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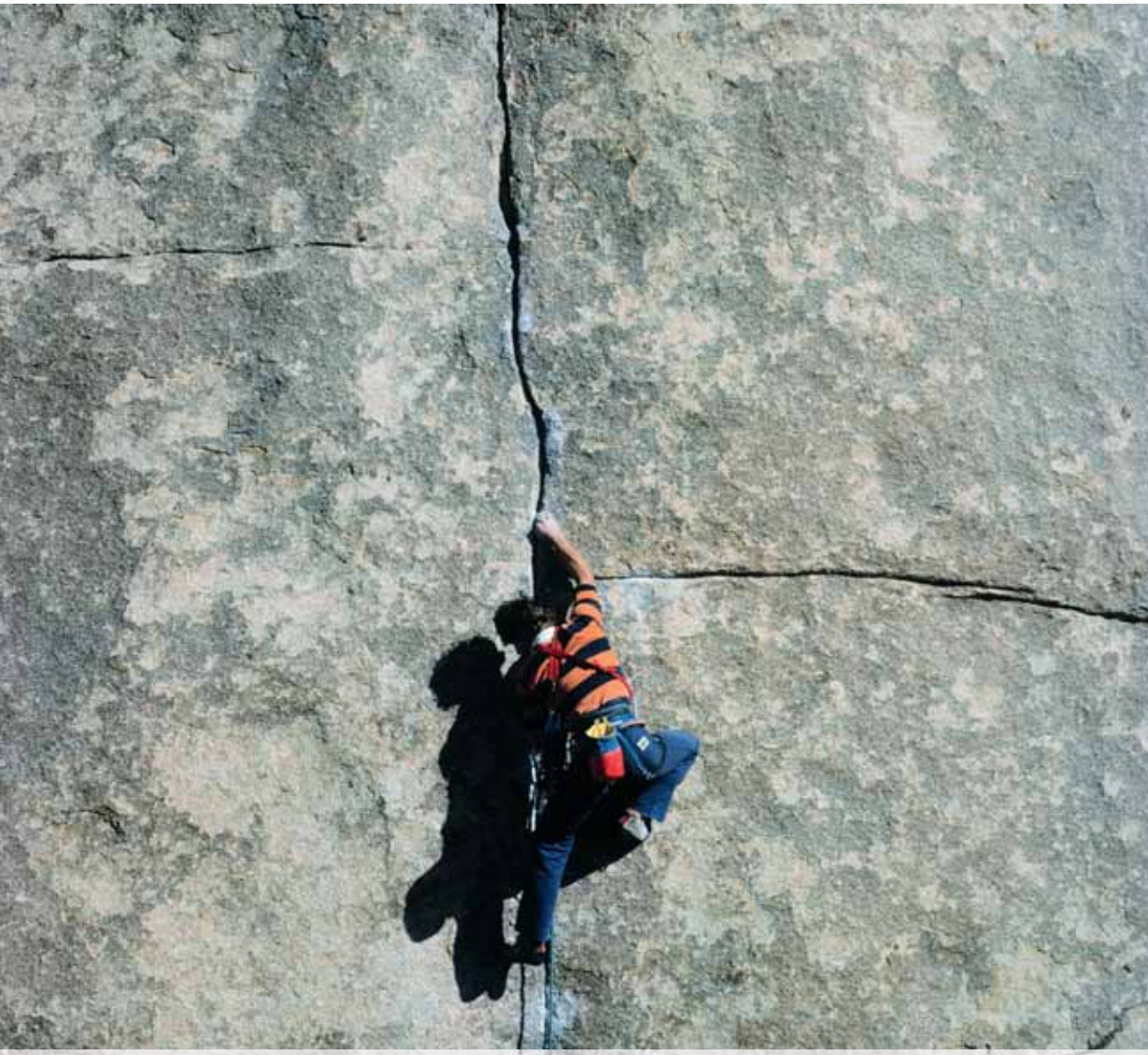

Risk perspective on final disposal of nuclear waste – individual, society and communication

An in-depth report supplementing KASAM's Nuclear Waste State-of-the-Art Report 2007 (SOU 2007:38)

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Swedish National Council for Nuclear Waste (KASAM) M 1992:A

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Preface

The Swedish National Council for Nuclear Waste (KASAM) has deemed it appropriate to treat the risk perspective in an in-depth report supplementing KASAM's Nuclear Waste State-of-the-Art Report 2007 (SOU 2007:38). The report is therefore entitled *Risk perspective on final disposal of nuclear waste – individual, society and communication*.

This in-depth report contains contributions from individuals active within KASAM. The report was prepared by a working group in which Inga-Britt Lindblad, KASAM, served as coordinator. The other persons associated with KASAM who also participated are Kjell Andersson (consultant), Yvonne Brandberg (member) and Sören Mattson (member).

KASAM has not issued a detailed judgement of the contents of the individual contributions, but finds on the whole that it provides a complex and fascinating picture of the complex of problems surrounding the nuclear waste.

Stockholm, May 2007

Kristina Glimelius
Chairperson

Contents

1 Introduction

The idea of this report is to put the spotlight on the importance of the risk perspective in relation to a final repository for nuclear waste. The term "risk" may have different meanings for experts and laymen, in different research fields and among different actors in the nuclear waste area. The purpose of this report is to provide a scientific perspective on the concept of risk. The authors have backgrounds in different disciplines: radiation physics, psychology, media and communications, and safety assessment. The report treats four different themes. The first theme concerns different *perspectives on the concept of risk* and describes different principles for how risks can be managed in society.

The second theme in the report has to do with *comparing different risks*. The section on risk comparisons shows that such comparisons can be made within a scientific framework and under certain given conditions.

The third theme examines results from research on *subjective risk perception,* which shows that a large number of factors affect how risks are perceived by an individual, which can influence the individual's risk-taking behaviour as well as how the individual thinks society should make decisions in risk-related questions.

The fourth and last theme has to do with *risk communication*. Because there are so many different aspects to be taken into account in the concept of risk, good communication, not just mere information, is vital. If a purely mathematical definition of risk were the only valid one, information provided by experts to citizens on risk assessments might be sufficient. But since there are other relevant factors to take into account (such as the individual's own values), information must be supplanted by communication, in other words the citizens must have a say in how risks are compared and managed.

In conclusion, the authors have chosen to reflect on these four themes, i.e. different perspectives on the concept of risk, risk comparisons, subjective risk perception and risk communication.

2 Some perspectives on the risk concept

Kjell Andersson

Risk can be defined in many different ways. There is a scientific definition of the concept, but there is also a subjective perspective – we speak of "subjective risk perception" that has to do with how we as individuals perceive risk and what factors lie behind what risks we perceive as the greatest. A third perspective has to do with values, which are more firmly anchored in the individual than emotions. A functional means of managing risk should therefore include such values. In this section we look at how the concept of risk has developed from being solely a matter for experts to also including values. We also address the question of how risk management can be done in a transparent manner in society, and we examine the problems associated with the practical application of the precautionary principle. Finally, we discuss in brief how risk management works in the Swedish nuclear waste management programme.

2.1 Development of the concept of risk

Our view of risk has gradually evolved from being purely scientific to also including values. Studies of risk perception have been accorded considerable importance in society, and risk communication has increasingly become an established activity. This trend is, for example, evident in a report series published by the U.S. National Academy of Sciences.

In 1983, the U.S. National Academy of Sciences/ National Research Council (NRC) published *the Red Book*, which described the relationship between science and political decision-making. The report made a distinction between risk assessment and risk management. Research provides data which are used for risk assessments, which in turn provide data for use in risk management. It can be said that this laid a foundation for what later has been called

risk-informed decision-making. The report also discussed the role of uncertainties and the potential problem of subjectivity in risk assessments.

The 1989 report *Improving Risk Communication* emphasized the necessity of a dialogue on risk issues between the government and the public. The report noted that discussions of risk issues are usually not concerned with facts but with values, and that dialogue does not always lead to consensus, since increased knowledge and understanding can also underpin and reinforce existing standpoints. The 1996 report *Understanding Risk – Informing Decisions in a Democratic Society* devoted limited attention to traditional risk assessment, the focus instead being on the decision process in risk-related matters. Values should be taken into account early in the process by an active dialogue with concerned citizens and their organizations.

These three reports illustrate a progressive development of how risk management is viewed from being an expert controlled activity to recognizing the importance of values, and finally to accepting the consequences of this by including citizens in an early phase of the decision process. The insight that risk is a multifaceted concept and that values must be included at an early stage in the process is now well established. In 2003, representatives of a number of organizations and interest groups in the nuclear waste arena made a statement: risk management should not only take into account the opinions of different interest groups, but also give them resources for arriving at their own opinions[1]. It can also be noted that decisions not only have to do with risks per se; the risks must be weighed against the benefits offered, for example energy and jobs. This line of reasoning raises the question of how decisions are made, or ought to be made, in risk-related matters. The question is how values are clarified in society's decision processes.

[1] An agreement was reached on the following definition of the concept of risk at a meeting that took place within the framework of the EU project RISCOM II:
"Although there are established methods of assessing risk by the nuclear industry and regulators, risk is a complex mixture of values and perceptions incapable of reduction to a simple mathematical formula, perceived differently from individual to individual. Both society and the communities affected must be empowered to develop their own understanding of risk and be encouraged to accept, reject or negotiate developments accordingly, taking into consideration issues such as the social and economic benefits or costs that such developments may bring."

2.2 Principles of risk management

There are different ways of approaching the decision process in risk-related matters. If consequences and probabilities are well known, a value of the risk can be calculated by adding the products of probability and consequence for all conceivable outcomes of the activity being considered. Different risks can then be compared so that measures can be taken to reduce the greatest risks. This is the scientific method, and risk management decisions that are based on this method are generally made by the expert community. In nuclear power contexts the concept of *risk-based decision-making* was introduced in connection with the introduction of probabilistic risk assessment (PRA) in the 1970s. The intention was that the results of PRA should govern the safety work. The event chains that were calculated to give the greatest risks were to be dealt with first. In time, *risk-informed decision-making* took over as the new concept. This suggested greater humility in the face of the difficulties of making the probabilistic risk assessments complete. Instead of the decisions being based on PRA, the results of PRA were to be *one of several information sources*.

In many cases, risk-informed decision-making is the most logical and effective way of managing risks. There are always uncertainties regarding both consequence and probability associated with risk calculations, but if they can be quantified this is not a problem, since they can then be included in the calculations. In other words, the uncertainties are included in the calculated risk.

However, it is not unusual for the uncertainties to be so great that a quantitative risk calculation is not possible. There may nonetheless be suspicions that a given measure or activity could pose a risk without there being any hard evidence that this is the case. In such cases, *the precautionary principle* says that the lack of evidence should not be taken as a reason for postponing preventing measures, particularly if the potential risk is serious. The precautionary principle was originally expressed as follows in the Rio Declaration:

"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The precautionary principle is not problem-free either when it is to be applied – judgements and values enter into the equation. For example, what is to be regarded as serious damage is not always self-evident, but a matter of judgement. And in order for there to be a suspicion or a threat of damage, there must be some indication based on experience or investigation. This is where the discussion often arises: how strong must the indication be in order for the precautionary principle to become applicable? On the other hand, if the indication is strong enough, the situation may rapidly be approaching the point where enough is known to make a risk calculation, in which case the precautionary principle is not needed.

The decision process regarding the precautionary principle is interesting: the existence of the principle stems from a political decision, but its application is usually the responsibility of expert authorities, whose job it is to interpret what the politicians intended. Some say that the politicians must assume greater responsibility. In a communication from 2000, the European Commission says that the politicians must decide what risks are acceptable, with awareness of the uncertainties[2].

Another procedure for arriving at decisions in society is that the citizens prepare the decisions by means of dialogue and participation, or even make decisions by consensus. There are political, ideological and ethical arguments in favour of a high degree of citizen participation in the decision process. This is called *deliberative democracy,* which entails the active participation of the citizens. A concept related to the deliberative method on the European arena is "Risk Governance". There are a number of ways to define risk governance. In its *White Paper on European Governance*, the European commission has formulated five principles for good governance: 1) openness, 2) participation, 3) accountability, 4) effectiveness and 5) coherence.

The Geneva-based International Risk Governance Council (IRGC) defines risk governance as the entire process where relevant risk information is collected, analyzed and communicated and where management decisions are ultimately taken. The EU project STARC, which was concerned with risk communication, used the concept of risk governance throughout its report to

[2] *Decision-makers need to be aware of the degree of uncertainty attached to the results of the evaluation of the available scientific information. Judging what is an "acceptable" level of risk for society is an eminently* ***political*** *responsibility. Decision-makers faced with an unacceptable risk, scientific uncertainty and public concerns have a duty to find answers. Therefore, all these factors have to be taken into consideration (*European Commission, COM(2000), p. 3).

designate an approach where the emphasis is on public and stakeholder participation in the decision process. This also seems to be the generally accepted interpretation, at least within the European Commission. Risk governance thus occurs frequently in the work programmes for the EU's framework programme for research – for example, there are now three projects in the nuclear waste field collected under the heading of risk governance.

This trend in the EU reflects a broadened view of what risk is and how risk-related decisions are made. Social values are included, and different groups in society are given a voice in the decision process in risk matters. In other words, it is no longer a question of a purely technical-scientific approach to how risks are to be managed and communicated.

Expert analyses, the precautionary principle and citizen participation are thus all parts of a coherent system of risk management. Ultimately, many risk-related matters, not least the establishment of nuclear facilities, are nevertheless decided by political decisions, which should be made with the greatest possible transparency. This involves exposing both the experts' analyses (including their underlying premises, uncertainties etc.) and values. Only then can the politicians make decisions on good grounds, and only then do the citizens have the insight needed for democratic control.

2.3 Risk management in the Swedish nuclear waste programme

Of the three methods mentioned here for managing risk (risk-informed decision-making, the precautionary principle and citizen participation), the first has been brought to the foreground in the Swedish nuclear waste issue due to the fact that the Swedish Radiation Protection Authority (SSI) has a risk criterion as the central element in its regulations for final disposal. The precautionary principle has thereby ended up more in the background. It is, however, one of the Environmental Code's general rules of consideration which naturally applies also to the management of nuclear waste. There is therefore a need for a more thorough discussion of how it should be applied than has so far been the case.

Elements of participation occur by the Environmental Impact Assessment (EIA) consultations which SKB is responsible for. Another element of participation was when SSI, in its work with guidelines, solicited and to some extent obtained viewpoints, particularly from the municipalities that were actively involved in the nuclear waste issue by virtue of being the objects of SKB's site investigations. The actual impact of these contacts on SSI's guidelines appears to be of limited scope, however. The studies of public attitudes to the siting of a final repository in particular, that SKB regularly conducts could also be mentioned in this context.

When it comes to the value-related aspects of risk management, the impression is that while SSI mentions these components in its regulations, for example human intrusion into a final repository and possibilities to retrieve the waste, they give SKB preferential right of interpretation in these particular matters. It is a matter of balance for the regulatory authorities not taking over the responsebility that is SKB's to find a solution for final disposal, while at the same time providing guidelines to SKB that are clear and in harmony with society's values. SKB is obligated to interpret the regulations and show that the requirements are satisfied, but it is ultimately up to the regulatory authorities to determine whether this is the case.

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3 Risk comparisons

Sören Mattsson

Risk is a word with many meanings. Risk in everyday terms is the probability of something undesirable happening, something threatening, a hazard that can afflict us – a diffuse concept that we seldom try to measure. Sometimes risk means the probability of harmful events multiplied by their average consequence (harm, injury, loss). Nothing in life is risk-free, but we fear certain risks more than others. There are many studies of how we perceive risk. It is well known that we underestimate big risks, such as the risk of dying due to smoking. We exaggerate small risks, such as the risk of being hit by lightning (Swedish Society For Risk Sciences, 1991).

It is usually difficult to put a quantitative measure on risks. One measure that has been mentioned above is the probability that an unpleasant event will occur. Another measure is the harm or loss caused if the unpleasant event occurs. This harm or loss may take different forms: disease, death, a degraded environment, degraded living conditions, economic loss, etc. The harm or loss may afflict the individual, or it may afflict the whole society or even be of a global nature.

The questions about radioactivity and radiation that are expressed by people in municipalities that are candidates for waste repositories often have to do with the size of the acceptable risk and what effects additional radiation doses may have in the long run. They also ask for comparison material so that they can form their own picture of the risk of disease or injury.

Because quantifying risk is so uncertain, a publication from the International Commission on Radiological Protection (ICRP) (ICRP 1966, Lindell 1998) proposed only talking about different degrees of the risk of dying in general terms. An annual probability of death of between 0.1 and 1 could be called a risk of the 1st degree, between 0.01 and 0.1 a risk of the 2nd degree, etc. With this

terminology, the annual risk of dying during childhood and adolescence is of the 4th degree, rising to a risk of the 2nd degree by retirement age. The *average* everyday annual risks of dying due to falling, fire and electric shock are of the 4th, 5th and 6th degree, respectively.

The average annual risks of dying after being stung by a wasp or struck by lightning are of the 7th degree. Se Table 3.1.

Radiation risks, as well as risks due to carcinogenic chemical substances, differ from many other risks in that exposure does not cause immediate death (with the exception of acute effects at very high radiation doses). The effect is delayed until far in the future. An annual risk therefore does not mean the same thing as in the case of other risks, but constitutes an annual contribution to an accumulated risk that is manifested some time in the future. With that reservation, degrees of risk from exposure to ionizing radiation can be specified if we assume proportionality between radiation dose and the probability of death from radiation.

Single risk sources that do not increase our total annual risk by more than one percent are not considered to affect our risk situation significantly. This means that annual extra radiation risks of the 5th–7th degree should not give cause for concern, but that an individual should not be exposed to doses near the dose limit for radiation workers year after year without very good reasons.

Risks of the 8th or higher degree are so low that they cannot be realistically estimated. They would lead to less than one death per year in Sweden. The annual cumulative risk of tobacco smoking is of the 6th degree for each cigarette smoked and therefore of the 3rd degree for someone who smokes one pack of cigarettes per day. The lifetime risk for the smoker of dying prematurely is of the 1st degree, which is a very high risk.

Table 3.1 Degrees of annual risk plus lifetime risk

Probability of dying	Degree of risk	Calculated per year		During a lifetime
0.1-1 (10-100 %)	1			Smoking one pack of cigarettes per day
0.01-0.1 (1-10 %)	2			Maximum permissible exposure of persons who work with radiation. Living in a "radon house" with 400 Bq/m^3 air
0.001-0.01 (0.1-1 %)	3		Smoking one pack of cigarettes per day	Natural background radiation. Eating 70 μg acrylamide per day
0.0001-0.001 (0.01-0.1 %)	4	Falling	Maximum permissible exposure of persons who work with radiation. Living in a "radon house" with 400 Bq/m^3 air	Maximum permissible exposure of persons near a repository for high-level waste. Swede's average dose contribution from Chernobyl accident. Diet at EU limit value for aflatoxins (0.2 μg/kg body weight) and most carcinogenic substances in food for which limit values exist.
0.00001-0.0001 (0.001-0.1 %)	5	Fire	Natural background radiation	
0.000001-0.00001 (0.0001-0.001 %)	6	Electric shock	Maximum permissible exposure of persons near a repository for high-level waste	
0.0000001-0.000001 (0.00001-0.0001 %)	7	Wasp sting, lightning		

It is difficult to estimate the risk from low doses of radiation. The risk contribution from such radiation is not distinguishable from normal levels of the effect being studied (e.g. a certain type of cancer). Despite this, efforts have been made since the 1950s to estimate risks from radiation through systematic studies. This has been done under the auspices of a number of research groups and national bodies as well as internationally by UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) and the ICRP and is based on experience from studies of survivors of the nuclear bomb detonations over Hiroshima and Nagasaki towards the end of the Second World War and from studies of the medical use of radiation for treatment and diagnostics in health-care.

According to today's best estimates (ICRP), the risk of dying of cancer after exposure to ionizing radiation is 5 % per Sv for instantaneous radiation doses and 2-3 times lower for protracted (chronic) exposures. These risk estimates are mean values for men and women of different ages and all types of cancer. There is great uncertainty in the estimates.

An important question is how much the radiation exposure increases the individual's risk of dying of cancer during his lifetime. As mentioned above, as many as 20 % of us die of cancer. However, we cannot know in advance which ones of us will die because of radiation. If, for example, 10,000 people are exposed to an average of 10 mSv, we can expect 5 extra deaths. This means that instead of 2,000 deaths due to cancer we may get 2005. Everyone realizes that this increment is not noticeable against the background of natural statistical fluctuations. It is also important to point out that we do not know whether 5 persons will die, but that there is a risk of 5 extra deaths among 10,000 people if everyone has received 10 mSv. Nor can we say which 5 will die as a direct result of receiving an extra 10 mSv.

3.1 Risk for individual versus society – individual and source-related assessments

It is natural to start protecting individuals exposed to a high occupational risk. Here society has for many years worked with limit values to keep the level of radiation dose low. Personnel who work with radiation are therefore exposed to a low risk today

compared with persons active in agriculture and forestry, industry, construction and transport.

With more and more pollution sources, many of which are global, it is no longer sufficient to make sure that one individual's risk increase from a single pollution source is negligible in comparison with the risk without this source, e.g. radiation. We need a total measure of the risk for the population. Let us consider the risk of dying in traffic accidents. We do not consider the risk particularly great when we take the car to work, but society must of course spend money to reduce the number of traffic deaths per year below today's Swedish level of 400-500 persons. In addition to individual-related dose limits for radiation, we therefore also need source-related limits. This has long been done in radiation protection by the calculation of a collective dose. The existence of both individual-related and source/society-related limits is not always easy to explain to people. Many people find it hard to understand why regulatory authorities say that an individual annual dose increment of 0.01 mSv is negligible from the individual's standpoint (in comparison with the natural background radiation from outer space, the soil and our buildings and the potassium in our body totalling 1 mSv/y), while at the same time requiring of the owner of a waste repository that the dose increment to a representative nearby resident may not exceed 0.01 mSv/y. The reason the limit is not set higher is that the regulatory authorities want to allow such a large margin for radiation contributions from future radiation sources that they can be certain that the dose from all sources will be well below 1 mSv per year. They have therefore chosen to allocate only 1 % of what they consider to be the highest permissible total value to a waste repository.

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4 Risk perception

Yvonne Brandberg

4.1 Factors of importance for risk perception

By "subjective risk perception" is meant how an individual perceives, evaluates and judges the probability of different exposures and their consequences. How the individual perceives information on risk is influenced by factors such as gender, age, personality profile, past experience and ideological orientation (Breakwell, 2000). Cognitive bias or "unrealistic optimism" (tending to judge one's own risk as lower than that of others) is also of importance. Other factors of importance for subjective risk perception are attitudes and societal values.

There are several models that try to explain subjective risk perception. The two most common ones are the "Psychometric Model" (Fischhoff et al., 1978) and the "Cultural Theory" (Douglas & Wildavsky, 1982). The Psychometric Model is based on a number of parameters that are believed to explain why risks are accepted. The Cultural Theory explains risk perception using a "world view" concept. People choose which risks to worry about based on values that are important to them and the group to which they belong. Both models have been criticized (Sjöberg, 2000; 2002). Sjöberg and Drottz-Sjöberg (1994) have shown that subjective risk perception can be explained by a model where attitudes, risk sensitivity and specific fear are explanatory concepts.

Gender

There is ample evidence of differences between women and men when it comes to risk-taking. Men are more inclined than women to take risks (Irga & Irwin, 1995). Women are more interested in

health and health related issues than men (Green & Pope, 1999), which means that they are more inclined to prevent risks. Several studies also show that men and women perceive risks differently (Gustafsson, 1998). Women worry about risks more than men. One study showed that gender differences were most pronounced where the risks were theoretical, but disappeared in areas where there were more concrete threats to deal with (Greenberg & Schneider, 1995). There are several explanations for the observed gender differences relating to risk behaviour and risk perception. One of these is that the difference is primarily biological and important for the survival of the species, while others claim that the differences are mainly cultural and social.

As far as nuclear waste is concerned, an American study showed that women to a greater extent than men were opponents of transporting nuclear waste through a community. (McBeth & Oakes, 1996).

Age

Teenagers and young adults are more inclined to take risks than adults (Steinberg, 2004). The reason can be considered to be biological and is a combination of young people's sensation seeking and novelty seeking and their lack of self-regulatory competence, which does not fully mature until adulthood. Age was also of importance in the American study cited above (McBeth & Oakes, 1996).

Parenthood

In studies of people's reactions after Chernobyl, Sjöberg et al. (1998) found that parents with newborn children had stronger reactions than others. The risks for children are often judged by their parents to be higher than the risks for the parents themselves. An example is bicycle helmets, which Swedish law requires children under the age of 15 to wear when bicycling, while adults can choose to bicycle without a helmet. Parenthood can also reinforce a sense of personal vulnerability, so that risks that were previously perceived as small are judged to be considerable.

Individual factors

A number of individual factors also influence subjective risk perception.

Worry: In everyday language there is no significant difference between worry and subjective risk perception. Sjöberg (1998) analyzed the difference between the concepts and found that the correlation between worry and risk perception was weak. However, the author pointed out that more research is needed to define the concept of worry. Previously, affect (emotional factors) was believed to play an important role in risk perception. On closer scrutiny of the questions on which these studies were based, Sjöberg found (2006) that most of the questions were related to consequences of risk exposure, while only one had to do with emotional reactions.

Attitudes: Risk perception seems to be affected by attitudes, rather than the other way around as was previously believed (Sjöberg, 2000). The fact that attitudes proved to be of such great importance for risk perception suggests that ideology, for example political affiliation and environmental engagement, are of great importance. People who are in favour of nuclear power tend to play down the risks compared with those who are against it (Sjöberg & Drottz-Sjöberg, 1994).

Knowledge: There is much evidence to suggest that knowledge of a phenomenon has very little effect on risk perception. Many risks that are discussed are abstract, and the individual has no personal experience of the consequences. They have no direct impact on our emotional systems. An example is smoking. Virtually everyone is aware of the dangers of smoking. Nevertheless, new smokers are recruited daily, and many people continue to smoke despite repeated information on the risks. Personal experience of smoking is often associated with feelings of tranquillity and pleasure, and this outweighs the hypothetical, but very great, risk of getting sick or dying as a consequence of smoking. When it comes to nuclear waste, greater knowledge can affect subjective risk perception in two directions. On the one hand, greater knowledge of technology and safety matters can provide security in the knowledge of how the waste is managed and the rigorous work being devoted to the

plans for a final repository. On the other hand, greater knowledge is also obtained of possible deficiencies in the planning, which could lead to the risks being perceived as greater than before the person had this knowledge.

Risk sensitivity: Studies have shown that there is a strong correlation between an individual's perceptions of different risks, i.e. if one risk is judged to be high, there is a tendency to judge other risks as high as well (Sjöberg, 2000). One of the explanations may be that subjective risk perception is a psychological disposition.

Specific fear: Each risk has its own specific consequences, for example fear of flying may elicit fear of heights, while a fear of nuclear power waste may elicit a fear of cancer. How the individual perceives and judges these risks has to do with each individual's personal history. Different people react differently to the consequences. If you have a relative who died of cancer, you may have a great fear of cancer, while you may not worry much about skating on thin ice. Conversely, someone who has fallen through the ice will have a greater fear of thin ice than of cancer. Ionizing radiation has long been associated with cancer, both as a cause and as a treatment method. Radiation is a hazard which man cannot perceive with his senses. This may cause it to be perceived as particularly hazardous; you cannot know when you are being exposed to ionizing radiation. Cancer is something that most people associate with suffering and death and that many people fear. Individuals who have a great fear of cancer may therefore exaggerate the risks of nuclear power and nuclear waste.

New Age beliefs: A Swedish study showed that people with "New Age" beliefs, including traditional folk superstition and beliefs in paranormal phenomena, perceived the risks of nuclear power as greater than those who did not share these beliefs (Sjöberg & af Wåhlberg, 2002). The strongest correlations were found between risk perception on the one hand and "Higher Consciousness Beliefs" and beliefs in paranormal phenomena on the other. Concern about affecting "Nature" and the perception that nuclear power is risky are also related.

Societal values

A common perception among decision-makers is that risk perception is a question of trust and confidence in the decision-makers (Sjöberg, 2001). However, research results indicate that trust and confidence have very little correlation with risk perception. The most important factor is instead a lack of faith in the knowledge base of scientists and decision-makers, i.e. that answers to important safety questions really exist. However, revelations (in early 2007) about how safety has been undermined at the Forsmark nuclear power plant in recent years have probably also affected the population's confidence in the industry and the supervisory authorities, which can in turn affect their confidence in the decision-makers. Although exactly how the public's risk perception has been affected by these revelations cannot be judged, it is probably dependent on how government authorities and decision-makers handle the situation.

Optimistic bias

How a person judges his individual risk might be affected by a general psychological tendency called "optimism bias" or "unrealistic optimism" (Kos & Clarke, 2001; Weinstein et al., 1987). Unrealistic optimism means that people have a tendency to judge their own risk of being harmed by an exposure to a potential hazard as lower than the risk for other people. An example is that several studies show that people rate their own risk of being harmed by smoking, sunbathing, unprotected sex or alcohol as lower than the risk for others. This phenomenon mainly applies to risks which are under the control of the individual. There are several explanations for this phenomenon. 1) selective attention, which means that people are more receptive to messages that agree with what they want, 2) threat denial, which is a psychological defence mechanism for alleviating anxiety, 3) believing that others are more vulnerable raises self-esteem, 4) people tend to draw conclusions based on previous experience, for example "I have always sunbathed and got tanned and I have never had melanoma". Unrealistic optimism was shown by one study to be greatest for diseases that are preventable, less well known, embarrassing or

unusual (Weinstein et al., 1987). Unrealistic optimism is greatest during youth, after which it declines with age (Cohn et al., 1995).

4.2 Risk perception and nuclear waste

A Swedish population-based study conducted in municipalities where site investigations were being conducted showed that political attitudes appear to be important for how risk was perceived (Sjöberg, 2004). People who had a political point of view that agreed with pro-nuclear power policies perceived the risks of nuclear power as lower than those who professed an anti-nuclear point of view. Another important factor for risk perception according to this study was the extent to which the individuals believed that nature was affected.

Members of action groups for or against a nuclear waste repository were identified in a Swedish study by a questionnaire concerning activity related to the siting of a repository for nuclear waste (Sjöberg, 2003). The study was conducted in the four municipalities then being considered as potential host municipalities. A total of about 2,500 persons responded (44 %), equally distributed in the municipalities. Each person's activity level in relation to the nuclear waste issue was measured by means of 20 questions. The "activists" had a higher level of education than others, but no differences were found in other demographic variables. They generally did not perceive risks as being higher than non-activists, but were very interested and involved in the nuclear waste issue. Their activity level correlated with risk perception and attitudes in this issue, but with different signs for those who were for as compared to those who were against a nuclear waste repository in their municipality. Opponents also expressed more extreme opinions about the project than the activists who supported the project.

In summary, individual risk perception is a complex concept that can be partially explained by individual factors, but where attitudes and societal values also play a large role.

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5 Communication of the risks of nuclear technology

Inga-Britt Lindblad

Communication concerning final disposal of nuclear waste is and will continue to be a challenge. This applies to many different actors, both experts in the nuclear power industry and mass media, environmental organizations, public authorities, researchers and citizens. The topic is of central importance in research traditions such as risk communication and mass media research. The purpose of this text is to discuss some perspectives and shed light on the complexity of the communication and information processes concerned with the nuclear waste issue. The search for solutions for a final repository for nuclear waste touches upon all fields of knowledge: engineering, the natural sciences, the social sciences and the humanities. Future nuclear waste disposal involves to a great extent finding technical solutions and showing that they can satisfy stipulated safety requirements. Finding a suitable site for the repository with the acceptance of the local inhabitants also involves disciplines in a number of the social and natural sciences. Humanistic fields can also contribute knowledge in e.g. ethical issues concerned with possible risks in the form of future human impact. The communicative challenge is thus multidisciplinary.[1]

Nuclear waste disposal is a controversial public opinion issue involving values, which means that the mass media play an essential role, not least in the question of where the final repository will be located. The scope of the media coverage is revealed by an analysis of the Swedish mass media nuclear waste discourse[2] the first four years after site investigations were begun in two Swedish municipalities in the early 1990s.[3] During the period from December 2001 to the end of 2005, Egan Sjölander found over

[1] Strandberg,Urban. 2005 I: Andrén & Strandberg (eds.). Kärnavfallets politiska utmaningar. Gidlunds förlag.
[2] By "mass media nuclear waste discourse" is meant here the way nuclear waste is discussed in the mass media.
[3] Egan Sjölander, Annika. 2007. Som natt och dag...(in press, May 2007).

1,100 newspaper articles and 77 news broadcasts about nuclear waste in 14 different media. The handling of the Swedish public debate on the long-lived radioactive waste between 1950 and 2002 is described in a book by Anshelm.[4] Both projects are a part of SKB's social science research programme. Egan Sjölander's study covers the first site investigation phase from 2002 to 2006. She discusses the democratic role of the media in complex decision processes of this type based on empirical examples, and one conclusion is:

> The media are particularly important when it comes to our understanding of abstract phenomena such as radioactivity, or phenomena which we as individuals have little experience of, such as nuclear waste management.[5]

5.1 Risk communication

Plans for final disposal of nuclear waste from Swedish nuclear power plants may be perceived by the public as either a high-risk project or a future safe final disposal scheme. A number of studies have shown significant gender differences in attitudes toward a final repository, where men are more positive than women.[6] There are several explanations for the view of final disposal as a high-risk project, and despite dissimilarities they can interact with each other. One explanation may be conceivable risk scenarios, such as those put forward by the Swedish environmental movement. Another possible underlying interpretation may be that our awareness of the fact that we live in a "risk society" has increased with time. This is to some extent due to the fact that media reports on crises and risks in numerous areas are often given big headlines. They have high news value. Many experts in risk communication also say that an increased technologization of western society is a

[4] Anshelm, Jonas. 2006. Bergsäkert eller våghalsigt? Frågan om kärnfallets hantering i det offentliga samtalet i Sverige 1950-2002. Arkiv.
[5] Sjölander, A. 2004. Kärnproblem. Opinionsbildning i kärnavfallsdiskurser i Malå. Medier och kommunikation no. 7.
[6] Sjöberg L. 2006. Attityderna till slutförvar. Vad förklarar dem? In: Samhällsforskning 2006. Betydelsen för människorna, hembygden och regionen av ett slutförvar för använt kärnbränsle. SKB.

driving force behind the risk dimensions of our time.[7] In his standard work[8] *Risk Society*, for example, German sociologist Ulrich Beck points out that we have become increasingly dependent on technology and thereby also on expert knowledge and the mass media to warn us of risks.

Just as the problem of a degraded safety culture at the Forsmark nuclear power plant was publicized in the media[9] during 2006–2007, other aspects of the nuclear waste issue can be quickly brought to public attention by the media. The media spread the news of deficiencies that had been discovered in the nuclear power plant's safety systems. The reporting of these incidents may have some impact on public opinion in the nuclear waste issue. Again, in the summer of 2006, the media reported extensively on an electrical fault in a switchgear in Forsmark. On both of these occasions the reactors were shut down, with media coverage by the press, radio and TV. Last summer's statement in the media by a styled nuclear power expert in the industry led to a number of interpretations that can complicate the communication, largely due to the fact that he used the highly charged taboo word "meltdown", a term which quickly appeared in headlines and probably triggered memories from the Chernobyl disaster among the public. Annual nationwide opinion polls will show whether public confidence in nuclear power has been altered by these incidents.[10]

In the risk communication research that studies what happens in connection with serious incidents or crises in the nuclear power area, several different actors are studied: the nuclear power industry and other experts including scientists, public authorities, media and private citizens.[11] Research has shown that several communication problems can arise in contacts and interactions between these actors.[12] The borderline between industry and science is blurred, since industry largely organizes the expertise on this topic.[13] The problem has been the subject of risk

[7] Much of the research in the field of risk and crisis communication was initiated by the National Board of Psychological Defence in connection with the environmental failure in the Hallandsåsen tunnel and the nuclear power disaster in Chernobyl.
[8] Ulrich Beck 1986 Risk Society. Towards a New Modernity. London.
[9] For example by the TV programme "Uppdrag granskning" in January 2007, and the subsequent media debate.
[10] The SOM Institute's annual surveys include a question about trust in nuclear power.
[11] An example is the research following the Chernobyl accident.
[12] See the National Board of Psychological Defence's report series, as well as other Chernobyl research: Findahl & Lindblad, 1987; Höijer, 1987.
[13] Sundqvist, Göran. 2005:8. In: Expertisens gränser och samhälleliga utbredning. Exemplet slutförvaring av kärnavfall. PDF file on SKB's website.

communication research based on the premise that the dialogue between different parties in society should be on an equal footing.[14] This viewpoint is linked to an information transfer concept that is in itself asymmetric. The reporting from the Chernobyl accident, when the need for communication was acute and great, shows that many information mistakes were made, for example the authorities went out with contradictory information on the hazards of radiation.[15]

5.2 Reflective communication

Communication of messages in the nuclear waste issue can take at least three different forms. The first is one-way information, where the sender can control how the message is perceived by the receiver. The second form is characterized by more mutual communication, where sender and receiver formulate the message in a dialogue. A third form of communication, reflective communication, can be regarded as a further development of mutual communication. This concept incorporates a reflective attitude on the part of both sender and receiver, i.e. they make a mutual effort to ensure that the content and implications of the message will create meaning. This creation of meaning requires that both sender and receiver analyze the content of the message and try to understand its implications and communicate this in some form of dialogue. Herein lies the basic philosophy of reflective communication, an attitude on the part of sender and receiver that takes into account how values and attitudes are communicated in the message.

Messages concerned with the nuclear waste issue have many different senders and receivers. One sender is the nuclear power industry, which communicates its messages, while another is the environmental movement. Intended receivers of these messages are the Swedish people, including the local population in the municipalities deemed to be potentially suitable for hosting a final repository. Other interested receivers include decision-makers on both the national and local level. If we consider this argument about the advantages of reflective communication, one conclusion

[14] Sjölander, Annika. 2000. Kärnproblem. Opinionsbildning i kärnavfallsdiskursen i Malå. Medier och kommunikation 7, Umeå University.
[15] Findahl, O, & Lindblad, I-B, 1987:82 f. 40 dagar med Tjernobylnyheter i radio och tv. Swedish Radio. Public and Programme Research Dept.

is thus that the dialogue-oriented two-way conversational form is preferable to one-way information about the future disposal of the nuclear waste. Of interest is then not only what is said, but how it is said. Both form and content are stressed: who says what in what context and from what perspective. The focus will be on the meaning-creating function of the message.

This perspective is based on a strategic communicative philosophy, based on an awareness of how signs, words, symbols, metaphors, values, notions, representations and images create meaning. Today's communicators generally work professionally with this knowledge in mind. In this way the communication is also more ethical and meaningful.[16] Command of language as a tool and mass media messages as dramaturgy can also entail greater ability to exercise power. Having power over form and content thus entails a great responsibility and therefore requires a reflective approach to the nuclear waste issue on the part of different actors.

5.3 Receiver aspects and interpretations

All human communication can generally be described as difficult, open to interpretation and often unpredictable. Additional problems in the dialogue about nuclear waste disposal are the nature of the topic, about which most citizens have little knowledge, and its complexity.[17] There is nevertheless in our information and communication society a tendency to believe that information and communication will automatically lead to changes in attitudes and behaviours. But what is often overlooked is the fact that people's interpretation processes cannot be controlled, so that interpretation complicates the communication.[18] Interpretations that become generally accepted may also be based on myths. Myths are created via language, in the choice of words, metaphors and similes that are used in the communication and can therefore be said to have symbolic power, such as characterizing the crystalline bedrock as a secure host medium. In this way, words and expressions can serve as thought templates for both sender and receiver. At the same time, symbolism is needed to make it easier

[16] Falkheimer, Jesper, & Heide, Mats, 2003. Reflexiv kommunikation. Nya tankar för strategiska kommunikatörer. Liberg.
[17] Sjölander, A. 2004 Kärnproblem. Opinionsbildning i kärnavfallsdiskursen i Malå. Medier och kommunikation.
[18] Falkheimer & Heide 2003.

for us to understand the nuclear waste issue and thereby perceive our actions as meaningful. Words and interpretations, myths and perspectives – particularly in opinion-sensitive issues such as final disposal of nuclear waste – have power in defining and describing. Looked at in this way, the "nuclear waste discourse"[19] influences how we perceive and talk about what we often call risks, threats and opportunities associated with a future disposal of nuclear waste.

The dilemmas and ambivalence of everyday thinking can partially explain why it is so difficult to find direct connections between knowledge, attitudes and behaviours.[20] Upon rational reflection, however, most people can understand the necessity of a final repository for nuclear waste. It is only reasonable that our generation, which benefits from the electricity generated by nuclear power, should take responsibility for finding a way to dispose of the waste and not shift this responsibility to future generations. This is also a widely held opinion among experts and the public, including the population of Sweden's most likely nuclear waste municipalities, Östhammar and Oskarshamn, where opinion polls show that the majority of the citizens accept a repository.[21]

5.4 Demands on the information

Information from the authorities must meet high demands on correctness and speed.[22] In connection with a high-risk incident, citizens have a right to credible and reliable information. Credibility is closely linked to how the information source, the sender, is perceived by the receivers, i.e. whether the source is legitimate, authoritative and competent to furnish information in the situation at hand. Public confidence in the nuclear power industry and the regulatory authorities is related to what experience the individual has of contacts with them. Ideally, these actors should be open and sensitive to the viewpoints and wishes of the citizens. The regulatory authorities should also be responsive and willing to

[19] Definition of discourse – Here simply expressed as "How we speak about the nuclear waste issue".
[20] Höijer, B. 1987. Tjernobylolyckan i människors medvetande. En studie av informationsinhämtande och upplevelser. Report no. 2. Swedish Radio/Public and Programme Research Dept.
[21] Temo public opinion surveys.
[22] The following line of reasoning is mainly based on Nohrstedt, S.A In: Lidskog, Nohrstedt & Warg, 2000:194.

listen to the citizens and their concerns about the nuclear waste repository. Reliability in the nuclear waste dialogue can be achieved if the information is correct, consistent and relevant, with truth as the overriding requirement. Nothing is so devastating to public confidence as if the sender is found out not to be telling the truth. In a report on the events associated with the tunnelling project through Hallandsåsen Ridge, researchers say that those affected were very critical of the information, which was inadequate, contradictory and unreliable.[23]

Inconsistency, in other words lack of agreement between different messages from the sender, is equally devastating. The reports on the Chernobyl disaster reveal many contradictory and unclear assessments of the radiation situation.[24] Furthermore, due to their lack of knowledge the journalists were completely dependent on the statements made by the radiation protection authority. Every other item on Rapport (TV news programme) for the first 40 days after the accident contained contradictions. An example is that Austrian experts recommended that children and the elderly remain indoors, while SSI in Sweden[25] claimed that such restrictions were not necessary. Another demand on the information, that it should be relevant, means that officials should not avoid answering bothersome questions by talking about something else. This can be perceived by the receiver as a significant problem in relation to the image of the sender as reliable and credible. The news programme Rapport invited Gunnar Bengtsson, head of the Swedish Radiation Protection Authority, to appear daily and comment on the situation in Sweden. The reports were generally balanced in the sense that the alarming information presented at the beginning of the report was balanced at the end by reassuring comments by authorities. This sometimes had the opposite effect. The reassuring comments were sometimes glossed over and the alarming and dramatic information made the headlines.

An obvious demand on risk and crisis information messages is also that they should be clear and comprehensible. Otherwise, language gaps between experts and laymen may hamper the communication, especially if the target group is heterogeneous with widely varying levels of education. An analysis of linguistic

[23] Sandberg, H & Thelander, Å: Miljöhot och medborgaroro. En rapport från Hallandsåsen 1997.
[24] Findahl, O. & Lindblad, I-B. 1987. 40 dagar med Tjernobylnyheter i radio och tv. Swedish Radio/Public and Programme Research Dept.
[25] SSI = Statens strålskyddsinstitut (Swedish Radiation Protection Authority).

markers[26] that were used in the media following the Chernobyl accident shows that there was some uncertainty in the official statements.[27] Another important demand on risk communication in conjunction with an incident is that information must quickly reach those who may be affected and threatened by danger. The communication must also be true and relevant, and characterized by sensitivity and openness, inviting a dialogue.[28] It is thus dialogue and not one-way information that is striven for in reflective communication.

5.5 Crisis reporting in the mass media

People's perception of the dangers of nuclear power can to a great extent be media-engendered, i.e. created in interaction with mass media narrative patterns.[29] The reporting of a risk-filled event in the mass media is usually unpredictable. In the first place, it may quickly come to focus on statements to the effect that the risk situation is partially the fault of the responsible authorities. In the second place, the inherent dramaturgy in mass media reporting may entail an exaggeration of the event, and in the third place the tendency of the media to focus on people's anxiety may accentuate the crisis.[30] The results of an international study of risk perception and confidence in the mass media[31] show that people report different levels of confidence in messages depending on what medium they use as a source. The lowest confidence is associated with weekly magazines and tabloid newspapers, while national radio and television enjoy the greatest confidence.

The first persons whose voice is heard in the mass media are usually experts.[32] The nuclear power industry and the regulatory authorities consist of experts who are specialized in different areas,

[26] Linguistic markers are speaker attitude adverbs and types of arguments that indicate a need to modify a statement.
[27] Lindblad, Inga-Britt. Attitydmarkörer i nyhetsspråk. En studie av talarattitydsadverb I nyhetsrapporteringen efter Tjernobyl-olyckan. In: Svenskans beskrivning no. 18. 1990.
[28] Sandman. P M.1992. Responding to Community Outrage: Strategies for Effective Risk Communication. Fairfax, VA: American Industrial Hygiene Association.
[29] Sjölander 2004:29. Kärnproblem. Opinionsbildning i kärnavfallsdiskurser i Malå. Medier och kommunikation No. 7.Umeå University.
[30] This analysis is based on Stig-Arne Nohrstedt's research review in Lidstedt, Nohrstedt and Warg: Risker, kommunikation och medier. En forskarantologi. 2000.
[31] Sjöberg, L. et al., Risk perception in commemoration of Chernobyl. A Cross-National Study. 1999:41.
[32] Brännström, I & Lindblad I-B. 1994. Mass Communication and Health Promotion: The Power of the Media and Public Opinion. Health communication, vol 6. number 1, 1994.

which can sometimes hamper communication with the citizens, whose knowledge level is at least initially low. Fully comprehending the implications of environmental risks, such as consequences of radioactive contamination, can be nearly impossible for ordinary people. At the same time, the public is in great need of information and risk interpretation. This gap can in some cases lead to distrust of the authorities and experts because they do not choose to tell the whole truth and because they may abuse their position of power. Such suspicions existed among the public in Sweden in conjunction with the Chernobyl accident.[33] This distrust cannot be dismissed as irrational, since citizens are so dependent on these expert authorities. Nohrstedt[34] claims that it is actually rational from the point of view of the citizenry, since public authorities often respond based on a communication strategy that says the most important thing is to reassure people. But it often has the opposite effect of alarming people.

Experts may even choose to avoid journalists, because they may misunderstand and exaggerate the risks in their reporting. This behaviour can aggravate a situation and instead trigger the crisis mechanisms the authorities want to avoid. The public's interpretations may at worst be that those in charge are not taking the risks seriously and are thereby in practice guilty of an abuse of power. They thereby lose in authority. Those in charge may then have a much harder time managing a communication situation, since their credibility has been undermined. This kind of problem could be seen in the Swedish media following the Chernobyl accident.[35]

Mass media generally judge crises in a similar manner to public officials, at least in the acute phase of the incident. They often convey the officials' perceptions of the situation and thereby assist them in their work. It is only in later phases, when the crisis has begun to spiral downward, that the reporters may begin to challenge the authorities and look for scapegoats. The news value of the events gradually begins to fade, and the media need new angles to capture the public interest. That is when the inherent logic and rhetoric of the mass media can make itself felt in a more sensationalistic style of reporting. The mass media's portrayals of

[33] Höijer, B. 1987. Findahl & Lindblad 1987.
[34] Nohrstedt I: Lidskog,,I, Nohrstedt & Warg 2000. Risker, kommunikation och medier. En forskarantologi. Studentlitteratur.
[35] Findahl &Lindblad 1987, Höijer 1987.

risks and crises thus exhibit several special traits that are governed by the codes and conventions that characterize news stories, for example.[36] What governs these portrayals is further elaborated on in section 5.6.

5.6 The key role of the mass media

The mass media can therefore be said to play a key role in the risk and crisis communication that is aimed at private citizens. Inherent in this role is a complexity that has to do with the norms and conditions that govern the activities of the media.[37] In conjunction with public crises or disasters, media and journalists have to make difficult judgements and decisions. Expectations on journalists in such a situation are generally both great and to some extent contradictory. On the one hand, the mass media are expected to act as an information channel, especially in the initial reporting of the news, and to take this responsibility seriously. The public also expects the media to quickly communicate important information about immediate crises as well as about what how people in the immediate area should do themselves. On the other hand, it is the duty of journalists to serve as an independent counterforce in scrutinizing and challenging politicians and public officials. Herein lies some of the complexity.

In the initial phase of what turns out to be a crisis, the demand for independent scrutiny may be difficult for the mass media to satisfy. The role of the media is then to furnish the citizens with as true and objective factual material as they can so that the citizens can act and participate in the public debate. In the event of a nuclear power accident, however, the problem is brought to a head. The following scenario can occur, for example, if journalists should discover deficiencies in the initial rescue and cleanup work after a nuclear power incident, deficiencies that could have been handled better. Official predictions may, for example, turn out to have been far too optimistic at this point. The authorities may therefore have failed to adopt vital measures and responded inadequately. The journalists' dilemma may then be whether or not they should criticize the authorities, even though the situation is in an acute phase. There is a risk that the necessary radiation protection

[36] Nord, L & Strömbäck, J. Medierna och demokratin. 2004.
[37] Nohrstedt, S-A, 2000:202 f.

measures may be further hampered. Another reason may be that public alarm could at worst manifest itself in panic reactions. The credibility of the authorities could thereby be questioned.

Managing such a communicative dilemma requires great expertise on the part of communicators to communicate nuanced and credible standpoints and on the part of persons in leading positions to take charge in an emergency situation. There is no simple or obvious solution to such a situation. Nohrstedt[38] has shown in his research that the way in which media and journalists deal with the situation varies in the different phases of the crisis. In the acute phase, priority may be given to getting out all information quickly. At the same time it is important that the journalists have time to check and scrutinize the reliability of the information and not leave it up to the receivers to judge the credibility of the message. According to Nohrstedt and other researchers[39] there may be a risk that the reactions on the part of the public will follow the principle "Act before you think". A reverse strategy could entail that the receivers take so long to arrive at a decision that it will be too late to act.[40] Nohrstedt says that the conflict is genuine, since it has to do with two conflicting demands that cannot be fully satisfied.

5.7 Dramatized news

Risk communication in conjunction with incidents reaches a broad public fastest in the form of "templated" news texts. All topics can be pasted into the structure and format of the news story. News is an institutional form of communication that has emerged in the media system and generally enjoys high credibility among the receivers.[41] News journalism, mainly in the daily press and public service media, has developed into a power and knowledge field, a media discourse that, with its special potential to reach a large audience daily, has the power to orchestrate and rank other

[38] Nohrstedt, S-A, 2000. Kommunikationsproblem i samband med katastrofer och allvarliga samhällsstörningar. In: Risker, kommunikation och medier. En forskarantologi. Studentlitteratur.
[39] Nohrstedt's text is based on previous studies for the National Board of Psychological Defence (SPF) and the Swedish Defence Research Institute (FOA). They are: Flodin 1993; Jarlbo 1993; Nohrstedt & Nordlund 1993; Nohrstedt & Tassew 1993. The text is also based on an update with relevant studies published subsequently up until the research anthology was published in 2000.
[40] Nohrstedt, S-A, 2000:204. In: Risker, kommunikation och medier. En forskarantologi. Studentlitteratur.
[41] Höijer, B. 2000. Från medborgarnas synvinkel. Vardagstänkande och massmedierna. In: Risker, kommunikation och medier. En forskarantologi. Eds. Rolf Lidskog, Stig-Arne Nohrstedt, Lars-Erik Warg.

discourses in society. Within classic mass media rhetoric, Bengt Nerman[42] describes the news media as a text-producing machinery, a "text factory" where reality is fed in and processed and subsequently moulded according to a number of fixed models.

The basis for the news logic lies in the technical, economic and logistical premises of the media. A prerequisite for the rapid daily production of texts in both the press and the broadcast media is ready-made media formats, genres and narrative patterns. They have been shaped over time by the working conditions and ideals of journalists, but are also influenced by older patterns of speech and rhetoric. The power of determination has to do with what information and knowledge is to be conveyed in news reports, how it is presented, and with what angles it is presented. To a great extent, media logic shapes the opinions of private citizens in the nuclear waste issue, especially if incidents occur, since they have great news value.

5.8 Complex communication situation

Communicating matters in the nuclear waste field in an ethical and meaningful way is no easy task. Most of us know little about the subject, although the inhabitants of the two nuclear power municipalities where site investigations are being conducted have some knowledge that others lack. Nor can we obtain much information and knowledge from other countries, even though Finland now seems to have come further in the final disposal issue than Sweden. The communication situation is therefore both complex and sensitive.

So far this chapter has focused on the roles of media and public authorities in the interaction in which the messages are formulated and perceived. In this section the focus is shifted to the roles of citizens in the same interaction. It should be stressed that public authorities, media and private citizens may have quite different expectations on how the communication – and content – of different messages should be designed. In emergency situations, the consequence may be that the citizens' expectations can simply not be fulfilled.

[42] Nerman, B Massmedieretorik. 1973.

Research in the field of risk communication has shown that a crisis can also be brought on by people's anxiety – in other words, the triggering mechanism lies in the public's irrational reactions to a risk or crisis situation. Such a course of events can be described in several stages, and I summarize Nohrstedt's description here in seven points.[43] The situation can arise when the public has irrational reactions to a risk or disaster:

1. People do nothing in advance to protect themselves against possible risks.
2. They do not know enough about how to avoid the consequences.
3. They are confused and overly stressed by conflicting messages.
4. They react in panic and are thereby exposed to more dangers.
5. This makes it more difficult for the authorities to handle the situation.
6. The media criticize the authorities for this.
7. The citizens start to doubt the competence of those in charge.

This sequence of events cannot be ruled out, says Nohrstedt, even though people seldom panic or respond irrationally. On the other hand, they do not act as recommended by the authorities. If a counter-discourse arises that is directed against the responsible authorities and other experts, this is often due to the fact that the latter have failed to live up to the demands of the public for information and thereby also failed to live up to the demands on reflective and dialogue-oriented communication. The media then start looking for scapegoats for all problems suffered by the citizens. The mass media take upon themselves the role of protectors of the public interest, and the crisis spirals downward.

In the event of an incident or a risk or disaster situation in the nuclear power area, a communicator can easily get jammed between the experts, the industry, the authorities, the media and the public.[44] Then it is particularly important that those in charge, whatever their role, are competent enough to understand the total complexity of the communication situation they are faced with. Crucial communication problems can arise from a discourse analytical perspective, since public officials, media and citizens

[43] The following points are based on Nohrstedt's text in the research anthology Lidskog, Nohrstedt & Warg. 2000. Risker, kommunikation och medier.
[44] The following argument ties in with Nohrstedt's chapter in the aforementioned research anthology 2000:214.

adopt such different roles and thereby have different expectations in a complicated situation. At worst this can lead to a loss of legitimacy for society's division of responsibilities. Basic democratic values may thereby be threatened when the situation is most dependent on high credibility. It is then that communication strategies and the competence and legitimacy of different strategists are really put to the test.

5.9 List of sources and literature

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6 Some reflections on the concept of risk

It is evident from the various contributions to this report that the concept of risk is multifaceted and can contain many different components. It may have to do with how society protects the individual from unacceptable risks, or how society protects the collective from excessive costs in the form of diseases, a poorer environment, poorer living conditions, economic loss or other harm. The concept of risk also includes how different individuals view risk to themselves and others and how risks are communicated and mediated. There is therefore no meaningful definition of the concept of risk that holds true for everyone.

The section on *risk comparisons* identifies a number of problems with such comparisons, for example that different quantitative measures of risks must be taken into account, such as the probability and type of harm that can befall an individual or a whole society. Even though quantitative risk comparisons are seldom sufficient as a basis for a decision, they contribute to increasing the awareness of those concerned, for example before they make a decision that entails increasing or reducing a risk.

Attitudes, values, political persuasion, gender, age and parenthood are examples of factors that influence our *subjective risk perception*. One outcome of this subjectivity may be that people tend to judge their own risk as lower than that of others. We can also underestimate our own risk more or less deliberately because we want to participate in a certain activity or are reluctant to give up a possibly risky habit.

In many contexts where risk is to be assessed, subjective risk perceptions are accorded less importance than "objectively" calculated risks. It is argued that this is more rational. According to this point of view, emotions and values are not worth as much as a quantitative risk analysis. An individual may, however, be more inclined to accept greater risks at the personal level than those that

are imposed from the outside, in other words emotions and values control our judgement. It is therefore very important that values be weighed into society's decision processes in a functional manner. A risk that is imposed on the citizens should perhaps be given greater weight in the decision process than a quantitatively equally great risk that is taken voluntarily. A functional way to manage risk must therefore include such values.

Certain given demands are made on *good risk communication*. It must be correct, be consistent so that different messages from the sender agree, and be clear and comprehensible. The communication should be reflective and encourage dialogue and not just be one-way information. In today's society, media logic also plays a part in shaping the image the public has of, for example, nuclear waste disposal. Even though the power to determine how information is communicated in news reports, discussion programmes and documentaries lies with the journalists, carefully planned strategies and competent communicators can also make a difference.

The Swedish National Council for Nuclear Waste (KASAM) has the following composition:

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The Swedish National Council for Nuclear Waste – KASAM – is an independent scientific committee within the Ministry of the Environment. Its mandate is to advise the Government in matters relating to nuclear waste and the decommissioning of nuclear installations. KASAM's members are independent experts within different areas of importance for the disposal of radioactive waste, not only in technology and science but also in such areas as ethics, the humanities and the social sciences.

KASAM's activities include describing the state of knowledge in the nuclear waste field every third year in a so-called state-of-the-art report. The 2007 report on the state-of-the-art in the nuclear waste field is the ninth in this series. This year the report consists of a main report entitled *"Nuclear Waste, State-of-the-Art Report 2007 – responsibility of those now living, freedom of future generations"* (SOU 2007:38), plus four in-depth reports. These are:

- *Final disposal of spent nuclear fuel – regulatory system and roles of different actors during the decision process* (KASAM Report 2007:1e),
- *Safety assessment of final disposal of nuclear waste – role, development and challenge* (KASAM Report 2007:2e),
- *Time for final disposal of nuclear waste – society, technology and nature* (KASAM Report 2007:3e) and
- *Risk perspective on final disposal of nuclear waste – individual, society and communication* (KASAM Report 2007:4e).

This report on safety assessment of final disposal of nuclear waste is thus one of the in-depth reports. The purpose is to give the reader a deeper understanding of the role and development of the safety assessment and the challenges facing us.

All reports are available at www.karnavfallsradet.se.

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