NORMS, VALUES AND NUCLEAR WASTE

A timely ethical "No Thanks" to nuclear energy

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June, 2004

Preface

Nuclear energy covers a small percentage of the global energy consumption, yet it seems like nearly a 100% of all discussions on the energy supplies are about nuclear energy. Even on the question how much a small percentage is, opinions differ between 3%[1] and 7%.[2] The disposal of radioactive waste plays an important role in this.

High radioactive waste remains dangerous for a million years and consequently poses a possible threat to human and non-human life and well-being. How do we deal with that? Which data is important to establish the social risks; who carry out the research; what is the value of a human life; how is the benefit of nuclear energy determined; is it responsible to produce nuclear waste; or, should we from a moral point of view quit using nuclear energy: which norms and values come into play? All these questions rise to the surface when we try to determine whether nuclear waste is 'good' or 'bad'.

The nuclear industry has reacted to this ethical discussion.
The main objective of the International Atomic Energy Agency (IAEA) in Vienna and the Nuclear Energy Agency (NEA) in Paris is the advancement of nuclear energy. In 1995, these agencies both published principles on storage of nuclear waste, which they personally described as 'a healthy ethical theory'[3]. In these principles, concepts such as 'acceptable safety level' and 'no unnecessary burdens for future generations' feature. However, what is acceptable or unnecessary and who determines that? Why is the IAEA and the NEA's starting point that nuclear energy is desirable, accepted as being incontrovertible? Is it ethically responsible to consider the production of nuclear waste a fact and what is its influence on the way people look at the storage of nuclear waste? And what do IAEA and NEA actually understand by ethics and what are the criteria for 'a healthy ethical theory'? The mentioned organisations do not go into these questions. We, on the other hand, did think it was about time we pursued this matter, for in May 2004, the NEA was still struggling in the same indefinite manner with the ethical questions on the storage of nuclear waste.[4] We have chosen to direct our argumentation towards radioactive waste that is created by the fission of the energy source uranium. The other energy sources may get a chance in a possible supplementary study.

The intention of this article is to discuss the ethical starting points, norms and values that are significant when radioactive waste is concerned. Norms and values are about what we find important and how we should act. In May 2004, the NEA posed "that the current system of radiological protection fails to provide that the environment is not put at harm", whilst

there are no norms for the long-term radiation consequences of nuclear waste, either.[5] How then, can the NEA still claim to have “a sound ethical theory”, or in fact, don’t values such as a salubrious environment and responsibility for the future count? Ethics is occupied with the question what we have to do and why. It concerns an explanation of the morally just. Occasionally, its goal is to convince others of the righteousness of ones stand, although this can only succeed if ones own stand is made as lucid as possible and is submitted to a general discussion.[6] That is also an objective of this article.

Contents

SUMMARY

1. The problem

High radioactive waste remains dangerous for a million years and consequently poses a possible threat to human and non-human life and well-being. How do we deal with that? Which data is important to establish the social risks; who carry out the research; what is the value of a human life; how is the benefit of nuclear energy determined; is it responsible to produce nuclear waste; or, should we from a moral point of view quit using nuclear energy; which norms and values come into play? All these questions rise to the surface when we try to determine whether nuclear waste is 'good' or 'bad'.

The Dutch government also stresses in the introduction to the coalition agreement of May the 16th 2003 the "responsibility of the people themselves" and the "transfer of norms and values". The government states:"With the eye on a liveable country for future generations, the environment and nature, as well as housing and infrastructure ought to be managed and developed in a responsible manner." The government hereby opts for a moral starting point for its policy, thus joining in on the trend of esteeming norms, values and ethics.

It is remarkable in the government policy that the moral starting points are not elaborated on any further in the policy on nuclear waste disposal. How is one to weigh up the disadvantages of nuclear waste disposal against the advantages? How are the interests of future generations accounted for in that balance? Based on what is – in the view of the government - the present prosperity more important than the disadvantages future generations may see themselves confronted with?

These questions are all the more coging as the government disregards an advice to carry out further research on the ethical-social aspects that are vital to come to a useful dialogue with the social groups in our society. The government evades the discussion on moral matters and refuses to talk about the choice for its policy.

On the 30th of January 2003 the European Commission (EC) published a draft directive on the storage of nuclear waste. According to the EC there is a "solid ethical basis" for the rapid development of storage facilities and "further delays in the development of storage facilities for the final storage of nuclear waste can no longer be justified."

On what grounds does the EC found the ethical basis for a rapid decision on the storage? The argument is the "wide international consensus under the technical experts" that final storage deeply underground is the best alternative. This may be concluded from "numerous studies". In this brochure we shall demonstrate that the arithmetic methods used to

calculate the consequences for the future, are unreliable. Is the blind faith the EC has in these tables a way of acting responsibly? To what extent is the EC acting responsibly in its appeal to the population to believe in the technical experts? We shall attempt to give an answer to these questions.

2. Ethics, morals, norms, and values

Ethics is the field that occupies itself with the study of morals. Ethics can also be described as the systematic study of moral behavior.

The concept of ‘moral’ refers to the whole of rules of conduct that is accepted to be self evident within a community or at least to a part of that community. It reflects the norms and values that are prevalent in a group or society and indicates what is expected from members.

Everybody has moral conceptions, ideas and convictions, which form the basis of what is thought to be right or wrong and of what should or should not be done. These moral conceptions are often the result of ones upbringing and therefore taken for granted. It involves a basic sense that certain matters are right and others are wrong.

A value is a starting point, a notion of what one considers to be important. They are abstract ideals or goals striven for by means of specific behaviour. Values have the tendency to be vague. They are mostly phrased positively: they indicate something that is important and worth striving for. An example of a value in the discussion of storage of nuclear waste can be found in the above mentioned government stand. The government considers prosperity to be an important value and therefore accepts the generating of hazardous waste and its additional risks.

Norms give meaning to values. A norm is a rule that says something about the way in which individuals are supposed to act. Often, they are negatively phrased; they limit our acts and have a tendency to forbid rather than to prescribe.

In order to realize certain values, specific norms are being formulated. With that, values are of greater importance than norms in the subject of ethics. Only if we know what the effort is worth, a variety of norms and rules in daily life become significant.
Norms should be determined by values, not the other way around. Norms can change; they depend on a specific time and culture, while values have a more permanent character. Norms and values are closely connected: a value such as friendship results in a norm like honesty. Norms and values together form the object of ethics as a subject.

3. Nuclear waste versus equality and justice

Ethics has penetrated discussions on the storage of nuclear waste. The Nuclear Energy Agency (NEA) published a collective opinion on the ethical and environmental aspects of the disposal of nuclear waste in 1995. The NEA considers equality within and between generations an important ethical foundation for the storage of nuclear waste. This concerns a fair division that is not elaborated upon any further. We therefore fill in this void with the help of the German ethicist Tugendhat.

In agreement with Kant, Tugendhat describes his idea of ethics as follows: “Act in such a manner that you always see humanity, both yourself as everyone else, as the goal and not just as an instrument.” It concerns the fact never to use others as a means to achieve your own goals. Or formulated differently: “Act in such a manner – to everyone- that, judging from an arbitrarily chosen person’s perspective you would want everyone to act.” The morality as described here is a universal and egalitarian one and considers all people to be equal. Everybody has equal rights, but this also means equal duties towards others.

Tugendhat refers in this instance to the human rights. These human rights have been put on record by the United Nations. They are about rights people have conferred upon themselves and all other people. The human rights have not been granted by “Nature” or by “God’, but originate from people themselves. People give themselves rights. This means it is possible to go to court if the rights are violated. According to Tugendhat, human rights involve a minimum of justice.

Apart from justice, responsibility is an important theme. In the case of environmental themes, we have to do with actions of which the consequences sometimes only occur on the long term. The German ethicist Hans Jonas places the concept of responsibility in the centre of interest, with the horizon of time and space in agreement with those actions. He sums up a number of principles:

1. Because of the long-term consequences, the lack of knowledge concerning those consequences ought to be reason for great reserves. A practical application of this is the prescription to take more heed of bad expectations than of the good expectations.
2. Reserves do not come about automatically. We should train ourselves by trying to imagine what may go wrong. In doing so, it is vital that the possible good or bad consequences for future generations are of influence.

4. Justification nuclear waste: the present generation

The NEA talks about equality and justice within the present generation. This gives rise to many questions. Nuclear waste storage facilities are set up in rural areas, far away from population centres. Is it fair to submit someone to risks just because he or she happens to live in the countryside? Should the local government or the local population be allowed to impose a veto, even if research can prove that that particular place is the most suitable of the country? Or should the government be allowed to decide on the location?

The third dilemma concerns the level of protection. When are risks acceptable? The government has calculated an average chance for this. However, the average risk for the entire population does not have to mean that the individual risk is acceptable.

5. Nuclear waste and justice between the generations

The storage of nuclear waste renders a risk for future generations. It is in the nature of human doings that they have side effects. The actions are goal-directed. Consequently, all other consequences of those actions are degraded to side effects, means or costs. The difference between means and side effects may be found in the fact that the means are wanted, whereas the side effects that happen to come with the bargain aren't.

The side effects of human behaviour can concern people who are principally unable to co-operate with the procedures according to which a decision has been taken, because they happen to be under age or have not even been born at all.

For nuclear energy and nuclear waste it concerns the problem of the irreversibility of the liberated radioactivity. In order to have nuclear energy at our disposal for perhaps the next 30 years, we create radioactive waste that continues to be dangerous for thousands of generations. The liberation of radioactivity results in a situation that cannot be reversed by any later decision whatsoever. The next generations will have to deal with this unalterable and as such unfruitful fact during their lives. The gist of the argument is that a minority (the present generation) makes a decision the majority (future generations) will be charged for.

That is why the exploitation of nuclear power stations cannot be ethically accounted for. It is the state that is responsible to judge the long-term consequences of human actions. For that reason the state should prevent them from being in operation, Robert Spaemann says.

6. Conclusion

In conclusion we can say that justice implies that future generations should not beforehand be worse off than we are now. Because of the storage of nuclear waste, damage may occur in

the future, while future generations will not have any profit of it. This complicates the application of the judiciary principle. Justice implies that we carry responsibility for the consequences of our actions. When talking about nuclear energy, responsibility over a period of hundreds of thousands of years is concerned. That exceeds our comprehension.

Justice could be a moral argument in the case of the storage of nuclear waste, if it had to do with the prevention of an even bigger threat to future generations, such as the greenhouse effect. However, we will demonstrate that nuclear energy is no solution to the greenhouse effect. Based on the judiciary principle, dealing with nuclear waste is a difficult matter.

1. Things worth knowing about nuclear waste[7]

1. Types of nuclear waste

Nuclear power stations run on uranium. This uranium is won from ore and has to undergo different processes before it is suitable for application in a nuclear power station. Those processes are: purification of the ore into natural uranium; transformation into a gasiform; enrichment; transformation from gasiform to solid substance and the manufacturing of fuel elements for application in the nuclear power station. Each single one of these steps, which - with the exception of enrichment – take place abroad, causes nuclear waste. The spent fuel elements of the nuclear power station are waste as well.

So, nuclear energy leads to radioactive waste. We are often told that this flow of waste can be controlled, because its volume is limited. It is, however, not so much the volume but the radioactivity that matters. Besides, it is also kept quiet in discussions that due to Dutch nuclear power stations in other countries a lot of waste is set free. This can particularly be applied to the radioactive waste originating from uranium mining; only for the nuclear power station in Borssele already approximately 11,000 tons of waste of ore is concerned annually. A nuclear power station also encounters industrial waste (like filters, contaminated clothes and the such), including the uranium fuel that has been used. The industrial waste can be categorised as light- and medium active waste.

The nuclear power station itself becomes radioactive too and consequently it has to be broken down (dismantled) after the expiration of its service. This creates waste as well. Apart from the waste of nuclear power stations we are dealing with radioactive waste from laboratories, research institutions, industry as well as hospitals.

For practicality's sake we shall limit ourselves in this brochure to the radioactive waste that has to be stored in the Netherlands.

2. Reprocessing

As soon as the spent fuel elements of the nuclear power station have sufficiently cooled down, they are taken to a reprocessing plant abroad. For the in the meanwhile closed nuclear power station Dodewaard this was the Thorp plant in Sellafield, England. The fuel from Borssele is send to La Hague in France. In a reprocessing plant the spent fuel elements are firstly sawed into small slices and afterwards dissolved in chemicals. The goal of the reprocessing is to separate the plutonium made in the nuclear power station. The same process

takes place in the case of the uranium that has not been used in the production of electricity in the nuclear power station. In these separation processes a vast amount of waste remains behind. Part of this is highly radioactive heat-shedding and poisonous nuclear fissionable waste, with substances such as caesium and strontium. All substances liberated during reprocessing remain the property of the nuclear power stations and will be send back to the Netherlands from this year onwards.

3. How long does nuclear waste remain dangerous?

Some substances loose their radioactivity very rapidly, but for some other ones this will take millions of years. The concept of “half-life” is important in this context. This means the time in which the radioactivity is halved. Therefore, after ten half-lives only one thousandth of the original radioactivity remains.

The half-life of iodine-131 is eight days. In the case of caesium-137 this will be thirty years, for plutonium 239 it takes 24,400 years and for iodine-129 no less than 16 million years will be needed.

4. Amounts of nuclear waste

The Central Organisation for Radioactive Waste (COVRA) is responsible for the storage of all sorts of nuclear waste in the Netherlands. In the middle of the year 2003 the COVRA had approximately 29,000 barrels of light and medium radioactive waste in store. This storage takes place in a ten metres high concrete building that includes three compartments of 2400 square metres each.

From 2003 onwards, the reprocessing waste will return to the Netherlands as well. A large part of this emits intense radiation. Because thick concrete shields radioactivity, the new COVRA buildings will get armour-plated concrete walls and roofs of at least 1.5 – 1.75 metres thick. The building measures 90 by 45 metres and will be 20 metres high.

Approximately 1,000 cubic metres of nuclear waste are produced in the Netherlands every year. This concerns waste from nuclear power stations, research institutes, hospitals, industry, etc. It is often implied that the larger part of the nuclear waste comes from hospitals and so on, but this is incorrect; about 85% of the radioactivity originates from the nuclear power stations of Dodewaard and Borssele. Half of the body of the radioactive waste that now lies at the COVRA has come from the nuclear power stations and nuclear research. Similarly, during the demolition of the nuclear power station, nuclear waste will be liberated as well: 2,600 cubic meters from Dodewaard and 2,700 cubic meters from Borssele.

The total amount of radioactive waste that has been produced so far and will be produced in the future comes close to 57,000 barrels. This concerns 300 barrels of 52 m^3 highly radioactive heat generating waste, 1,260 barrels of 514 m^3 highly radioactive non-heat-shedding waste and 56,288 barrels or 19,173 m^3 both low and medium radioactive waste. All of this in addition to 3,900 kilograms of plutonium from the nuclear power station of Borssele and 260 kilograms from Dodewaard.

5. Underground storage in clay or salt.

For a "final" solution for nuclear waste, underground storage is particularly looked at. According to the authorities, layers of clay that might be suitable for underground storage of nuclear waste can be found underneath the greater part of the Netherlands. The layers of clay are at their thickest south of the Isle of Schiermonnikoog (275 metres), around the town of Arnhem (250 metres), the Noordoostpolder (150 metres) and in the region of the Peel (100-150 metres).

In addition to this there are salt domes. These are underground mountains consisting of salt, covered with layers of earth and clay. The salt is lighter than the layers of earth and is consequently able to ride up slowly. That is how the salt domes originated.[8] In the North of the Netherlands the salt domes have broken through the layers of clay.[9]

The potential storage takes place as follows. From the surface of the earth, galleries will be dug in a downward direction, the so-called shafts. Then underground salt is removed in order to create room for the storage of nuclear waste. This is called a storage mine. A similar plan exists for the development of a storage mine for the underground storage in layers of clay.

In 1976 the government mentioned five salt domes for possible storage of nuclear waste: Gasselte, Schoonlo, Pieterburen, Onstwedde and Anloo. Since 1977 the condition has prevailed that only deeply located salt domes qualify. For this reason we may conclude that the list now consists of: Ternaard (Frisia), Winschoten (Groningen) and Hooghalen, Anloo and Gasselte (Drenthe).

6. Shortening nuclear waste's dangerous period not up for discussion

The risk of nuclear waste is often compared with the risk of uranium ore. According to this standard for comparison, depending on the arithmetical models used, the risk of nuclear waste after 250,000 to 8 million years is comparible to that of uranium. Should it succeed to transform this long living material ("burning-up" in jargon), the nuclear waste material will reach a comparable risk level after merely 250 years. But first those radioactive substances

need to be individually separated in reprocessing plants. Such plants in which - next to both plutonium and uranium- for example also americium, curium and neptunium are being separated, do not exist and have not been planned either.

Suppose that such reprocessing plants would exist. We then would have to burn up the separated materials in a nuclear power plant. This may best be done in fast breeders such as the one that was planned in Kalkar. [10] That fast breeder has been reconstructed into an amusement park, because the breeding process was too immature and too expensive.
We then find ourselves in the absurd situation that a power plant similar to the one in Kalkar needs to be build in order to burn up the long living materials such as plutonium, originating from the nuclear plants of Borssele and Dodewaard. Moreover, in April 2004, it was decided to dismantle the world's largest breeder reactor, the French Superphenix, which will cost € 880 million.[11] In England, the Radioactive Waste Management Advisory Committee, which was established by the government, concluded in a report issued in December 2003, that the technology for partitioning and transmutation hasn't been proven: "There is no magic answer for dealing with UK radioactive waste." [12]

7. Long-term check on nuclear waste

The fuel elements from the nuclear power stations contain substances, such as plutonium, which are usable to terrorists. This calls for long-term inspection of misuse. The International Atomic Energy Association (IAEA) in Vienna intends to deploy satellites for this.

Spent fuel elements from nuclear power stations remain dangerous for mankind and the environment for many thousands of years. This is brought forward in a report of the IAEA, which appeared at the end of July 2003. These spent fuel elements, or the products that remain after the reprocessing of the fuel elements, need to be monitored to prevent its misuse for nuclear weapons or radation bombs. The IAEA elaborates on this by stating that the monitoring should proceed as well if the nuclear material or waste is being stored in underground mines. On being asked, Gordon Linsley, spokesman of the IAEA, emphasizes there hasn't been any experience with this form of inspection and supervision. It is the IAEA's intention to deploy satellites for this. These satellites can perceive whether there is any activity on the surface of the underground storage facility that could indicate the excavation of the stored nuclear waste. The inspections will take place as long as there is a need for it. Linsley is unable to indicate the duration of that period.

All storage data has to be clear and easy readable for future generations, according to the IAEA report. The quality of paper gradually decreases, and insects or mildew can affect it. This is not the case for modern, computer based storage systems; nevertheless, software can become incomprehensible with new systems. For that reason, constant upkeep of the data is required. The loss of data is more serious for above ground storage, than for definite underground storage, says the IAEA.[13] Seen the long half-life of nuclear waste, we can conclude that this check will have to be sustained for thousands of years. The ways to achieve this remain open to discussion.

8. Nuclear waste and nuclear energy

The discussion about storage of nuclear waste is always held with the application of nuclear energy in the background. Nuclear energy is controversial within the European Union. The referenda in Austria in 1978, in Sweden in 1979 and in Italy in 1987 announced the end of nuclear energy in those countries. After the Italian nuclear power stations had already been closed down at the end of the eighties, the decision to close down a second nuclear station in Sweden was taken in March 2003.[14] Early in 2000, Germany decided to close its nuclear power stations.[15] The Belgian parliament laid the end of nuclear energy down in January 2003.[16] In February 2003 the English government decided against new nuclear power stations. The reason: nuclear energy is too expensive.[17] British Energy (BE), the finacially faltering nuclear generator, privatized eight years ago; this brought BE into a financial quagmire, the UK National Audit Office wrote in February 2004.[18]

The liberalisation of the energy market and the availability of plenty of electric current are of importance here. According to the French electricity firm EDF, the owner of 58 nuclear power stations, hardly any new nuclear power stations will be built in Western Europe.[19] In April 2003 the French Nuclear Community (SFEN) stated that the liberalisation would lead to a run on natural gas.[20] And the Dutch minister of Economical Affairs, Brinkhorst, said in October 2003 that in a liberalized European electricity market it will be long before new nuclear powerstations will be build. [21]

Since the beginning of the eighties, no new nuclear power stations have been ordered anymore in France, Germany and Great-Britain, the members of the EU with the largest number of nuclear power stations.[22] Together with the Greens, the Spanish Socialist Labour Party (SPOE) decided in January 2004 to close down the nuclear powerstations if they would come to power; and accordingly, the PSOE repeated this after their electoral victory of the 14th of March 2004.[23] [24]

The only two EU countries that are momentarily planning to build a nuclear power station are Finland and France. In Finland the order for the construction was placed at the end of 2003, and a similar decision is expected in France in 2004. It concerns a turn-key-order in Finland, in which the construction company has to pay for overspending, whereas the French electricity company want governmental subsidy. [25] Early in the year 2004, an increasing amount of resistance against the construction of a nuclear power station became visible, which caused the decision making process to slow down.[26] Francois Roussely, the CEO of the French electricity company EDF, proposed in March 2004 to apply for a building permit. But the decision to launch the EPR project does not commit the EDF to build the reactor, Roussely said. To bring this about a separate resolution is needed.[27] In addition to that, the construction of the nuclear power station in Finland isn't going as smooth as planned, either. The reasons for this are a few safety related matters. Vulnerability to aircraft sabotage, adequacy of severe accident management and reliability of digital instrumentation and controls, all loom as safety issues for the EPR that Framatome wants to build in Finland, according to the Finnish nuclear safety authority (STUK) in March 2004. A decision on licensing will not be made in the near future.[28]

Apart from the expenses, the storage of nuclear waste will determine the future of nuclear energy as well. That is why e.g. in South Korea the lack of storage facilities may result into the closure of a number of nuclear power stations.[29] Both Japan and Taiwan suffer from the same problem.[30] On the 18th of May 2002, the Swiss people decided in a referendum that the existing nuclear power stations are allowed to remain in operation. At this moment a nuclear energy law comes into force, which demands that a solution for the storage of nuclear waste has to be found within a period of ten years. New nuclear power stations are no longer built.[31] In the Netherlands the discussion about the future of nuclear energy and the closing down of the nuclear power station of Borssele is also related to the question of what has to happen with the nuclear waste.[32]

2. NUCLEAR WASTE AS A MORAL PROBLEM

1. The government and decorum

In the coalition agreement of the 1st Balkenende Government of the 3rd of July 2002, a special paragraph on decorum is included. The government is in favour of "a society in which everyone can live in freedom and responsibility on the basis of mutual respect". All of this is based on "common values" and "an open eye for a lasting balance".

The second Balkenende government also stresses in the introduction to the coalition agreement of the 16th of May 2003 the "responsibility of the people themselves" and the "transfer of norms and values".

The government states:"With the eye on a liveable country for future generations, the environment and nature, as well as housing and infrastructure ought to be managed and developed in a responsible manner."[33] The government hereby opts for a moral starting point for its policy, thus joining in on the trend of esteeming norms, values and ethics.[34]

2. Moral weight

We often encounter moral starting points, norms, values and ethics in many discussions and conferences on the storage of nuclear waste.[35] But why are we dealing with a moral matter? The philosopher Henk Vos says on this subject: "A problem turns into a moral problem, because we are afraid that in that particular situation certain values are being violated or insufficiently realized. This is how an environment problem comes into being: from care for e.g. life, freedom to secure the joy of a good environment and justice in reference to future generations. All these values are mentioned in the environmental debate."[36]

Nuclear waste is radioactive. Recent research shows that radioactivity damages one-third of people's genealogical cells, as a result of which a small part of the cells that originate there can be the cause of cancer. The moral problem with nuclear waste is: can we approve of the production and storage of a substance that can potentially cause cancer, either now or in the distant future?[37]

The Dutch Scientific Council for Government Policies (WRR) mentions in an essay published in February 2003 some moral principles that can be applied to many areas. The WRR attaches great value to the autonomy of the individual and justice. This justice is vital not only because of the inequality of global economic relationships, but also for the protection

of the challenged people, unborn children, nature and the environment.[38] In a report issued in December 2003, the WRR mentions 6 values which are of great importance to the western culture: faith in the future; equality; reason and reasonableness; universality; individuality; and justice.[39] To what extent do these moral principles play a role in the government policy concerning the storage of nuclear waste?

3. Returnable nuclear waste in cabinet policies

On the 11th of November 2002 the Balkenende-Government indicated it wanted to continue the existing policy of the storage of radioactive waste in the deep underground.[40] The existing policy was phrased in 1993. It then concerned the storage of toxic waste, i.e. both chemical and radioactive.

At that time the government posed[41]: "Complete prevention of the development of highly toxic waste is at this moment not possible without big changes in the social process," as "it is created at the production of materials that form an essential part of those products which are aimed to improve health, safety and prosperity".[42] Therefore, according to the government, the use of these production processes needs to be weighed up against the disadvantages the development of highly toxic waste bring about. The government thought that "the interests of future generations should be carefully considered alongside on the short as well as the long term."[43]

Because of this, the government wanted the producers of this waste to state for what reasons its production could be justified. The storage of this "justified waste" will have to be done on a retrievable basis.[44]

Retrievability "has the consequence that future generations will be burdened with the care for the highly toxic waste. The expectations are that the disadvantages of the effort this will take in both time and money won't weigh up against the advantages of the possibility of intervention (and) relocating," the government said.[45]

The government also pointed out that "due to the property of the salt to encapsulate the waste when the storage place is closed up"; the returnability "will be limited as a result of it".[46]

With these words the government indicated to have doubts about the retrievable storage in salt domes. And yet the research on it had to and still has to continue.

In the above we come across various moral starting points: equality, liberty, responsibility, the interests of future generations, the indications why the production of nuclear waste is justified,

as well as the comparison of the use of the production of nuclear waste versus its disadvantages.

4. Coging moral questions that have not been elaborated on

It is remarkable in the government policy that the moral starting points are not elaborated on any further. How is one to weigh up the disadvantages against the advantages? How are the interests of future generations accounted for in that balance? Based on what is the present prosperity more important than the disadvantages future generations may see themselves confronted with?

In 2002 the government stated that: “The limited scale of the Dutch nuclear energy programme and the relatively small amount of radioactive waste derived from it, hardly justifies the construction of a proper underground laboratory.” [47] In this case the government referred to a laboratory for the research of the storage of nuclear waste, prior to the actual storage. Why exactly is “the relatively small amount” an argument against large investments?

In addition to this, the government intends to pursue a reversible storage “if possible in cooperation with other countries. This guarantees on the one hand that the number of final storage places may be limited to the most optimal locations and on the other hand that they can be exploited more efficiently.”[48]

The scheme of combining the disposal of the nuclear waste from various countries is a change in the policy and can imply that the nuclear waste of a number of countries will be stored in the Netherlands. An argument in favour of this is that common storage is cheaper for each country. Does this argument suffice in justifying a policy review? If we put ourselves in the position of future people potentially developing cancer as a result of the stored nuclear waste, would we consider it justified that this nuclear waste had been produced at all? And why is it that government policies only mention the consequences for mankind? Don’t other living creatures or the ecological system count? The government holds their tongue about all those questions.

These questions are all the more coging as the government disregards an advice to carry out further research on the ethical-social aspects that are vital to come to a useful dialogue with the social groups in our society.[49] The government evades the discussion on moral matters and refuses to talk about the choice for its policy. This brochure tries to fill in this void.

5. The European Community: "nuclear waste into the ground"

On the 30th of January 2003, the European Commission (EC) published a draft directive on the storage of nuclear waste.[50] The Commission wants its member states to appoint storage facilities for highly radioactive waste in 2008 at the latest. Maximally ten years from then, in 2018, the first barrel of nuclear waste is to go underground. The final underground storage of short-life radioactive waste should take place even earlier: such a storage place has to be taken into use no later than in 2013. Discussions on this draft directive are still being held in both the Council of European Energy Ministers and the European Parliament. Should the directive be passed, the Dutch government will have to translate it into its own legislation. If it is up to the Commission, this will have to be completed by May 2004.[51] According to the EC there is a "solid ethical basis" for the rapid development of storage facilities and "further delays in the development of storage facilities for the final storage of nuclear waste can no longer be justified."[52] On the contrary, further delays ought to be avoided, the EC concludes, so as not to pass on the responsibility of storage to future generations; and moreover, further delays and storage aboveground increase the risk of accidents and terrorist attacks.[53] One can remark here that nuclear power stations also happen to be aboveground and should in accordance with the point of view the EC adapts also be a risk. The EC, however, doesn't go into this matter. In contrast to the Dutch government, the Commission does insist on holding a debate on the storage of nuclear waste.[54] But, due to the fact that the debate is supposed to result in the fast settlement of a location, this inspires little confidence.

On what grounds does the EC found the ethical basis for a rapid decision on the storage? Two arguments are to be considered here. Firstly, the EC mentions the lack of storage facilities for nuclear waste an important drawback for the construction of new nuclear power stations.[55] The second argument is the "wide international consensus under the technical experts" that final storage deeply underground is the best alternative. The EC states that the "remaining-activity" can only escape after many thousands of years in insignificant concentrations in comparison to the natural background radiation. This may be concluded from "numerous studies". The EC finds it reason for concern that many members of the European Union are postponing the storage. Namely, storage aboveground means that "an unacceptable burden" will be passed on to "future generations who won't have any advantage of the electricity that is generated by nuclear power stations."[56]

With the draft directive we may conclude, that the European Commission intends to clear away all obstacles to enable the construction of new nuclear power stations. An

important moral principle, whether or not the construction of new nuclear power stations is justified, isn't explained by the EC. According to the EC, nuclear waste may cease to be an obstacle, as long as we believe in technical experts who have published numerous reports. And the removing this obstacle becomes a moral issue because of the reference to the responsibility towards future generations. However, the EC does not state how this responsibility will take shape.

In the continuation of this brochure we shall demonstrate that the arithmetic methods used to calculate the consequences for the future, are unreliable. Is the blind faith the EC has in these tables a way of acting responsibly? To what extent is the EC acting responsibly in its appeal to the population to believe in the technical experts? We shall attempt to give an answer to these questions.

The Dutch government does not agree with the draft directive of the EC. Nevertheless, the government does not in pursue in any way these moral matters we have just described. On the 12th of May 2003, Secretary of State Van Geel wrote that the government "supports the proposals in such a manner, that plans should be designed for the final storage of radioactive waste. The Netherlands will not agree however, with the proposed requirement of final underground storage according to the time schedule as proposed by the Committee."[57] [58] And so it appears that the time schedule remains the sole argument. Why is this argument important? Because the draft directive can "lead to social unrest (…) in the province in which the underground storage location for the nuclear waste has to be realized," said the Dutch government.[59]

Germany, Finland and Sweden have also objected to the dates proposed by the European Committee. Therefore, by the end of 2003 the Commision decided not to mention any dates anymore.[60] However, in April 2004 they were of the opinion that the memberstates do have to draw up a time schedule themselves, and live up to that.[61] On the 27th of November 2003, a commission of the European Parliament passed a motion to refrain from mentioning any dates, but still to oblige the countries to draw up plans for the storage of nuclear waste in 2006.[62] The European Parliament passed this resolution on the 13th of January 2004. They argued that "action must soon be taken to avoid the responsibility to manage the growing quantities of spent fuel held in temporary storage being passed on to future generations."[63] Meanwhile, in the resolution it is nowhere put forward how that responsibility to future generations will be given shape, or which actions should be undertaken. From the above follows that moral considerations hardly play a role in the discussion on the directive of the European Union. We don't consider this to be right.

6. Nuclear industry is being protected, not the population.

The European Committee says that the storage of nuclear waste should meet the important principle that both humans and the environment are to be protected now, as well as in future.[64] The impression this gives is that the protection of life is an important value for the EC. But is this really the case?

Those who have studied the small print in his or her property insurance policy will undoubtedly have come across the clause stating that damage, "caused by, occurring with or resulting from a nuclear power reaction, no matter how this happened", is excluded. This exclusion is not a haphazard one. An agreement namely exists between the insurance companies that they will not insure any individual against the risks of a nuclear incident.[65]

The liability of the owners of nuclear power stations has been limited in the Treaty of Paris (1960) as well as in the Treaty of Brussels (1963). These treaties underlie the Dutch law for liability in the case of nuclear incidents.

Why is the liability limited? In the joint comment on the treaty of Paris we read:"In the first place, because owners of nuclear installations would have unlimited liability according to standing law, while it is obvious that unlimited financial coverage cannot be obtained." We can also find: "The extremely heavy financial burden, which could be the result of unlimited liability, might seriously endanger the development of nuclear industry." In March 2003 Juhani Santaholma of the Finnish Energy Industry Committee stated that unlimited liability in the case of a possible incident would lead to the bankruptcy of the operator of the nuclear power station. He said this because of the prospects to build a fifth nuclear power station in Finland.[66]

So, the nuclear incidents liability law particularly protects the nuclear industry. To both the European Commission and the Dutch government, nuclear industry is of greater value than the population and the environment.[67] This we reject.

7. The polluter pays: stop nuclear energy!

An important starting point of environmental policy is to put it shortly: "the polluter cleans up his own mess". The German Martin Kalinowski points out the long period necessary to find a solution for the storage of nuclear waste, even if there would not be any opposition against the storage plans. In order to test e.g. safety models, many decennia are needed. "If we take the principle that he who produces the nuclear waste, ought to take care of its storage, seriously, the consequence will be that no more new nuclear power stations are taken into operation and that the production of waste has to be reduced as soon as possible."

He continues: ”Therefore the goal should be to stop as quickly as possible producing nuclear waste by means of closing down the nuclear power stations.”[68]
As general requirement to managing nuclear waste, the European Commission demands that “the polluter pays”.[69] If we would apply Kalinowski’s reasoning to the draft directive on nuclear waste it would mean that we would have to stop nuclear energy altogether. However, this is in conflict with the goal of the EC to remove all obstacles that prevent the construction of new nuclear power stations.
The Dutch Environmental Secretary of State, P. van Geel, stated on the 18th of June 2003: “In the general sense the principle is that the polluter pays. The law, however, doesn’t offer sufficient ways to enforce this.” Neither did van Geel know whether sufficient money had been reserved for definite storage.[70] Therefore, in the Netherlands, the polluter – in this case the operator- doesn’t pay enough. A logical consequence of that would be the closure of the nuclear power station in Borssele, but the government refuses to do that.

8. Conclusion

The storage of nuclear waste is a moral or ethical problem. The Dutch government has not elaborated upon its moral principles. The European Commission bases its ethical starting point on the matter of nuclear waste on the faith in technicians. The authorities say they intend to protect the population and the environment against the consequences of the storage of nuclear waste. Yet in fact the Dutch as well as the European legislation protect the nuclear industry. We reject this. This is in short a reason to stop nuclear energy.

3. VALUES, NORMS AND NUCLEAR WASTE

1. Introduction

In the study of ethics, issues like morals, norms, values, virtues, rights as well as concepts of justice and future generations are being studied. In the following the various concepts will be explained.

2. What is moral?

The concept of moral refers to the whole of rules of conduct that is accepted to be self-evident within a community or at least to a part of that community. It reflects the norms and values that are prevalent in a group or society and indicates what is expected from members. Everybody has moral conceptions, ideas and convictions, which form the basis of what is thought to be right or wrong and of what should or should not be done. These moral conceptions are often the result of ones upbringing and therefore taken for granted. It involves a basic sense that certain matters are right and others are wrong[71].

Everything that makes life liveable and human is considered to be morally good. Evil is what's hindering this. The word moral is derived from Latin 'mores' and means customs, habits or virtues. Thus, it demonstrates that the prevailing customs and habits of a community are of vital importance for survival, although not everything that makes sense has to be correct. The sensible doesn't always coincide with what is decent or indecent. The elimination of adversaries for instance may be a mentally and strategically correct move, but not morally responsible[72].

3. So called 'hidden values' and nuclear waste

A value is a starting point, a notion of what one considers to be important. They are abstract ideals or goals striven for by means of specific behaviour. Values have the tendency to be vague. They are mostly phrased positively: they indicate something that is important and worth striving for.

An example of values in the discussion of storage of nuclear waste can be found in the above mentioned government stand. The government considers prosperity to be an important value and therefore accepts the generating of hazardous waste and its additional risks.

The English philosopher Kate Rawles gave an overview of the most important values regarding the storage of nuclear waste. Nuclear waste poses a possible threat to both human

and non-human life and well-being and will continue to do so for thousands of years. It is this central aspect that raises questions in which values are important, like the division of the risks between generations and within the present generation.

Rawles wonders whether we hold the same duties toward future generation as we do to people alive now and how far in the future our liability should go. She adds that elaboration on this matter often tends to be forgotten.

Yet, during the decision-making stage moral issues already come up: which process and which values play a part? Rawles is referring to values as openess, impartiality and freedom of information. And how far does the discussion go? Do we move on from nuclear energy to the issue of energy production and energy consumption?

Assessments are unavoidable in research concerning the storage of nuclear waste, Rawles states. Choices will have to be made namely, and therefore criteria are needed. And criteria are based on both assessments. But scientific facts and scientific facts are not without values either. Science functions within a frame in which values do play a part. Examples of these values are; which data are important, how should research be carried out; what is consensus and intellectual honesty.

Geology as a science renders us knowledge of the soil and deep underground structures. This knowledge can teach us something of water flows, in which radioactive waste can come to the surface, possibly contaminating eco-systems, and people developing cancer. The importance given to geological knowledge is based on the values granted to eco-systems and human life. If a human life would be considered worthless, the geological criteria for storing nuclear waste would be different. The basic values attached to the care of the storage of nuclear waste are the values that are granted to a human life and the health of eco-systems. This concerns the stand that human life and health matters.

These values mentioned above are often concealed. To leave it that way (also politically) is in itself unethical. It then boils down to scientists forcing their norms and values onto others, without a debate. And when one does not reflect on these matters, nothing will be learned from the past.

The values mentioned are often said to be personal or subjective. Therefore, a critical debate has never taken place. This way, moral concerns are marginalized and science cleared from having to think about the issue. These are all unwanted consequences of the judgement that values and thinking about values (also called ethics) are considered to be subjective. So far Rawles's analysis.[73] [74]

Hidden values are found in the government's outlook on the storage of nuclear waste as well. The government rejects an ethical-social discussion, yet considers further technical research necessary. The Central Organisation for Nuclear Waste (COVRA) is in charge of this research but also manages the temporary storage of nuclear waste in Zeeland. Thus, further research is in the hands of the government related institution instead of an government independent commission. In accordance to Rawles's analysis this is an un-ethical procedure.

The COVRA has been government property since 2002.[75] Up to that time the exploiters of nuclear energy owned 90% of the stocks and the government 10%. According to the government, the liberation of the electricity market is the reason for this nationalisation. Exploiters of nuclear energy wanted to be 'set free from unforeseen financial cutbacks attached to the expense of both temporary and final storage' This is why the government already granted 50 million guilders in 1996. [76] The consequence is that those operating nuclear energy, (i.e. the polluters) do not have to pay for all the cost. Furthermore, it is completely unclear how much money is reserved for future storage. From a letter by the Environmental Secretary of State of the 9th of December 2003, we do know which assumption is at the base of the reservation.[77] That is the assumption that the reserved money increases anually by 3,5% in its value; inflation has been deducted from this percentage and it concerns actual, genuine increase in a period of a hundred years. After being stored aboveground for a hundred years, the waste goes into the underground. We can demonstrate the meaning of this assumption as follows: For the interest rate of 3,5%, the amount will double in 20 years; € 100 becomes € 200 and after a hundred years the present € 100 will have grown to no less than € 3200. Thus, the assumption of a genuine interest boils down to the fact that one need not reserve a lot now, to have a lot of money in a hundred years time. However, how plausible is that? Suppose we deposit a certain amount of money in the bank; the bank will lend it out to someone or a company, who will have to pay to money back to the bank with interest. Hence the bank is enabled to refund us our interest. So, in order for the bank to compensate our interest, someone else has to work and produce a surplus. That is only possible if there is a lasting economical growth and related to that the necessity for enterprises to tempt the consumers to purchase new products (e.g. new mobile phones, while the exiting still work). [78] However, is an abiding economical growth possible, seen from experiences from the past? And is economical growth desirable? This concerns surpressed matters and assumptions by the government, which we would like to bring up for discussion.

It appears – we can conclude - that the government has attached such great value to nuclear energy that the polluters do not have to pay for all the costs. We cannot agree with this judgement of values.

4. Radiation norms

Norms give meaning to values. A norm is a rule that says something about the way in which individuals are supposed to act. Often, they are negatively phrased, they limit our acts and have a tendency to forbid rather that prescribe.

Nuclear energy produces radioactive radiation and norms limit the consequences of this radiation. The International Commission for the Protection against Radiation (ICRP) made a system for the protection against radiation in 1997. This system has been copied into the Dutch legal system and is based on the following principles: the application of radiation must be justified and the amount of radiation people may be exposed to must be kept as low as reasonably possible. These principles mean that the purpose of the application should outbalance the damage. As low as reasonably possible means in essence: a striving to maximise the use, in comparison to the damage brought onto society as a whole. These principles live up to the starting points in which actions are being judged by their consequences, often expressed in profit in comparison to the necessary costs to implement a specific measure. [79] The radiation norms are an interpretation of the values of the government, namely that now prosperity is more important than the risks attached to nuclear waste.

5. Norms versus values: What is worth the effort?

In order to realize certain values, specific norms are being formulated. With that, values are of greater importance than norms in the subject of ethics. Only if we know what the effort is worth, a variety of norms and rules in daily life become significant.
Norms should be determined by values, not the other way around. Norms can change; they depend on a specific time and culture, while values have a more permanent character. Norms and values are closely connected: a value such as friendship results in a norm like honesty. Norms and values together form the object of ethics as a subject. [80] [81]

6. Virtues as solidarity.

A virtue is a positive character trait of human beings. Moral virtues are the virtues everybody profits from by having them.[82] Some examples of virtues are solidarity, reliability, wisdom, honesty, thriftiness, justice, responsibility, courage and consideration.[83]

Virtues and important values are inter-dependable. The ethicist Van Tongeren defines: "Virtue is an attitude in which the direct connection with values has become concrete, and in which a norm has been embedded in relation to the good life. [84] An illustration: on the 8th of September 2002, the 189 member states of the United Nations concluded their Millennium Summit Meeting by accepting six 'basic values' in honour of this century. These values were: liberty, equality of individuals and countries, solidarity, tolerance, respect of nature and shared responsibility." [85]

7. Responsibility

When are we responsible for something that happens? We are not merely responsible when we act (positive responsibility), but also if we allow something to happen (negative responsibility). In addition to that, I am also responsible if by my actions I have, either directly or indirectly, caused something to happen, even though I didn't want it to take place.

Taking responsibility means that I acknowledge the other person's right that I justify my behaviour to him or her. This acknowledgement also signifies that I have to be willing to revise my behaviour. Recognition of responsibility thus means to refrain from all that cannot be justified. That is a self-imposed limitation to the freedom of action. [86]

Life is typified by fragility and the danger of it being destroyed. Others possess the power to keep or destroy life, and that responsibility isn't reciprocal. Examples of that are parental responsibilities towards their children and that of the contemporary people towards future generation, in addition to their responsibility towards the non-human environment. [87]

The responsibility for the long-term consequences is sometimes discarded with the following argument: we have to limit the time horizon for moral responsibility to that of our children and grandchildren; the responsibility doesn't count for abstract future generations with an unknown and possibly a completely different lifestyle and values. "However", so poses the German ethicist Birnbacher, "the existence or non-existence of sympathies between the generations is a questionable argument. Moral obligations usually exceed emotional ties. This is all the more applicable to future victims of contemporary deeds or negligence. They have an even worse position than today's victims, as they are unable to protest against the causes of their suffering."[88] [89] [90]

These questions on the matter of responsibility have not been elaborated on in the government's stand on storage of nuclear waste.

8. Conclusion

In the discussion on the storage of nuclear waste many norms and values are involved. Questions such as which facts are of importance; who will do the research; what is the value of human life; and, how is the usefulness of nuclear energy determined, need consideration. Hidden values often are involved, as in the case of the European Commission appealing to the people to put trust in technicians. The EC proposes not to talk about the hidden values of the technicians this way. The Dutch Government prefers to evade a discussion on nuclear waste altogether. We do not consider this a morally just position.

4. FUTURE GENERATIONS AND RETRIEVAL

1. Introduction

The Dutch government and the European Commission mention the interest of future generations, yet it remains unclear what they mean by this. Because of the future, the Dutch government insists on retrievable storage of nuclear waste; however, the European Commission rejects this for the very same reason. In this chapter we shall first go over some general objections against underground storage of nuclear waste and then we will go further into the concept of future generations.

2. Unreliable safety models: a smoke screen

Arguments against underground storage have to do with the unreliability of the calculations as well as with questions about the suitability of the underground layers which qualify in the Netherlands: salt domes or layers of clay.

In her thesis the German Christa Garms-Babke has given an analysis of the unreliability of the models that are used for the calculations of long-term consequences. Estimates for the short term concerning the possibility and consequences of relatively frequently occurring and thus frequently noticed phenomena, such as earthquakes and volcanic eruptions, often tend to be incorrect. Estimates on the long term are all the more insecure. An incident causing damage to final storage cannot be excluded. This type of storage is not remediable and is as far as the consequences are concerned unmanageable. Consequences may occur that cannot be reversed by any decision taken afterwards. Therefore, a resolution towards final storage based on unreliable calculation models cannot be accepted, according to Garms-Babke. Due to the limited possibilities to make predictions, Garms-Babke comes to the conclusion that technologies and their consequences should be calculable, controllable and reversible. The immoderation of science is opposed by the postulate of self-limitation.[91]

The problem of the unreliability of the calculation models comes up everywhere. In the Netherlands, the Commission ‘Opslag te Land’ (OPLA – ‘Storage on Land’), which was founded by the Dutch government, stated in its final report of 1993 that calculations of the risks of underground storage of nuclear waste are unreliable on the long term. The results of model-calculations namely depend on both the model used and the personal insights of its makers, whereas fundamental knowledge is often lacking.[92] In November 2002, the Dutch

government decided to opt for further research of “further sophistication of the model calculations”.[93]

3. Questionmarks with salt and clay: the risks[94]

3.1 Explosive salt

Professor H.W. den Hartog of the Laboratory of Solid Physics of the Rijksuniversiteit Groningen states that: “when we heat radiated salt, explosive reactions will occur. During our experiments we sometimes found a fairly heavy platinum lid being blown away.” Den Hartog has studied the influence radioactive radiation has on salt for 15 years already. [95]

One of the scientific differences of opinion concerning the storage of nuclear waste in salt is about radiation damage. The radioactive waste beams forth radiation, which ends up in the salt. Because of that, salt partially transforms into the elements it is originally composed of, i.e. sodium and chloride.

Den Hartog wanted to do research on this, as with the rise in temperature of the salt, transformation takes place in the opposite direction. Then sodium and chloride fuse into salt again. In the process a considerable amount of energy is being released, causing barrels of nuclear waste to melt and vaporise. This may lead to an underground explosion. ”The salt dome will not explode”, Den Hartog stresses, “but the explosive force I calculated is considerable and may cause serious damage.”

3.2 Foreign salt: unsuccessful storage

The salt dome of Asse is situated in the German federal state of Niedersaksen and until 1978 approximately 124,000 barrels of light and medium radioactive waste had been stored there. It was the intention that around the year 1970 highly radioactive waste should be stored there, too. This German project was a vital reason for the Dutch government to opt for storage in salt domes. Things went differently, however. The salt mine has three wide, deep descending corridors, the shafts, of which two have been inundated for a long time. And now the third is in danger of inundating as well.[96] Highly radioactive waste has never been stored in it.

The salt dome in Morsleben in former Eastern Germany was liscensed to store both light and medium radioactive waste. This salt dome is also in danger of inundation and collapse. Also for this reason, the German government decided to end the storage in Morsleben in May 2000. In March 2003 it was decided to fill 670,000 m³ of the saltdome’s

space with a mixture of salt, charcoal filters, cement and water, as the safety was in acute danger. [97]

Germany's most prominent salt dome is the one in Gorleben. Since 1977 research has been done here, during which it was discovered that the salt dome is in contact with ground water.[98] Because of this, the dome does not live up to the central aptitude requirement. And yet the Kohl government continued the research and the construction of a partial storage mine with the argument that there was hope for favourable results. However, the present Schröder government thought Gorleben unfit and decided on the 14th of June 2000 to end all research, which had added up to 2.2 billion marks (€ 1.3 billion) up to then. [99]

The subsiding of the ground caused cracks in the corridors, possibly loosening lumps of salt. That is why the authorities decided on levering these lumps and scraping away the salt. In those places where big cracks are found, developer DBE (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern) is installing additional reinforcement with anchors. This work will continue until October 2003. According to the DBE, this phenomenon occurs in all salt mines and it's not spectacular because it concerns Gorleben. Keeping a salt mine operational requires continuous maintenance.[100]

The experiences with the German salt domes support the point of view the Dutch government had at the time that retrievable storage of nuclear waste in a salt dome is not easy to implement. This is all the more reason for us to end all storage in salt.

As early as 1955, the American Academy of Science said that nuclear waste would be best off stored in salt. However, after a number of failures the American authorities removed salt from the list of storage facilities for nuclear fission waste in 1985.
Nevertheless, the resolution was passed to store non-heat-shedding trans-uranium nuclear waste in a layer of salt near Carlsbad in New Mexico. The construction of the mine cost 1.5 billion Dutch guilders. The storage was supposed to start in 1988, however, it was then established that water was seeping into the mine. It was decided that there had to be a test phase first. In this phase no more than half a percent of the entire capacity for barrels is to be dumped.[101] The actual storage began in March 1999. Still, this doesn't mean the storage is safe; on the contrary, it concerns unsafe storage with long-term hazards for future generations.[102]

3.3 Insufficient knowledge of clay

On a worldwide scale, Belgium is the most advanced country concerning research on storage in clay. However, after 25 years of research many questions remain unanswered with regard to the safety of storage in clay. This is mentioned in the SAFIR 2 report of the Belgian governmental angency the NIRAS institution (National institution for radioactive waste and enriched fissioned materials), which appeared in February 2002. That is why it is now "premature to openly speak out on the technical feasibility of a storage in this hostformation or on the operational and long term safety of such storage", as the NIRAS writes.[103]

4. Future generations

As demonstrated above the Dutch government states that with the storage of nuclear waste "the interests of future generations need to be carefully considered on both the short and the long term." The government does not mention how this consideration should take place.

For starters, we may ask ourselves: what do we mean by future generations? That question isn't easily answered. The future generations are more or less synonymous to the future itself; it is a particular manner of referring to the future. The coming generations may be looked upon as our children and grandchildren. We are then dealing with people that have already been born. However, there is a smooth transition between the generations. Therefore, it is not clear where the next generation begins.

The future generations can also be seen as the (yet) unborn. But our present actions not only influence the fact ´if and how many` people there will be in the future, but also ´who` they are. Taking future generations into account, means taking people into consideration who may or may not exist at all and who may be different from how we now imagine them to be. The German ethicist prof. Christoph Lumer argues that future generations concern many people, who can be far away from us time-wise. The obligations towards future generations can therefore be enormous. Take for instance the demand that future generations may not be disadvantaged by the exhaustion of the raw materials. This can imply the present generation can hardly use anything. If moral stands are generally applied, the following has to be right: people who live in a thousand years from now have to –with the same insights and knowledge- morally judge our actions in the same manner as we do now. On the other side, we have to weigh their fate equally heavy to that of contemporary people.[104] But how can we realize that, Lumer researched. He researched the motives for acting morally on account of future generations, as they are mentioned in ethical theories. The conclusion he reached is little satisfactory; the main motive is empathy, the ability to imagine walking in someone

else's shoes. Lumer estimates this motive is insufficiently strong to draw up a convincing directive for the responsibility towards future generations. [105]

From that we conclude that claims about responsibility for future generations aren't completely solid. No statements against which nothing can be said follow from the existing ethical theories. At most, we can try and found our point of view as good as we possible can.

The Israeli environment philosopher Avner De-Shalit distinguishes two interconnected aspects about the relationships between generations. The first has to do with the environment: we produce poisonous and radioactive material and exhaust resources that cannot be renewed. The second is economical. We do not only divide goods and resources within the present generation, but also within generations. The moral dilemma may arise because we cause damage to future people as a side effect of our efforts to improve our present standard of living.

Our obligations towards future generations are a matter of justice, according to De-Shalit. Our commitments toward more distant generations (e.g. thirty generations from now) are not as determined and defined. In respect of those distant generations we do have a strong negative obligation, namely to avoid causing damage to that generation.
The problem is that we do not know how future generations wish to live. And De-Shalit refuses to reduce the justification between the various generations to the relationship between one generation and its direct successor. Those who support the so-called contract-idea hope that the obligations the contemporary people impose on the next generation, will be passed down from generation to generation. But according to De-Shalit this can also be interpreted in such a manner that the first generation will not need to make any efforts. For example: this generation may store nuclear waste in such a way that during the next two generations no leakage will occur and may rely on the following generations to find a solution. However, this policy is too risky according to De-Shalit. For what will happen when the next generations don't find a way to prevent leakage, he wonders.[106]

We do not find any of these questions in the policy of either the Dutch government or the European Commission on the storage of nuclear waste.

5. Retrievable storage of nuclear waste: a magical criterion

The Dutch government has chosen for retrievable or returnable storage. Consequently "future generations are being burdened with the care for the highly toxic waste material. It is to be expected that the disadvantages of the necessary effort taken in both time and money aren't balanced out by the advantages of the possible intervention, re-destination and

relocation", the government states. However, it remains unclear what this care enhances and how the advantages and disadvantages are balanced.

We come across a moral argumentation on retrievable storage with Martin Kalinowsky. The ethical principle that technical behaviour which has irreversible and unwanted consequences must be avoided, pleads against final storage. The consequences of radiation from long-term interstorage will especially damage the present and close generations; later generations will suffer fewer consequences when during the period of interstorage ameliorations are made in the techniques for the final storage. Nevertheless, it should be taken into consideration that most of the decisions concerning the storage techniques will have to be taken prior to the licensing procedure, Kalinowsky says. So in the license procedure the government determines who may be subjected to particular damage of the storage.

It is a moral issue who we subject to more and who to less of the consequences of our present use of nuclear energy. Final storage essentially implies that the present generation prefers to protect itself better than future generations. It remains to be seen whether final storage outweighs a much larger insecurity in the distant future, Kalinowski concludes.

He also refers to another moral principle: the polluter should be held responsible for the consequences. This seems to imply that nuclear waste should rapidly and finally disappear under the ground. However, the choice for non-retrievable final storage is in conflict with another ethical principle, namely the unlimited posibility for future generations to freely decide for themselves.[107]

The German Christa Garms-Babke also looks into this loss of freedom. In her thesis of 2002 she states that non-retrievable storage coincides with the loss of freedom of proceedings of both present and future generations. With non-retrievable storage the political freedom of the citizens is being limited. They are deprived of the opportunity to form a new majority claiming retrievable storage during elections. The present majorities make themselves into permanent majorities by deciding for non-retrievable storage. This is in conflict with the principle of democracy to be able to form new majorities.

Another argument of Garms-Babke in favour of retrievable storage is the unreliability of the arithmetic models as referred to above.[108] The European Commission comes up with the faith in both models and technicians as a reason to oppose retrievable storage. As explained earlier, we consider this faith unrealistic. On the other hand, retrievable storage should be made concrete. In a Belgian scientific study we can find to what the policy of the Dutch government may lead, without a more elaborated care provision. The Study Centre for

Nuclear Energy (SCK) in Mol has a special project for research into the ethical questions on the storage of nuclear waste. G. Cornelis is involved in this. He expresses serious doubts about retrievable storage. It concerns questions we also have to take into account in the Netherlands; hence we go into this at this point.
Why should spent fuel elements be stored retrievably at all? Some say that future generations intend to use them. But then these future generations must have the expertise and how are we to organise that, Cornelis asks. And if the present generation thinks that future generations are very likely to retrieve the fuel, why do we put that very fuel in an underground storage place at all?

The guarantee of retrievability alone will not be sufficient. Future generations should also have reprocessing plants at their disposal to e.g. separate plutonium from waste fuel, as well as nuclear plants to burn up the plutonium. Knowledge on this has to be preserved. All this will cost a lot, Cornelis claims.

He continues on the topic of plutonium for a bit longer. If people intend to use this for nuclear arms, this could cause more damage to humanity and the environment than the leakage of nuclear waste from a storage facility. In other words: more future lives are endangered by nuclear weapons than by the storage of nuclear waste. Is that an acceptable reason to allow the retrievable storage of spent fuel?

And storing nuclear fissioned waste retrievably, why should we? Some people argue that future generations will have better solutions that the contemporary. But how can we be so sure, Cornelis wonders? Does it imply that the present generation agrees with careless work, just because it is assumed that future generations will do better? And don't we consequently create the illusion that the nuclear waste problem has already been solved? Based on this illusion, don't we create the opportunity to produce more and more nuclear waste instead? And how much does the retrievable storage of toxic waste cost? Who is going to pay for that and how can we guarantee sufficient funding?

In conclusion Cornelis states that we may consider this retrievability to be "a reduction of the responsibility we are willing to take, as a method to wait and see."[109] So far, the Dutch policy thinks Cornelis is right. It strongly looks like it as if the Balkenende 1 government intends to limit itself to short term policymaking.

The Secretary of State for the Environment, Mr. Van Geel, rejects the draft proposal of the European Union by arguing that the Netherlands have chosen for "temporary storage above ground".[110] He calls this: "retrievable storage"[111] and in doing so he gives the impression that underground storage is no longer being considered. However, there's lack of

evidence for this, as the Secretary of State has not dissociated himself from the government's point of view on nuclear waste, dating from November 2002.

6. Conclusion

There are many questionmarks at the safety of final storage of nuclear waste. The models to determine the security are unreliable. Experience abroad with the storage of nuclear waste in salt does not reassure us and too little information is available on storage in clay. In reply to these insecurities the Dutch government has chosen for retrievable storage. There are moral arguments for this choice, like e.g. the freedom of action will be preserved in this manner. However, the government should give meaning to the retrievability, for example by setting out explicit rules as to the manner in which the operators of the nuclear power stations put aside money to be able to meet future demands. This isn't happening. Retrievability is thus rendered an empty expression.

The European Commission passes over these insecurities by urging the population to have faith in technicians. This is not a valid argument.

5. ETHICS, JUSTICE AND STORAGE NUCLEAR WASTE

1. Introduction

We have discussed notions like moral, norms and values. At times the word ´ethics´ came up. There are a number of ethical trends and it is tempting to go over these trends now in order to relate them to the storage of nuclear waste. This would mean that the line by which we continuously try to relate ethics with the storage of nuclear waste as much as we possibly can, would be broken. Therefore, we chose to merely glance over those theories and go into them more explicitly in an appendix.

2. What is meant by `ethics´?

Ethics is the science in which morals are being studied. Scientists can study the prevalent moral or also prescribe how one should act.[112] Ethics is a systematic contemplation on responsible acting, the systematic study of the moral. To justify oneself means: coming up with arguments for one's own acts, to hold a debate with others on the reasons in favour or against a certain dealing. At that moment the ethical process, the ethics, is in full process.[113]

3. Ethics: a minimal norm

In his much read book "The Elements of Moral Philosophy"[114] the ethicist James Rachels claims that it would be handy if we would be able to set out with a simple non-controversial definition of what ethics really is. According to him this is impossible, however. Rachels did develop the concept of the various ethical theories, though. This consists of a mutual core of the various ethical theories. He states that ethics is at least the effort to act according to the best of reasons by which the interests of all people likely to undergo the consequences of these acts in an evenly balanced manner form the starting point. We have to be able to back up our judgements with valid reasons and explain why these reasons matter. Rachels demonstrates that certain moral rules are the same in all societies. Without these rules a society could not exist. He gives "Don't lie and don't kill"as an example. These are rules enforced in all healthy societies.[115]

The Dutch philosopher Trudy van Asperen joins in on this by saying that "in spite of all their differences, people are quite equal, they are (physically) vulnerable, and charity, minerals, rationality and willpower are limited. These simple truths of the human nature and the natural environment have more or less been generally accepted. The interesting aspect of

it is that these innocent looking truths, in combination with a formal theory of the moral duty, are able to generate a great number of moral principles that can count on general support. (..) Nobody doubts that it is correct not to kill or steal and to keep one's promise etc. They are the conditions to make a human society possible in the first place. These simple yet fundamental rules constitute the hard core of what is sometimes also called: ´narrow morals´."[116]

According to an important scientific advisory institution of the German government, no society is able to function without a minimum of norms and principles. But how is one to agree on those principles? How can one judge norms? The answer depends on whether it concerns primary or secondary principles. Primary principles are the starting point of an ethical system. The secondary principles are derived from the primary ones. Primary principles have a categorical nature. We then have to do with principles that cannot be violated under any circumstance. However, how can these principles be founded? It is impossible to do this in a logical manner, because if they are the logical consequence of something, the question comes up how this can be founded on its turn. In practice, this question is of lesser importance, as e.g. human freedom, the right to live and social justice are generally accepted as vital principles. This disagreement particularly concerns the question which meaning these starting points have in certain situations and how we are supposed to convert these starting points into concrete action.[117]

4. Ethical theories

The ethical theory of utilitarianism is often implicitly raised in the discussion on the storage of nuclear waste. This is a system in which the greatest possible use for the people of today is concerned, where the future people don't count as much as the contemporary people. We reject this type of reasoning.

The discussion on nuclear waste is sometimes held on the basis of ethical starting points like equality and justice. The points of view of the German philosophers Immanuel Kant and Ernst Tugendhat are important here.

Justice also happens to be a central virtue in the ethics of virtues of which the Greek Aristotle was the founder. The philosopher Ad Verbrugge writes: "justice is the mentioned perfect virtue, in which all other ethical virtues are included and moreover in which the fellow human being is acknowledged. (..) Therefore, in this perfect value of righteousness it is not only one's own well being, but also that of others that is decisive for one's actions."[118]
From now on we shall emphasise justice in reference to our dealings with nuclear waste.

5. Benefit and nuclear waste

Constantine Hadjilambrinos, an environmental ethicist has analysed the debate on the ethical aspects of storage of nuclear waste and published about it in 2002.[119] She is struck by a common denominator: the analyses are not so much given by ethicists, but rather by government representatives or people originating from nuclear industry, the very people who quietly support the ethical system of utilitarianism. The reason for this is that utilitarianism offers an apparently reasonable goal, namely to maximise the social benefit. This goal can be reached in a rational, methodical and quantitative manner.

There are a number of objections against utilitarianism. Calculations for the distant future presume that in e.g. 10,000 or a million years from now, people will be similarly sensitive of radioactivity as the people of today. However, a solid foundation for this presumption is lacking. It is in fact assumed that in the future people will demonstrate a similar behaviour to the present, but this isn't factual knowledge. The consequences of the risks involved with regard to the social benefit cannot be calculated with surety in any possible way. This is all for Constantine Hadjilambrinos's analysis.

In the Netherlands environmental philosopher Wim Zweers criticised the utilitarian way of thinking about nuclear waste. He analysed the question of which sacrifices (for example cancer-related deaths caused by radioactivity) we are willing to make in return for material prosperity and economic growth. According to him two attitudes can be fundamentally distinghuised:

1. A zero risk is the only risk that can acceptably be imposed upon people against their own will.
2. A zero risk is unacceptable in connection to the economical consequences.

Whoever adheres to this point of view will have to point out the limits of the acceptable. This point of view is the embodiment of utilitarian ethics.

Zweers severely questions utilitarianism. The main problem of utilitarianism is that in this theory the attention for the rights of the individual is absent. This theory is incompatible with the concept of the inalienable basic rights of the individual with regard to life and health and on the matter of equal protection for all.[120] Here Zweers links up with the analysis of the American ethicist Kristin Shrader-Frechette.[121] Since future generations will not have profited from the production of nuclear waste, it is unlikely for them to assent to the exposure of the risks involved, Shrader-Frechette states.

By deciding for underground storage, this generation is taking decisions that involve future generations. In a democracy decisions are indeed being taken that concern people, yet the

question arises whether this may also be done over future generations as well. Shrader-Frechette denies this and provides 3 reasons for this. Firstly, it is unclear whether or not a majority is in favour of underground storage (for a longer period of time), nor is it clear if that majority can accept the requirements attached to such storage. Secondly, she points out the fact that even this generation does not consent to underground storage with a majority. The third reason why this generation does not have the right to decide over the next is the unequal division of risks, which are namely stretched out over the future. According to Shrader-Frechette it is debatable whether this generation may operate as a representative of future generations.[122]

The philosopher Henk Vos states that utilitarianism "may easily lead to being negligent of the rights and well-being of the individual and even entire groups within a larger context."[123]

The American Donald Brown rejects utilitarian justifications in the environmental policy, because human interest becomes the measure for all values. As utilitarianism is aiming for the maximisation of human happiness, it often undermines the values of non-human beings such as plants and animals. Utilitarianism in environmental policy-making presupposes that values can be expressed in numbers, but expressing a tree's or health's values in numbers is often hard or impossible.

Utilitarian argumentation and calculations create ethical questions not easily answered within a utilitarian system. It concerns assumptions on the alternatives, calculating methods as well as the time scheme. So, the results partly depend on non-utilitarian assumptions.[124]

5.1. Utilitarianism: the future is less important

As we indicated, utilitarianism is an important trend in ethics. In short - although this makes it incomplete according to some ethicists - we can describe utilitarianism as follows. Utilitarianism concerns maximising the benefit by subtracting the evil from the good. Utilitarianism comprises a universal theory; so, everybody should count, including future people. However, in a study from the ethicist Hilhorst it appears that not everybody counts equally: the determination of happiness and the suffering of future people is more problematic than that of the present generation. We are not so certain about future generations as we are about ourselves. That is reason to fully stress the present and not the future: the importance of future generations weighs less in accordance with the distance between us in time.[125] This method of applying a weight factor is called discount, a term with a strongly economical background. The principle thought is that a Euro has more value now than later: its value

being annually reduced by a certain percentage. This percentage is called discount rate. This way, the value of the present is of more importance than the value of the future. In the same way, the importance of a human life now outweighs future life.

The application of a discount rate creates a central objection against a utilitarian contemplation in connection with the justification towards future generations. In 1996 the Dutch Centraal Planbureau (CPB – Dutch bureau for economic policy analysis) contemplated: Some say that the prosperity and well being of future generations should be equally considered with that of the contemporary. In that case discounting is not desirable.[126] However:" This attractive principle may be somewhat objectionable. The reason for this coincides with the fact that we do not know for certain how many generations will follow ours. The reason for the finite yet unknown life extent of the human kind is reason enough for a scanty discount by 0.01 %,", the CPB proposes.

Against that we oppose the fact that even though we don't know the number of generations that will follow ours, this cannot be an argument to give them less opportunity to decide than the present generation. Justice between generations is only possible if we let go of the emphasis on the present and refrain from discounting.[127]

We will now demonstrate a calculation with such an interest rate. It costs money to cure a person. Hilhorst shows that by applying a discount rate of 5%, curing 10 people in a hospital right now costs just as much as curing 16 people in 10 years' time.[128] Ten human beings are of equal value now as the lives of 16 people will be in 10 years.

With a discount rate of 5%, next year's victims will weigh a thousand times as much compared to the ones 200 years from now. Yet it remains unclear if the moral consequences deriving from future mishaps, such as the death of people, are reduced by a percentage of x% annually. Hilhorst comes to the conclusion that there are limits to what one can handle morally. But based on that, to discard the far future merely because it is far ahead in time isn't right.[129] [130] This is all the more reason to reject utilitarianism as a system when storage of nuclear waste is concerned.

The American researchers Paul Slovic and Howard Kunreuter summarise the drawbacks of utilitarianism concerning storage of nuclear waste as follows. The cost-benefit model pre-assumes that a citizen makes a comparison of his or her public benefits, in other words: the sum of his costs and benefits. There are two alternatives: a storage facility or not? The common cost/benefit model makes a vital presumption concerning the relative weight of the short term, versus the long term. The model uses a discount rate. This implies that the costs that may arise in the distant future (i.e. future risks) have fewer consequences for the present

net benefit. The consequence is also that these long-term consequences will hardly have an effect on the choice of the individual. Research shows that the contrary is in fact the case. Therefore, to determine the public's attitude towards nuclear waste, the cost-benefit analysis isn't suitable.[131]

6. Nuclear waste versus equality and justice

Justice is an important topic in ethics. But what is justice? It is not naturally clear. For instance, justice can mean that everyone gets according to accomplishments or needs; but in practice this gives different results. We will elaborate further on that in this paragraph, with a focus on justice between generations.

Ethics has penetrated discussions on the storage of nuclear waste. The Nuclear Energy Agency (NEA) of the OECD, the joint effort of the 25 wealthiest countries in the world, has the primal goal to propagate nuclear energy. In 1994 the NEA devoted a 2-day workshop to the ethical questions surrounding the storage of nuclear waste.[132] As a reaction to this, the NEA published a collective opinion on the ethical and environmental aspects of the disposal of nuclear waste in 1995.[133] Conspicuously enough, ethicists were not invited to join in on the discussions.

Ethics returns in the NEA reports of 1996, 1999, 2000, 2001, 2002 and 2004 on the information for the public about the storage of nuclear waste.[134] [135] [136] [137] [138] [139].

The NEA considers equality within and between generations an important ethical foundation for the storage of nuclear waste.[140] This concerns a fair division that is not elaborated upon any further. We therefore fill in this void with the help of the German ethicist Tugendhat.[141]

A point of contact for equality and justice is the so-called golden medium, Tugendhat says. We come across this in the saying:"If you would not want something to happen to you yourself, don't do it to someone else either." And in the Bible we find: "So in everything, do to others what you would have them do to you" (Matthew 7:12). The golden medium isn't just found in the New Testament, but also with Confucius, in Buddhism, Hinduism and in the Islam.[142] This rule in itself does not guarantee moral behaviour, but is related to the guarantee for minimal conditions, which make the execution of concrete actions on the long term possible.[143] The next three points are central:

1. Do not cause damage to others (also called: negative duty, the duty to refrain from certain things)
2. Help other people (positive duty) and

3. Live up to co-operation rules (e.g. not lying and keeping promises)

Tugendhat states that this golden rule is found in traditional concepts of morality, which are based upon an authority such as the belief in God. Will general morality be possible if one does not want to be based on an authority? The German philosopher Immanuel Kant has attempted to base an unconditional and absolutely valid morality on one's intellect (Vernunft). Tugendhat demonstrates such absolute morality does not exist, due to the fact that moral judgements are always related to positive or negative feelings. Next to that he adopts much of Kant's ethics.

In agreement with Kant, Tugendhat describes his idea of ethics as follows: "Act in such a manner that you always see humanity, both yourself as everyone else, as the goal and not just as an instrument. It is about the fact never to use others as a means to achieve your own goals." Or formulated differently: "Act in such a manner – to everyone- that, judging from an arbitrarily chosen person's perspective you would want everyone to act." The morality as described here is a universal and egalitarian one and considers all people to be equal. Everybody has equal rights, but this also means equal duties towards others.

Tugendhat refers in this instance to the human rights. These human rights have been put on record by the United Nations. They are about rights people have conferred upon themselves and all other people. The human rights have not been granted by "Nature" or by "God', but originate from people themselves. People give themselves rights. This means it is possible to go to court if the rights are violated. According to Tugendhat, human rights involve a minimum of justice. He considers his idea on morality plausible, meaning that he can give good reasons for it and cannot think of better reasons for a different conviction.[144]

Apart from justice, responsibility is an important theme. In the case of environmental themes, we have to do with actions of which the consequences sometimes only occur on the long term. The German ethicist Hans Jonas places the concept of responsibility in the centre of interest, with the horizon of time and space in agreement with those actions.[145] He sums up a number of principles:

1. Because of the long-term consequences, the lack of knowledge concerning those consequences ought to be reason for great reserves. A practical application of this is the prescription to take more heed of bad expectations than of the good expectations.
2. Reserves do not come about automatically. We should train ourselves by trying to imagine what may go wrong. In doing so, it is vital that the possible good or bad consequences for future generations are of influence.

These moral opinions of Tugendhat and Jonas form our starting point for further considerations on the storage of nuclear waste.

7. Justification nuclear waste: the present generation

The NEA talks about equality and justice within the present generation. As we know from the works of Shrader- Frechette, this gives rise to many questions.[146] Nuclear waste storage facilities are set up in rural areas, far away from population centres. Is it fair to submit someone to risks just because he or she happens to live in the countryside? Should the local government or the local population be allowed to impose a veto, even if research can prove that that particular place is the most suitable of the country? Or should the government be allowed to decide on the location?

The third dilemma concerns the level of protection. When are risks acceptable? The government has calculated an average chance for this. However, the average risk for the entire population does not have to mean that the individual risk is acceptable.

8. Nuclear waste and justice between the generations

The storage of nuclear waste renders a risk for future generations. As early as in 1980, Robert Spaemann gave the following analysis on this.[147] It is in the nature of human doings that they have side effects. The actions are goal-directed. Subsequently, all other consequences of those actions are degraded to side effects, means or costs. The difference between means and side effects may be found in the fact that the means are wanted, whereas the side effects that happen to come with the bargain aren't.

The side effects of human behaviour can concern people who are principally unable to co-operate with the procedures according to which a decision has been taken, because they happen to be under age or have not even been born at all.

For nuclear energy and nuclear waste it is about the problem of the irreversibility of the liberated radioactivity. In order to have nuclear energy at our disposal for perhaps the next 30 years, we create radioactive waste that continues to be dangerous for thousands of generations.

The liberation of radioactivity results in a situation that cannot be reversed by any later decision whatsoever. The next generations will have to deal with this unalterable and as such unfruitful fact during their lives. The gist of the argument is that a minority (the present generation) makes a decision the majority (future generations) will be charged for.

That is why the exploitation of nuclear power stations cannot be ethically accounted for. It is the state that is responsible to judge the long-term consequences of human actions. For that reason the state should prevent them from being in operation, Robert Spaemann says.

9. God and nuclear waste

Early 1998, the Swiss cardinal emeritus Henri Schwery gave a lecture on nuclear energy and ethics.[148] Ethics has to do with fundamental values, he stated. They are values held good with regard to humanity as a whole and should preserve the human race, just as the basic rights society has to garantee every single human being of. The Universal Declaration of Human Rights is one of the best examples.

The cardinal quoted from a statement of Pope John Paul II of 1980: “Energy is a universal good, divinity has rendered at the disposal of humanity. At the disposal of all humans, no matter in which part of the world they happen to live. Next to that, we should also consider the people of tomorrow.” The Pope was of the opinion that the efforts to spare our energy stocks and the effort to hold Nature into high esteem could be seen as a commandment of justice and love of one’s fellow men. The reason for this is that not only contemporary humanity but also future generations can profit from it. Cardinal Schwery pleaded for a just energy policy, both for now and the future. It is striking that in his argumentation the concepts of justice and human rights play an important role. Even if one does not believe in God, one is able to agree with the conclusions of Schwery nonetheless.

The Belgian Christian Hoenraet, who has worked in the nuclear sector at Synatom’s for over thirty years, tries from the same idea to establish a link to the storage of nuclear waste. “We received the divine commandment to preserve the natural wealth of the earth like a good bailiff. God has destined the earth with everything in it for the use of all human beings and peoples, in order to provide all created goods in fair distribution for all, under the protection of justice, accompanied by love. (..) Striving for the well being of present and future generations is an ethical duty of humanity,” Hoenraet states.

According to him, nuclear energy fits in with the aspiration of welfare:”The negative image of nuclear energy can mostly be contributed to a lack of objective information or a fear for the unknown or insecurity because of the large-scale character of that particular type of energy.”[149]

The question Hoenraet doesn’t answer is how come people are afraid of nuclear energy. If God has predestined everything, resistance against nuclear energy may be

explained as a sign of divine providence. So, we notice that a call for God will not help us any further.

Hoenraet also discusses the storage of nuclear waste:"The problem radioactive material constitutes is technically speaking not bigger than the problem of industrial and domestic waste. (..) The actual problem is mainly of a psychological and political nature, of public acceptance of the storage of nuclear waste. For Belgium, which uses nuclear energy on a very large scale (60% of its total electricity production), the annual electric-nuclear production gives reason for just one can of beer of lower active and one thimble of higher active waste per inhabitant. Does the managing of this limited amount of waste material weigh enough to give up nuclear energy altogether? It doesn't according to us." This is also because according to Hoenraet nuclear waste"-in contrast to what some claim- (...) can safely be stored on the long term."[150] So far for Hoenraet.

So, according to Hoenraet the 'limited amount 'of nuclear waste and its safe storage are two important arguments to continue nuclear energy. We have already discussed doubts concerning safety. Does a relative small amount make a good argument (an argument we also find in a publication of April 2004 by the Dutch Rathenau Instituut?[151] We do not think so. As a result of the incident with the nuclear power station in Chernobyl in 1986, a large part of Europe was contaminated. A calculation made on the basis of the reports of the Nuclear Energy Agency demonstrates that the mere amount of 50 kilograms of long-term dangerous material such as caesium, strontium and plutonium has been scattered.[152] Still, those 50 kilograms mean that a considerable area in Whiter Russia, Russia and Ukraine has been contaminated for a longer period of time and is uninhabitable. So, 'a small amount' can have big consequences and is no valid argument to continue the production of nuclear waste.
It has to be taken in mind that the above concern statements of catholic nature. Protestant churches, or at least those in Germany, have a negative attitude towards nuclear energy. They pose that peaceful application of nuclear energy isn't acceptable as long as there are wars. In addition to that, they are of the opinion that nuclear energy is an aim too high for mankind and that faith in nuclear energy is in fact in collision with the faith in Jesus Christ.[153]

10. Nuclear waste and moral indignation: 'troublesome' emotions

We often hear that the resistance against research concerning storage of nuclear waste is based on sensibility and emotions and is therefore wrong. However, a starting point for ethical behaviour as justification demands a well-developed emotional life.

People have a physically build-in response to danger. This constitutes the basis of our thoughts on risks. This concerns neurological and biochemical processes, which enable us to immediately judge danger and react to it (e.g. by fighting or by fleeing). The reaction to a threatening situation is quick (thus saving lives) and rough (no reaction when needed causes more victims than prematurely acting, although this reaction might have been superfluous). The impact to a threatening situation stays with us for a long time and remains inscribed in our memory. It may be typical for a human being to show a reaction, which is not only fast but also extreme, in case of a perceived risk. This is why people tend to react more vehemently to the potential dangers of new technology than to its advantages. Once the fear for a certain activity that is considered risky has manifested itself, it will not so easily leave us again.[154] Ethicist Martha Nussbaum states that emotions such as fear, jealousy, compassion and love are closely related to ethics. Yet emotions may also cause problems to act properly. They can prevent a clear judgement and cause instability in a human being.

Aristotle established a close connection between emotions and the forming of a judgement. For instance fear combines a sense of pain with the thought that bad things are at hand. The combination is not a causal one: the pain is the pain felt at the thought of the threatening danger. Changes in thought (e.g. whether or not something is dangerous), will bring about a change in the emotions. Nussbaum says emotions come with people as well as with animals, “they give information vital for survival”.[155]

Feelings are used to evaluate the emotional and ethical state of affairs. Someone wonders: “Does it feel good?” When it comes to decision-making, people tend to trust their feelings rather than their intellect. We sort of check our intellectual decision, made on the basis of factual information, with our own feelings on it. Feelings also play a role in the evaluation of risks. These feelings and emotions lead to a moral judgement. The concept of justice involves more than just a simple rational consideration, as we are able to read in several articles written by Dutch ethicists that appeared in 2001 and 2003.[156] Justice also appeals to our emotions. “A moral judgement, no matter how well developed, is in itself insufficient to act morally. The motivating force of well-cultivated emotions is needed to overcome the gap between judgement and taking action (..). An adequate practical judgement is hard to imagine without a well-developed emotional life. Moral judgement is not a solely intellectual affair. On the contrary, which factors we use in our consideration depend on the functioning of our moral sensitivity concerning the morally relevant aspects of the situation.”[157] And “emotions can play their own precious part in the process of consideration (..) moving towards a morally just conclusion”.[158]

We come to the conclusion that it is unappropriate to dismiss emotions that play a role in the discussion on nuclear waste as beside the point.

11. Nuclear waste and the greenhouse effect: the fairytale of the nuclear lobby

The present generation is exhausting a part of the raw materials and energy supplies. As a result of that, less will be left for future generations. Is that morally just? According to the prevalent opinion that is no problem, because it is thought that due to technical and medical progress the contemporary generation is better off than the previous one. As the technique doesn't rest on its place, the coming generation will be even better off than the present. Despite the reduction of the energy and raw material supplies, it is about a morally acceptable situation. The German ethicist, Christopher Lumer, questions this. He mentions the greenhouse effect and the climate change due to the use of oil and natural gas. This results in damage for the future generations. Moreover, the cause lies with the high energy consumption of the western world, while the consequence will be noteable mostly in developing countries. That's why the current level of oil and gas consumption can no longer be called morally responsible, according to Lumer.[159] Alternatives to oil and gas would make the continuation of high energy use morally acceptable. The discussion on nuclear energy and the greenhouse effect fits into the attempts to maintain the prevalent moral conception of progress.
Nuclear energy is mentioned as the solution of the greenhouse effect. In May 2003 the French junior minister for Industry, Nicole Fontaine, stated that a choice has to be made between the risks of nuclear energy and the threat of the climate change.[160] The fact that nuclear energy also results in nuclear waste is a fact. But, is nuclear energy the solution for the greenhouse effect? We supply three arguments:

1. Nuclear energy is not free of CO_2, as written by the Nuclear Energy Agency in May 1998.[161] Nuclear energy is not a solution for the greenhouse effect, either. This is because of the indirect emission of CO_2 caused by the exploitation and processing of the uranium for the nuclear power stations. This is remarked in a study by Professor Philip Smith and Jan Willem Storm van Leeuwen, which was published in September 2002. In a report that was published on the Internet, both Smith (a retired professor of the University of Groningen) and Storm van Leeuwen (a specialist in the analysis of energy) calculated how much CO_2 is indirectly released with nuclear energy.

They established that the indirect emission of CO_2 particularly depends on the exploitation and cultivation of uranium-ore. To do this machines that run on petrol are used and they emit CO_2. But also with the demolition of the nuclear power station as with the

storage of nuclear waste machines which produce CO_2 are being used. The scientists have compared the total of the direct and indirect emission of both nuclear- and gas power stations. At this moment the richer ores are being exploited with an average of 0.1% uranium; consequently a rock of 1000 kilograms contains 1 kilogram of uranium. Calculated over the expected life span of 30 years, in this situation the entire CO_2 emission of a nuclear power station will be 30 % of the emission of a gas power station.

However, there is only a limited amount of richer uranium ore: with this quantity, three times the present demand for electricity can be generated all over the world. When due to the greenhouse effect more nuclear power stations are built, we shall have to switch to ores containing less uranium in ten to fifteen years' time. In that case, more rock will have to be excavated and processed for the very same amount of uranium. This will result in a rise of CO_2 emission. At an ore percentage of 0.02%, the CO_2 emission of a nuclear power station is 60% of that of a gas power station. In this case a nuclear power station will have to produce electricity for a period of 14 years, before a CO_2 profit arises.

For the even less precious ores of 0.01%, a nuclear power station is responsible for more CO_2 emission than when the same amount of electricity would have been produced by the direct burning of fossil fuels.[162]

2. Even if we pretend that nuclear energy hardly emits CO_2, nuclear energy will not be the solution for the problem. In February 2003, Marvin Fertel of the American nuclear lobby group 'the Nuclear Power Institute' stated that –from his point of view- thousands of nuclear power stations are needed to fight the climate change effectively.[163] That is unrealistic. In 2002, the 440 nuclear power stations with 355 Gigawatt were responsible for – depending of the source – 2,9 or 6,9% of the worldwide energy production on a wordly scale.[164] In 2002 the nuclear power stations produced 2450 billion kilowatt-hours. The fight against the greenhouse effect requires a strong growth of the number of nuclear power stations, yet this number is stagnating. Between 1998 and April 2003, the number of nuclear power stations only increased by 11 on a world wide scale.[165] [166] [167] [168] [169] [170] [171] The Nuclear Energy Agency expects that during the next ten to twenty years –apart from South Korea and Japan- few or no nuclear power stations will be build in the countries of the OECD.[172] The US Department of Energy said in April 2004 that the world nuclear capacity would grow to 385 Gigawatts in 2025.[173]

Strong growth of nuclear energy bumps into the limited stock of uranium. If the prognoses of the seventies on the construction of the number of nuclear power stations had come true, the uranium would be finished in about five years'.[174] [175] [176] [177] According to a

report of the Dutch government in 2002, the proven stocks of uranium may just suffice in answering the expected worldwide demand till the year 2050.[178] Exactly because of the limited stock of uranium, the nuclear industry intended to switch to breeder reactors, but this has become a failure.[179]

3. The nuclear industry is using a neglectable CO_2 emission from nuclear energy in its calculations and so does the Nuclear Energy Agency in Paris. The NEA has pictured a scenario in which nuclear energy produces 18 times as much electric current in the year 2100, than it does now. This requires an average of approximately 60 large nuclear power stations to be taken into operation annually. But even by extending the number of nuclear power stations as planned by the nuclear industry, the CO_2 emission –which has in fact been underestimated- will only be reduced by 4% in the year 2100 in comparison to 1990.[180]

12. Conclusion

In conclusion we can say that justice implies that future generations should not beforehand be worse off than we are now. Because of the storage of nuclear waste, damage may occur in the future, while future generations will not have any profit of it. This complicates the application of the judiciary principle. Justice implies that we carry responsibility for the consequences of our actions. When talking about nuclear energy, responsibility over a period of hundreds of thousands of years is concerned. That exceeds our comprehension.

Justice could be a moral argument in the case of the storage of nuclear waste, if it had to do with the prevention of an even bigger threat to future generations, such as the greenhouse effect. However, in the previous paragraph we have demonstrated that nuclear energy is no solution to the greenhouse effect. Based on the judiciary principle, dealing with nuclear waste is a difficult matter.

APPENDIX
ETHICAL TRENDS IN A NUTSHELL

1. Introduction

The ethicist is called in for aid for all sorts of problems. But THE ethicist doesn't exist, as is shown in the following classification.

The head ingredient of the subject of ethics is normative ethics, the forming of theories on norms and values including judging which norms and values are better. There are a number of ethical theories, which we shall shortly discuss: utilitarianism, Kantian ethics, social contract theories, the theory of justice and the ethics of virtue.

Applied ethics is the second area. This concerns the application of an existing ethical theory to concrete problems, like environmental ethics.[181] [182] [183] For the subject of meta-ethics, ethics itself as a field is considered, for instance the truth of moral statements and the question of whether man is good by nature or not. [184] [185] [186] Given the theme ‘the storage of nuclear waste’, we shall limit ourselves to a short explanation of normative ethics.

2. Utilitarianism

We encounter utilitarianism as an elaborated theory when we look at the Englishman Jeremy Bentham (1748-1832). He poses that when people do something, they take account of the benefit or harm of their actions. In the first place that means benefit or harm to oneself. A person knows from experience what is beneficial or harmful. According to Bentham, what produces a good is beneficial for us, while what results in bad is harmful. Good, then, is what makes us happy and provides pleasure. Bentham supposes that an individual knows how much pain or pleasure an action will produce. He made a study of the valuation of lust and uneasy feelings and composed extensive tables. In this way he hoped that society as a whole would achieve "the greatest happiness of the greatest number". In Bentham’s theory we see the so-called calculating citizen who wonders with everything they do, how they will be able to profit most of his or her actions.

Bentham states in his research that one person’s interest can easily clash with the interest of another. Therefore, the differences in interest should be brought into balance as much as possible according to him. He considers this a task for the state, which has to look after the harmony between the various interests. In this manner “the greatest happiness of the greatest number” will be reached.

During the past centuries the theory of Bentham has come to mean: to place as many material goods as possible at the disposal of as many people as possible through the market of supply and demand. The ideological background of the present economy is concerned here.[187]

John Stuart Mill, also an important founder of this theory, asked the question, 'Is there something for which people strive on its own account?' You can ask people why they want to make so much money, but you can't ask why they want to be happy. This is because, according to Mill, happiness is intrinsically valuable. That action is morally correct, that maximises the total amount of happiness.

Utilitarianism can be found in, among other places, the cost-profit analyses made by the government, or in usefulness and need discussions about the expansion of Schiphol airport or the construction of a new rail line. The utilitarian will lay emphasis on economic yields (the measurement for the increase of happiness) versus damage to nature (deterioration of the perceived value of nature means a decline in well being, and thereby a decline in happiness). The ethicist makes a sort of cost-profit analysis.

3. Kantian ethics

The German philosopher Immanuel Kant (1724-1804) developed a second important trend in ethics. The central question is what people should do, what the highest principle of morality is. A lot of behaviour is directed by the terms 'should' or 'ought'. We have a certain wish and in order to realize that, we must follow a certain course of action. Kant called this the 'hypothetical imperative', because it tells us what to do provided that we have certain desires.[188] Moral laws on the other hand, are not dependent on certain desires according to Kant. The moral law is an objective principle, valid for everyone. It is on the basis of this principle on which people ought to act: Kant calls this the 'categorical imperative'. It can be described as follows: you should act only conform principles you would like to be adopted universally.[189] The categorical imperative is a prescription to act in such a way that is unconditional and binding for everyone at all time. Kant calls this a duty. For this reason, Kantian ethics is also called duty ethics.

In order to determine if an action is morally good, the consequences of the action aren’t concerned, but the intention; whether that intention can be applied universally. For instance, do I want a world in which everyone can damage everyone else? Then I can also be harmed, but I do not want that. Therefore, I should not want such a world, either. Do you want a world where everyone acts on the basis of economic profit? Would you want a world in

which everyone acts on the motive for economical profit? Probably not, because that would lead to an unliveable world.

Why is it morally acceptable to recycle glass bottles? My few empty bottles won't make any difference, so why should I make the effort? If I want a world in which everyone throws glass away, a garbage problem will be the result. Therefore, it is morally objectionable not to recycle glass out of laziness. So far for Kantian reasoning.

This ethical trend has been very influential because of the clarity of the reasoning, in which an individual isn't allowed to award himself any special privileges. Kant, like many more recent political theorists, derives legitimate government from the original contract between free persons. This idea of the united will of the people has normative force for Kant.[190]

On the other hand, Kant wanted to apply the rules too strictly. According to Kant you may never lie, even in the case that you could save the life of a political refugee by doing so. Rachels points out that Kant has made it unnecessarily difficult for himself. Suppose that we break a rule and by lying save the life of a refugee. In this situation we could wonder: "Would we want everyone to save the life of a political refugee, even if it involves lying?" It is obvious that we must answer this question positively. In this way we interpret our actions less stringently without losing the spirit of Kant's position.[191]

The ethicist Henk Vos[192] points out that we cannot avoid the fact that we shall have to take the consequences of our actions into account. Kant is of the opinion that a man should not act in consideration of good results but by considering his duty. The rules for justice have to compete with other rules (like those for welfare or life). Therefore, we still have to take the consequences of these rules into account when we make a decision. A strict application as Kant demands is not possible in Vos's opinion.

The American philosopher Brown points out Kant's importance for the contemporary environmental policy. The power of this Kantian approach in the case of environmental policies is that it is an acceptable ethical basis for the claim that some actions are wrong, even though we do not know the exact extent of e.g. the climate change and when it will occur. Kant would say that the government has the duty to adjust that particular human behaviour which brings in a considerable risk to both mankind and the environment with it, even though the consequences of this behaviour in hindsight might not have been so bad after all.[193]

4. Social contract ethics

The social contract ethics has been developed by the 17th century philosopher Thomas Hobbes. He claimed that people have homogeneous needs like food and clothing. There is a scarcity of material goods, which can lead to a war of everyone against all. To escape this situation, people enter into a social contract with association rules. Ethics is formed by the collection of rules that make our social behaviour easier. The rules describe how people should treat one another in order to have a mutual benefit of it. It concerns rules rational people are willing to accept, on the condition that others also follow those rules. Social contract ethics has a number of weak points. Firstly, people haven't really signed a contract. In the second place, the theory can easily be used to justify all the written and unwritten rules in a society, even if there is a lot of injustice in the society. Thirdly, Rachels shows that mentally challenged people fall out of the community to whom the social contract applies. In the fourth place, the non-human world is excluded because animals for instance cannot conclude any agreements with people.[194] But, future generations of people -we can conclude from this ethical trend- are also excluded in the contract. The future people have yet to be born and therefore cannot enter into any contract with the momentarily living people.

5. Theory of justice

No ethical vision on justice can go around John Rawls's important book, "A Theory of Justice".[195] Namely, since the first print, more than 3000 books and articles have been written on it.[196]

Suppose that people bear the responsibility for their common social, political and economical relationships. How can we develop a system that is just, then? Rawls says: "you have to pretend there is a veil of ignorance with regard to the position in which you are born". So, you do not know your race, handicap, appearance etc. As a rational person with a self-interest that is well understood, you will probably fear the worst from that position. So you would design a society with special measures for protection, so that – in case you belong to the less privileged - you won't have to suffer from it. Therefore, you would also found institutions which guarantee future generations the access to the treasures of the earth and the opportunities to exploit them. You would do this for fear of belonging to a late generation and that earlier generations have already consumed it all.[197]

Rawls calls his theory of justice "justice as fairness". Justice means that the loss of freedom for some cannot be compensated by gains for others. Justice does not allow that the

sacrifices a small number of people make are compensated by the larger sum of advantages for many. A just society means that freedom and equality for everyone is a fixed fact.

A society is well ordered when:

1. Everyone accepts and knows that the others accept the same principles of justice; and
2. The important social institutions fulfill those principles.

Rawls distinguishes two principles of justice.

According to the first principle, everyone is similarly entitled to a system of basic freedoms which is as elaborate as possible. The basic freedoms are political freedom, freedom of speech and assembly, freedom of conscience and thoughts, integrity of the person, and private property. All these freedoms fall under the first principle. The second principle applies to the division of income and prosperity. Social and economic inequality can only be justified if a system exists with equal opportunities for everyone and that inequality partially results in the advantage of the lesser priviliged of society.

The two principles are emphatically in this order. The first principle precedes the second, because limitation of the basic freedoms cannot be compensated by greater economical advantages.

The principles are universal. Everyone can understand the principles and bring them into their considerations. A principle is discarded if an internal contradiction arises when everyone acts according to that principle. The principles of justice mean that people do not see each other as means but as goals in themselves. This is a Kantian interpretation of the justice. Kant begins with the claim that moral principles are the object of rational choice. They define the moral laws a rational person will want to use as guideline for their behaviour. The moral law has to be acceptable for everyone and public. People are free and equal. These matters are also in Rawls's principles.

6. Ethics of virtue

There is an enormous revival of the ethics of virtue, the fourth important trend of ethics. Aristotle (384-322 BC) is an important figure in the virtue ethics.

Aristotle begins with the question for what the most important good for people is. If there are different -and sometimes controversial- goals there ought to be a basis on which we are able to decide how to weigh these goals up against each other. This is the highest good according to Aristotle; it is desirable for itself, not for the sake of something else.

Aristotle says he highest good is 'eudamionia', which means a good and virtuous life, doing well, being well off. In this fashion a person can develop his/her opportunities to the

fullest. Some call pleasures the highest good, but pleasure is a manner in which the good life manifests itself, not the essence.

What is a virtuous activity? It has to do with the optimal functioning where character is concerned. Here we should note that at present the word virtue is often brought into contact with religion, something it does not have for Aristotle, of course. For Aristotle the most important virtues are: wisdom, courage, sobriety and justice. In Christianity the most important virtues are: faith, hope and generosity.

Aristotle points out the importance of habituation and education in virtues. He does not consider a virtue to be a habit, however.

A virtue is a quality that continually demands effort; we have to keep working on it. A habit is responsible for predictable behaviour. A virtuous life is not a predictable one, so. In the course of time we experience for example the meaning of justified behaviour. This is accompanied by ups and downs and feelings play an important part in it. From Aristotle's point of view virtues have to do with eagerness, passion and emotions. It concerns finding a middle course in which we balance intellect and emotions. As a response to fear we can for example develop courage, without tipping the scale towards the alternative to murder everyone we find frightening.
Does knowledge of what is just also lead to just actions? "No", Aristotle says, "Because there are factors that can act as obstructions, like the lack of self-control as a result of the striving for pleasure".[198]

Dr. Martin van Hees, professor of ethics in the Philosophy Department of the University of Groningen, has an explanation for the revival of the ethics of virtue: "I often use the example of a visit of someone who is ill. Suppose that you are in hospital and your best friend comes to visit you. You thank him for his visit and he answers: "As a friend I do my moral duty". You then understand that your friend is acting under the influence of Kantian ethics and you are deeply disappointed. This makes the limitations of acting according to duty clear. The aspects that make life valuable are missing."[199] Nevertheless, the complete system of duties that Kant finally presents to us is a doctrine of virtue, says the German philosopher Manfred Kühn: what Kant "ultimately aims at is a virtue-based ethics."[200]

The philosopher Paul van Tongeren writes: "For a long time the concept of 'virtue' was nearly suspicious. It seemed a symptom of a moral idea especially associated with conventional worthiness (...) Not until our time could a true revival of the ethics of virtue be

spoken of."[201] An important book for this renaissance was MacIntyre's "After Virtue" of 1981.

The ethics of virtue is, according to van Tongeren, partly a "reaction to ethics which reduced moral to rational and obligating rules of living together. In opposition to this, in the ethics of virtue attention is asked for (...) the art of the good life. Virtue partly looks after the need that is felt in the professional ethics, where was discovered that despite codes and commissions no *good* doctors or employees of a company were created. Partly, virtue has returned to the centre of attention, because a number of philosophers have rediscovered the wealth of the traditions of the ethics of virtue in the history of ideas. Now we discover that virtue really has nothing to do with conventional worthiness, but sooner with strength, excellence, quality of life and the art of living."

Virtues are important in order to be able to lead a better life, and to get on with others. Rachels shows that all people at all times need certain virtues, such as truthfulness, generosity, and friendship. In this sense the ethics of virtue is timeless.[202]

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In comparison: the damage of the Chernobyl incident in 1986 amounts to at least 300 billion dollar; an incident with a new-to-build nuclear power station in the Netherlands, in which one tenth of the radioactive materials would be released of those drained in the Chernobyl incident, would result in a damage of 17 to 39 billion guilders, according to the Dutch government. We may conclude from this that the greater part of the damage will not be covered.

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