technology can use this strategy to gloss over problems in that technology by appealing to reason itself to justify the use or further development of that technology. Another form of rationalization could be to justify it with reference to the existence of an official nuclear policy, or the legality of a set of enacted rules. The existence of such a policy or such a set of enacted rules, however, does not justify any proposal that is made within the framework of that policy, or that set of legally enacted rules. To put it bluntly, the ethical acceptability of a policy or legal framework does not automatically amount to the ethical acceptability of any proposal that is portrayed to follow from that framework. The ethical acceptability of that proposal need to be established independently in its own terms. Alternatively, the links between a proposal and the policy framework need to be demonstrated and argued for in a clear and accessible manner.

Those strongly in opposition to nuclear technology, however, could make use of the same set of devices to achieve exactly the opposite ideologial effect, namely an anti-nuclear stance that stands above criticism and cannot be questioned. One example in this regard is to use the absence of an official nuclear policy, or the absence of a set of legally enacted rules to dismiss a particular proposal about the development or application of nuclear technology. The absence, for example, of a national nuclear waste disposal policy or plan, or the absence of an Integrated Energy Plan for South Africa could come in very handy within this regard. This lack or absence could then be used to dismiss a proposal without looking thoroughly at the merit of the proposal itself.

In cases of *narrativization*, appeals are made to some generally accepted narrative to justify a course of action, or to protect if from criticism. In the case of the nuclear debate, those strongly in favour of nuclear technology could, for instance, refer to the narrative of "progress" or "development" to justify support for it, while glossing over some of the real problems that may be present in the development and application of nuclear technology. In the same manner, those in strong opposition to nuclear power can make use of the negative appeal of a narrative of an inescapable doomsday scenario of future disaster and mayhem to justify opposition to it, while glossing over some of the advantages of nuclear technology.

The linguistic strategy of *dissimulation* could also be used to draw attention away from crucial issues in the nuclear debate. This could be achieved, for instance, by the displacement of terms with a strong descriptive value that can draw attention to pertinent problems within a proposal by inserting words with a positive value, or even by inserting euphemisms that smoothe over the rough edges of reality. An example of this strategy can be found in references to the "walk-away safety features" of the proposed PBMR at Koeberg. This brings to mind the very positive image that even in the case of the worst possible accident at the PBMR, nothing as serious as even an injury to the operators on site could occur. In a worst case accident they will be able to simply walk away and wait until it is safe again to attend to the accident. This very positive image, however, can gloss over and neutralize the question whether this claim is true. Would a worst case accident really be one that one can simply walk away from and return later? Should such a safety claim not rather be demonstrated and argued for? Does the use of a positive term really amount to the existence of a positive, ethically acceptable reality?[7]

Similarly, those strongly opposed to nuclear technology could use terms with a strong negative connotation to put any proposal about nuclear technology in such a bad light that even an attempt to duely consider that proposal could be portrayed as the incorrect thing to do. One example in this regard would be to refer to "the cult of the atom" when references are made to the nuclear industry and its operations.[8] With this phrase, an image of a diabolic brotherhood of secrecy is invoked, plotting the supremacy of evil over good. To link a proposal about the development or application of nuclear technology to this "cult" would therefore be to dismiss the proposal before it is even considered.

[7] It should be borne in mind that a linguistic strategy does not necessarily have to serve ideological purpose. It often does not. A linguistic strategy acquires an ideological dimension if it is used in such a manner that it establishes or sustains asymmetrical power relations characterized by domination and/or exploitation. An ideological effect is therefore a function of the manner in which a message is constructed, circulated and received in society. References to the "walk-away safety features" of the proposed PBMR would therefore not achieve ideological effects if these safety features can be demonstrated and argued for.

[8] See the book by Daniel Ford, *The Cult of the Atom* (1982).

Another set of linguistic devices employed by ideology to establish and maintain relations of domination and exploitation is that of *fragmentation*. This is usually done to divide and disperse groups that may lodge an effective opposition to a certain policy or course of action. Within the nuclear debate, those strongly opposed to nuclear power could, for instance, be branded as misanthropes, or as a bunch of romantics blocking the road to progress and prosperity. Through this they are portayed as enemies of society, and therefore become scapegoats that should be expurgated from society wherever they are found. The very same strategy could also be used by those strongly opposed to nuclear technology. They could, for instance, refer to nuclear scientists as mad, or crazy, and thereby these scientists in turn are branded as dangerous to society and as people whose activities should be summarily stopped. In the first case, the ideological effect is that the merits of the arguments against nuclear energy are not seriously considered because the source of the arguments are dismissed as unacceptable. In the second case, the work of nuclear scientists are dismissed without even considering what they are doing and what the significance of their work could be.

The converse of this is found in the strategy of *unification*, where language is used to provide symbols of unification around which like-minded people can rally (Thompson 1990: 64). These symbols of unification are usually very difficult to oppose (for instance "a future of peace and prosperity"), without providing reasons why there is a direct and necessary link between, for instance, nuclear power and that "future of peace and prosperity". However, the same kind of ideological effect, albeit an opposite one, could be achieved by portraying science in general, and nuclear science in particular, as "the enemy of the people". Opposition to nuclear science and technology then becomes a device to unify people on the basis of a symbol of unifaction that already exists, namely "the struggle of the people against oppression" - which in the case of South Africa is the struggle against apartheid.

Often, ideological effects are achieved by the linguistic strategy of *reification* (Thompson 1990: 65-66). One instance of this strategy is found in the practice of referring to historical and cultural processes as if they are *natural* processes. If this ploy is successful, the opponent to a point of view would not be able to challenge it, since processes of nature cannot be argued against: they are inevitable and inescapable. This strategy is often used to justify cultural or societal arrangements that could just as well have been organized differently. Another instance of reification can be found in the linguistic practice of using *passive language* to refer to processes or actions as if they were things. With this kind of strategy, the fact is glossed over that processes or actions are carried out by agents within

specific contexts with particular outcomes, and that these agents can be held accountable for these processes and actions.

In the nuclear debate, the strategy of *naturalization* is often used by both pro- and anti-nuclear groups to achieve ideological effects. Those strongly in favour of nuclear technology would, for instance, maintain that "there is no alternative" to nuclear energy. That we have to make use of nuclear technology is therefore portrayed as a kind of destiny - as a path of natural development that we cannot escape, and have to follow out of necessity. What humans are in fact doing, and should take responsibility for, namely the development or application of a certain kind of technology, and what they accordingly can decide about, is hereby portrayed as a natural process that cannot be questioned. As such, this strategy has become so well known, that it even has acquired a name: the TINA syndrome (**T**here **I**s **N**o **A**lternative). This name in itself could be seen as an instance of a linguistic device with an ideological effect: a certain position assumed by people is portrayed as an illness or an abberation (a syndrome) - something against which one should be warned and from which one should escape through a process of healing.

The strategy of reification, and in particular that of naturalization, is often also used by those strongly opposed to nuclear technology to portray it as something unnatural, as something going against the grain of the natural order of things. A very revealing passage that speaks for itself in this regard is found in the dramatic opening lines of Nicholas Lenssen's study on nuclear waste (Lenssen 1991: 5):

> In December 1942, humanity's relationship with nature changed for all time. Working in a secret underground military laboratory in Chicago, the emigré Italian physicist Enrico Fermi assembled enough uranium to cause a nuclear fission reaction. He split the atom, releasing the inherent energy that binds all matter together.

From these examples it is then evident that the ideological character of discourse can be mobilized to support both an anti-nuclear and a pro-nuclear stance. In each case, language can be mobilized in such a manner that the other party is rendered mute, not able to speak or to be heard. In both cases, however, it is possible to unmask the ideological effects of the language by showing how it elevates one point of view above the level of reasoned and reasonable discussion and criticism, and dismisses another as something that should not be taken seriously.

Some examples of language with ideological effects have been given immediately above, as well as in Section 5.1 towards the end. The ideological character of claims such as these lies in their power to mobilize our positive evaluation of, for example, prospects for a better future in such a manner that it hides or glosses over the fact that there are real and far reaching dangers involved with any nuclear technology. As such, this kind of claim would discourage

any discussion of the dangers of nuclear technology, or it will endeavour to prevent such a discussion by branding those who question nuclear technology as in opposition to improving the human condition. Ideological effects, however, can also be achieved by *those strongly opposed* to nuclear power. They can, for instance, use the uncertainty of nuclear science and technology to argue that it should not be further developed, because it will only bring negative results to humankind in future. Similar to the blind faith in the inevitable positive outcomes of nuclear technology referred to above, the latter claim presupposes a blind faith in the inevitable negative outcomes of nuclear technology.

A non-ideological, and therefore a more moderate pro-nuclear perspective in this regard would therefore be open and honest about the dangers of nuclear technology, and would actually encourage discussion of these dangers so as to better understand and better respond to them - if it can be demonstrated that we indeed can appropriately respond to them. Similarly, a non-ideological, and therefore a more moderate anti-nuclear perspective in this regard would be open and honest about those instances where nuclear technology can be operated well within the parameters of reasonable safety standards, and would acknowledge that their opposition to nuclear can only be justified in cases where these safety standards cannot be achieved.

Recommendation 10

General formulation

Decision-makers about the development and application of nuclear science and technology would typically not fall totally within the group of pro- or anti-nuclear. However, they should be aware of the fact that any decision about nuclear technology and its applications constitutes a move in the societal and cultural battle about different ways to define and safeguard the future, different ways to use and direct science and technology, different ways to think and respond to risks and hazards.

Specific formulation

Decision-makers about the development and application of nuclear technology should be able to clearly articulate which position they assume within this cultural and societal battle, and to indicate with reasons why that particular position should take precedence above others.

Application

This self-critical awareness should be applied by the decision-makers in every step of their process of decision-making. It should also be applied in their evaluation of every submission made to them to inform their decision-making.

Recommendation 11

Introductory note

Decision-makers about the development or application of nuclear technology should be acutely aware of the fact that proponents and opponents of development proposals may tend to make use of ideological language to put across their points as forcefully as possible. The danger of ideological language in the nuclear debate lies in the fact that it distracts attention from the content of crucial issues, and redirects it to subsidiary issues. Ideological battles are furthermore of such a nature that they represent sectoral interests, and can only be won by neutralizing or silencing the opposing side. If this happens, a monologue is established in which only one party speaks, resulting in situations where important inputs from those differing from the speaker can be lost.

General formulation

Decision-makers about nuclear technology and its applications should determine whether language with ideological effects have been used in argumentation for or against a proposal, and to what extent this language has privileged one set of sectoral interests over and above another, or has effectively silenced the voice of an interested or affected party.

Specific formulation and application

A responsible approach for a decision-maker with regards to ideological language would be to take seriously all of the voices in the nuclear debate, with a view to determining (a) which interests they are speaking from, (b) what overlap, if any may exist between these interests, and (c) to what extent and how these different sets of interests are compatible with the minimum standards of common morality in society - as these standards have been codified in our Constitution, Bill of Rights, specific legislation, regulations, standard operational procedures, etc.

With this in mind, we can now turn to a closer look at the core assumptions and value issues of a number of specific pro- and contra-arguments that are central to debates about the development and application of nuclear science and technology.

6. IDENTIFYING CORE ASSUMPTIONS AND VALUE ISSUES IN THE ARGUMENTS FOR AND AGAINST NUCLEAR ENERGY

6.1 A schematic overview of the arguments for and against nuclear power generation

In this section, we will identify and analyze the core beliefs that are implicit in the extreme arguments for and against nuclear power generation. We will also attempt to show how the two extremes of the debate are embedded within two opposing views about the sources and functions of knowledge in society. This will then make it possible to identify more moderate positions for or against nuclear power.

In order to do this analysis and differentiation, we first give a schematic overview of the extreme arguments for and against nuclear power generation. In this overview, the substantive claims of these arguments are presented in the far left and far right columns, while the assumptions on which these claims rest, are represented in the two middle columns. This is done to highlight the adversarial and oppositional character of both the claims made from the extreme positions and the assumptions on which they rest.

STRONG PRO-NUCLEAR STANCE Nuclear Power Is Clean		**STRONG ANTI-NUCLEAR STANCE** Nuclear Power Is Dirty	
REASONS GIVEN	IMPLICIT BELIEFS	IMPLICIT BELIEFS	REASONS GIVEN
a) Nuclear power does not pollute	a) Data on nuclear pollution reliable	a) Unreliable facts/data about nuclear pollution	a) Polluting
b) Radiation emission is insignificant	b) Scientific knowledge provides us with sufficient ability to control radiation pollution	b) Science and technology can never provide us with sufficient understanding and control of the effects of radiation	b) Much uncertainty about radiation emissions

c) Waste is responsibly contained	c) We already have enough technical and scientific expertise to handle waste responsibly	c) We will never have enough technical and scientific knowledge to deal adequately with the waste	c) Irresponsible handling of waste

STRONG PRO-NUCLEAR STANCE Nuclear power is always safe		**STRONG ANTI-NUCLEAR STANCE** Nuclear power is always too dangerous to take on board	
REASONS GIVEN	IMPLICIT BELIEFS	IMPLICIT BELIEFS	REASONS GIVEN
a) Nuclear power radiation never contains a real risk to public	a) There is sufficient scientific data to prove nuclear power is not a radiation risk to public	a) There will never be sufficient scientific data to prove that nuclear power is not a radiation risk to public	a) Nuclear power radiation always poses a life-threatening risk
b) Accidents are rare and controllable	b) There is sufficient scientific knowledge to prevent catastrophe	b) Scientific knowledge will always be unable to prevent catastrophe	b) Accidents are frequent and disastrous
c) There are many safe places for nuclear power stations	c) There is sufficient engineering and technological skill available to identify and secure a safe place	c) There will never be sufficient engineering and technological skill to ensure safety	c) No safe place for nuclear power stations will ever exist
d) Nuclear waste storage sites are always safe	d) Scientific and technological knowledge will always solve problems now and in the future	d) Human science, technology and engineering will never be able to solve all problems that occur	d) No nuclear waste storage sites can ever be safe

e) Waste repositories never pose a serious threat to future generations	e) Our scientific and technological knowledge is sufficient to guarantee absolute safety	e) Our scientific and technological knowledge can never be sufficient to guarantee safety	e) Waste repositories always pose a serious threat to future generations
f) Nuclear power never promotes the proliferation of nuclear weapons	f) There will always be sufficient international and local controls to prevent nuclear weapon proliferation	f) There will never be sufficient international and local controls to prevent nuclear weapon proliferation	f) Nuclear power always promotes the proliferation of nuclear weapons

STRONG PRO-NUCLEAR STANCE Nuclear power is economically viable		**STRONG ANTI-NUCLEAR STANCE** Nuclear power is always too costly to afford	
REASONS GIVEN	IMPLICIT BELIEFS	IMPLICIT BELIEFS	REASONS GIVEN
a) The threat of a nuclear accident within a nuclear power station or waste storage site is always so low that it can always be traded as a factor, like any other, in a cost-benefit analysis	a) Our scientific and technological knowledge is always able to prevent nuclear catastrophes from occurring	a) Our scientific and technological knowledge is unable to ever prevent nuclear catastrophes from ever occurring	a) The threat of a nuclear accident within a nuclear power station or a waste storage site is always so high it is impossible to cost the risk in a cost benefit analysis
b) The external costs of nuclear waste to present and future generations is lways cancelled by nuclear power's engineering safety features	b) Human scientific and engineering safety features are always able to remove all nuclear radiation risks	b) Human scientific and engineering safety features are never able to remove all nuclear radiation risks	b) The external costs of nuclear waste to present and future generations can never be removed by engineering and safety features

What emerges from this table is that those strongly in favour of nuclear energy share a strong belief in the ability of science and technology to address all society's serious problems. Similarly, those who are against the development of nuclear power share a deep and overwhelming skepticism of all scientific endeavours. A third, less extreme, and some might argue, more honest look at the issue of whether nuclear energy is a viable form of energy generation or not might look something like this:

A TENTATIVE, MODERATE POSITION THAT IS OPEN FOR DEBATE	**IMPLICIT BELIEFS**
a) There is sometimes radiation pollution at nuclear waste sites and power stations b) Radiation pollution is usually minimal but sometimes not c) Radiation pollution from nuclear power stations does not pose an unreasonable risk to the public	a) Data on radiation pollution is sometimes reliable, sometimes not. b) Scientific knowledge often, but not always provides us with sufficient ability to control radiation pollution c) Present scientific data suggests that nuclear power's radiation risk to present generations is low
d) There are only a few safe places for the siting of nuclear power stations	d) There is usually sufficient engineering and technological skill to identify and secure a safe place for the siting of a nuclear power station
e) Nuclear accidents occur and can be difficult to control f) The threat of a nuclear accident within a nuclear power station or waste storage site is sometimes low and tradable and sometimes not.	e) Scientific knowledge does often reduce the risk of catastrophic nuclear accidents f) Our scientific and technological knowledge is not always able to prevent nuclear catastrophes from occurring

g) Nuclear waste is often responsibly contained, but sometimes not h) Nuclear waste storage sites are usually safe for present generations i) Waste repositories could pose a serious threat to future generations	g) We often assume we have enough technical and scientific expertise to deal with nuclear waste, but often we do not have enough expertise h) Science and technology often solves problems at waste storage sites i) We are not sure if our scientific and technological knowledge is sufficient to ensure the safety of nuclear waste storage sites for future generations
j) Nuclear power might promote the proliferation of nuclear weapons	j) There are sometimes sufficient international and local controls to prevent nuclear weapon proliferation and sometimes not
k) We don't know if the external cost to present and future generations will be reduced by nuclear power's engineering safety features now	k) We don't know if the scientific and engineering safety features of nuclear waste storage sites are able to protect all future generations from nuclear radiation pollution

To some extent, the initial two extreme positions represent two distinct ways of acquiring knowledge in the world, one is through the scientific route of rigorous experimentation to obtain objective knowledge and the second through reliance on subjective experience and non-expert opinion. Supporting nuclear power in the past has meant choosing a society that relies heavily on scientific knowledge to survive. A society that relies heavily on science, or human intervention, to exist is also a society of risk where constant human management is required to ensure safety.

However, it is also true that nuclear energy is not the only form of industrial action that requires this amount of monitoring. There are a number of other industries, like, for example, the chemical industry, which requires just as much human intervention, to prevent disasters from occurring. However, because of catastrophes like Chernobyl, nuclear energy symbolizes and brings to a head the kind of risk and uncertainty that we must be prepared to live with, if

we choose to live in world that relies on science to sustain itself.

The underlying value theory that this kind of society uses to justify its actions within the environment is an instrumental one where humanity is seen as separate from nature. In order to survive, humanity must dominate its environment and bring all the natural forces under control. Nature is therefore viewed as a resource to be used for our benefit. Technology, in this case, nuclear technology, is a tool that enables humanity to transform the environment for our purposes.

One of the fallacies that might arise if this kind of interacting with the environment is used in isolation from other forms of knowledge is that humanity could suppose that it is, in fact, totally and fully in control of the environment. It might assume that when mistakes occur in the future that they could always be overcome by further planning, more science, or better technology. While this may often be the case, there are many studies of past environmental damage which suggest that this might not always be so, and that irrevocable damage does indeed exist (Sedgewick 1991: 215).

The second way of relating to the environment which is suggested in the other extreme in the grid above is that of subjective experience. This form of knowledge gathering, instead of attempting to filter out all personal bias uses it as a point of reference. It is distrustful of expert opinion and scientific endeavour and relies on lived experience for trustworthy knowledge. Lidskog makes the point that there are times when contextually generated knowledge may be more relevant than science's context-free truth claims. He uses the example of farmers in a geographic area that may have knowledge that is more essential than that of scientists (Lidskog 2000: 215).

These two extremes when taken in exclusion of the other side leave us with two choices, either to return to a technology-free world where we are totally subject to the forces of nature and make all our decisions based on non-expert, experiential intuition. Or, to continue relying on experts alone whose knowledge is highly specific and far removed from everyday life. It would seem that either position is largely untenable and unlikely to achieve much consent in decision-making where both parties are represented.

If we allow expert scientific opinion alone to define nuclear power's risk issues, other approaches become peripheral and the public is seated on the fringe rather than at the centre of environmental action. It is this kind of attitude that usually results in problems in the relationship between science and citizens. Often, when the expert approach is followed, then problems between the two are seen as a result of public ignorance or public irrationality

(Lidskog 2000: 217).

However, on the other hand, the public might not see experts as the final authority on what social risks should be accepted in society. Technical and scientific experts who value reason and evidence highly are also often not comfortable with participating as stakeholders in debates, nor are they comfortable with being seen to have vested interests. It could be said that scientists and engineers generally value efficiency and cost-effectiveness more highly than long-term safety, and the public might favour the reverse (Catron 1996: 381).

Caldwell makes the point that the role of science and scientific expertise is to enlarge our understanding so that we can make more social choices and action. It is not science's role (or that of scientific experts we add) to apply this knowledge, society as a whole does this. Society makes its choices in the light of the understanding that is derived in part from scientific expertise and in part from moral and/or emotive values, which are beyond the realm of science (Caldwell 1990: 197).

It seems, therefore, that in our attempts to make decisions about nuclear power we should be wary of being trapped by either of the two extremes, that is a positivist belief in the ability of the science to control all risk in our world, or the opposite, a romantic belief in a world that can exist without science. Neither science nor experiential knowledge can be seen, in isolation, as the only producers of legitimate knowledge. Instead, both can, and in fact do, make valuable contributions to the public domain, although both also have to justify their respective roles on the basis of the kinds of results that they yield. We can't afford to put an uncritical form of trust in only one form of knowledge but need to have them working together. It is when we realize this that we can begin to take seriously the communication between the public and expert opinion (Lidskog 2000: 217, 218).

The task of any public decision-maker on the question whether to further develop or apply nuclear technology, would therefore be first of all to contextualise nuclear energy by placing it within the framework of the needs and aspirations of our human and non-human world today, and then to project possible implications of any decision for the future. In effect, the decision-maker would then endeavour to determine which decision is appropriate to and ethically justifiable within all of the ever widening circles making up and enabling the lives that we live as humans, namely the economic, social, political, cultural and natural "circles".

In the sections below, further discussion follows of the substantive arguments that have been formulated from various positions on the central issues of nuclear power generation, namely whether it is clean or dirty, safe or unsafe, contributes to weapons proliferation or not, and

whether it is affordable or too expensive to contemplate. In what follows, some evaluation of the arguments will be given from the point of view of the central principles of common morality that were discussed in Section 3 above. What is of particular relevance in this regard are the notions that all things being equal, free informed consent is required to impose risks on others; that those that are victims of risks can legitimately insist on compensation in proportion to any substantive harm suffered; and that future generations have a right to enjoy the same quality of life as present generations

Using these and other principles of common morality, we will now assess the broad arguments for and against the use of nuclear power. While doing this we will make recommendations as to what criteria would assist decision-makers to make morally justifiable decisions within the public domain about nuclear power generation.

6.2 On the question whether nuclear power is clean or not

One of the most commonly heard justifications for the use of nuclear energy is that it is one of the cleanest forms of power generation available. It is often claimed that, unlike coal, it does not produce sulphur dioxide, nitrogen oxide, carbon dioxide and tons of heavy metals like lead, arsenic or harmful organic compounds. While coal is either blown in the air we breathe or dumped into ash heaps, nuclear waste remains in the reactor until it is removed to be stored. It is said to be solid, stable and it becomes less radioactive over time (Darroll 2001: 31, 32).

A similar argument is made by Hodgson who states that nuclear power stations discharge almost no waste into the atmosphere because all the waste is in the radioactive fission fragments. He states that on the other hand the atmospheric waste due to coal and other fossil fuel power stations is an "intractable problem" with serious health and environmental consequences (Hodgson 1997:65).

The perils of using fossil fuels are also documented by those in favour of alternative forms of energy. Flavin and Lenssen point out that the ash collected from coal-burning power plants often contains heavy metals that leach into nearby streams. The number of injuries and deaths caused by coal mining is another cause for concern (Flavin and Lenssen 1995: 57, 58).

It has also been suggested that nuclear power has already contributed to the lowering of greenhouse gas emissions because it emits much less carbon dioxide than fossil fuel power does. Authors Vera, Bertel and Steven claim that a "comprehensive analysis of greenhouse

gas (GHG) emissions from different electricity generation chains shows that nuclear power is among the least carbon intensive technologies" (Vera et al 1998: 1). This ability of nuclear to contribute to the lowering of greenhouse gas concentrations so as to prevent anticipated dangerous changes to climate is mooted again in *Science's Compass Policy Forum* where it is suggested that nuclear power, if expanded under high safety conditions, can play a significant role in mitigating climate change (Sailor et al 2000: 1178).

Nuclear energy has also been compared favourably to renewables like gas, with Kenny claiming that gas stations might be cleaner than coal but they also produce nitrogen oxide and carbon dioxide. It is also argued that natural gas contains radon, a radioactive gas, which is emitted from the air (Darroll 2001: 32). Moreover, these negative environmental impacts of natural gas are also not denied by those who are not in favour of nuclear power as an alternative. Flavin and Lenssen acknowledge that if natural gas supplants oil and coal it could be one of the largest producers of greenhouse gas. They make the point that methane gas, as an energy source is a powerful heat-trapping device that contributes to climate change in itself (Flavin and Lenssen 1995: 113).

A similar argument is used to compare nuclear energy to solar power. Kenny claims that solar power, although it is a renewable form of energy, produces waste that is toxic, i.e. lead. The lead in solar power is found in the batteries that store electricity. He states that lead remains dangerous for infinity and causes foetal damage, mental retardation in children, infertility and is linked to cancer. However, despite all these characteristics of lead, Kenny makes the point that it is absurd to pretend we can't deal with its dangers and risks properly (Darroll 2001:32). Therefore, he infers just because nuclear energy produces waste that is very toxic doesn't mean we can't deal with its dangers effectively.

One of the strongest arguments here is that nuclear energy is cleaner than the main source of energy in South Africa - coal. It is suggested that nuclear energy has been unfairly judged and is actually the clean solution to the dirty burning of coal for energy. Moreover, it is also suggested that it is not only better than coal but it is no worse than even some renewables, like solar which have highly toxic byproducts such as lead.

On the counter-side of this argument, a case could be made that this is true in the short term for as long as the waste products of coal are allowed to be continually emitted into the atmosphere without any effective pollution controls. However, over the longer term this point can't be accepted, as we simply don't know what the impacts of nuclear waste will be on future generations. We don't know how geological and social conditions will have changed in the tens of thousands of years that high-level radioactive waste remains harmful to human

beings. The same can be said for other chemicals that remain harmful over long periods of time.

As such, this observation points to the need to investigate the impacts not only of nuclear processes, but of all chemical processes in industry. This is important in order to place the nuclear debate in context, because it could be argued that there are chemical processes that are as dangerous to human health as nuclear processes. For example, in 1976 a chemical plant explosion in Seveso, Italy released a giant cloud laced with dioxin. Piller claims that dioxin is one of the deadliest substances ever created. He states that thousands of pets and wild animals died; hundreds of people developed blurred vision and the highly disfiguring skin rash chloracne, and that more than 7 000 townspeople were evacuated from their homes, some for years. Moreover, birth defects soared (Piller 1991:6).

It is a fallacy of accident to assume that the long-term harmful effects of other industrial processes justify the continued use of nuclear power. This is because it is not logically acceptable to claim that an action is right, simply on the grounds that nothing is done about other actions that are wrong. The principle of consistency that is often invoked to commit this fallacy, should in fact be reversed: making the point that all forms of power generation, including nuclear and other industrial processes need to take full responsibility for their short and long-term waste. If they can't then that industry that produces long-term toxic or radioactive waste should either be denied the right to continue, or forced to take effective responsibility for the risks that they impose on the public of present and future generations. One of the forms that such responsibility will have to take, is that of continual training, supervision and management of personal that will be required to look after and effectively protect the waste storage of these long-term toxins.

Recommendation 12

General formulation

There rests a stong obligation on the operators and managers of all forms of power generation, to take due cognisance of the risks that they impose on the public and their workers, and to respond to these risks in accordance to the minimum standards of public morality as these are codified in legislation, regulations, standard operational procedures and the reasonable expectations of the public.

Specific formulations

a) The operators and managers of all forms of power generation, including nuclear, have an ethical obligation *to inform* the public of how much risk they are being exposed to by their activities or proposed activities.

b) The operators and managers of all forms of power generation, including nuclear, have a responsibility to ensure that the public, in particular those who are, or may be directly affected by the risks, well *understand* the risks they are being exposed to (or may potentially be exposed to).

c) The operators and managers of all forms of energy generation, including nuclear, must offer reasonable *compensation* in proportion to any risk or harm workers or the public are (or may be) exposed to.

d) The operators and managers of all forms of energy generation, including nuclear, have an ethical obligation to inform the public about what risk their activities pose to *future generations*, and to put reasonable measures, procedures and institutions in place to minimize these risks for future generations, or to ensure that they can be duely compensated in proportion to any substantive harm that they may suffer.

Application:

Decision-makers and regulators should make sure that these obligations are met during the normal course of all power generation operations, but in particular, that these obligations are met when proposals for new activities are considered. In the case of new proposals, the latter will entail that decision-makers and regulators should be satisfied that:

- The public is duely informed about the risks of the proposed activity
- The public, and in particular those directly affected by the risks understand them well
- The acceptance of any risk (by the workers or the public) under the promise of due and proportionate compensation is done on the basis of free and informed consent, compatible with the minimum standards of common morality
- That the acceptance of any risk by the public to future generations is done on the basis of free and informed consent, subject to the strictest standards of common morality applicable to the impact of present generations on the well-being of future generations.

6.3 On the question whether nuclear power is safe or not

The second common justification for the promotion of nuclear energy as a form of power generation is that it is one of the safest forms available. Key to unpacking and evaluating the arguments in this debate is assessing to what degree radioactive waste places a risk on human health. There is much disagreement about this and this has lead to much uncertainty regarding what can be conclusively regarded as a real risk.

6.3.1 The dispute about the certainty surrounding the effects of radiation

Price claims that the harmful effects of radiation have been over-exaggerated. He states that all human activity involves some risk and that the risks of normal living should be the backdrop against which the need for protection from the damage of radiation should be measured. He says that much of the anxiety surrounding radiation is unjustified and that a great depth of knowledge already exists about the effects of radiation on the human body. Moreover, much effort has gone into regulating the extent to which the human body is exposed to it. Price concludes that risks from the normal operation of atomic energy installations are well under control (Price 1990: 203, 205, 225).

A similar point is made by Hodgson who claims that the radiation from nuclear power reactors is kept carefully under control and far below those that could cause any sort of illness. He draws these conclusions from the fact that in India and Brazil the natural radiation levels from rocks are far higher than the quarter millirem a year emitted from UK nuclear power reactors and there are no effects on the humans living there (Hodgson 1997:39).

However, this confidence in society's knowledge about the effects of radiation is not accepted by all. There are some that claim there is much uncertainty regarding:

a) how much radiation is emitted from nuclear power stations.
b) what radiation exposure levels are detrimental to human health and what are not.
c) how different doses from different sources affect human health.

Despite claims by Kenny (Darroll 2001:32) and Hodgson (Hodgson 1997: 65) that nuclear power stations discharge no to little waste into the atmosphere, there are others who claim that the solid waste of nuclear reactors is the part that is admitted by the nuclear industry, but that gases and liquids are also released to the environment. Moreover, that routine releases from nuclear power plants are spread out in time, dispersed in the air and diluted by water. This dispersal, however, doesn't reduce the cancers or birth defects caused by radionuclides

but merely spreads it over a larger population, making it difficult to trace (Bertell 1994: 115).

On the issue of what radiation levels are detrimental to human health and what are not, the serious genetic and cancer damage caused by high levels of radiation appear undisputed, but on the lower levels it is not clear. Kenny claims that the effects of lower levels are not known but states that increasingly studies are showing that at certain levels of radiation, the incidents of cancer decrease (Darroll 2001: 33). This alleged uncertainty regarding the effects and acceptable doses of radiation is further fanned by the fact that no direct relationship can be drawn from the activity of a material and the resulting dose. It is said that to arrive at a dose, it is necessary to take into account the chemical nature of the radionuclides and how they are delivered to the tissue (Wendell 2000:9).

This uncertainty over the effects of radiation is said to spread beyond the confines of the scientific community and among members of the public who are largely unaware what the sources are of excessive radiation (Wendell 2000: 9). The public's lack of knowledge is confounded by the fact that they are also unable to physically see excessive radiation which can be inhaled, ingested or simply absorbed by the body's exposure to the substance. Given the disputed facts regarding the effects of radiation, the perceived lack of scientific certainty surrounding the effects of radiation on human health and the lack of awareness among members of the public, especially in South Africa, about the sources and effects of radiation, a number of ethical questions emerge regarding the risk that is being undertaken.

Shrader-Frechette formulates the central ethical question like this: Is it morally acceptable to impose technological and industrial risks like those associated with nuclear energy generation (we add as well as other forms of electricity generation like coal and hydro power), on members of the public? She points out that this is contingent upon several factors, two of which we believe are relevant in this section:

a) If the hazard is well-understood by the public who must bear the risks
b) If the risk is accepted voluntarily (Partridge 1982: 266).

6.3.2 Nuclear energy and the problem of accidents/terrorism

In the second part of the arguments surrounding the safety of nuclear power generation, we discuss the impact on the debate of accidents like Three Mile Island, Chernobyl and the possibility of terrorist sabotage.

Price states that the financial disaster of Three Mile Island and the tragedy of Chernobyl have sharpened the industry's awareness of what could happen if design and operating standards

were not improved. He states that the statistics prove that the message has been taken. He claims that unplanned automatic shut-downs in the USA dropped by more than 50% between 1980 -1987, the radiation exposure of the work-force showed a similar fall, high quality simulators for operator training have been developed and there were now worldwide communication networks for exchanging experience. He makes the point that "the industry has been jolted into realizing that one more serious accident anywhere in the world could call its future everywhere into question" (Price 1990: 250, 251).

Hodgson claims that nuclear is no different to any other polluting industry. He compares the accidents of the nuclear industry with those of other major sources of energy like coal. Drawing the comparison, he says coal is very hazardous because of the dangers of mining as well as the sulphurous and nitrous gases discharged into the atmosphere. He makes the point that even renewables like wind and solar can be dangerous because of the many collectors that have to be built which results in mining and construction hazards (Hodgson 1997: 31).

Hodgson claims that nuclear energy compares favourably because not only is uranium a concentrated source of energy with small quantities being mined but there is no poisonous smoke from nuclear power stations. In a table of severe accidents where he compares coal, oil, gas, hydro and nuclear, he shows how nuclear had only one major incident between 1969 -1986 that resulted in 31 deaths whereas coal had between 10 and 434 deaths per accident and a total of 62 accidents over the same twenty year period (Hodgson 1997: 31).

With differing figures but similar conclusions, Kenny makes the same point that accidents in power generation using gas, coal, oil and hydropower claim far more human lives than nuclear plants. He states that Chernobyl, the worst nuclear accident in the world, killed two people directly and another 50 died since the accident as a result of radiation release. He states that a gas explosion in Moscow in 1989 killed 650. Similarly, he argues that in the worst nuclear power accident in the West at Three Mile Island in USA no one was killed or injured and that there were no negative after-effects (Darroll 2001: 31).

However, our literature survey showed that there is much disagreement over the perceptions about the effects of accidents at nuclear power stations. This is well illustrated by the Three Mile Island incident where the *Report of the President's Commission on the Accident at Three Mile Island* stated that the maximum estimated radiation dose received by anyone off site, excluding plant workers, was 70mRems. The report also claimed that this release would have no "detectable additional doses of cancer, developmental abnormalities or genetic ill health as a consequence of the accident". It stated that the major health effect on the individuals was mental stress (Report of the President's Commission 1979: 12, 34).

However, an article written by Joyce Hollyday entitled *In the Valley of the Shadow of Three Mile Island* raises several serious questions about the health effects of the incident. In the series of interviews she conducts, it becomes clear residents believe the accident was linked to cancers, cancer deaths, thyroid problems, respiratory ailments, leukemias and skin rashes. Residents also recorded dogs being born without eyes, kittens being still born and the appearance of deformed flowers following the incident (Shrader-Frechette 1991: 138, 140, 141, 142). [Shrader-Frechette (2000) has pointed out similar discrepancies in statistics about the Chernobyl disaster of 1986.]

One of the key problems with connecting any of these incidents to nuclear radiation is proving the connection between the exposure of the patient and the resulting illness. Bertell states the reason for this difficulty is the wide dispersion of radionuclides and the several myths surrounding radiation and health (Bertell 1994: 115). The fact that the effects of radiation can sometimes only be detected several years later is another reason why it could be difficult to pin statistics to the effects of nuclear energy on health.

Shrader-Frechette states if the often heard claim "no-one ever died as a result of an accident in a commercial nuclear plant" means that no bodies could be found on the premises, then it may be true, "but if it means that no-one dead would now be alive but for nuclear power", or even occasional accidental incidents of radiation, then that claim appears false. She claims many have died as a result of nuclear power while no one can individually be identified as a victim (Partridge 1982: 264).

Given the perceived uncertainty regarding the true extent of the effects of nuclear accidents like Three Mile Island and Chernobyl, it would appear that Shrader-Frechette's moral question remains pertinent: Is it morally acceptable to impose a technological and industrial risk like nuclear energy generation on members of the public - in particular if these risks are not well understood, and if the public does not voluntarily accept them? Following our discussion on the effects of radiation, it would appear the answer to this question would be contingent on clear answers that can be given on the following two questions:

a) are the risks imposed by nuclear energy "common risks" or are they extraordinarily grave and dangerous (Partridge 1982: 266), and
b) if the risks are "extraordinarily grave and dangerous" can a convincing case be made for the absolute necessity of those risks?

Similarly, the same kinds of questions about risk are raised when one considers the threat of the sabotage of nuclear plants and waste storage sites by terrorists, in particular after the

events of September 11 2001 in New York. Here it becomes pertinent to determine what is the probability of such a risk. It could be argued that the probability of nuclear power stations and waste storage sites being blown up by saboteurs, particularly in the manner of flying an aircraft into them, is so low that the demand for the non-polluting electricity it supplies far outweighs the small probability of a catastrophe.

Or, alternatively, one could argue that nuclear plants and waste storage sites are so vulnerable and the likely effects so catastrophic that it is not an acceptable risk. But just how vulnerable nuclear power stations and storage sites are to terrotist attacks is also not clear. Statistics about the probability of risks that may be applicable to the normal operations of a nuclear power plant or a waste storage site under the strictest possible management, simply does not apply if terrorist activities are factored into the equation. The force of will of one single terrorist organization that may escape the attention of the best counter-terrotist surveillance apparatus in the world (which has happened in the case of 11 September 2001 World Trade Centre scenario) makes it impossible to predict which installation would be targeted where in the world for which cause.

In addition, the extent of a catastrophic explotion of a nuclear waste storage site or power station, would have to be compared with the kind of devastation that the blowing up of gas power stations and hydro power plants would cause. If it could be argued that nuclear energy is less dangerous or as dangerous as other forms of power generation in a certain area, then a case could be made for its necessity.

Recommendation 13

General formulation

The operators and managers of all forms of energy generation, including nuclear, must prove that the accident risks (including the risks of terrorist threats) imposed on society by their activities are not extraordinarily grave or dangerous. However, if these risks indeed are extraordinarily grave or dangerous, there rests a further obligation on these operators and managers to demonstrate with reasons and sound argumentation the absolute necessity of using that form of power generation as opposed to others that might be less dangerous.

Particular formulation

The burden of proof regarding the safety of any nuclear power generation plant or waste storage facility (in particular in the light of probability statistics - or lack of it - about accidents

and terrorist attacks) rests on the producer of nuclear power or any other energy source. It is not the responsibility of members of the general public to prove the possibility or probability of a nuclear accident occurring.

Application

Decision-makers on nuclear technology and its applications should ensure that the proponents of new activities in the nuclear energy field take full responsibility for this burden of proof, and that they discharge this responsibility in a manner that is open, transparent, accessible to the public, and in accordance not only with the minimum standards of common morality, but with the principle of proportionate care that follows from it. (See page 10 for a discussion of this principle, and also the Glossary.)

6.3.3 The problem of locating nuclear power stations and nuclear waste storage sites

The final question regarding the argument that nuclear energy is the safest form of energy concerns itself with location - the location of the nuclear energy plant and the location of the nuclear waste storage site. One of the main problems with finding a place to locate a nuclear power plant or nuclear waste storage site is that nobody wants it in their backyard (the NIMBY syndrome). While many people are happy to enjoy the benefits of electricity generated from nuclear power, given the disputes over the effects of radiation, the ignorance of the public, and the possibility of nuclear accidents, many are reluctant to live near nuclear reactors or nuclear waste storage sites. It would also be likely to assume that people might also be reluctant to live near a gas plant or a coal power station.

The location of nuclear reactors therefore brings up the important issue of equity, i.e. how fairly the environmental and social costs of power generation should be divided between people living within a country and within a generation. This is an issue that is not only unique to nuclear energy, but also affects other forms of energy like gas or coal. The point could be made regarding coal that the people living close to the air pollution caused by coal are being forced to pay the full price for the benefit of electricity that are being enjoyed by others who are not directly affected by the pollution.

Similarly, when a nuclear reactor leaks or an accident occurs, it is likely to affect those closest to the plant the worst. They are the people who will pay the full price for the benefit being enjoyed by all. The ethical question posed by Shrader-Frechette is once again relevant here: Is it morally acceptable to impose a technological and industrial risk like nuclear energy generation, or any other form of hazardous energy generation on members of the public - if

that imposes an unfair distribution of burdens and benefits between people? We would suggest, in this section, that the answer is contingent on the answer given to the question whether the risk is distributed equitably within the country (or between countries) or not, and whether reasonable and proportionate compensation is offered or not.

On the issue of locating nuclear waste storage sites for high-level, and even intermediate level waste, the question of the equitable distribution of risk becomes more difficult to fulfil because of our inability to predict the geographical conditions that are likely to prevail in areas that far into the future.

Some authors suggest that finding a suitable long-term nuclear waste storage site will not be solved by developing better ways of digging holes into bedrock or protecting radioactive waste from water tables, because the "technical problem is not of digging a hole in the ground; it's of forecasting the unknown". Lenssen makes the point that, given that the English Channel did not exist 7 000 years ago, only someone who could see into the future could choose an inviolable permanent hiding place for nuclear waste (Lenssen 1991: 23, 27).

Others, on the other hand, suggest that uncertainty does not mean that risks are significant and that the public should reject repository siting. They claim that the emotions that surround the siting of a repository are remarkable given the confidence of most technical engineers and scientists. Instead, they believe the nuclear waste problem is really a management problem. They make a case that it is a lack of confidence and distrust in risk management procedures, rather than a technical problem. Slovic et al states that although everyone appreciates the sophisticated engineering needed to store nuclear waste safely, the political and institutional requirements to do that have not been appreciated. Lots of resources have been spent on developing sophisticated technologies, but little has been spent on equally sophisticated political processes and institutions (Slovic et al 1993: 81).

Then there is also the viewpoint that it is not realistically possible to fairly compensate future generations that live near our nuclear waste storage sites. A compensation fund created now may have no monetary value that far into the future. Moreover, the case could be made that we can’t compensate future generations when we can’t predict what kind of accidents will happen in the future. It could be said that the issue of the disposing of long-term radioactive waste ethically is by definition not possible, because the time frame extends beyond the ability of a generation to be responsible. Once again, however, the argument could be made that this goes for all forms of energy generation or industrial processes that produce waste that can't be adequately disposed of within the time span of one generation.

Solutions to the intergenerational equity problem require that a list of principles be agreed upon to guide present conduct. This is likely to be the subject of much debate but we have suggested that the general principle that no generation should (needlessly) deprive its successors of the opportunity to enjoy a quality of life equivalent to its own, be accepted for the purposes of nuclear energy ethics (Catron et al 1996: 140). The kind of secondary principles that follow from this central principle is that every generation is the trustee for generations that follow, we are obliged to protect future generations without jeopardizing the interests of present generations, concrete hazards in the near-term have priority over long-term hypothetical hazards, that the preference for the present is reduced when questions of irreversible harm exist and that any action that carries the plausible threat of catastrophic effects should not be pursued in the absence of significant countervailing need (Catron et al 1996: 140).

Recommendation 14

General formulation

Those who expose others to risks should ensure that these risks are minimized and fairly distributed, and that due compensation is made available to those affected by these risks.

Specific formulations

(a) The operators and managers of all forms of energy generation, including nuclear, must ensure that no one carries an unfair burden of risk because of their location near a nuclear power plant or storage site. If they do, those exposed to the risk should be made aware of this and be compensated for it.

(b) In the event of an accident, or major catastrophe, the operators and managers of all forms of energy generation, including nuclear, should take pro-active responsibility for the health and well being of everyone that may be affected. In cases such as these, the burden of proof should not be on potential or actual victims to prove that they have been affected. Furthermore, the onus is on the energy producer to bear the medical costs of, and pay compensation to all those affected by an accident or major catastrophe.

Application

If energy producers, including nuclear, cannot demonstrate how it would compensate those affected by the risks of power generation, then they should not be allowed to proceed with their activities.

Recommendation 15

General formulation

The same as Recommendation 14

Specific formulation

Producers of energy, including nuclear, need to demonstrate that their present activities do not pose a threat to the quality of life of future generations, leave them with diminished resources or the impending threat of a catastrophe.

Application

If energy producers, including nuclear, cannot demonstrate how it can satisfactorily take care of its long-term, high-level waste problem in an ethically justifiable way then they should not be allowed to proceed with their activities.

6.4 Nuclear energy and nuclear weapons

In this section we will examine nuclear energy's close link with the production of nuclear weapons. It is this link to the atom bomb horror of Hiroshima and Nagasaki that spreads a cloud of fear and political insecurity over the use of nuclear power. We will examine the origin of these similar fears in South Africa and analyze how they affect the argument that nuclear energy is a safe form of electricity generation.

Willrich makes the point that the use of nuclear energy to generate electric power will result in the widespread availability of fissionable materials in civilian nuclear industries around the world. He claims that the ramification of this development for the security of the entire world is immense. This is because plutonium, which is a byproduct of the fission process in a nuclear reactor, can be used either to fuel power reactors, or as an explosive for nuclear weapons. Similarly, the technology used to produce the slightly enriched uranium used for electric power reactors is the same technology required to produce fully enriched uranium used in nuclear weapons (Willrich 1971: 3).

However, Price makes the point that while there can be no guarantee that the pursuit of civil nuclear power will not aid proliferation in some states, equally it can't be said abandoning it will rule out the continuation of nuclear arms proliferation. He points out that historically nuclear power has usually been developed out of the military use of nuclear power and not the other way around. He admits that although civil reactor designs are not ideal for creating

weapons, it is also true there are no “absolute technical fixes” that can prevent them from being made unusable. He concludes, therefore, that barriers to the use of nuclear materials have to be political rather than technical (Price 1990: 175, 201).

It is true that South Africa, as a country, is no stranger to the technology of nuclear weapons. During apartheid, the country built a pilot uranium enrichment plant that produced highly enriched uranium to fuel nuclear weapons. It also created a facility to develop and test its nuclear weapons. When the programme ended in 1989, South Africa had built six nuclear explosive devices and almost finished a seventh one. Research was also being conducted in implosion type nuclear weapons and facilities to integrate warheads with ballistic missiles had been developed. When the programme was terminated the weapons were dismantled and Armscor sent the highly enriched uranium to the Atomic Energy Corporation facilities at Pelindaba for safe storage, where the International Atomic Energy Agency (IAEA) later inspected it (Albright 1994: 144, 145, 146).

While it is true that South Africa has given up its nuclear weapons and signed the Non-Proliferation Treaty, Albright states that the process of disarmament is more complicated than that. He states that nuclear weapons programmes depend on secrecy. It is this legacy of secrecy that surrounds nuclear weapons programmes that hampers the very processes that seek to establish that the programme has indeed ended (Albright 1994: 141,142).

A valuable commodity - public trust - has been lost in nuclear power generation by this veil of secrecy that shrouded the nuclear weapons programme. The theoretical link between a nuclear weapons programme and the nuclear power programme has been confirmed to have been true in South Africa. This is also internationally true. It is also on record that India exploded a nuclear weapon fueled by plutonium reprocessed from the fuel rods of a nuclear power plant already in 1974 (Gerrard 1995: 28). This was the first example of an explosive device being produced from a nuclear reactor that had been installed for non-military purposes (Price 1990: 193).

However, Price states that the barriers to proliferation are stronger than they were in the past. Speaking in the 1990s, he claims that the International Atomic Energy Agency’s inspections have moved from symbolic gestures to regular visits. He calls for the periodic review of regulations so as to keep pace with changing world perceptions of proliferation risk as well as the development of new technologies that might increase access to materials that could be used for weapons manufacture. Price also sees the revision meetings of the Non-Proliferation Treaty as the debating ground for political issues that are not yet resolved (Price 1990: 201).

Given the past, South Africa's new democratic government will need to work hard at establishing the SA public's confidence as well as the confidence of the international community, that SA is not supporting nuclear weapons. They will also need to ensure that former nuclear weapons experts do not sell their expertise to other nuclear programmes. Moreover, there remain a lot of unanswered questions about South Africa's extensive military co-operation with Israel and international relations with China that were not answered (Albright 1994: 147-151).

If nuclear energy producers wish to continue to justify the use of nuclear energy with the argument that it is one of the safest forms of electricity generation they will have to address the high degree of uncertainty that the South African nuclear weapons programme has placed in the minds of the general public and the international community about the peaceful intentions of our country's nuclear programme. It is not enough to simply sign the Non-Proliferation Treaty and allow IAEA visits.

So, given the historical experience of the close link between civilian nuclear power generation and nuclear weapons in South Africa, there is a special need for the nuclear industry to assure the South African public that it will not continue with the centralized, closed door and undemocratic decision-making processes which allowed the nuclear weapons programme to begin in the first place. If nuclear energy is to survive in a democratic country then it has to demonstrate how it is going to increase participation both within the scientific and technological community, and between it and members of the general public. Without the support of the later, any move to erect a new nuclear power plant or establish a new nuclear waste storage site could result in a "not in my backyard reaction" by residents who would slow up all development of the industry.

Recommendation 16

General formulation
In order to justify its continued operation in South Africa, the nuclear industry needs to re-establish public trust.

Particular formulation
The nuclear industry, in cooperation with and under the superivision of appropriate authorities should set up and maintain structures, processes, procedures and institutions that can effectively serve as safeguards against weapons proliferation. This would have to be sensitive enough not to release information that might promote nuclear proliferation and further jeopardize international security.

Application

If nuclear energy producers cannot demonstrate how it would set up and maintain effective measures to safeguard against nuclear weapons proliferation, then they should not be allowed to proceed with their activities.

6.5 On the question whether nuclear power is affordable or not

In this section, we will examine the argument that nuclear energy is a justified form of electricity generation because it is one of the most affordable forms of energy available. In order to test whether this statement is valid we could subject nuclear, and other alternative forms of energy generation, to a cost-benefit analysis. In this process, the external and internal costs of producing the electricity are weighed up against the benefits of using that form of power generation.

Price points out that there is no easy answer on this.[9] He states that while there are instances where nuclear power can be regarded as cheaper, this depends on how factors such as interest rates, future coal prices, on how a nuclear project is run and regulated and on how these assessments are carried out. Moreover, he makes the point that power stations exist for so long that economic circumstances change within that time. He concludes that well managed, well-engineered nuclear power is broadly competitive with coal for base-load electricity generation, however states that he is in favour of a mix of electricity sources (Price 1990: 153, 172-174).

Hodgson, states that the relative costs of coal and nuclear power depend on many factors, like for example the proximity of coalfields, but that nuclear power has a relative cost advantage because the energy is extremely concentrated. He says there is as much energy in a pound of uranium as there is in a thousand tons of coal. While this advantage is reduced by the cost of building nuclear power stations, the running costs remain less because such small amounts of fuel need to be transported (Hodgson 1997: 25, 26).

One of the key difficulties with trying to weigh the costs and benefits is that there are so many

[9] This is also true of the proposed PBMR. Steve Thomas (1999) for instance, has done a comprehensive analysis of the economics of nuclear power, what the world market for nuclear power plants are, and what the prospects for exports from South Africa is. He points out that the economics of nuclear power is a highly contentious area, and argues that Eskom's estimates are unrealistic in a number of respects (Thomas 1999: 13). He comes to a similar conclusion about the prospects of exporting PBMRs to the world market.

uncertainties regarding the costing of externalities in nuclear and other power stations. Kenny points out that the social and environmental externalities in power generation can be immeasurable and range from the medical costs incurred by people who suffer disease as a result of air pollution, to the loss of life caused by accidents, damage to the environment caused by waste disposal, plummeting of property values and even the aesthetic values of having power lines spoiling a landscape (Darroll 2001: 31,32).

One most frequently used economic argument in favour of nuclear power generation, as opposed to coal, its biggest competitor, is that it does not produce the large amount of pollution i.e. sulphur dioxide, carbon dioxide and nitrogen oxide that coal power stations do (Darroll 2001: 31,32). However, those critical of nuclear power claim that while nuclear reactors themselves compare favourably to coal-fired plants in terms of plant emissions, the human health costs occur mostly at other points in the fuel chain. Externalities include the impacts of uranium mining, the toxic as well as radioactive wastes from uranium processing, enrichment and fuel production, the effects of intensive energy use in the fuel fabrication process, and the effects of radiation on worker and public health. Finally, it is claimed that the expense of maintaining national institutions to ensure rigorous licensing procedures and monitoring is another external cost often not included in calculations (Earthlife Africa 2000: 17).

The anti-nuclear lobby also frequently argue that nuclear power has only been able to flourish in countries with centrally-planned economies, such as the USSR, and in countries like Britain and France, where electricity utilities are said to be protected from market forces by direct and indirect state subsidies (Koeberg Alert Research Group 1987: 15). Shrader-Frechette also reinforces this view when she explains how in the USA an act of Congress (the so-called Price-Anderson Act of 1957) was passed to limit the liability of the nuclear industry in the event of a catastrophe (Partridge 1982: 267). The question being begged here is if nuclear energy is a viable market commodity why should it need state intervention to protect it from liability and bankruptcy.

Others claim that the nuclear industry is able to produce cheaper electricity simply because it doesn't pay the bill for all its externalities but instead pushes the real cost of nuclear waste on to future generations. This argument is, however, not necessarily unique to nuclear energy. The list of unaccounted for external costs of the nuclear as well as the coal energy industries is long, convincing and well researched by the anti-nuclear lobby.

However, what arises out of the weighing of the costs and benefits of the various forms of energy is that the competitive economic cost of one form of energy over another can’t be

considered in isolation. Each industry needs to make a case for why, in a particular circumstance, their form of power generation, would be most socially and environmentally economical. Kenny also makes the reverse point that these should be weighed up against the cost of not providing electricity, i.e. the respiratory diseases and deaths that arise out of burning coal and wood in poorly ventilated households, the perils of paraffin, candles and open fires and the degradation of the environment caused by the chopping of trees for firewood (Darroll 2001: 31).

Recommendation 17

General formulation

Nuclear energy, like all other forms of energy generation, needs to justify its existence in a given area as the best available economic option. This process must include a thorough, comprehensive costing of all social and environmental costs imposed on present and future generations.

Particular formulation

Nuclear energy, like any other form of energy generation, has to prove that its total benefits to society outweigh its total costs to society. If it can't, and has to rely on the state to limit its liability, or to subsidise it, it needs to justify why.

Application

Decision-makers should make sure that this costing is done in a broad and comprehensive manner, based on progressive economic principles in which social and environmental costs and benefits are taken seriously (in contrast to a narrowly conceived procedure in which financial calculus alone is taken into account).

7. CONCLUSION

In this study an overview has been given of the value issues raised by nuclear power generation, and the implications they have for decision-making.

Against the background of an analysis of common morality as the basis of our ethical recommendations, and within the framework of a growing trend to acknowledge the importance of explicitly dealing with value issues in public decision-making (see Addendum 2), a survey was done of the historical emergence of value issues related to nuclear energy

within the contexts of the USA, Europe and South Africa respectively. We then mapped the extremes of the debates for and against nuclear energy, as well as a more moderate approach that is open for debate about the issues involved. This all set the scene for a closer analysis of the technical arguments offered for and against nuclear energy.

In this regard, we have focused on arguments related to the claims that nuclear energy is clean, safe, cheap and affordable. It is clear from this value analysis that the nuclear industry has much to achieve if it wishes to ethically justify further development of nuclear power generation in South Africa. A comprehensive list of its tasks in this regard is given in the summary of recommendations that follows. Here we wish to highlight that it has been established in this study that:

1. Comprehensive justifications need to be given when decisions regarding nuclear energy are made. Since the development and application of nuclear technology has the potential for acute exposures and catastrophic accidents, there rests a strong obligation on decision-makers to demonstrate with sound and accessible arguments exactly what the reasons are for their decisions. In this regard decision-makers should make explicit which definitions of concepts, and which values under which interpretations have been used to substantiate their conclusions. In addition, decision-makers should demonstrate with clear and sound arguments why certain other concepts, or values or interpretations have been disregarded or rejected in their decision-making.
2. Decision-making about nuclear energy should not only and exclusively be informed by science or scientific experts, but instead should also include and seriously consider non-expert views.

Given this framework the following are some of the main issues that need to be addressed with regards to particular value issues in ethical decision-making about nuclear technology:

3. The operators and managers of all forms of power generation, including nuclear, have an ethical obligation to inform the public of how much risk they are being exposed to by their activities or proposed activities.

4. The operators and managers of all forms of power generation, including nuclear, have a responsibility to ensure that the public, and in particular those who are, or may be directly affected by the risks, well understand the risks they are being exposed to (or may potentially be exposed to).

5. The operators and managers of all forms of energy generation, including nuclear, must

offer reasonable compensation in proportion to any risk or harm workers or the public are (or may be) exposed to because of their activities.

6. The operators and managers of all forms of energy generation, including nuclear, have an ethical obligation to inform the public about what risk their activities pose to future generations, and to put reasonable measure, procedures and institutions in place to minimize these risks to future generations, or to ensure that they can be duely compensated in proportion to any substantive harm that they may suffer.

7. Accordingly, **decision-makers and regulators** should make sure that the obligations (mentioned from 3-6 above) are met during the normal course of all power generation operations, but in particular, that these obligations are met when proposals for new activities are considered. In the case of new proposals, the latter will entail that decision-makers and regulators should be satisfied that:
   - The public is duely informed about the risks of the proposed activity
   - The public, and in particular those directly affected by the risks understand them well
   - The acceptance of any risk (by the workers or the public) under the promise of due and proportionate compensation is done on the basis of *free and informed consent*, compatible with the minimum standards of common morality
   - That the acceptance of any risk by the public to future generations is done on the basis of free and informed consent, subject to the strictest standards of common morality applicable to the impact of present generations on the well-being of future generations.

8. The operators and managers of all forms of energy generation, including nuclear, must prove that the accident risks (including the risks of terrorist threats) imposed by their activities are not extraordinarily grave or dangerous. However, if these risks are indeed extraordinarily grave or dangerous, there rests a further obligation on these operators and managers to demonstrate with reasons and sound argumentation the absolute necessity of using that form of power generation as opposed to others that might be less serious.

9. The burden of proof regarding the safety of any nuclear power generation plant or waste storage facility (in particular in the light of probability statistics - or lack of it - about accidents and terrorist attacks) rests on the producer of nuclear power or any other energy source. It is not the responsibility of members of the general public to prove the possibility or probability of a nuclear accident occurring.

10. The operators and managers of all forms of energy generation, including nuclear, must

ensure that no one carries an unfair burden of risk because of their location near a nuclear power plant or storage site. If they do, those exposed to the risk should be made aware of this and be compensated for it.

11. In the event of an accident, or major catastrophe, the operators and managers of all forms of energy generation, including nuclear, should take pro-active responsibility for the health and well being of everyone that may be affected. In cases such as these, the burden of proof should not be on potential or actual victims to prove that they have been affected. Furthermore, the onus is on the energy producer to bear the medical costs of, and pay compensation to all those affected by an accident or major catastrophe.

12. Energy producers, and in particular nuclear, should be able to demonstrate how it can satisfactorily take care of its long-term, high-level waste problem in an ethically justifiable way.

13. Producers of energy, including nuclear, need to demonstrate that their present activities do not pose a threat to the quality of life of future generations, leave them with diminished resources or the impending threat of a catastrophe.

14. In order to justify its continued operation in South Africa, the nuclear industry needs to re-establish public trust.

15. The nuclear industry, in cooperation with and under the superivision of appropriate authorities should set up and maintain structures, processes, procedures and institutions that can effectively serve as safeguards against weapons proliferation. This would have to be sensitive enough not to release information that might promote nuclear proliferation and further jeopardize international security.

16. Nuclear energy, like any other form of energy generation, has to prove that it can pay its way without relying on the state to limit its liability or further subsidize its running costs. If it can't, it needs to justify why.

17. Nuclear energy, like all other forms of energy generation, needs to justify its existence in a given area as the best available economic option. This process must include a thorough, comprehensive costing of all social and environmental costs imposed on present and future generations.

18. Nuclear energy, like any other form of energy generation, has to prove that its total benefits to society outweigh its total costs to society. If it can't, and has to rely on the state to limit its liability, or to subsidise it, it needs to justify why. Accordingly, **decision-makers** should make sure that this costing is done in a broad and comprehensive manner, based on progressive economic principles in which social and environmental costs and benefits are taken seriously (in contrast to a narrowly conceived procedure in which financial calculus alone is taken into account).

With these obligations in mind, resting on all operators and managers of energy generation, and in particular on the proponents of new developments and applications of nuclear technology, the **obligation of decision-makers** can be summarized as follows:

> They (decision-makers about nuclear energy) have to make sure that the nuclear energy industry can satisfactorily discharge these obligations, without imposing unreasonable and ethically unacceptable risks and burdens on society. If the nuclear energy industry cannot satisfactorily discharge these obligations, or impose unreasonable and ethically unacceptable risks and burdens on society, they simply should not be allowed to proceed with their activities or proposals.

In conclusion, we would like to reiterate that this is a desktop study in which we were not able to go at length into each and every issue that was raised above. It should also be stated that a separate study in its own right could be devoted to an analysis of the structures and institutions required for ethical decision-making about nuclear technology. This clearly is a topic that requires further in-depth investigation.

We also would like to point out that it would in all probability not be possible to settle each and every argument within the nuclear debate by finding some kind of common ground between pro- and anti-nuclear advocates. In the case of the extreme positions sketched above, the vastly different assumptions (which in some cases are ideological in nature) preclude finding such a common ground. In the case of more moderate approaches where dialogue is possible between those in favour of and those opposing nuclear power generation, the trouble is that any common ground that is found can easily be undermined by questions of an epistemological nature that takes the debate to ever deeper going levels of abstraction and philosophizing.

For the practical purposes of decision-making it should therefore be borne in mind that any decision about any energy option is in the last instance a judgement call that will require strong justification if it is based on assumptions, or is likely to lead to results that undermine, disregard or clash with the generally accepted principles and minimum standards of common

morality. A different way to make the same point is to say that decision-making about nuclear power generation should not in the first place aim to address the myriad of arguments that can be formulated for or against nuclear energy generation. While not ignoring these arguments, it should rather aim to adequately respond to the value issues raised by these arguments in a manner that is consistent with and supportive of the generally accepted principles and minimum standards of common morality as they have been sketched in Section 3 above.

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ADDENDUM 1

SUMMARY OF RECOMMENDATIONS

In this section, the recommendations of this study are consolidated in one list. The same sequence is kept as they have been given in the study above. However, certain key categories are distinguished under which they can be grouped. These recommendations should be read in conjuction with one another, and agains the background of the argumentative passages within which they are embedded.

A. VALUES, ETHICS AND DECISION-MAKING IN GENERAL

Recommendation 1

General formulation

Decision-makers and those commissioned to inform decision-making (e.g. scientists, engineers and environmental assessors) should clearly state which values they are using, and how they are using their values to make their choices and formulate their recommendations.

Application

This recommendation applies to all of the phases of the scientific and technical studies commissioned to inform decision-making. This also applies to all of the phases of decision-making.

Note

This could be done without falling into the traps of subjectivity and relativism by referring back to the minimum standards set by common morality.

Recommendation 2

General formulation

Decision-makers about nuclear technology should duely acknowledge and respect the differences in the articulations and interpretations of value issues brought forward by any use of nuclear technology. Special attention should be given to the sharp divide between those opposed to nuclear technology, and those that support it.

Specific formulation

In order, to enable themselves to make up their minds in a rational and reasonable manner in a situation of such differences, decision-makers about nuclear technology should familiarize themselves thoroughly with the nature and structure of these differences, as well as the grounds and the justifications for the different positions that are defended.

Application

If a decision is made for or against any proposal about nuclear technology, a strong obligation rests on decision-makers to clearly spell out what the grounds and justifications for their choices are, and why these grounds and justifications should be accepted above others.

B. SECRECY AND EFFECTIVE PUBLIC PARTICIPATION

Recommendation 3

General formulation

With the scenario of a new generation civilian nuclear industry being established in South Africa, the temptation may be to promote the industry by protecting it from effective public scrutiny, thereby blocking the ability of the public to influence development and regulatory decisions in this regard. Decision-makers as well as the proponents of nuclear technology should avoid this at all costs.

Specific formulation

Because nuclear based energy generation has become a sensitive issue, the ability of the public to participate and influence the process of decision-making should rather be actively promoted and developed.

Explanatory note 1

The central value assumption on which this recommendation rests, is that effective public participation in the process of decision-making about nuclear power plants is essential to ensure (a) the health and safety of the public, and (b) to establish trust in both the nuclear industry and the institutions responsible for its regulation on the one hand, and the process of decision-making about it on the other hand.

Explanatory note 2

Effective public participation within this context entails at least (a) access to adequate information about nuclear technology and its applications that will enable interested and affected parties to make up their own minds about the value issues (e.g. health and safety issues) involved; (b) reasonable time allocations for interested and affected parties to digest and understand the information; (c) reasonable time and opportunities for interested and affected parties to convey their views to decision-makers; (d) reasonable time and opportunities for interested and affected parties to explain their views to decision-makers and to answer questions about these views.

Recommendation 4

Introductory note

The introduction of any new-generation nuclear technology in a country rests on the hidden assumption that it is indeed *necessary* to establish such a new generation of nuclear technology.

General formulation

In order to ensure that the development of new-generation nuclear technology in South Africa is not seen as a foregone conclusion that cannot be changed or influenced by the public, a strong burden of proof rests on the proponents of such technology to make it clear whether they see the development of this technology as necessary or not, what the grounds for this view is, and how these grounds can be justified.

Application

Such grounds and justifications given by the proponents should subsequently be made available for public review in a process of effective public participation, and eventually proponents should be able to demonstrate if, how and why these grounds and justifications should be upheld in the face of criticism.

C. EXPERT KNOWLEDGE AND PUBLIC PERCEPTIONS

Recommendation 5

General formulation

Decision-makers about any proposed development or application of nuclear technology should be able to clearly demonstrate that public opinion expressed in the process of public participation has been taken seriously, and that concerted efforts have been made to understand and accommodate public opinion in the process of decision-making.

Application

In order to do this, decision-makers will have to do much more than merely provide a list of concerns and views that have been raised in the process of public participation. They will have to provide in the first place clear and coherent reasons and justifications for their decisions, and show, in the second place with proper arguments why certain concerns and views were dismissed in the process of decision-making, and why others were taken into account.

Explanatory note

Given the technicalities of the issues related to decision-making about nuclear technology, and given the fact that public concerns can easily be swept off the table by experts in the field as unfounded, a real danger exists that the public can lose its trust in the ability and willingness of decision-makers and regulators to take their concerns seriously. This clearly can happen if the concerns of interested and affected parties are dismissed as unimportant without providing explicit reasons why this is done. Similarly, trust in decision-makers and regulators would be severely underminded if the concerns or views of interested and affected parties were reduced to merely technical or management problems - as challenges that can be addressed by public relations programmes, or information and education campaigns.

D. DECISION-MAKING AND SERIOUS FRAMEWORK ISSUES

Recommendation 6

General formulation

Decision-makers about nuclear technology should familiarize themselves with the different answers and kinds of answers that have been given in the socio-political debate about nuclear technology on the radical questions with which the development and application of

nuclear technology confronts us (such as: who are we as humans and where are we going in this world with our knowledge and technology).

Specific formulation

Decision-makers should familiarize themselves with the reasons and justifications given for the different answers provided in the socio-political debate about nuclear technology on the radical framework questions conjured up by the development and application of nuclear technology.

Application

When decision-makers decide about any development or application of nuclear energy, they should be able to explain in public why they give precedence to a certain position in the broad socio-political debate on the radical framework questions referred to above, and why that particular position is better than another.

Recommendation 7

Granted that the conversation of humankind about the radical framework questions referred to above is incomplete and unending, and that we therefore cannot postpone decision-making about a particular proposal about nuclear technology indefinitely, decision-makers at least have the obligation to show that (a) they are aware of the existence of this conversation, (b) that they are aware that they are implicitly contributing to the substance of this conversation by the choice that they will make, and (c) that they, in the choice that they make, do not foreclose the outcome of that conversation or undermine the conditions for its continuation.

Recommendation 8

General formulation

Decision-makers should bear in mind that factual disputes in the nuclear debate can often not be settled by merely falling back on science "to objectively determine what the facts really are". Facts do not speak for themselves. Facts are always determined, and given meaning within a framework of value assumptions

Specific formulation

To come to grips with diverging factual claims in the nuclear debate decision-makers will have have to familiarize themselves thoroughly with the different definitions and investigative

frameworks used to establish these diverging factual claims, as well as the different definitions and interpretive frameworks used to give meaning to these factual claims (i.e. to determine their weight and their significance).

Application

This recommendation places a strong requirement on the proponents of any proposal about the development and application of nuclear energy to clearly explicate the definitions of the concepts that they have used in making their factual claims, and to clearly explicate the value assumptions of the investigative framework within which they formulated their factual claims. The same requirement applies to those opposing the proposal.

Recommendation 9

General formulation

Decision-makers about nuclear technology and its applications should take due cognisance of the difference between responding to public opinion about nuclear energy (or the absence of it) and addressing the content of the issues related to nuclear energy. To respond adequately to one (e.g. public opinion) does not necessarily imply that the other one (content issues) has also been addressed adequately. The converse is also true.

Specific formulation

Decision-makers about nuclear technology and its applications should make explicit if, and also how they have taken the difference between public opinion issues and content issues into account in their decision-making.

Application

Decision-makers about nuclear technology and its applications should be able to explain if they have made a distinction between public opinion issues and content issues, and how they have arrived at that distinction (by making use of which concepts with which definitions, working within which investigative framework).

Recommendation 10

General formulation

Decision-makers about the development and application of nuclear science and technology would typically not fall totally within the group of pro- or anti-nuclear. However, they should be

aware of the fact that any decision about nuclear technology and its applications constitutes a move in the societal and cultural battle about different ways to define and safeguard the future, different ways to use and direct science and technology, different ways to think and respond to risks and hazards.

Specific formulation

Decision-makers about the development and application of nuclear technology should be able to clearly articulate which position they assume within this cultural and societal battle, and to indicate with reasons why that particular position should take precedence above others.

Application

This self-critical awareness should be applied by the decision-makers in every step of their process of decision-making. It should also be applied in their evaluation of every submission made to them to inform their decision-making.

Recommendation 11

Introductory note

Decision-makers about the development or application of nuclear technology should be acutely aware of the fact that proponents and opponents of development proposals may tend to make use of ideological language to put across their points as forcefully as possible. The danger of ideological language in the nuclear debate lies in the fact that it distracts attention from the content of crucial issues, and redirects it to subsidiary issues. Ideological battles are furthermore of such a nature that they represent sectoral interests, and can only be won by neutralizing or silencing the opposing side. If this happens, a monologue is established in which only one party speaks, resulting in situations where important inputs from those differing from the speaker can be lost.

General formulation

Decision-makers about nuclear technology and its applications should determine whether language with ideological effects have been used in argumentation for or against a proposal, and to what extent this language has privileged one set of sectoral interests over and above another, or has effectively silenced the voice of an interested or affected party.

Specific formulation and application

A responsible approach for a decision-maker with regards to ideological language would be to take seriously all of the voices in the nuclear debate, with a view to determining (a) which

interests they are speaking from, (b) what overlap, if any may exist between these interests, and (c) to what extent and how these different sets of interests are compatible with the minimum standards of common morality in society - as these standards have been codified in our Constitution, Bill of Rights, specific legislation, regulations, standard operational procedures, etc.

F. SPECIFIC ETHICAL RISK AREAS IN DECISION-MAKING

Recommendation 12

General formulation

There rests a stong obligation on the operators and managers of all forms of power generation, to take due cognisance of the risks that they impose on the public and their workers, and to respond to these risks in accordance to the minimum standards of public morality as these are codified in legislation, regulations, standard operational procedures and the reasonable expectations of the public.

Specific formulations

a) The operators and managers of all forms of power generation, including nuclear, have an ethical obligation *to inform* the public of how much risk they are being exposed to by their activities or proposed activities.

b) The operators and managers of all forms of power generation, including nuclear, have a responsibility to ensure that the public, in particular those who are, or may be directly affected by the risks, well *understand* the risks they are being exposed to (or may potentially be exposed to).

c) The operators and managers of all forms of energy generation, including nuclear, must offer reasonable *compensation* in proportion to any risk or harm workers or the public are (or may be) exposed to.

e) The operators and managers of all forms of energy generation, including nuclear, have an ethical obligation to inform the public about what risk their activities pose to *future generations*, and to put reasonable measures, procedures and institutions in place to minimize these risks for future generations, or to ensure that they can be duely compensated in proportion to any substantive harm that they may suffer.

Application:

Decision-makers and regulators should make sure that these obligations are met during the normal course of all power generation operations, but in particular, that these obligations are met when proposals for new activities are considered. In the case of new proposals, the latter will entail that decision-makers and regulators should be satisfied that:

- The public is duely informed about the risks of the proposed activity
- The public, and in particular those directly affected by the risks understand them well
- The acceptance of any risk (by the workers or the public) under the promise of due and proportionate compensation is done on the basis of free and informed consent, compatible with the minimum standards of common morality
- That the acceptance of any risk by the public to future generations is done on the basis of free and informed consent, subject to the strictest standards of common morality applicable to the impact of present generations on the well-being of future generations.

Recommendation 13

General formulation

The operators and managers of all forms of energy generation, including nuclear, must prove that the accident risks (including the risks of terrorist threats) imposed on society by their activities are not extraordinarily grave or dangerous. However, if these risks indeed are extraordinarily grave or dangerous, there rests a further obligation on these operators and managers to demonstrate with reasons and sound argumentation the absolute necessity of using that form of power generation as opposed to others that might be less dangerous.

Particular formulation

The burden of proof regarding the safety of any nuclear power generation plant or waste storage facility (in particular in the light of probability statistics - or lack of it - about accidents and terrorist attacks) rests on the producer of nuclear power or any other energy source. It is not the responsibility of members of the general public to prove the possibility or probability of a nuclear accident occurring.

Application

Decision-makers on nuclear technology and its applications should ensure that the proponents of new activities in the nuclear energy field take full responsibility for this burden of proof, and that they discharge this responsibility in a manner that is open, transparent,

accessible to the public, and in accordance not only with the minimum standards of common morality, but with the principle of proportionate care that follows from it. (See page 10 for a discussion of this principle, and also the Glossary.)

Recommendation 14

General formulation

Those who expose others to risks should ensure that these risks are minimized and fairly distributed, and that due compensation is made available to those affected by these risks.

Specific formulations

(c) The operators and managers of all forms of energy generation, including nuclear, must ensure that no one carries an unfair burden of risk because of their location near a nuclear power plant or storage site. If they do, those exposed to the risk should be made aware of this and be compensated for it.

(d) In the event of an accident, or major catastrophe, the operators and managers of all forms of energy generation, including nuclear, should take pro-active responsibility for the health and well being of everyone that may be affected. In cases such as these, the burden of proof should not be on potential or actual victims to prove that they have been affected. Furthermore, the onus is on the energy producer to bear the medical costs of, and pay compensation to all those affected by an accident or major catastrophe.

Application

If energy producers, including nuclear, cannot demonstrate how it would compensate those affected by the risks of power generation, then they should not be allowed to proceed with their activities.

Recommendation 15

General formulation

The same as Recommendation 14

Specific formulation

Producers of energy, including nuclear, need to demonstrate that their present activities do not pose a threat to the quality of life of future generations, leave them with diminished

resources or the impending threat of a catastrophe.

Application

If energy producers, including nuclear, cannot demonstrate how it can satisfactorily take care of its long-term, high-level waste problem in an ethically justifiable way then they should not be allowed to proceed with their activities.

Recommendation 16

General formulation

In order to justify its continued operation in South Africa, the nuclear industry needs to re-establish public trust.

Particular formulation

The nuclear industry, in cooperation with and under the superivision of appropriate authorities should set up and maintain structures, processes, procedures and institutions that can effectively serve as safeguards against weapons proliferation. This would have to be sensitive enough not to release information that might promote nuclear proliferation and further jeopardize international security.

Application

If nuclear energy producers cannot demonstrate how it would set up and maintain effective measures to safeguard against nuclear weapons proliferation, then they should not be allowed to proceed with their activities.

Recommendation 17

General formulation

Nuclear energy, like all other forms of energy generation, needs to justify its existence in a given area as the best available economic option. This process must include a thorough, comprehensive costing of all social and environmental costs imposed on present and future generations.

Particular formulation

Nuclear energy, like any other form of energy generation, has to prove that its total benefits to society outweigh its total costs to society. If it can't, and has to rely on the state to limit its

liability, or to subsidise it, it needs to justify why.

Application

Decision-makers should make sure that this costing is done in a broad and comprehensive manner, based on progressive economic principles in which social and environmental costs and benefits are taken seriously (in contrast to a narrowly conceived procedure in which financial calculus alone is taken into account).

ADDENDUM 2

FOCUSING ON VALUES IN PUBLIC DECISION-MAKING: IMPORTANCE, METHODOLOGY AND VALUE ADDED

Since the nature, methodology, importance and implications of an ethical analysis of the value issues pertaining to public decision-making about nuclear power generation is not evident from the outset, a brief overview is given herewith in which the following questions are addressed:

- Why is it important to focus on values in a process of decision-making on nuclear power generation?
- What is the nature of an ethical analysis of the value issues involved?
- What is the difference that such an ethical analysis can make to decision-making?

During the course of discussing these questions, the question What is ethics? will be addressed, as well as the usual, albeit misguided objections against ethics and the consideration of value issues, namely that they cannot be objectively addressed, that values and ethics are relative to people and cultures, that value and ethical issues cannot be settled in a rational manner, that ethics cannot provide answers, that we argue about value and ethical issues at length, moving in circles taking us nowhere, and that values and ethics are so intertwined with emotions and biases, that one cannot really take it seriously in any process of decision-making about important matters.

1. Why is it important to focus on values in decision-making?

It is widely acknowledged in the literature about environmental assessment and risk decision-making that the dominant paradigm in which values and ethics are "screened out" from the outset, is becoming more and more under threat. In this dominant paradigm, a classic, two-tier model of decision-making is followed: first find the facts through a process of objective scientific investigation and assessment, and only then enter into the political, value-laden process of decision-making (Cothern 1996:53).

This approach is driven by the assumption that science and technology are value-free and neutral, and therefore, that the factual can be separated from the normative, the descriptive from the prescriptive, the technical assessment of risk from its management. Within this model the task of finding the facts and making technical assessments is placed on the

shoulders of science, while the normative assessment ultimately leading to decisions is left for a political process over which scientists have little, if any control.

However, thoughtful decision-makers and scientists sensitive to what they do, would be the first ones to acknowledge that values do not enter into the picture only after the facts have been established. They would be able to confirm that values and value choices are present from the outset when the terms of reference of a scientific investigation or assessment is drawn up, clarified, debated and accepted. Values and value choices are also already in the picture when the scope and focus of a factual investigation are delineated; when borderlines are drawn between relevant and irrelevant facts, or between significant and trivial facts. Values and value choices are always already present when a methodology is chosen for an investigation among many others; and when certain strategies and instruments are chosen above others. The same applies when alternatives are identified, and when these alternatives are ordered/ranked in order of importance; when scientific uncertainty enters into the picture; when direct factual investigation cannot be done and models have to be used; when standards of proof are set; and when burden of proof is allocated.

This line of thinking then states that values and value choices (and therefore ethical issues) are present at the centre of every phase of any factual investigation and any assessment based on it: values have always already entered into the picture. A widespread problem, however, is that this presence of values is currently not acknowledged - at least not within the positivist model of practicing science as a value-free enterprise, or within the dominant and classic two-tier model of decision-making. What is typically found within this dominant approach are attempts to actually disguise the characteristics of values and ethics in the practice of science and decision-making by making use of labels such as "scientific", "objective" or "technical" (Cothern 1996: 53). This entails that only what is deemed to be scientific or objective is taken seriously in the assessment and the eventual decision-making. This in itself is a value judgement, the grounds of which are mostly not explicated or openly discussed.

This confronts us with the serious question, namely: what is the problem with not acknowledging values and ethics within the core activities of science and decision-making? What is the problem with insisting on objective, unbiased, ideology free facts and figures as basis for decision-making about important issues? Cothern (1996: 60) argues that it is dishonest not to acknowledge the role that values play in scientific assessments and decision-making. It entails a disregard for the value of truth. To deny or to disguise the role of values in assessment and decision-making just does not correspond with reality. It further creates the problem that such unacknowledged value choices cannot be discussed, tested and

evaluated, and this, in turn, creates the problem of perpetuating by default certain value choices, biases and even ideologies of the past that could be highly problematical in the present or in the future. In fact, it is widely recognized in current literature (see Thompson 1990) that disguising the values on the basis of which social and public choices are made, and thereby closing down the space in which these value choices can be discussed and scrutinized, are some of the key mechanisms through which ideology operates.

The converse of the previous question is this: what are the advantages of openly acknowledging the role that values play in assessments and decision-making? In the first place, it helps us to understand the political nature of assessment and decision-making. It furthermore enables us to discuss the value choices involved, and the advantage of that in turn is that we can change these value choices (or even these values themselves) if they are found to be unjustifiable. A further advantage is that this will enable us to make our decisions in a more transparent, self-conscious and critical manner.

This is not the place to go into the question of how to make value choices explicit in assessment and decision-making. There are various instruments available to do so, some of which are more successful than others (see Cothern 1996; Winkler and Coombs 1993). However, it should be stated here that all of these instruments and methodologies have one thing in common, namely to culminate in an ethical analysis and evaluation of the values and value choices that have been made explicit. The nature of an ethical analysis of value issues will be discussed in the next section.

2. The nature of ethical analysis of value issues

Morals (or ethics in the practical sense of the word) has to do with the distinctions we make between right and wrong, good and bad, and that which deserves our respect and that which does not. As such, morals/ethics on one level of analysis has to do with our duties and obligations, with what we ought to do and what we ought not to do; it has to do with our rights, and with matters of fairness and justice. On a deeper level of analysis morals/ethics has to do with our notions of the Good Life; with quality of life issues and our desires and aspirations in this regard. On a third, even more profound level, morals and ethics has to do with what we can identify ourselves with, what we have a strong allegiance to, what we can support and what we cannot support (Taylor 1989). As such, morals/ethics exists as a concrete reality within any society. It forms the basis of individual and collective action, and it provides the platform for institutional, organizational and public decision-making.

On this concrete, practical level, the morals or ethics of a person is typically expressed in choices made and actions undertaken. In this regard, what one chooses for is as important as that what one chooses against. The same applies to that which one actually does, and that which one actually does not do. Commissions are as important as omissions. Within this context, values can be defined as those reasons that people quote to justify their choices and actions. Values, usually expressed in short phrases or in single terms of a normative nature (such as: respect other persons, do not harm others, do good, truth, honesty, integrity, health, safety, fairness, justice, keep your promises), capture that which people care strongly about. As such, these values serve as guidelines for people's conduct - if they are committed to act ethically. At the same time, these values form the points of reference when the choices and actions of others are evaluated ethically. Accordingly, the values of individuals, institutions, organizations or communities can be captured by observing what they offer as justifications for their choices and actions.

An important characteristic of values (understood to be the reasons on the basis of which people choose and act), is that they can be justified with reference to a further set of normative considerations (Rachels 1997: 21-48). Someone, for instance, can say that his motivation for not accepting a certain gift before allocating a large contract is his commitment to the value of integrity. On the question why integrity is then so important, he could say that in this case it will enable him to consider the allocation of contracts without the burden of a particular bias towards a certain individual or company. On further analysis he may say that it will prevent him from giving someone an unfair advantage in the bidding process.

Ethical analysis comes into the picture as a systematic, second order activity that entails a critical reflection on, and an examination of the reasons and justifications offered by individuals, institutions, organizations or communities for their choices and actions. The aim of such an activity would be to determine the meaning and scope (applicability) of these reasons, to clarify how they are further justified (with reference to deeper-lying normative considerations), and to determine whether these reasons and justifications make sense under the circumstances within which they are used. What this means in concrete terms, is that in an ethical analysis the aim is to establish if the reasons and justifications offered for choices and actions are reasonable - under the circumstances involved. As such, ethical analysis is based on the assumption that a community of rational people exists that can reason about things, that this community functions as a community on the basis of certain common beliefs, convictions, commitments and values, and that this community can, and in fact do make distinctions between what they consider to be good or acceptable reasons for actions and choices, and that which they consider to be poor or unacceptable reasons for actions and choices.

In so far as ethical analysis occupies itself with an explication and clarification of the criteria used to make this distinction between good (acceptable) and poor (unacceptable) reasons and justifications for choices actions, if fulfils a descriptive function. In so far as these criteria are evaluated, defended or criticized, ethical analysis fulfils a further normative function in its own right. In so far as the focus falls on the meaning and scope of the concepts used in descriptive and normative ethics, ethical analysis fulfills a further meta-ethical function of conceptual clarification.

For the purposes of public decision-making on nuclear power generation, ethical analysis then entails a multi-layered activity:

- It will identify, clarify and evaluate the values (i.e. the normative reasons) that people offer to accept or reject nuclear fission as a source of electricity generation
- It will identify, clarify and evaluate the deeper-lying justifications offered for these values
- It will identify, clarify and evaluate the criteria used to distinguish between good and poor justifications for these values and the choices/actions based on them.

3. What is the difference that ethical analysis can make to public decision-making?

The description given above of the nature of ethical analysis raises the question what difference ethical analysis of value issues can make to decision-making? (see Rachels 1997) As it has been described above, the object of ethical analysis is clearly the highly subjective and relative field of people's commitments, beliefs, convictions and values. How can ethical analysis of such a domain help when public decisions have to be made about nuclear power generation? After all, ethical analysis itself seems to be part of a normative activity that is subjective; in the last analysis it analyses a subjective domain from a position that is itself nothing but subjective.

A short answer to this objection is that public decision-making itself is a normative activity. In so far as choices are made between different policies and different courses of action, public decision-making falls back on reasons, justifications and criteria that are as subjective as any other reasons, justifications and criteria used in any other domain of human life. These reasons, justifications and criteria, however, are often not acknowledged or systematically examined to determine how good or how poor they are. Ethical analysis can help to determine just that, and through this can help us to reach better decisions, to offer better

reasons for our choices and actions, to offer better justifications for these reasons, or to be more conscious and self-critically aware of the criteria we use to distinguish between good and poor reasons/justifications in this regard.

A longer answer in this regard will entail an excursion into meta-ethical deliberations in which it can be shown that morals/ethics and ethical analysis does not occupy a totally subjective and therefore irrational domain of human existence about which nothing that is meaningful can be said. This is not the place to revisit all of these deliberations, except to mention that numerous studies devoted to this question have shown that morals/ethics and ethical analysis falls within the arena of rational, inter-subjective deliberation about the meaning, scope and justification of commonly shared values that can legitimately be accepted as basis for individual, institutional, organizational and public decision-making (see Outka and Reeder 1993; Rachels 1997). Within these studies it is acknowledged that there indeed exists an area of freedom within which people can legitimately differ from one another. This domain of freedom typically has to do with human action in the domain of customs: the organization of social life around marriage, birth, death, burial, sexuality, the provision of food etc.

This domain of freedom clearly exists because we typically cannot offer good reasons as to why some people should be denied the right to organize their lives as they do. However, there also exists a domain of common morality among people in which we restrict the freedom to act in any which way. In this domain, we can, and in fact succeed to offer strong reasons that are acceptable to others as to why they should act in a certain manner and ought not to act in another manner. In this domain, we typically find a set of minimum standards that prescribe that we should not harm others, do good to others, respect persons, and act in a fair and just manner. This is usually supported by certain ideas or values that help us to determine what is acceptable and what is not acceptable in this regard.

In this domain, morals and ethics is clearly not a matter of pure subjectivity and absolute relativity. Those that choose to transgress the standards of common morality are clearly held responsible by society for their choices and actions - in the sense that they are subjected to sanctions if they cannot offer an acceptable reason or justification for that transgression.

Accordingly, ethical analysis for the purpose of public decision-making will focus on the values, reasons, justifications and criteria that form part of common morality, and therefore could be seen as part of an inter-subjective domain of deliberation in which we can debate on a reasonable basis on the standards we set for public decision-making about nuclear power-generation.

GLOSSARY

Modernism	In this report, this term refers to an ideology in which the basic tenets of modernity is inflated to such an extent that it entails a blind faith in progress and a narrowly conceptualized instrumental rationality. As such, *modernism* is driven by the desire to control reality fully and completely through science and technology alone.
Modernity	This term refers to a historical era beginning in the 1500s in Western Europe, characterized on the one hand by a rejection of the dogmas of the Roman Catholic Church and the shackles of tradition and superstition, and on the other hand by an emphasis on the ability of humans to ensure their well-being by rational thought, science and independent action. Strongly associated with Renaissance humanism, modernity is also characterized by tolerance for differences, respect for diversity, and a consciousness of the boundaries of knowledge and rationality.
Reflexive modernity	This entails a self-critical consciousness of the shortcomings and boundaries of scientific reason and technology. In reflexive modernity the ideology of modernism is rejected. Instead of striving for scientific control of nature and society, reflexive modernity rather assumes a critical stance in which the focus falls on an examination of the conditions under which scientific and technological claims can legitimately be made, what the boundaries of these claims are, as well as on the manner in which these claims circulate and function within society within larger political and ideological contexts.
Ideology	Meaning mobilized in the service of the establishment, maintenance, and perpetuation of asymmetrical power relations, characterized by domination and exploitation. Alternatively: a doctrine and practice used to justify the status quo or vested interests.
Instrumental rationality	Means-end thinking that focuses more on the *efficiency of the means* to reach an end than on the nature of the ends that are to be achieved. Instrumental rationality is characterized by its focus on indicators that can be quantified, thereby neglecting social and ethical considerations that rather require a qualitative approach.
Proportionate care	The principle (or corollary) of proportionate care states that when one is in a position to contribute to greater harm, or when one is in a position to play a more critical part in producing harm than is another person, one must exercise greater care to avoid doing so.