

Radiation and nuclear risk - Considerations for those affected

A RISKPERCOM summary report

*Jon B.Reitan, Claire Mays, Ana Lena Cebrián Lindström, Lennart Sjöberg,
Arnfinn Tønnessen*

StrålevernRapport 1999:1

Det radioaktive nedfallet etter kjernekraftulykken
i Tsjernobyl - et utvalg litteratur 1986 - 1995

StrålevernRapport 1999:2

Håndtering av radioaktive avleiringer i olje- og
gassproduksjon i Norge, Storbritania og Nederland

StrålevernRapport 1999:3

Virksomhetsplan for 1999

StrålevernRapport 1999:4

Seminar on Waste Treatment and Disposal.
Engelsk utgave.

StrålevernRapport 1999:5

Seminar on Waste Treatment and Disposal.
Russisk utgave.

StrålevernRapport 1999:6

Radioactive Contamination in the Marine Environment

StrålevernRapport 1999:7

Årsmelding 1998

StrålevernRapport 1999:8

Radiation risk perception in Norway ten years after
Chernobyl: Effects of commemoration and living in
an area especially affected by fallout.

Reference:

Reitan JB, Mays C, Lindström ALC, Sjöberg L, Tønnessen A: Radiation and nuclear risk - Considerations for the affected. A RISKPERCOM summary report. StrålevernRapport 1999:9
Østerås: Norwegian Radiation Protection Authority, 1999. Language: English.

Key words:

Radiation, risk, communication, nuclear facilities, radiation sources, fallout.

Abstract:

This report contains a short introduction, 4 summaries of national case reports from France, Norway, Spain and Sweden, published elsewhere, and a general discussion. The case reports deal with various aspects of radioactive waste and radioactive fallout, and the situation and information needs of affected populations.

Referanse:

Reitan JB, Mays C, Lindström ALC, Sjöberg L, Tønnessen A: Radiation and nuclear risk - Considerations for the affected. A RISKPERCOM summary report. StrålevernRapport 1999:9
Østerås: Statens strålevern, 1998. Språk: Engelsk.

Emneord:

Stråling, risiko, kommunikasjon, atomanlegg, strålekilder, nedfall.

Sammendrag:

Denne rapporten inneholder en kort introduksjon, 4 sammendrag fra nasjonale case rapporter fra Frankrike, Norge, Spania og Sverige, publisert andre steder, og en generell diskusjon. Rapportene omhandler forskjellige aspekter av radioaktivt avfall og radioaktivt nedfall, og situasjonen for og informasjonsforholdene for affiserte befolkningsgrupper.

Godkjent/approved:

Jon B.Reitan, avdelingsoverlege/ medical director

Reitan JB, Tønnessen A: NRPA, N-1345 ØSTERÅS
Mays C: Institut SYMLOG, F-94232 CACHAN Cedex
Lindström ALC: CIEMAT, E-28040 MADRID
Sjöberg L: Stockholm School of Economics, S-11383 STOCKHOLM

16 sider

Utgitt 1999-07-20

Opplag 300

Form omslag: Graf, Oslo. Trykk: Lobo grafisk A/S, Oslo

Bestilles fra:

Statens strålevern, Postboks 55, 1332 ØSTERÅS

Telefon 67 16 25 00, Telefax 67 14 74 07

ISSN 0804-4910

CONTENTS

	P
1 Summary/ Sammendrag	1
2 Acknowledgments etc./ Anekjennelser m.m.	1
3 Introduction	2
4 High profile and deep strategy: Communication and information practices in France's underground laboratory siting process	2
5 Radiation risk perception in an area especially affected by radioactive fallout from the Chernobyl accident	4
6 The communication strategy of a Spanish institution around radioactive waste	6
7 Attitudes and opposition in siting a high level nuclear waste repository	8
8 General discussion	9
9 Conclusion	12
10 References	13

SUMMARY

This report contains a short introduction, 4 summaries of national case reports from France, Norway, Spain and Sweden, published elsewhere, and a general discussion. The case reports deal with various aspects of radioactive waste and radioactive fallout, and the situation and information needs of affected populations.

SAMMENDRAG

Denne rapporten inneholder en kort introduksjon, 4 sammendrag fra nasjonale case rapporter fra Frankrike, Norge, Spania og Sverige, publisert andre steder, og en generell diskusjon. Rapportene omhandler forskjellige aspekter av radioaktivt avfall og radioaktivt nedfall, og situasjonen for og informasjonsforholdene for affiserte befolkningsgrupper.

ACKNOWLEDGEMENTS ETC.

RISKPERCOM is a European Commission sponsored project (contract no. F14P-T95-0016, DG12-WSMW) involving UK, France, Spain, Norway and Sweden, and coordinated by Lennart Sjöberg, Sweden. The Norwegian part is financed by a grant from the Norwegian Research Council (contract no. 113353/720). The authors are grateful for comments and ideas from various colleagues and scientists in different institutions. The views expressed in this report are those of the authors and do not necessarily represent any official views, decisions or stated policy of any of the agencies.

The basic national reports are those by Barthe & Mays (1998) from France, Cebrián Lindström *et al* (1998) from Spain, Sjöberg *et al* (1998) from Sweden, and Tønnessen *et al* (1999) from Norway. The bibliographical references may be found in the References section in this report.

ANERKJENNELSER M.M.

RISKPERCOM er et prosjekt støttet av den Europeiske kommisjon (kontrakt F14P-T95-0016, DG12-WSMW) omfattende Storbritannia, Frankrike, Spania, Norge og Sverige, og som koordineres av Lennart Sjöberg, Sverige. Den norske delen er finansiert ved et forskningsbidrag fra Norges Forskningsråd (kontrakt nr. 113353/720). Forfatterne takker for kommentarer og ideer fra flere kolleger og forskere i forskjellige institusjoner. Synspunkter i denne rapporten er forfatternes og representerer ikke nødvendigvis noe offisielt syn, beslutning eller policy for noen av myndighetene.

De tilgrunnliggende nasjonale rapporter er av Barthe & Mays (1998) fra Frankrike, Cebrián Lindström *et al* (1998) fra Spania, Sjöberg *et al* (1998) fra Sverige, og Tønnessen *et al* (1999) fra Norge. De bibliografiske referanser finnes i referanseavsnittet i denne rapporten.

INTRODUCTION

RISKPERCOM is a European Commission sponsored project involving France, Norway, Spain, Sweden and the United Kingdom, coordinated by L. Sjöberg, Sweden¹. It studies risk perception and communication, in particular radiation risk, partly in connection with the 1996 ten year commemoration of the Chernobyl accident. As a part of the project, national case studies were performed in four of the participant countries (France, Norway, Spain and Sweden). The case studies deal with various aspects of radioactive waste and radioactive fallout, and the situation and information needs of affected populations.

The four research groups have all made individual national reports. The aim of the present report is to summarise these, and give some common interpretation of the results. The basic national reports are those by Barthe & Mays (1998) from France, Cebrián Lindström *et al* (1998) from Spain, Sjöberg *et al* (1998) from Sweden, and Tønnessen *et al* (1999) from Norway. The bibliographical references may be found in the References section of this report.

HIGH PROFILE AND DEEP STRATEGY: COMMUNICATION AND INFORMATION PRACTICES IN FRANCE'S UNDERGROUND LABORATORY SITING PROCESS

Introduction

France is engaged in a research programme for the management of high level radioactive wastes. The programme is framed by a national law (Waste Act of 30 December 1991) that seeks to guarantee «permanent democratic control» of a transparent process. This represents a significant innovation in regard to past management of nuclear technology and strategy in France, formerly the reserve of the Commissariat à l'Énergie Atomique, with its historic national defence profile.

Among the innovations of the Act is the definition of three parallel research avenues, in which progress is evaluated annually by an independent expert committee. Based on research outcomes in the three defined directions, France's Parliament in 2006 should decide which technical solutions (or combination thereof) to retain for the management of high level² nuclear waste (HLNW). Research is to be carried out on partitioning and transmutation of long-lived elements, and on waste processing and packaging; the third avenue explores retrievable and non-retrievable disposition methods. At least two underground laboratories are to be constructed in this latter research goal. They will serve to evaluate the feasibility of a permanent deep storage facility.

Brief outline of the case

This case study examines the underground laboratories site research process as seen in 1997. Public information and communication practices are of special interest in this context. Indeed, the Waste Act may be seen as a direct response to a prior communication crisis. Research on radioactive waste disposal had already been initiated in France in the 1980's. Laboratory site search had been performed with no accompanying information to the public, and the violence

¹ The EU member participants (France, Spain, Sweden and the United Kingdom) are sponsored by the EU Commission RISKPERCOM grant (contract no. F14P-T95-0016, DG12-WSMW). The Norwegian part is financed by a grant (contract no. 113353/720) from the Norwegian Research Council.

² "High level and long lived" waste according to the French terminology.

of local opposition had led the government in 1990 to interrupt that search with a moratorium. These conflicts led to the reformulation of the problem posed by the existence of nuclear waste, in which decisions could no longer be evaluated on their sole technical merits, their social acceptability emerging as a criterion of equal importance.

The language of the Waste Act makes explicit a shift from an authoritarian, «technocratic» decision style: secrecy and dependence on the all-powerful expert give way to «dialogue» and «concerted action»³. Throughout the parliamentary debates leading up to the Act's vote, particular attention was given to the problem of acceptance by future neighbours of a possible underground storage facility. Article 14 of the Act addresses this concern by providing for each laboratory site a local information and monitoring commission⁴ (LIC) grouping scientists, local elected officials, and other stakeholder representatives. A Mediator was designated by the French government subsequent to the passing of the law; he travelled around the country to meet and listen to stakeholders at potential volunteer laboratory sites. On his suggestion, rather than awaiting final site selection, LICs were instituted earlier, from the very start in 1993 of technical site preselection carried out by ANDRA, France's national radwaste management agency. This initiative highlights the understanding that public information is not to be treated as a luxury add-on to a technological project after it has reached a certain point of development, but rather, to be effective, must accompany the project in all its stages. Moreover, this initiative reveals the strategic importance given to information procedures in the goal of obtaining local acceptance of radwaste management policy implications.

The first author of the case study visited two French localities pre-selected for laboratory construction, observing the LICs in session, and interviewing many of their members, as well as onsite ANDRA representatives. Available written materials were consulted, including numerous public information brochures and local press articles.

Conclusions

ANDRA's information efforts appear to fit well with a strategy of insertion into the local context, including methods to rally potential allies in local officials. The agency respects the law in providing information and justification of each step in the scientific process of research. ANDRA's siting mission is presented to the public as a large scale scientific experiment whose progress laypeople are invited to follow in real time. At the same time as they explain themselves to their potential neighbors, however, the implementors gather information and position themselves to influence the evolution of local attitudes. The high visibility of the siting process is seen in the study to serve the different stakeholders⁵ in different ways, and moreover to allow new stakeholder voices to emerge, in the end contributing to unsettling the careful framework laid out by the Act.

The LIC are portrayed in the study as highly institutionalized, created ostensibly to disseminate public information, but working effectively to channel debate and contain controversy. They thereby miss an opportunity to foster a true public forum and solution-seeking deliberation.

³ This transformation is examined in Mays (1996).

⁴ *Comité locale d'information et de suivi*, commonly abbreviated to CLI (LIC in English).

⁵ The authors use the term «stakeholders» to refer to *all* players, including implementors.

The study also reviews arguments by opponents to the Rhône Valley site proposal, the Rhône Valley being a famous wine region. Opponents' discourse is seen to centre on the danger of regional stigmatisation, with concern for midterm economic losses. All in all, the counterpoint of public information messages, serves to demonstrate the broad range of definitions associated today with the «risks» of radioactive waste.

RADIATION RISK PERCEPTION IN AN AREA ESPECIALLY AFFECTED BY RADIOACTIVE FALLOUT FROM THE CHERNOBYL ACCIDENT⁶

Introduction

During the Chernobyl accident, Norway experienced fairly high levels of nuclear pollution. In Oppland county many municipalities got scattered and uneven deposition of radiocaesium, some of them up to 100-300 kBq^m⁻². These are mainly located in mountainous regions, sparsely populated but important meat production areas. Extensive countermeasures had to be taken, especially for reindeer herding, sheep breeding and inland fishery. Restrictions on trade with meat and fish were imposed, use of special feeding programs and Prussian blue (a dye binding radiocaesium and increasing excretion) were introduced, and some economic compensation granted.

Brief outline of the case

Selected individuals in these populations affected above Norwegian average by the Chernobyl accident have been studied by several means earlier. Whole body counting for body burden of radiocaesium has been done yearly, and some studies on health parameters as immunologic functions and chromosome aberrations have been done. The people in these areas got higher radiation doses than the average Norwegian population and experienced restrictions on livelihood. During these studies, a multitude of selected persons were contacted, and according to their reports it was reasonable to assume that the need of information and the experience of the situation in these areas differed from that of the rest of the country. Thus, in parallel with the third wave of the 3-wave RISKPERCOM cross national survey study, a special survey was performed in 4 municipalities (Sel, Vang, Vestre Slidre and Øystre Slidre) of the Oppland county. The aim was to contrast the risk perception of this affected area with the risk perception of the general Norwegian population. Both the personal risk and the general risk (risk to others than the person interviewed) were studied.

One objective behind the selection of these special municipalities in Oppland was to investigate the effects on risk perception from the widespread use of countermeasures in this area. The hypothesis was that the widespread use of countermeasures could induce a feeling of greater control of the effects of fallout, thus enhance the feeling of positive outcome expectancies.

Conclusions

The respondents in the study area perceive the fallout from Chernobyl to impose a significantly higher personal risk to them than what is found in the general Norwegian

⁶ This case study has not been documented in a separate report, but is incorporated in the general RISKPERCOM survey report (Tønnessen *et al* 1999).

population. They also perceive the fallout to have a higher risk for people in general, but the magnitude of the difference vs. the general population data is less for the general than for the personal risk. In line with this, the respondents in the study area perceive a higher personal risk from food containing radioactivity. However, a difference of the same magnitude is also observed for risk from food containing radioactivity for the general population. Thus, the rating of personal risk from Chernobyl fallout shows a very distinctive pattern. In addition the respondents in the affected area also judge themselves to have more knowledge about the fallout.

The expected widespread use of countermeasures was confirmed. 65% of respondents in the study area had made changes of living of different kinds because of the Chernobyl accident. Of the changes made, a change in dietary habits was the most common, just as observed in the general Norwegian data set. In the study area 46% had made dietary changes, and for one out of ten respondents the changes were still in place in 1996. In accordance with the hypothesis, the respondents in the study area judge themselves as more capable of protecting themselves from the risk from food containing radioactivity. It is interesting to note that even though they also slightly judge themselves to be more able to protect themselves against the risk from the Chernobyl fallout, the difference vs. the general population is much less for this risk issue. So during the ten years of living with Chernobyl fallout there seems to have occurred a learning effect on how to deal with food production problems in a contaminated area.

Even though this slight learning effect has occurred, the respondents in the study area express a much higher concern that the food they and their children consume today may contain radioactivity. Whereas in the general Norwegian population more than half of the respondents with children feel no or very little concern for this, only one out of five parent respondents in the study area feel likewise carefree for the risk of consuming food containing radioactivity. More than three out of ten respondents in the study area felt that the accident probably or surely put them in danger, and twice as many warned others about the accident than in the general population. Even though the majority among the study area respondents denies that they have a health problem because of the accident, they are less firm in their beliefs. In the future they believe that they may possibly get an illness related to the accident. However, their health concern because of the accident has not reached a level where for instance more respondents in the study area have consulted a doctor because of their worries.

The respondents in the study areas have also to a larger extent heard or seen reports about Chernobyl in the media recently. When evaluating these reports the respondents in the study area believe to a larger extent that the media coverage provided them with practical advice. This is a finding quite in accordance with a previous report on printed media content analysis, as the local Oppland newspapers were found more often to give practical advice in the selected study period in April 1996 (Nilsson *et al* 1997).

Summing up, the populations most affected in Norway by the Chernobyl accident feel themselves more at risk than the national average. Despite extensive changes in dietary habits and feeling to have more knowledge and be more capable to protect themselves, they still seem uncertain about their health, and parents are sincerely occupied with childrens' health risk. It seem that interventions, countermeasures and information have been successfull on the practical and cognitive level, but probably not as effective in achieving a positive expectancy outcome. From another perspective the individual's concerns for the situation may be adequate and not necessarily a problem, and it is not obvious that the concerns in the study

area are something that should be counteracted by authorities. Nevertheless, there seem to be a need to develop better information both from the authorities to the public and *vice versa*, and more study of how to facilitate understanding and obeying of emergency instructions and of countermeasures.

THE COMMUNICATION STRATEGY OF A SPANISH INSTITUTION AROUND RADIOACTIVE WASTE

Introduction

The CSN (Spanish nuclear regulatory council) carried out an inventory study on the uses of radioactive lighting-rods in Spain. Several tens of thousands of lighting rods with heads containing radioactive sources were found to be installed throughout the national territory. Conclusions underlined that radioactive lighting-rod benefits did not justify the radiological risk associated with its massive use and dispersion. The aim of this case study was to analyse how the competent institution ENRESA (Empresa Nacional de Residuos Radiactivos) dealt with the communication strategy in connection with removal of these items, which strategies were employed, which do still remain, and with which effects. Institutional answers to the worries and concerns of social groups (e.g. parents, school directors and hospitals) who were most directly affected by the risks were also analysed.

Representatives of the Technical unit of radiological protection (Department of safety and licensing) and the Department of communication were interviewed in order to collect information, both technical and about the communication strategies. A set of legal and technical documents provided by ENRESA were analysed in depth. Available surveys and other opinion data as well as a database of press news (national, regional and local) were also examined.

Brief outline of the case

A Royal Decree in 1986 stated two possible alternatives: a) to consider the lighting-rods as radioactive installations (in needs of control measures), or b) to remove them in one year. ENRESA, as the company authorised by the Government, should in case manage the removal and disposal of the lighting rods. A strategic plan had to be designed over a strict period of time, with no site available for a temporary storage, and with no idea of how many or where the radioactive lighting rods might be located.

At first, an evaluation of possible disposal alternatives had to be developed. Contacts and negotiations were made with several municipalities throughout the country in order to obtain the required authorisations for a temporary disposal: It was however socially considered that private companies should not manage lighting rods, and a change in the strategy had to be taken. After a “Ministerial Order on Compensations for Municipalities with Radioactive Disposals” in 1998 a few municipalities showed interest, but complex and long bureaucratic procedures made any smooth agreement difficult. Meanwhile, two strong opponents appeared on stage: ecologists and nearby municipalities not included in the economical compensation area. The sociocultural context was characterised by time limitation and lack of temporary storage. The immediate effect was a delay in the countermeasures taken to dismantle. The key actors were individuals making requests and specific demands, and also the mass media.

Later, radiation contamination was detected in some schools, affecting directly several social groups. People had been told about a possible danger they could not see or touch, and suddenly the possibility became real. They were no longer passive receivers of different messages, they took on an active role. As in the earlier stage, several actors were involved in the communication messages: APAS (parents associations), ecologist groups, and local administrators became especially active in the media.

Eventually, a recycling agreement was achieved with the British Company Amersham, and in 1992 200 intact lighting rods were sent to the UK in a first pilot experience. Later, lighting rods were dismantled in Spain and the radioactive materials only were sent to the UK. At the time of the study, 18 000 lighting rods had been dismantled. 5.000 or 10.000 were remaining. No requests were made and ENRESA has no authority to dismantle them without permission, it would be intrusion in private property.

Thus, two different phases may be described during the process: Phase I: Finding storage (1986-1993), and phase II: Contamination at schools (1994-1996). Key variables studied (Cognitive, behavioural and social amplification related ones) were analysed in order to understand the internal process that influenced risk perceptions. An explanation of the key moments and actors involved in the process was also developed. Moments were analysed separately, each having its own actors, some of them participating with same or different roles across time.

Conclusions

The study revealed some serious problems: 1: Lack of institutional coordination between competent authorities when publishing the law. 2: Underestimation of the social alarm that could arise. Although lighting rod risks are very small “the items are radioactive”. 3: Technical solutions should be found before communication. The communication strategy designed by ENRESA aimed to communicate a viable solution. 4: No clear communication strategy could be designed. Actions and responses were adopted on demand.

First of all, there is a need for coordination between related institutions, especially when decisions of one institution have effects on the competences of the other. Decision should take into account the public that may be potentially affected. One more lesson of this case is that in communication issues an effort should be made in order to simultaneously approach technical solutions and communication. The optimum level takes place when the institution has continuous bidirectional communication towards the community before the issue takes place, and responds to the problem, with again, bidirectional information. A coordinated communication strategy is desirable.

Some variables were detected to have affected risk perception. These comprise the levels of previous knowledge of the institution and images and credibility of diverse actors, the delay of the countermeasures, messages given by diverse actors and conflicts created, and direct experience by the public and characteristics of the hazard. These variables should be considered when designing an effective communication strategy. Public participation is a consensus making process to resolve conflicts. The instruments to reach the public may be diverse (e.g. letters, press releases and public phone lines). Direct contact measures (e.g. through public meeting) are the ones to be increased, if knowledge and trust are to be obtained.

As a last remark, permanent and close relation as well as, bidirectional communication has to be increased with those collectives potentially critical to ENRESA (ecologists, media, etc).

ATTITUDES AND OPPOSITION IN SITING A HIGH LEVEL NUCLEAR WASTE REPOSITORY

Introduction

In Sweden, the owners of the nuclear power plants are responsible for final disposal of nuclear waste. The owners have formed the Swedish Nuclear Fuel and Waste Management Company (Svensk Kärnbränslehantering AB, SKB), which handles all issues concerning nuclear waste. SKB handles the siting process in Sweden, in which the final outcome is intended to be that a repository for high level nuclear waste is placed relatively deep down in bedrock.

Siting is to proceed in three steps: 1: 5-10 municipalities are selected for feasibility studies, 2: two of these are selected for a site study and 3: one is selected for a detailed study. The main objective of the siting process is to find a host community where two important conditions exist: the security demands have been met and agreements with the municipality in question can be accomplished. Only in such municipalities, feasibility studies will be conducted. After conducting general studies in the whole country, SKB, in October 1992, sent a letter with information about the intended feasibility studies to all Swedish municipalities. As a result, feasibility studies are or have been considered – and in some cases also been conducted – in eleven Swedish municipalities up until 1998. These are the municipalities in which the attitudes and opposition towards a feasibility study, and possibly a final repository, are studied here.

Brief outline of the case

The objective of the study is to describe the events concerning the proposed feasibility studies in those Swedish municipalities that in some way are or have been involved in this process. Also, we want to investigate attitudes to the siting of a final repository for high level nuclear waste. The study further aims to clarify the circumstances associated with local opposition to a national repository. Is there a discernible pattern to the events, which can explain the different reactions and outcomes, regarding the proposed feasibility studies?

The information sources used in the present study consist of research reports, official documents, newspaper articles and interviews with officials (mainly those responsible for the issue in the different municipalities concerned). The events taking place in the communities can be presumed to be more or less objectively depicted in the sources. Especially the interpretations of facts by different authors may be incorrect, however. Therefore, an effort has been made not to take interpretations and views at face value, but rather to use them as evidence that this view exists, or that it is possible to interpret the events in this way.

The Competing Values Approach is used as a theoretical framework. The model aims at identifying and clarifying the contradictions inherent in the process of siting a final repository for nuclear waste. The main elements in the model are four different perspectives, each representing a specific focus that is possible to use when managing a siting process.

These perspectives are: 1: the rational perspective, a goal-centred process aiming towards efficient decisions, 2: the empirical perspective, a data-based process aiming towards accountable decisions, 3: the consensual perspective, a participatory process aiming towards supportable decisions, and 4: the political perspective, a flexible process aiming towards a legitimate decision.

The discussion can be divided into three main parts: 1: Management of the siting process 2: Inherent «chaotic» processes and/or factors 3: Risk perception.

Conclusions

It is argued that two important problems could have been avoided at least partly, if SKB had received more national support. First, the citizens in many municipalities were not sure of the relationship between a feasibility study and a final repository. Second, in many municipalities the citizens were afraid of the ability of the Government to overrule the municipal veto. Because of these fears, a common argument among the opponents of a feasibility study was «To be sure of not receiving a final repository, we say no to a feasibility study».

Some inherent factors, more or less prevalent in the municipalities as well as in society in general, may also partly explain the outcome of the siting process. The municipalities in which the debate has been heated, and where public support has been more difficult to reach, share some common characteristics. Especially in the municipalities in the north of Sweden, there have been worries of becoming the «nuclear rubbish-heap of Europe», and there have been hostile feelings towards SKB. Linked to these debates have been underlying perceptions of SKB as coming from the central power of Sweden – a tension between the Centre versus Periphery and a situation of David versus Goliath.

Finally, risk perception of the citizens has been an important factor. Earlier research suggests that three predictors explain about 60 % of the variance in risk attitude. The present study supports the idea of the attitude towards nuclear power as an important predictor of the attitude towards nuclear waste. The second suggested predictor is the trust in experts. It has been noted that experts and citizens differ very much in their risk perception concerning nuclear waste. Both scientists advocating a final repository and SKB have to quite a large extent focused on the local benefits of a final repository, while the citizens have been more concerned about the risks. The scientists opposing a final repository have confirmed the worries of the citizens by focusing on the risks. The third suggested predictor is general risk sensitivity. One could assume that a municipality with many people who are risk averse would be more negative towards a final repository than a municipality with few people who are risk averse. However, the present study was not designed to collect data on risk sensitivity in the municipalities. Therefore, we are not able to draw any conclusions on this matter.

GENERAL DISCUSSION

Although risks are part of everyday life, some of them are better known than others, some more frightening than others, and some beyond our realm of personal experience. Local nuclear installations, siting of repositories, and accidents such as the Chernobyl accident in 1986, may trigger feelings of insecurity in the population. Some segments of the population are in this connection obviously more at risk than others, even though the risk may be negligible or even not directly quantifiable.

The French and Swedish case studies summarized in this report deal with the problems of high level radioactive waste and siting of repositories/laboratories. The Spanish case also deals with disposal of radioactive waste. The Norwegian case deals with risk perception and coping of people facing radioactive pollution, but the same elements are also inherent in the Spanish case by the school contamination, and the local populations in the French and Swedish cases may be looked upon as people facing the potential presence of radioactivity in their backyards. These four national case studies therefore have in common that they all deal with specially affected populations, and their interaction with authorities and informants. Such «affected» segments may be in special need of tailored information, but even more important they may be considered interested parties in negotiations for solutions of problems.

Selection of waste disposal technology and siting processes

In the Swedish case, the siting process for the high level waste repository is intended to start with feasibility studies after negotiations with several municipalities⁷. Both at the municipality level (especially in northern Sweden) and among individuals, opposition has so far been substantial⁸. The French case emphasizes the need of a «permanent democratic control» of an open technology choice and siting process, as an innovation compared to earlier more «paternalistic» processes. The process so far is restricted to the technology development through underground laboratories. Definitive repository siting is not under question at the moment. In the Spanish case, neither the technology nor any storage or dismantling facilities were identified at the time the Royal Decree in 1986, a fact that seems to have been a problem for the authorities.

The approaches have been different in the countries as to at which stage of the process the public should be involved. In the Spanish case, the public was involved «accidentally» during the process of negotiation with municipalities, and without a developed disposal strategy. In the French case, the public (or some special "representative" entity treated as the public) has been involved very early, at a stage when firm decisions as to preferred technical solutions are officially as yet untaken, whereas in Sweden the technological option was determined first, and then contacts were made with the municipalities⁹. Public outcry seems to have been maximal in Spain and minimal in France. From the perspective of the authorities, it may therefore seem advisable to involve the public very early to counteract the NIMBY problems¹⁰. On the other hand, the final outcomes of the French and Swedish cases are not known. Neither strong state initiatives, nor extensive public participation and detailed

⁷ The technology to be applied has been decided by the SKB. This KBS-3 method is a multibarrier system. The ceramic nuclear waste will be contained in steel capsules covered by copper, and deposited in bentonite masses 500 m down in stable crystalline bedrock.

⁸ The SKB has so far done feasibility studies in the municipalities of Storuman and Malå. In Storuman the study was started in 1994 in agreement with municipality officials, but in a local referendum 1995, 70% of the inhabitants voted against any repository. In Malå, the municipality ordered the study in 1994, but in 1997 54% of the inhabitants voted against.

⁹ In Norway, no decisions have been made regarding high level waste. Recently, however, the disposal/storage facility for low and intermediate level waste was put in operation (NRPA 1999). The process for siting of this facility dates back to 1989. In 1994 the Parliament decided to investigate in detail the site in Himdalen, further evaluated by the IAEA (WATRP 1995). The public involvement was not planned as part of the process, and local groups opposed the siting (Halvorsen *et al* 1994). After the parliamentary decision to build the facility, the public debate has however calmed. The stage of involvement of the municipality authorities and the public seem to be comparable to the Swedish case.

¹⁰ «Not In My BackYard»: Popular expression of the phenomenon that although nasty things as scrap piles and nuclear waste have to be located somewhere, nobody is willing to accept the disadvantages for themselves. The NIMBY notion rests upon the assumptions that these facilities really are perceived as undesirable neighbours, and that they are socially desirable, as a public good, and should be placed somewhere. But these assumptions are not very well substantiated by empirical studies and may carry unacceptable value judgments (Heiman 1990).

negotiations could be positively identified with actual success in a study of 81 US applications for hazardous waste facility location (Heiman 1990). It is a question to what extent authorities can have goals close to persuasion of the public (O'Keefe 1990) or actually overruling local opponents. The French emphasis on a «permanent democratic control» is representative of a idealistic and liberal planning process, aiming at social harmony and attainable through informed and rational public participation. In the Spanish case as well, public participation is expected to resolve conflicts.

Considerations for population segments involved/affected and non-involved/non-affected

Both in location processes, and in uneven distributed pollution cases, there are segments of the population which are more directly affected than others. If intended to help people to cope with a situation experienced as risky, information needs to be practical. The possibility to be active is a powerful tool to counteract anxiety (Curado 1996, Tønnessen *et al* 1996). In the French and Swedish cases these segments are represented by inhabitants in municipalities or locations considered for siting. In the Norwegian case they are those living in areas with high pollution levels compared to other areas, and in the Spanish case those in the vicinity of radioactive lighting rods.

Storage facilities may (after the construction period) imply some few employees, but otherwise the direct benefits of siting will probably be minimal except for any economic compensation. Municipality inhabitants are expected to consider a local storage facility as an inconvenience imposed on them for the benefit of the general public. There are clearly parallels to the inhabitants in municipalities in Norway affected by the Chernobyl fallout: Restrictions and inconveniences connected to regulations and agricultural countermeasures are imposed on them due to the theoretical health benefit of consumers of their products. Thus, minor groups have to carry the burdens on behalf of the general public, and economic compensation by itself does probably not relieve this. In the Spanish case there are many of the same aspects, especially for those suffering from the radioactive contamination in schools. But an additional point is that the possibility of removing the sources, or even decontamination of the school locations, may entail greater importance for the authority's interaction with local groups. There is at least a possibility for removal of the risk, but the method chosen must be satisfactory for the population.

Information aspects

In connection with all four case studies, different agencies have issued information of various kinds. For both the French and the Swedish cases, there is an obvious public need and authority obligation to provide a solution to the storage requirement, and to inform about the issues, both scientific and social, involved. The same is true for the Spanish case, where a safe dismantling and/or acceptable protection measures were aimed for. Information (or lack of information) in Norway during the Chernobyl accident led to an information crisis (Hernes *et al* 1986), and several studies, including the present case study, indicate a continued need for tailored information.

Information in such contexts has often previously been mainly technical, and often from the authorities to the public only. In Sweden, the primary information was to municipality authorities. In the French case it is stressed that they wanted to deviate from previous

management style of nuclear technology and strategy in France, with its historic national defence profile, by incorporating social communication and acceptability as a goal. In the first phase of the Spanish case, public involvement was apparently restricted to communication with municipality officials, and one of the conclusions is that bidirectional communication has to be increased. In the Norwegian case, media coverage providing practical advice has probably been important, compared to little tailored information to inhabitants of affected municipalities from the authorities.

In some aspects the inhabitants in question may have a self experience as «victims» and perceive authorities or implementors as encroaching. It is therefore reasonable to assume that the need for information (and communication) in «affected areas» is somewhat different from the general needs. This has bearings upon communication styles and content, which must be tailored to the local needs, partly dependent upon national factors and history (Reitan *et al* 1998). The perception of messages may differ markedly according to different emphasis on different aspects, and may lead to community outrage (Sandman *et al* 1993). "Oneway" information, as compared to bidirectional communication, may enhance this. On the other hand, information needed is different before, during and after an event (whether a decision is to be made or e.g. in connection with an accident), and this will have impact upon possibilities for communication versus information (Curado 1996, Waldahl 1995).

Audience segmentation for the purpose of advertising is common. No commercial firm will use resources to address irrelevant consumers. Public governmental information shall on the other hand be general. Neighbours to a nuclear waste disposal need other messages than do officials in the Ministry to pay for it, and in cases of nuclear emergencies it is obvious that a mother of young children needs another type of information than a civil servant. Different messages must be tailored to different receivers.

CONCLUSION

The four case studies have not examined the same problems. Nevertheless, they are focusing segments of the population experiencing or perceiving an actual or future radiation or nuclear risk larger than the average citizen. The studies show problems in addressing those groups, and with different solutions in the four countries. No definite answer can be given as to which approach is the most rewarding. A multitude of factors may contribute to any success. It seems, however, that an increased emphasis on communication and public involvement versus information alone is considered important. The situations reported cannot be said to have achieved effective public involvement. Indeed, in the siting cases, it may be hypothesized that the contradiction between stated intentions to involve the public, and the actual opportunities for (unorganized) residents to make themselves heard, may contribute to tension and detract from credibility. Still, the trends observed in these case studies toward more consideration by authorities of communication needs, should be welcomed.

REFERENCES

- Barthe Y, Mays C: High profile and deep strategy: communication and information practices in France's underground laboratory siting process. A RISKPERCOM national case study on communication and radioactive waste management.
Note Technique SEGR/98 n° 18. IPSN, Paris 1998
- Cebrián Lindström AL, Prades López A, Solá Farré R: The communication strategy of a Spanish institution around radioactive waste. A RISKPERCOM Case Study.
Report, CIEMAT, Madrid 1998
- Curado MP: The communication of radiological risk to populations exposed to a radiological accident: Considerations concerning the accident in Goiânia.
Radiat Prot Dosim 68:283-286,1996
- Halvorsen B, Kristiansen AC, Vedam LM: Deponi for lavt- og middelaktivt avfall - et overgrep mot livet i Himdalen (Disposal facility for low and intermediate level waste - an encroachment upon life in Himdalen)? In Norwegian.
Stabekk høyskole, Bekkestua 1994
- Heiman M: From «Not in my backyard!» to «Not in anybody's backyard!». Grassroots challenge to hazardous waste facility siting.
J Am Plann Ass 56:359-362,1990
- Hernes G, Fremo S, Larsen R, Mellum L, Oltedal A: Informasjonskriser (Information crises). In Norwegian. NOU 1986:19.
Universitetsforlaget, Oslo 1986
- Mays C: Another view... and another: Impact of management framework on public perceptions of nuclear waste. In: Proceedings: Opinion 96, International Conference on Public Perception of the Nuclear Power Industry.
British Nuclear Industry Forum, London 1996
- Nilsson Å, Reitan JB, Tønnessen A, Waldahl R: Radiation and other risk issues in Norwegian newspapers ten years after Chernobyl.
StrålevernRapport 1997:8. Statens strålevern, Østerås 1997
- NRPA: The Norwegian combined disposal and storage facility for low and intermediate level waste - Now in operation.
NRPA Bulletin 1.99. Statens strålevern, Østerås 1999
- O'Keefe DJ: Persuasion. Theory and research. Current communication Vol. 2.
Sage publications, Newbury Park 1990
- Reitan JB, Mays C, Menard M, Sjöberg L, af Wåhlberg A: A European perspective on radiation risk and nuclear safety information. A RISKPERCOM study.
StrålevernRapport 1998:11. Statens strålevern, Østerås 1998

- Sandman PM, Miller PM, Johnson BB, Weinstein ND: Agency communication, community outrage, and perception of risk: Three simulation experiments.
Risk analysis 13:585-598,1993
- Sjöberg L, Viklund M, Truedsson J: Attitudes and opposition in siting a high level nuclear waste repository. *Rhizikon, Report 32, Center for Risk Research, Stockholm 1998*
- Slater MD: Choosing audience segmentation strategies and methods for health communication. In: Maibach E, Parrott RL (Eds): Designing health messages. Approaches from communication theory and public health practice. Pp 186-198.
Sage publications, Thousand Oaks, 1995
- Tønnessen A, Skuterud L, Panova J, Travnikova IG, Strand P, Balonov MI: Personal use of countermeasures seen in a coping perspective. Could the development of expedient countermeasures as a repertoire in the population, optimise coping and promote positive outcome expectancies, when exposed to a contamination threat?
Radiat Prot Dosim 68:261-266,1996
- Tønnessen A, Reitan JB, Strand P, Waldahl R, Weisæth L: Radiation risk perception in Norway ten years after Chernobyl: Effects of commemoration and living in an area especially affected by fallout.
StrålevernRapport 1999:8. Statens strålevern, Østerås 1999 (In press)
- Waldahl R: Public information strategies.
Radiat Prot Dosim 62:107-111,1995
- WATRP: Norwegian work on establishing a combined storage and disposal facility for low and intermediate level waste.
StrålevernRapport 1995:10. Statens strålevern, Østerås 1995