OECD PROCEEDINGS

The Societal Aspects of Decision Making in Complex Radiological Situations

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
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NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consist of all OECD Member countries, except New Zealand and Poland. The Commission of the European Communities takes part in the work of the Agency.

The primary objective of the NEA is to promote co-operation among the governments of its participating countries in furthering the development of nuclear power as a safe, environmentally acceptable and economic energy source.

This is achieved by:

- *encouraging harmonization of national regulatory policies and practices, with particular reference to the safety of nuclear installations, protection of man against ionising radiation and preservation of the environment, radioactive waste management, and nuclear third party liability and insurance;*
- *assessing the contribution of nuclear power to the overall energy supply by keeping under review the technical and economic aspects of nuclear power growth and forecasting demand and supply for the different phases of the nuclear fuel cycle;*
- *developing exchanges of scientific and technical information particularly through participation in common services;*
- *setting up international research and development programmes and joint undertakings.*

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has concluded a Co-operation Agreement, as well as with other international organisations in the nuclear field.

FOREWORD

In its 1994 collective opinion, *Radiation Protection Today and Tomorrow,* the NEA Committee on Radiation Protection and Public Health (CRPPH) noted that society is showing an increasing concern with decisions affecting the life and well-being of its members, and is demanding to be involved in the decision-making process. This tendency is particularly evident in matters concerning the protection of human health and the environment. In particular, the CRPPH noted that "decision making in several areas of radiation protection can less and less be made in isolation from its social dimensions".

The CRPPH considered this issue at its March 1996 meeting, and felt that it could help improve the quality of the decision-making process by exploring how to identify public concerns (and the driving force behind those concerns), and how to include them in the decision-making process. Work was to focus on "real world" problems currently faced by the radiation protection community, notably chronic exposure to radiation resulting from a major accident or from past practices.

The CRPPH proceeded to create the Working Group on Societal Aspects of Radiation Protection (WGSA), including social scientists with appropriate experience, and entrusted it with the task of preparing a paper for consideration at its April 1997 meeting. The paper, "NEA Workshop on the Societal Aspects of Decision Making in Complex Radiological Situations" NEA/SAN/DOC(97)17/RV7 set forth the following remarks:

- For a major decision to be equitable and accepted, appropriate mechanisms must be found to involve affected members of the public in the decision-making process starting from its early stages. A foremost concern or requirement of members of the public is to have some degree of control over decisions which can affect their lives.

- In a radiological event, risk can include radiation consequences, post-event trauma and economic impacts. All of these impacts must be included in an ethical analysis, made transparent and managed in terms of uncertainty, consent and compensations in a process leading to solution development.

- The concept of "return to normality", *i.e.* the return to conditions as they existed prior to the situation leading to chronic exposure, may not be possible. In such instances, the focus should be on improvement of living conditions and the quality of life, the purpose being to allow affected populations to establish living conditions and restrictions which are accepted by them.

- The resolution process can be divided into three broad stages: a) analysis of the problem, b) development of a programme to improve living conditions through decisions negotiated by all parties concerned and, c) independent monitoring of the programme's implementation and results.

- The basis for differences between public dose limits for practices and the various reference and action levels associated with intervention are difficult to explain and justify, especially to members of the public. This raises the question of whether the present system of radiological protection needs further refinement, particularly with respect to how dose/risk criteria and related policies should be developed and applied at the national and local levels.

- Generally, the role of the radiological protection expert is to define risk and its consequences, as well as the impact of options to mitigate consequences in situations involving chronic exposure. As such, the expert can be an advisor, and sometimes an educator, to both the public and the authorities in the decision-making process. However, the role of the expert too often becomes confused with the function of governmental authority. Guidance on the role of radiation protection specialists, as experts in the decision-making process should be further developed.

- In a complex democratic society, responsibility to achieve ethical and equitable decision making is typically vested in a governmental authority. The role of such an authority is complex, involving orchestrating a process whereby various experts and the public are engaged in the assessment of problems, the development of options and the selection of an option for implementation. In the end, the authority must arrive at a solution, often the result of negotiation, which is accepted as the best fit for the circumstances. It would be beneficial to elaborate on the complex nature of the role of the governmental authority in situations involving intervention and chronic exposure situations resulting from accidents or past practices.

- The media undoubtedly influence public concerns and reactions to radiation risk. It would be useful to provide some insight into how the media influences public attitudes and the degree of that influence.

- A review of a number of case studies involving chronic exposures resulting from accidents and past practices should provide insights into what works well and what does not in different kinds of settings and situations.

In order to discuss these issues in detail, in January 1998 the WGSA held its proposed workshop on the societal aspects of decision making in complex radiological situations. The objectives of the workshop were defined as follows:

- to improve radiation protection specialists' understanding of the societal dimensions of major decisions involving radiation risk;

- to illustrate the dynamics of public health policy, its decision-making process, and the role of the radiation protection specialist;

- to identify potential areas where the system of radiological protection and its implementing infrastructure might be modified to facilitate the decision-making process.

The scope of the workshop was to cover intervention situations involving long-term chronic exposure. The workshop was hosted by the Swiss Nuclear Safety Inspectorate (HSK) at its headquarters in Villigen, Switzerland. The members of the WGSA responsible for preparing the workshop were:

- Dr. S. Prêtre, HSK, Switzerland (Chairman);
- Mr. J.L. Butragueno, CSN, Spain;
- Mr. R. Cunningham, Rapporteur, United States;
- Dr. A.J. Gonzalez, IAEA;
- Mr. G.F. Heriard Dubreuil, Mutadis Consultants, France;
- Mr. C.R. Jones, United States Department of Energy, United States;
- Dr. T. Lazo, OECD/NEA;
- Dr. T. O'Flaherty, Radiological Protection Institute of Ireland, Ireland;
- Mr. T. Schneider, CEPN, France;
- Prof. L. Sjöberg, Stockholm School of Economics, Sweden;
- Dr. P. Smeesters, SPRI, Belgium.

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DECISION-MAKING IN ABNORMAL RADIOLOGICAL SITUATIONS

by

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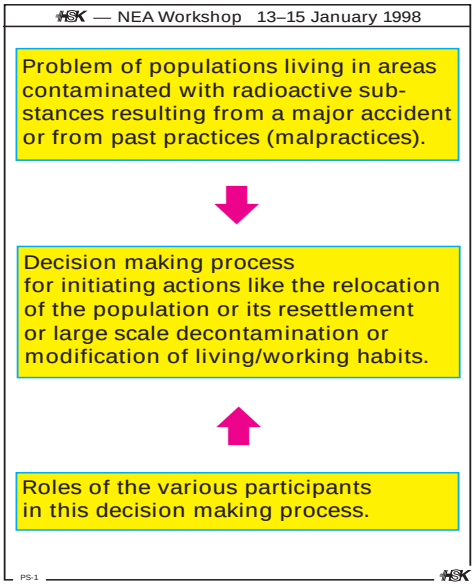
Introduction

To launch this workshop I would like to present – sometimes in a provocative way – the main ideas which have been discussed in the CRPPH – Working Group on Societal Aspects. These ideas have emerged mainly after it became evident that the post-Chernobyl contamination has caused an enormous societal problem. But Chernobyl is not the only example, as this workshop will show.

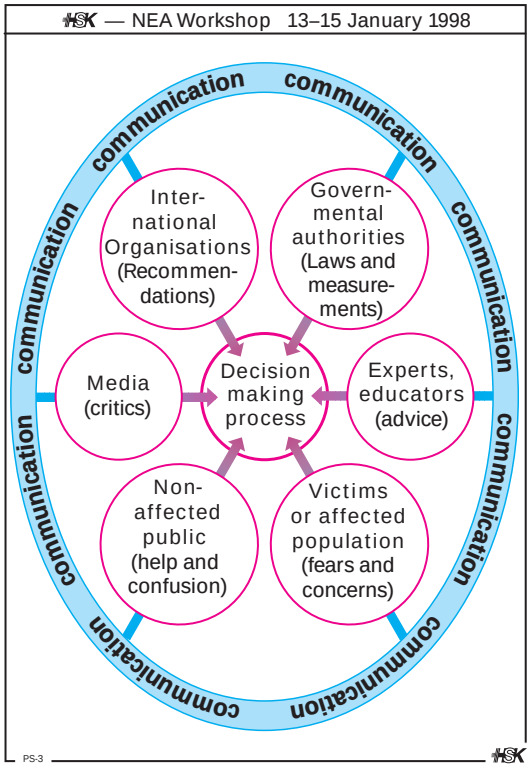
For this keynote address, 18 flipcharts were prepared and became its support. I will present them in what follows and accompany them by comment.

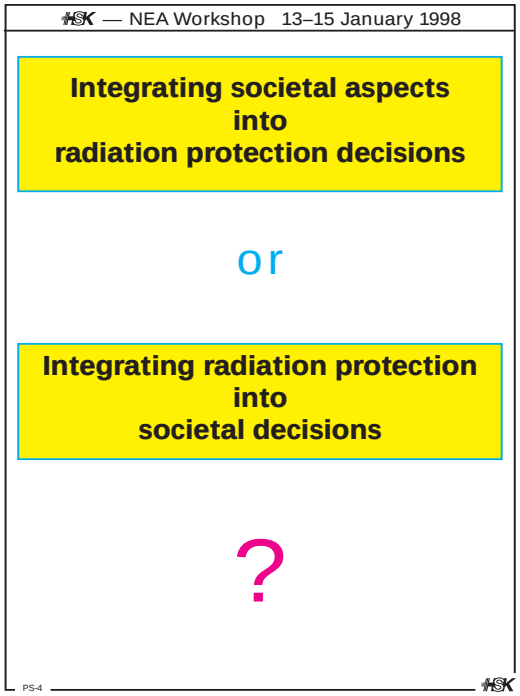


The theme of this workshop is presented: a difficult decision making process. It is influenced by the radiological situation on one side and by the participants in this process on the other side.

The difficulties in making decisions in abnormal radiological situations and even greater difficulties to implement them, are recognized. People do not agree on the proposed explanations. After Chernobyl many superficial explanations were suggested in order to avoid the recognition of the fact that it is a deep societal problem.

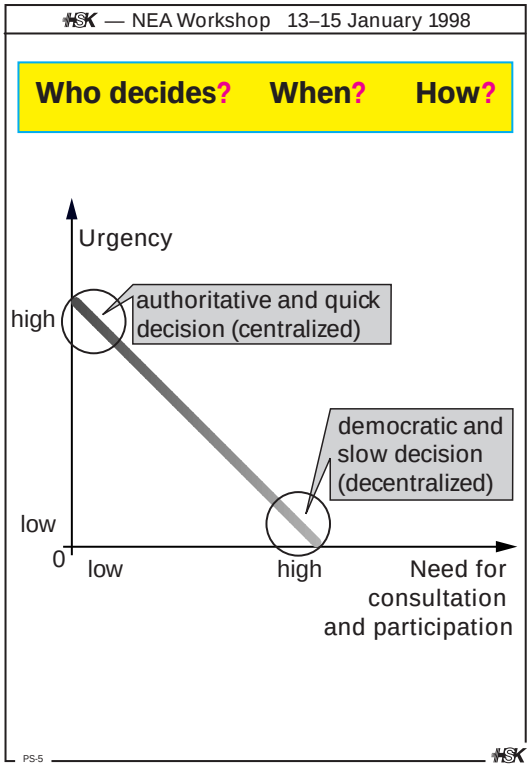
Six quite different groups of persons will influence, in some way, the decision making process. Their influence might appear at different times. Some will act quickly and others will react much later. The chart indicates what elements these groups can bring into the decision making process.





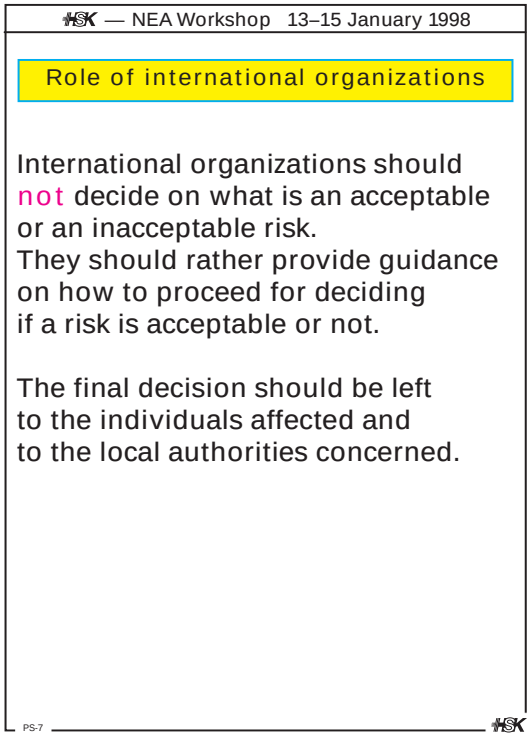
There has always been the tendency of the radiation protection community to take the leading role in every situation where radiation protection has some role to play. Here it is asked if the leading role should not be left to the sociologists.

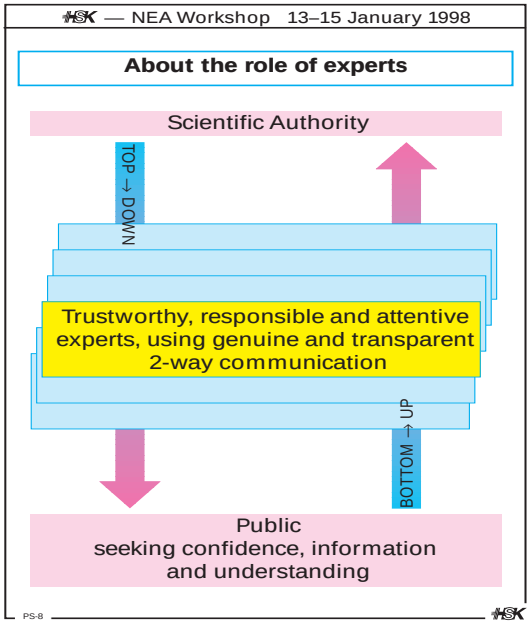
At the beginning of a crisis provoked by the radiological contamination of a region, it is broadly accepted that if urgent decisions are needed, they should be taken quickly. This means that they will be authoritative and be taken by a centralized organization (emergency center or emergency board). After some days or weeks, the situation will not be so urgent anymore and time will become available for consulting various societal groups concerned. Therefore, later decisions should be taken in a more democratic way.



"Decentralize!" means that the leading role in the management of the crisis should be left to local authorities. The emergency organization of the central government will have difficulties to give up the lead function and to accept that local authorities, which are probably less competent in the field of radiation protection, react in several different ways to the contamination problem. These many solutions might give the global impression of heterogeneous and disharmonized actions. In compensation for this drawback there will be much more acceptance of the decisions. The more competent persons of the central emergency organization could continue to be very useful by advising the local authorities. The point is: they should only advise and not decide!

The principle of "optimization of protection" recommended by ICRP and IAEA leaves the door open for local decisions that might diverge one from the other. It is an excellent basis for successfully managing an abnormal radiological situation. What has created a problem in every case being presented at this workshop is the dose limit of 1 mSv/year. Although this limit was not intended to be used for managing a large scale land contamination, it defines, indirectly, a limit between acceptable and unacceptable risk. The Chernobyl case, the Marshall Islands case and the East Germany case would have been more easier managed if this famous limit had never existed. This suggests that international organizations should be more cautious in their recommendations and should also avoid giving numerical limits.

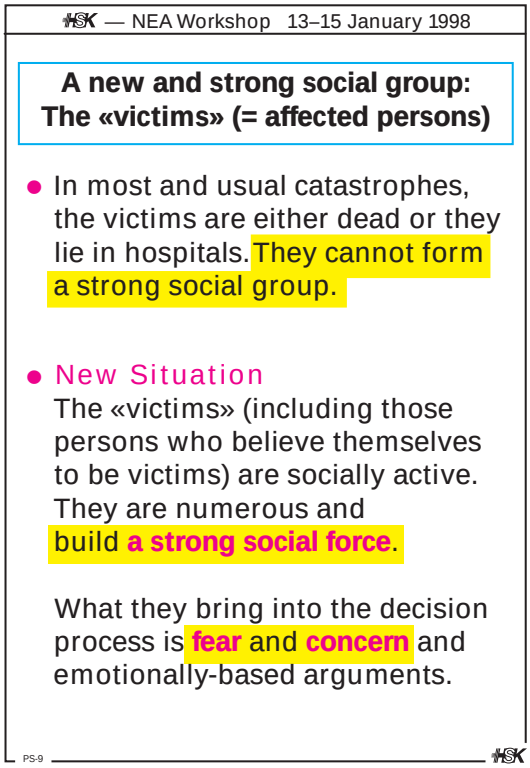


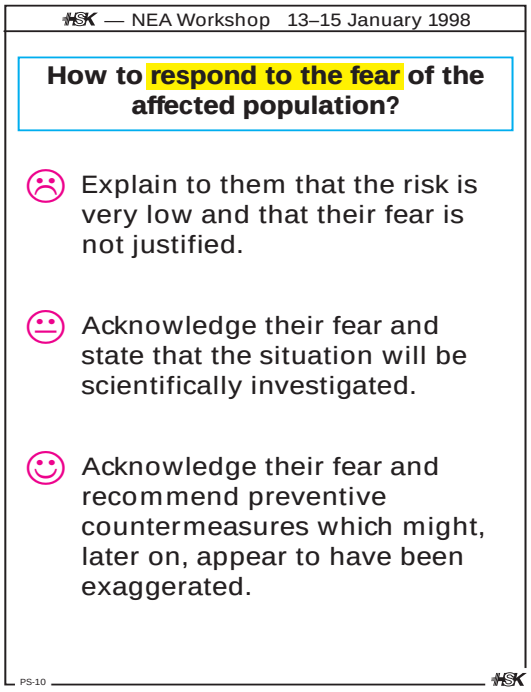


As experts can never fully agree between themselves they might perturb the population and create confusion and distrust. A good procedure for the local population seeking confidence and truth could be the following: bring together some experts from different organizations and different opinions and let them debate the problem between themselves. Local authorities and members of the affected public should assist in this discussion. After one or two days of observation, the concerned persons will know which expert they want to believe!

In an abnormal radiological situation like the one we discuss in this workshop there are many persons who believe themselves to be victims. A victim is anyone having received a certain “abnormal” dose and now believes it be a potential cancer case. With this definition, the number of victims is very high and together they build a strong social group.

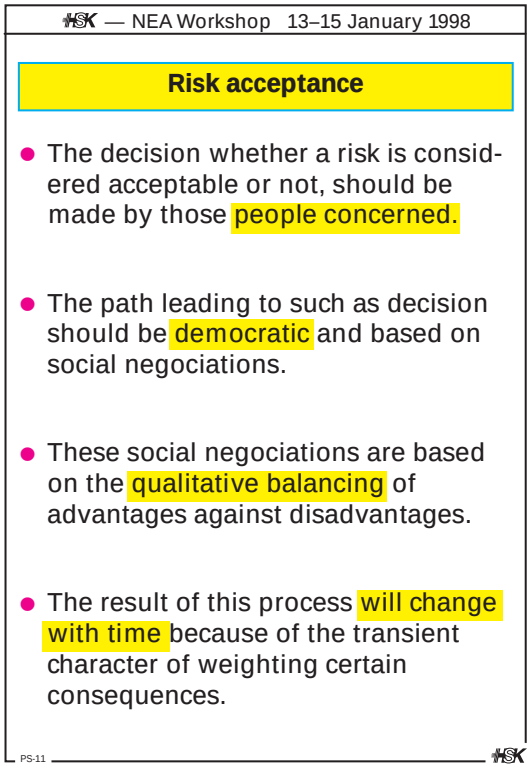
This situation is new as compared to usual or so called conventional catastrophes. In most conventional catastrophes it is mainly quite clear for everybody to decide or to understand who is a victim and who is not. Usually the group of victims does not constitute a strong social force.

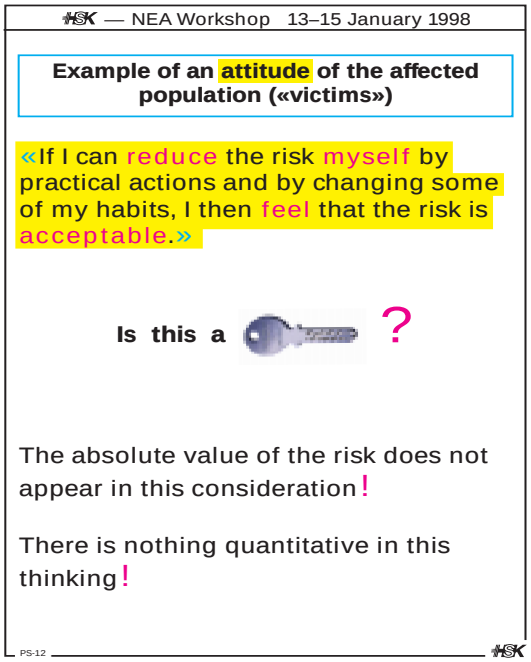




What the victims bring with them is their fear and concerns. They are concerned by their higher probability of cancer and by the effects that radiation could have on their children. How should authorities react to this fear? The explanation stating that the risk is very low and that their fear is not justified is always rejected and considered to be a lie or a lack of respect. In order to acknowledge the fear of the population and to respect it, some protective action should be initiated and accompanied by a scientific investigation of the situation. Such a response will awake confidence and should be applied, even if the risk is very low.

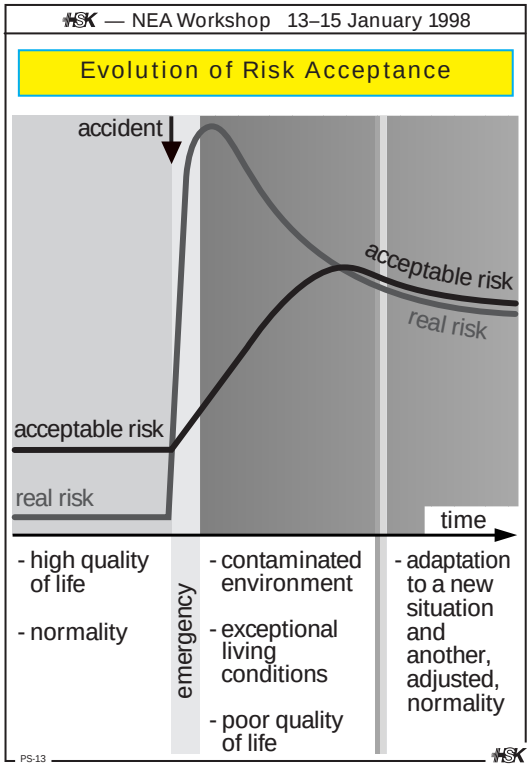
The process of risk acceptance is not an abstract intellectual decision. It is strongly connected to the real situation and is the result of an emotional balancing of advantages against disadvantages. With the progression of time some advantages or disadvantages might become more or less important and thus modify the balance. Therefore, a situation, which in earlier times was totally unacceptable, might become acceptable.

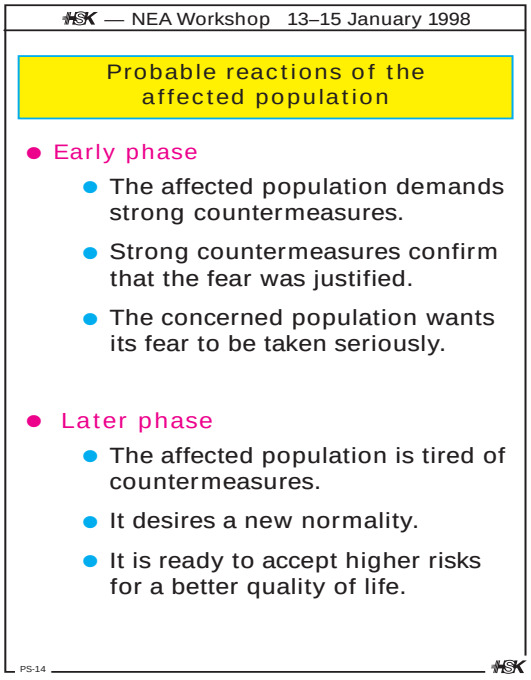




One key element of risk acceptance is connected to the fact that the considered person can improve the situation by some practical action. This person develops the feeling that the risk has become acceptable because he or she has done something to reduce it.

During the early phase of a radiological emergency, the real risk grows and becomes higher than the acceptable risk. This leads to diverse protective actions, exceptional living conditions and thus a lessened quality of life. As the time for a return to the previous conditions is too long, the population evolves through a mental adaptation process and builds another adjusted normality. By this it shows its inner willingness to accept a higher risk as a trade-off for a better quality of life and for the feeling that the situation has reached a new normality.

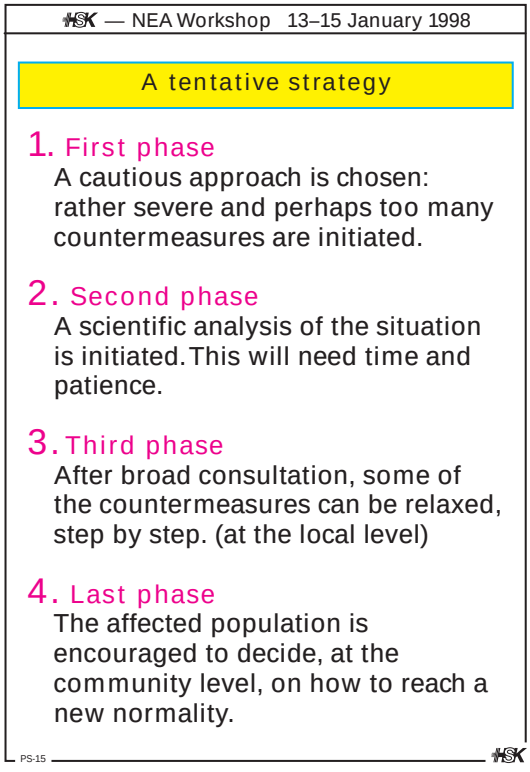


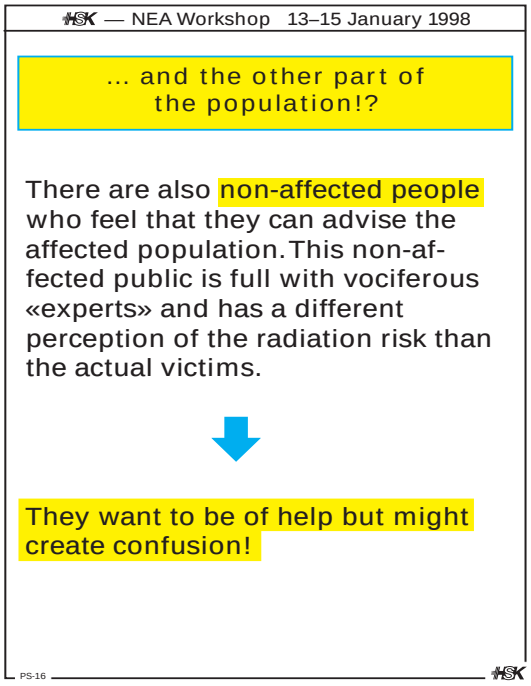


Let's take an example:

It can be expected that during the early phase the affected population will ask to be relocated. If the relocation is performed, it is very probable that in a later phase, the same population will wish to return to the towns and villages where it used to live. Both reactions could be fairly independent of the level of the contamination.

This strategy was already developed 30 years ago on an intuitive basis. But such a strategy is expensive in the first phase and provokes a tremendous reaction by the economical groups concerned (*e.g.* food processing and food distribution companies). It needs a high degree of political courage and a very good liability insurance to recommend the ban of a foodstuff when its contamination is probably leading to a calculated risk which is, seen objectively, very small. But in the long run, we are persuaded that this strategy is economically the cheapest because it helps to keep the crisis within a relatively short duration.

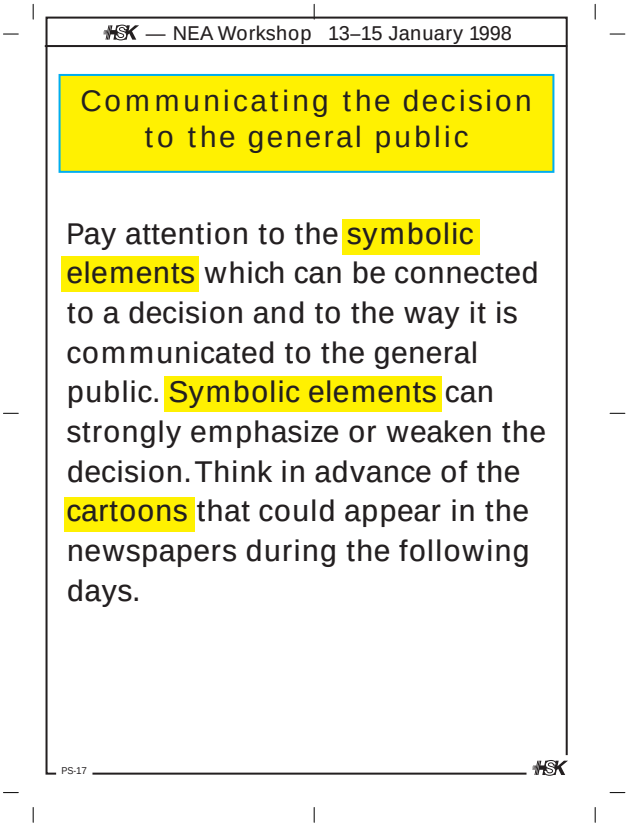


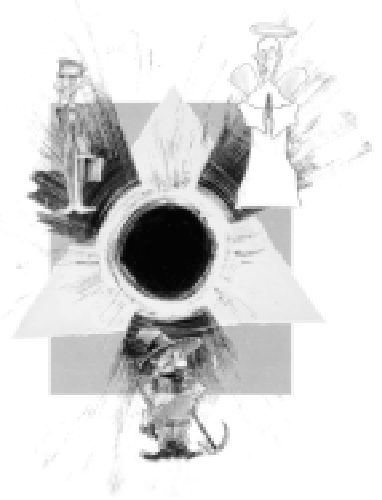


There are concerned people who are not affected by the radiological situation and also not affected by the socio-economic consequence of the crisis. These people believe that they know what the government should do and what the affected population should do. They will produce an avalanche of advice that might provoke more confusion than help. The reason is that they perceive the risk intellectually, and from far away, compared to the emotional risk perception of the true victims. This perturbation will not be so important if the affected population is fully supporting its own decisions.

Whatever the decision is, it will have to be communicated to the general public. Care should be taken to potential symbolic aspects like: – The person presenting the decision to the media should have a function which cannot be negatively connected to the decision itself. – The day of the communication of the decision should not be an anniversary which can be connected negatively to the decision. – The explanation of the reasons for the decision should be credible and evoke confidence. – It is important to state clearly that this decision represents the will of the affected population.

Respect, understanding and trust should accompany this communication process.





and how is the inclination of your public? What do they put first:

Freedom? Order? Purity?

In every country, in every region, and at a given time, the society is basically composed by a mixture of 3 sub-societies (theory of Mary Douglas): the sub-society for which freedom is the most important; the sub-society for which order is the most important; and, finally, the third sub-society for which purity is the most important. The relative importance of each group and the fact that 2 groups will usually form a coalition against the third will determine the risk acceptance inclination of that society. This inclination will influence the decision and the way it should be presented to the public.

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THE DECISION-MAKING PROCESS IN RETURNING RELOCATED POPULATIONS TO THE MARSHALL ISLANDS

by

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Introduction

Between 1946 and 1958, the United States conducted a nuclear weapons testing program in the northern Marshall Islands, detonating 66 nuclear weapons at Bikini and Enewetak. The indigenous populations at Bikini and Enewetak Atolls were evacuated prior to the initiation of testing at these respective atolls. In the beginning of nuclear testing from 1946 until 1954, 41 of these atmospheric nuclear detonations were atomic fission devices of low yield (20-500 kilotons). Fallout in these cases were typically distributed within a few miles of the detonation.

Beginning with Operation Ivy in 1953 and continuing to the end of testing in 1958, the remaining 25 nuclear tests were thermonuclear fission:fusion devices of high yield (1-15 megatons) with fallout distributed within 10s to 100s of miles from the detonation. Six of these 25 tests were detonated as part of the 1954 Operation Castle series. One of these tests was detonated on March 1, 1954 and was code named “Castle Bravo.” This 15-megaton thermonuclear Bravo device at Bikini resulted in the inadvertent deposition of radioactive fallout on the 253 inhabitants of Rongelap and Utirik atolls. The Rongelap and Utirik populations had not been evacuated prior to this test designed to detonate at about 5 megatons. The three-fold increase in yield greatly increased both the amount of fallout created and the distance the fallout traveled in the stratosphere – both much greater than expected.

65 Rongelap individuals received whole body fallout doses of about 1.8 sievert (180 rem), 18 Ailinginae individuals received whole body doses of about 0.7 sievert (70 rem), and 157 Marshallese individuals at Utirik received a whole body fallout doses of about 0.14 sievert (14 rem.)

Current DOE Activities

From 1956 to the present, the U.S. Department of Energy (DOE) and its predecessor agencies have provided special medical surveillance and treatment of radiation-related injury and illness for the surviving members of the populations of Rongelap and Utirik exposed during the “Bravo” test.

In addition, DOE conducts environmental and radiological monitoring and performs agricultural research studies to characterize the radioactivity remaining at the four atolls of Bikini, Enewetak, Rongelap, and Utirik in the aftermath of the 1946-58 U.S. nuclear testing program.

These activities provide vital health information and environmental data to those Marshallese who have already returned to their "home" atoll (Enewetak and Utirik) and to those communities which are assessing the prospects for resettlement (Bikini, and Rongelap). Various national and international groups addressing Republic of the Marshall Islands (RMI) concerns over the years have identified and scoped the needs of such studies. The Marshall Islands environmental monitoring program has provided valuable data for use by the international scientific community in better understanding the transport and uptake of residual environmental contamination, its incorporation into the food, water and aquatic chains and the factors that affect environmental half-life, and reduction of contamination levels by various mitigation strategies.

Special Medical Care for the Rongelap and Utirik Exposed

Medical surveillance and care of the Rongelap and Utirik exposed populations has been ongoing since 1954 and began immediately after Test Bravo in 1954 when the exposed Marshallese were seen and treated by U.S. physicians at Kwajalein Atoll. From its inception, the primary objective of the DOE Marshall Islands Medical Program has been the early detection and treatment of any medical condition in the remaining members of the exposed populations of Rongelap and Utirik that might evolve as a consequence of radiation exposures resulting from the "Bravo" fallout.

This program has been run by the Department (and its predecessor agencies) with the support of Brookhaven National Laboratory (BNL). BNL physicians first began to treat the exposed populations of Rongelap, Utirik, and Ailinginae atolls shortly after the "Bravo" test. A medical team from BNL, supplemented by physicians and health professionals from academic centers and other Federal agencies, has provided ongoing medical surveillance and treatment programs ever since.

Environmental Monitoring and Residual Radionuclide Mitigation Programs

The U.S. government conducted monitoring for surface fallout levels and cloud sampling of the fallout from nuclear tests from 1946 until the end of the nuclear testing period. Such U.S. government testing was greatly intensified after the detonation of Castle Bravo. In 1978, the U.S. Government conducted aerial and ground surveys on 11 atolls and 2 islands thought to have received the most significant portions of fallout from the testing era.

DOE and its predecessor agencies have conducted detailed environmental monitoring and agricultural research studies that have been carried out for many years by the Lawrence Livermore National Laboratory (LLNL). These DOE programs commenced about 1972. These have been done to determine the radiological conditions at four atolls in the northern portion of the Marshall Islands. Doses have been estimated for the populations most affected by the fallout from the atmospheric nuclear weapons testing in the 1950s in the Marshall Islands.

Whole-Body Counting and Bioassay Dose Assessment Programs

The Department of Energy has conducted whole body counting on the four most affected atolls of Bikini, Enewetak, Rongelap and Utirik since the late 1950s. DOE currently conducts whole-body counting and urine bioassay monitoring programs at Enewetak each year. Committed and annual effective dose equivalents to populations or individuals are assessed from internally deposited radionuclides. Permanent installation of DOE whole-body counting equipment at Enewetak has facilitated whole-body counting for a larger segment of the Enewetak population at each visit.

In addition, baselines are being established for those individuals who plan to return to the atolls of Bikini and Rongelap previously contaminated during the atmospheric weapons testing era. These baselines help to document if individuals have any residual ^{137}Cs or $^{239+240}Pu$ from prior exposure so that any ingested or inhaled contaminants can be more easily assessed.

Scientific Goals of the DOE Programs

The DOE scientific goals include the recommendation of mitigation strategies to reduce dose, implementation of needed technical assistance and support, enhancement of community infrastructure and commitment to more effective community-based medical systems, and environmental monitoring and dose assessment processes. This includes providing environmental monitoring data to help affected communities make informed resettlement decisions.

To accomplish these important tasks, DOE has utilized the technical expertise and ability of the contractor DOE laboratories. At the Lawrence Livermore National Laboratory (LLNL), a world-class environmental monitoring and dose assessment capability has been evolved which has the capacity to turn around more environmental monitoring samples than most other such laboratories all over the world. This laboratory capability is constantly cross-calibrated with the best international environmental laboratories world-wide.

At the Brookhaven National Laboratory (BNL), a fission track assay technology has been developed and used for the past 5 years to monitor for plutonium in urine for resettled population at Enewetak. Within the past year, BNL has developed an even better inductively coupled plasma mass spectrometry(ICP/MS) technology that will soon enable a cheaper and more accurate plutonium bioassay process that will permit detection of plutonium at the near environmental sensitivity of 1.5 FBq (40 aCi). This will facilitate the broader application of such monitoring for other resettling populations at Bikini and Rongelap.

Authority for the DOE Marshall Islands Program

The Department conducts its Marshall Islands Program under the authority of the Compact of Free Association Act of 1985, Pub. L. No. 99-239 (“COFAA”), Public Laws 95-134 and 96-205, and annual congressional appropriations made directly to DOE in defense-related funding statutes.

Special Medical Care. Section 103(h) of COFAA directs that:

“... the President (either through an appropriate department or agency of the United States or by contract with a United States firm) shall continue to provide special medical care and logistical support thereto to the remaining 174 members of the population of Rongelap and Utirik who were

exposed to radiation resulting from the 1954 United States thermonuclear "Bravo" test, pursuant to Public Laws 95-134 and 96-205."[1]

Public Law 95-134, enacted in 1977, directs the Secretary of the Interior to provide, for the populations residing on Rongelap and Utirik on March 1, 1954, "adequate medical care and treatment ... of any radiation injury or illness directly related to the ["Bravo"] thermonuclear detonation ..." Section 104(a)(4) of Public Law 95-134 goes on to state that "the costs of such medical care and treatment shall be assumed by the Administrator of the Energy Research and Development Administration", a predecessor of the U.S. Department of Energy.[2]

Environmental Monitoring and Dose Assessment. Section 106(a)(2) of Public Law 96-205, enacted in 1980, mandates for Bikini, Enewetak, Rongelap and Utirik a program of "environmental research and monitoring" which includes

"... the periodic comprehensive survey and analysis of the radiological status of the atolls to and at appropriate intervals, but not less frequently than once every five years, the development of an updated radiation dose assessment, together with an estimate of the risks associated with the predicted human exposure, for each such atoll."

Congressional Appropriations for the DOE Marshall Islands Programs

Funding for the Marshall Islands Program is appropriated directly to DOE by the U.S. Senate Committee on Energy and Natural Resources. The program has been level funded at $6.8 million for the past three years, is currently funded at that level in fiscal year 1998, and is budgeted for the same level in fiscal year 1999. These funds are specifically earmarked for the medical surveillance and care of the remaining Rongelap and Utirik exposed population, as well as for the environmental monitoring and dose assessment activities of the Department. Progress is monitored closely by the U.S. Congress to ensure that these departmental activities meet joint U.S. government/RMI needs and priorities.

Assessment of the Effectiveness of DOE's Activities

Medical Surveillance and Care

The Department provides special medical care to the 130 currently living, exposed Rongelap and Utirik population and a comparison population of 107 Marshallese who were residents of the affected atolls, but were not exposed to the "Bravo" fallout (being elsewhere at the time of the

1. The surviving members of the exposed population of Rongelap and Utirik currently number 130 individuals.

2. The second statute cited in the 1985 Act, Public Law 96-205, addresses (1) the entire 1946-58 nuclear testing program rather than the 1954 "Bravo" test, (2) the atolls of Bikini and Enewetak, in addition to Rongelap and Utirik, and (3) environmental research and monitoring as well as medical care "for any injury, illness or condition which may be the result directly or indirectly of [the 1946-58] nuclear weapons testing program." (Pub. L. No. 95-206, section 106(a))

1954 test). Such special medical care includes primary and secondary medical care for all patients and tertiary medical care for those exposed patients who need diagnostic care and medical treatment for radiation related diseases that cannot be provided in the Marshall Islands.

The current DOE medical program for the exposed Rongelap and Utirik communities is expensive to deliver. DOE expends about $2.5 million per year on its medical surveillance and treatment program. As the DOE patient population ages (even as their numbers decline), additional medical care needs have, and will continue to, drive patient care and overall program costs upward.

From its inception, DOE's medical program has been delivered biannually by teams of physicians consisting of BNL employees supplemented with volunteer medical specialists. In 1995, DOE began to transition from biannual vessel-based medical missions to biannual land-based missions. The land-based approach makes available at existing medical facilities in the Marshall Islands (the contractor-operated medical facility at U.S. Army Kwajalein Atoll (USAKA) more sophisticated diagnostic equipment and improved laboratory capabilities, and facilities to perform some surgical procedures that previously had to be performed in Honolulu, Hawaii.

Presently, the Department is competitively bidding the special medical care program to find an awardee who can provide continuous on-island care, that is community-based, and delivered in the context of a program that spends more of the allocated budget on medical services rather than logistical support. At the same time, the new awardee will be encouraged to help build community health care infrastructure and enhance training and involvement of Marshallese health care personnel in the delivery of needed medical services.

Environmental Monitoring

Since 1988, the environmental monitoring program has stepped up its output to about 5 000 soil, water, and vegetation samples per year that are analyzed for the presence of $^{239}Pu/^{240}Pu$, ^{241}Am, ^{137}Cs, and ^{90}Sr as the predominant radionuclides monitored. Environmental monitoring has been done predominantly at Bikini, Enewetak, Rongelap, and Utirik, but other smaller atolls such as Ujelang, Bikar, Ailinginae, and Rongerik have also been environmentally characterized.

The environmental monitoring process is comprised of field sample collection, laboratory processing of samples, gamma spectrometry counting, wet chemistry preparation, and data base management and evaluation. The gamma spectrometry facility has 18 solid-state gamma spectrometers connected to a sophisticated bank of computers. Such a large scale output requires an extensive effort to complete analytical and data evaluation on a large throughput of sample data that must be completed prior to the next field mission.

In addition, agricultural research studies on local plants and food products, as well as planted agricultural products at Bikini Island, have provided important mitigation strategies that help to reduce the uptake of radionuclides in food products.

Whole Body Counting

Whole-body counting missions have been conducted by DOE since the late 1960s. With the installation of a whole-body counter at Enewetak in 1995, it is now possible to do more complete whole-body counting for the approximately 1 000 Enewetakese currently resettled on Enewetak

Island. Whole-body counting is conducted by local missions to Enewetak on an annual basis. DOE is also assisting Bikini and Rongelap in evaluating whole-body counting needs for their future resettlement initiatives.

This whole-body counting and urine bioassay dose assessment program includes the ability to perform whole-body counting and to design, organize, and conduct urine bioassay for exposed populations. These technologies can be used to quantify known radionuclides or to identify radionuclides both in the Marshall Islands, as well as in other areas of the world.

The whole-body counting program has developed and maintains a field-ready capability for whole-body counting. State-of-the-art equipment facilitates reliable radionuclide identification and quantification of internally deposited radionuclides.

Calibration, operating, and quality assurance procedures are available for application of these techniques to all age groups. Annual and committed effective dose equivalents are calculated based on models given in International Commission on Radiological Protection Publication 56.

The whole-body counting program's capability includes data interpretation and dose assessments for individual or population groups based on whole body counting or excreta analysis.

Plutonium Urine Bioassay

DOE has developed one of the world's most sensitive plutonium (Pu) bioassay techniques known as "fission track assay" which permits the assessment of dose at or near background levels. This analytical procedure has permitted over the past 4-5 years, the monitoring of Marshallese currently living on atoll islands which still have some residual Pu contamination. The dose to such Pu exposure is relatively low, amounting to only about 80-100 FSv (8-10 millirem/year) above normal background levels. Sample analyses on an annual basis vary from 250-350 samples per year.

The urine bioassay program is based on a capability to perform the extremely sensitive fission track analytical (FTA) method for ^{239}Pu in urine. The program can analyze about 400 samples per year, with a sensitivity of about 2-4 μBq (54-108 aCi) per sample. Extensive calibration, operation, and quality assurance documentation continues to be developed. A new technology known as inductively coupled plasma mass spectrometry (ICP/MS) has been developed to replace FTA and is being implemented as a cheaper, faster screening technology with similar sensitivity. An independent intercomparison and certification of this new technology has just been completed with excellent results, under an interagency agreement between DOE and NIST.

Field personnel are selected and trained to operate and calibrate field equipment and maintain operating procedures and quality assurance documentation is assured for all activities. Particular emphasis is being placed on sample collection and personnel identification.

Program efforts recently have been focused on improving sensitivity, enhancing accuracy and precision, and ensuring quality assurance and reduced cost per measurement. This will permit application of these dose assessment techniques to larger populations without adding extra cost burdens.

Environmental Monitoring and Residual Radionuclide Mitigation Programs

The contribution of each exposure pathway and radionuclide has been evaluated. Dose assessments show that the major potential contribution to the estimated dose is ^{137}Cs uptake via the terrestrial food chain. ^{137}Cs in the terrestrial food chain accounts for about 90% of the dose at the atolls surveyed by LLNL. These studies also show that the radionuclides remaining today that contribute in any significant way to the estimated dose of ^{137}Cs are ^{90}Sr, $^{239+240}$Pu, and ^{241}Am.

Environmental and dietary models have been developed utilizing as input residual levels of contaminants in samples of soil, vegetation (food crops and natural species), marine species, animals, fowl, and ground and cistern water. Soil samples are dried and with the use of gamma spectroscopy are analyzed for their activity level. Radiochemistry is conducted to determine the amount of $^{239+240}$Pu and its potential contribution to dose. Quality assurance is provided through multiple intercalibration exercises every year with the International Atomic Energy Agency (IAEA), the National Institute of Standards and Technology (NIST), and other organizations throughout the world. The IAEA intercalibration exercises cross-calibrate the LLNL analytical results with other participating laboratories around the world.

Mitigation technologies, such as the use of non-radioactive potassium fertilizer have been developed that can effectively reduce the uptake of ^{137}Cs by foods and plants that prefer the potassium if present. In addition, studies are on-going on the environmental half-life of ^{137}Cs and other radionuclides in the soils and water sources which effectively reduce environmental dose due to gradual natural disappearance of the radionuclides from atoll soils and water tables.

Resettlement of the atolls in order to live at “home” is very important to many of the Marshall Islands people. Decisions by those wishing to resettle are facilitated by providing dose estimates from the environmental monitoring. These realistic dose assessments help to ensure that people are not precluded a priori from going home because of unrealistic, over-conservative dose calculations. In the Marshall Islands, this translates into realistic diet models for estimating the intake of local foods because of the importance of ^{137}Cs uptake in terrestrial foods that subsequently provide the majority of the estimated dose.

Cost to the U.S. Government

The U.S. Government has accepted full responsibility for the land damages and personal health effects associated with the U.S. Government’s atmospheric nuclear testing program in the Marshall Islands. The Compact of Free Association Act of 1986, Public Law 99-239 and its associated Agreement established the Republic of the Marshall Islands as an independent nation, changing its previous status as a U.S. Trust Territory. This previous status had been in existence since the Second World War when the United States liberated the Marshall Islands from Japanese control.

Under the provisions of the Compact of Free Association, each of the four atoll communities of Bikini, Enewetak, Rongelap and Utirik has received resettlement trust funds to assist in the process of resettling in their local atoll communities and to continue to build new infrastructure on their islands. The funding provided to each atoll is: Bikini ($110M), Enewetak ($34M), Rongelap ($43 million by 2002) and Utirik ($23M).

Since 1986, the U.S. Government has invested and assisted the Republic of the Marshall Islands by infusing almost $1 billion dollars to help the Marshallese people establish and operate their

own independent nation. Over $0.5 billion of this was established as a means of compensation for disease and illness associated with radiation exposure and associated land claims from the atmospheric nuclear weapons testing in the Marshall Islands. Per capita, this is the one of the highest overseas foreign aid program of its kind averaging about $2 thousand dollar per person.

Currently, the U.S. Government is providing about $50 million annually to support activities and needs of the Government of the Marshall Islands.

Over the last 12 years, the U.S. Government has provided about $20 million for agricultural support.

$30 million of these funds have been earmarked and have assisted in providing a health care program of the four atolls of Bikini, Enewetak, Rongelap and Utirik who were most affected by the nuclear testing and whose lands are still residually contaminated by the significant fallout associated with the middle to late 1950s thermonuclear weapons tests.

$2 million is provided annually to fund the 177 Health Care Program which continues to provide medical surveillance and care to exposed populations of Bikini, Enewetak, Rongelap and Utirik.

External Independent Scientific Review

National Academy of Sciences Radiological Assessments for Resettlement of Rongelap in the Marshall Islands

From 1992 to 1994, the Department sponsored and funded the National Research Council of the National Academy of Sciences (NAS) Committee on *Radiological Assessments for Resettlement of Rongelap in the Republic of the Marshall Islands*. Their report was published in 1994. This committee visited the Marshall Islands and reviewed the conditions particularly at Rongelap Atoll but their recommendations are pertinent to Bikini Atoll as well. The NAS committee recommended the following remedial actions. Food gathering should be limited to the southern atoll areas. The continued use of imported foods, an important part of the current Marshallese diet, is projected to reduce the update of ^{137}Cs by a factor of five. Surface soils should be removed from the village areas and replaced with soils relatively free of ^{137}Cs, at least to near world-wide background levels. Potassium fertilizer (KCL) should be applied in agricultural areas. The NAS Committee projected that over half of these remedial actions might be relaxed if whole-body burdens are lower than expected, once the populations return and are carefully followed as to their uptake of ^{137}Cs in local foods eaten.

In the post-settlement period, the NAS Committee recommended that each person receive a whole body count and be followed with further whole-body counting if any appreciable ^{137}Cs is detected. It was recommended that a percent of persons be monitored for radionuclide burdens of all potential radionuclides. Baseline urine bioassay samples were recommended for all returning Marshallese. It was further recommended that a central repository of dosimetry and sample data be established and effectively maintained. Lastly, regular medical surveillance was recommended.

International Atomic Energy Agency Review

In 1996, the International Atomic Energy Agency (IAEA), at the Request of the Government of the Republic of the Marshall Islands and the Kili, Ejit, Bikini Local Atoll Local Government Council, undertook a second independent review on Radiological Conditions at Bikini Atoll, Prospects for Resettlement. An interim final report was published in September, 1996, but an additional visit of the IAEA committee to Bikini Atoll in 1997 has resulted in a delay in the final published report. The report is expected to be published in early 1998.

The interim conclusions of the IAEA Committee indicated the following. No further measurements at Bikini are needed. Sufficient environmental data has been obtained on which to make resettlement decisions. There is a need for a limited monitoring program. Remediation is needed and the local resettling population is advised not to eat all local food but to continue to supplement their diet with the imported foods that have become a part of their normal diet. With these remedial measures, limited scraping in village areas and the use of potassium fertilizer to reduce the uptake of ^{137}Cs in local food that is eaten, the IAEA Committee recommended that the Bikinians could resettle on Bikini and Eneu Islands at Bikini Atoll. This includes the regular measurements of foodstuffs. The IAEA Committee cautioned that scraping all soil off Bikini Island and trying to replace this with new soil could have serious environmental impacts, if chosen as an option.

Document Retrieval

The Department of Energy has provided the Government of the Marshall Islands, as part of its openness initiatives, about 60 boxes of hardcopy documents to date. Over one-quarter of these have been recently declassified documents. Over 8 000 of these documents have been digitally scanned and are accessible for word and author search scanning on the world-wide-web through the Office of International Health Programs Web Page. The Web Page URL address is: http://tis-nt.eh.doe.gov/ihp. Click on Marshall Islands within that web page.

The making available of documents relating to atmospheric nuclear weapons testing is part of a Departmental openness effort to make documents available to the public in a readily accessible manner. It is planned to make another 8 000 or so available both in hardcopy and via electronic form each year for at least the next 7 years. At this point it is hoped that all of the some 75 000 documents related to the nuclear testing in the Pacific, now located at the Center for Information and Coordination (CIC) in Las Vegas, Nevada will be publicly released to the Marshall Islands in both hardcopy and electronic form.

The CIC is a jointly funded and operated by the Department of Energy (DOE) and the Department of Defense (DoD) and facilitates public access to some 500 000 documents related to the atmospheric nuclear testing era both on-site and off-site of nuclear weapons detonations. The documents have been and are available to the Public through index searching and a nominal fee for reproduction costs by contacting the CIC at 702-295-0748.

Decision Making Processes to Assist in Resettlement

Medical Care Delivery

The local atoll communities of Rongelap and Utirik have been brought into the process of reinventing the special medical surveillance and care program established by the Compact of Free Association Act of 1986 and administered by the Department of Energy. This involved assisting in the developing the language and provisions contained within a Request of Applications (RFA). The RFA provided potential bidders, a full description and definition of the parts considered essential to a medical care delivery process. The primary emphasis is on a more community based and can assist in primary health care needs on a more year around basis. This sharing process not only included sharing and editing the Request for Application, but also provided the opportunity for dialogue and questions entertained during a public meeting. At this meeting, potential bidders and atoll community members and leaders discussed the proposed Request for Application. Formal input of questions arising out of the public meeting were entertained and later responses to the questions were provided in writing.

The Request for Applications was published in final form in the Federal Register on September 12, 1997, proposals were received by October 27, 1997, and the proposals are currently being evaluated by an independent review panel at the National Institutes of Health. A competitive award in expected is May 1998, with a new awardee beginning to phase in and take over by October 1998.

Environmental Monitoring and Mitigation Strategy Decision Making

The Department of Energy and the Government of the Republic of the Marshall Islands have jointly pursued and funded both independent national and international experts and review bodies to assess the viability of resettlement options. This has included the Department of Energy funded and supported National Academy of Sciences Radiological Assessment of Rongelap in the Marshall Islands culminating in a report published in 1994.

The Government of the Republic of the Marshall Islands and the Kili, Ejit, Bikini Local Atoll Government Council requested and was supported by the International Atomic Energy Agency to undertake a second independent review on Radiological Conditions at Bikini Atoll, Prospects of Resettlement.

Both Bikini and Rongelap Atoll Government Communities also brought in internationally well-known and respected experts to advise them on resettlement options.

The Lawrence Livermore National Laboratory has sponsored visits to their facilities by local atoll government groups to better understand the environmental sample preparation and assessment process that has led to prospective dose assessments and development of mitigation strategies that have been instrumental in helping shape environmental resettlement options.

The Department of Energy has continually met and worked with local atoll communities and officials of the Government of the Republic of the Marshall Islands to develop a more comprehensive understanding of what residual levels still exist in their atoll communities, what

mitigation and resettlement options can be employed to reduce the impact of the residual radionuclides and how best to plan for needed monitoring once the populations begin to resettle.

The U.S. Congress has begun the process and has funded over half of the funding needed to effect the resettlement of Rongelap by the year 2002 and the Rongelap Community is conducting their own planning with the advice and help of U.S. federal agencies as to how to effect needed infrastructure development to permit the beginning of resettlement within the next three years.

The U.S. Federal Agencies and the Government of the Republic of the Marshall Islands continue to explore together how monitoring regimens will ensure compliance with internationally accepted dose guidelines for populations living in areas of residual contamination.

Whole Body Counting and Plutonium Urine Bioassay

Once populations begin the process of actually resettling in their atoll communities, a greater shift of emphasis and resources will need to be devoted to actual individual whole-body counting and urine bioassay monitoring to ensure that their dose from environmental contributions remains as low as mitigative strategies can effect. Although it is too expensive to continue to monitor all such individuals, initially a broader coverage of individuals will be desirable.

Some of this can be effected by helping the local atoll communities build training and equipment infrastructure that will make it easier to provide this individual monitoring coverage. The Department of Energy plans to work with the resettling communities of Rongelap and Bikini to determine the level of support and technical assistance needed and to effect these levels of effort as resources permit. Of course, the Enewetak community has been resettled successfully since 1981 and the individual monitoring and dose assessment activities of the Department of Energy have shown that doses are staying below the 3 FBq (81 aCi) level of plutonium in a 24 hour urine and that ^{137}Cs uptake from local food sources are kept to a bare minimum by using potassium fertilizer to compete with the ^{137}Cs uptake in food products.

The screening technology of inductively coupled plasma mass spectrometry (ICP/MS) is currently being implemented to ensure that this cheaper, sensitive means of detecting plutonium in urine can be applied to the increasing numbers of resettling people at Bikini and Rongelap and to ensure that their levels of plutonium remain low, as is the case with the Enewetak population.

Local Marshallese students had been trained in the whole body counting and plutonium urine bioassay procedures and are now in a position to help in applying these technologies among their own people. Their interpretation of results, provided in their own native tongue, will go a long way in helping the local resettled populations better understand the individual dose assessment results and their successes in learning to live in these still slightly contaminated atoll environments.

THE DECISION-MAKING PROCESS IN DEALING WITH POPULATIONS LIVING IN AREAS CONTAMINATED BY THE CHERNOBYL ACCIDENT: THE ETHOS PROJECT

by

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1. Introduction

Experience from the Chernobyl accident revealed strong disturbance in social life and stress phenomenon in the population living in the contaminated territories. The unacceptable nature of the consequences of the accident affects the legitimacy of the political and scientific powers, on which the society relied before the accident. Furthermore, the presence of long lasting radioactive contamination in the territories significantly disturbs and depreciates all types of values (social, environmental, economic, aesthetic, symbolic, ethical, political, ...).

In this context, the ETHOS project (founded by the radiation protection research programme of the European Commission-DG XII) has initiated an alternative approach of the rehabilitation of living conditions in the contaminated territories of the CIS in the post-accident context of Chernobyl[3]. This project started at the beginning of 1996 and is implemented in the Republic of Belarus. Based on a strong involvement of the local population in the rehabilitation process, its main goal is to create the conditions for the inhabitants of contaminated territories to reconstruct their global quality of life. This reconstruction deals with all the day-to-day aspects that have been affected or threatened by the contamination. The project is aiming at the creation of a dynamic of rebuilding acceptable living conditions. Radiological security is developed in the ETHOS project as part of a general improvement of the quality of life.

This paper presents the main features of the methodological approach of the ETHOS project and how it is implemented in the village of Olmany in the district of Stolyn (Brest region) since March 1996 as well as its first achievements.

3. Hériard-Dubreuil *et al.* (1998), "The ETHOS project: background, implementation and first achievements", EC-DGXII Mid-term Report.

2. Background

2.1. Analysis of the post-Chernobyl situation

Several studies dealing with the post-Chernobyl situation have highlighted specific features and problems raised by the continuous presence of human settlements on a contaminated territory. A post-accidental crisis without return to normality[4] was reported from the IAEA project (1990). Further European surveys undertaken within the EU/CIS Co-operation Programme on the Evaluation of the Consequences of the Chernobyl Accident (1991-1995) have provided an extensive assessment (qualitative and quantitative[5]) of the social and psychological effects of the accident on liquidators, relocated populations and inhabitants of contaminated territories. The investigations carried out in Ukraine, Belarus and Russia have revealed strong social disturbance and stress phenomena within the population of the contaminated regions. A climate of widespread anxiety is observable among the population. A particular focus is the health of children.

The contamination of the environment is perceived as omnipresent but invisible and hardly localizable and measurable. Surveys have demonstrated that this fear was, in psychiatric or psychoanalytical terms, not akin to a phobic syndrome. Those questioned expressed their fears and their anxiety, but never in the form of unreasonable fear, or uncontrollable anxiety. The radiation protection concept of intervention levels has been rejected by the population as soon as the emergency phase of the accident was ended. Risk levels in coherence with normal situation standards was a strong claim of the inhabitants of the contaminated territories. All post-accidental laws passed in 1991 in the concerned CIS countries therefore refer to the limit of 1mSv/year. Later on the various attempts to regulate the situation by the means of intervention levels have also failed.

From the point of view of the inhabitants of the contaminated territories, it seems that their quality of life is strongly and irreversibly affected. In most cases, those questioned speak about their lives "before and after the Chernobyl accident". One of the major feature of the post-accident situation is the lack of trust of the population in the scientific, medical, and political authorities. An extensive anxiety is observed as a result of that distrust experienced by individuals facing a highly complex post-accident situation. Inhabitants of the contaminated regions feel insecure and deprived of means to avoid radiological hazards experienced as all-pervasive in their day-to-day life.

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4. Lochard J., S. Prêtre (1995), "Return to normality after a radiological emergency", *Health Physics*, Vol. 68, No. 1.

5. Drott-Sjöberg B.M. (1992), "Pilot study in Novozybkov - Russia", Center For Risk Research, Stockholm School of Economics.
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Girard P., G. Hériard-Dubreuil (1996), "Stress in accident and post-accident management at Chernobyl", *Journal of Radiological Protection*, United Kingdom, Vol. 16, No. 3, p. 167-180.
Lochard J., S. Belayev (Eds) (1996), "Decision aiding system for the management of the post-accidental situations", Final Report EUR 16534 EN – Brussels.
Hériard-Dubreuil G., P. Girard (1997), "Conditions de vie dans les territoires contaminés en Biélorussie 8 ans après l'accident de Tchernobyl", *Radioprotection*, Vol 32, pages 209-228.

2.2. Towards an involvement of the population in the risk-management

The initial strategy implemented since 1991 by the national authorities of Ukraine, Belarus, and Russia was to organise a large process of relocation of the population according to the level of contamination of each territory (zoning process). Different approaches have been proposed and implemented since 1993 in order to cope with the local situation of the contaminated territories notably the so-called "social consequences" of the accident. One of these approaches is based on the idea that the only way to resolve the social crisis is to develop a risk communication strategy in order to fill the existing gap in terms of risk perception between the experts and the public.

From the previous studies, it was clearly pointed out that stress and social disturbance result from the confrontation with the contamination rather than from any kind of psychological pathology. Therefore, the real issue for the post-accident management is to investigate to what extent inhabitants of contaminated territories can rebuild their security and restore their own quality of life[6]. Inhabitants of the contaminated territories have no way to deal directly with the radiological risk and to regain control of their protection. Risk communication can hardly be efficient when trust is lacking. In such a context, experts minimising the risk are perceived by the population as denying the risk which re-enforces mistrust and anxiety.

Although some 80% of the inhabitants of the contaminated territories in Belarus are living in an area where the level of contamination remains low in the eyes of experts (less than 185 Kbq/m^2 in Caesium), for several reasons the remaining radiological risk is not considered as negligible by the population and therefore should be managed in a way to reduce it as low as reasonably achievable as recommended by the international risk management guidelines. The first reason is, as observed in the ETHOS project, that an average level of ground contamination can lead to problematic levels of internal contamination notably for children as a result of complex radioecological and agricultural process of re-concentration. The second reason is grounded on the ethical principle of precaution given the uncertainty of the long term consequences of this unknown situation that represents the life of a human community in a contaminated environment.

In this context, experts cannot guarantee to the population of a contaminated area that there is no risk (the lowest their estimation of risk is). The population cannot be constrained to live in a contaminated territory and experts cannot decide whether or not people should live in a contaminated territory which is a political decision. The decision making process must therefore involve the population confronted with the risk in order to increase their accountability[7]. As a matter of fact prescriptive centralised programmes of countermeasures face many obstacles when implemented: not coping with local features, being rejected by local stakeholders, being inefficient and expensive on the long term. Centralised approaches for post-accidental risk management, although necessary at the early post-accident phase, can hardly cope with the long term situation. Most of the choices must be contextualised at the local level and involve local populations if they are to be acceptable, coherent and efficient.

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6. Hériard-Dubreuil G., P. Girard, J. Lochard, T. Schneider (1996), "Confiance sociale et gestion post-accidentelle: les leçons de l'accident de Tchernobyl", Paris, *Annales Des Mines* (Responsabilité et Environnement).
7. Girard P., G. Hériard-Dubreuil (1996), "Tchernobyl : repères pour un paradigme post-accidentel", *Proceedings of the International Seminar on: "The Environment in the 21st Century – Environment, Long-term Governance and Democracy", September 1996,* Abbaye de Fontevraud, France.

3. The ETHOS project

3.1. The framework of the project

The ETHOS project has initiated an alternative approach of the post-accident rehabilitation to better cope with those main features of the Chernobyl situation. One characteristic of this new approach is to address jointly the social and the technical dimensions of the post-accident situation in an attempt to avoid the difficulties resulting from making on the one hand the risk assessment and risk management a technical problem for the experts and on the other hand the public acceptability an insoluble communication problem in a context of distrust. The ETHOS project is aiming at the creation of a dynamic of rebuilding acceptable living conditions, based on a strong involvement of the local population into the rehabilitation process. Radiological security is developed in the ETHOS project as part of a general improvement of the quality of life.

ETHOS is a three year project initiated in the Republic of Belarus at the beginning of 1996 and is implemented in the village of Olmany in the district of Stolyn (Brest region). This village (1 265 people) is linked to a kolkhoze of roughly 1 800 hectares. The main production of the kolkhoze is milk, wheat and meat. The village of Olmany is characterised by a quasi-absence of evacuated people in spite of having a ground contamination (Caesium) ranging from 37 to 555 KBq/m^2. Problematic contamination levels of privately produced food appear to be a real concern for both the population (notably the mothers) and the local authorities. Despite an on-going political debate on the opportunity to relocate the population of the village, there is a strong opposition from most of the inhabitants to leave their village.

A co-operation framework was signed in July 1996 between the European research teams and the CIS partners of the project including three administrative levels: the Chernobyl Ministry of Belarus, the District of Stolyn, the Village of Olmany (Kolkhoze).

3.2. The main stages of the ETHOS approach

The first stage of the ETHOS approach is to create relations and to establish trust between the population and the researchers. This process is driven by strong ethical premises in order to get in contact with the population and to establish mutual trust. Several ethical principles underpin the co-operation between the European team of researchers and the local population. The first one addresses the usual question of whether or not the local population leaves the village. This type of question relates to the lack of trust between the population and the experts. With regard to this situation, it was decided not to take decisions in place of people confronted with the radiological risk but to help those having decided to stay in the village to build their security and their quality of life. The second main ethical principle relates to the responsibility of the research team towards the improvement of the local situation of the implementation site. It was necessary for the ETHOS team to commit itself to improve as far as possible the real local situation within three years of the project.

The second stage is a process of collective learning and assessment of the local situation. Local working groups are created with volunteers and researchers with limited tasks aiming at a concrete improvement of the quality of life and including a radiological dimension (for example: to provide the children with clean milk). Each working group is involving progressively the different kinds of actors that have some interest in its task (stakeholders) at different levels. This includes the population itself, the administrative framework at the local, regional and national levels but also the

different kinds of networks at stake such as public health, agriculture and farm produce industries, retail business, *etc*. The relevant aspects of the radiological situation are assessed by local means of measurement and managed directly by the population. This process makes possible for both the population and the ETHOS team to draw a common picture of the situation and to validate collectively each piece of information. Within this stage, the research team does not make its own assessment to be communicated afterwards to the population. The primary goal is the creation of a context in which the radiological appraisal makes sense for the local actors as regards concrete improvement achievable with the available resources.

The third stage is then a process of reconstruction and improvement. The creation of reliable common pictures of the radiological situation makes it possible for the local people to reassess and reconstruct aspects of life which have been threatened or deteriorated: their food, their safety notably at home, their social and economic relations, their relation with nature, their leisure, their future, their individual and collective identity, *etc*. They can reassess what is still good (but was wrongly considered as deteriorated). They also have to reconstruct affected aspects of life in developing for example new techniques to grow safe vegetables or to produce clean milk and clean meat, new economic activities coping with the radiological context and in creating new safe leisure activities for the children. By examining the problems in their real context rather than in general with average measurements, various means of improvement are revealed and elaborated by the different stakeholders.

While starting with a few local volunteers aiming at one specific task, each group progressively extends or modifies its goals given its findings and the emerging potential of actions to improve the situation. The relevant stakeholders are then involved according to the nature of the revised goals. This process is a sort of dialectic between the structure of the group (the social system) and the proposed goals of the group (the project). This process makes it possible to gradually restore the usual interactions (economic, political, cultural) of the social network that have been shaken by the accident.

3.3. First achievement of the ETHOS project

A total of 7 practical projects have been developed in the village of Olmany dealing with the health of children, the production of clean milk, the meat quality, the young people, the school, the kolkhoze and the firewood and ashes. Two of these practical projects of ETHOS (the “mothers group” and the “clean milk group”) and their provisional results are presented thereunder.

3.3.1. The mothers group

Creation of the first working group

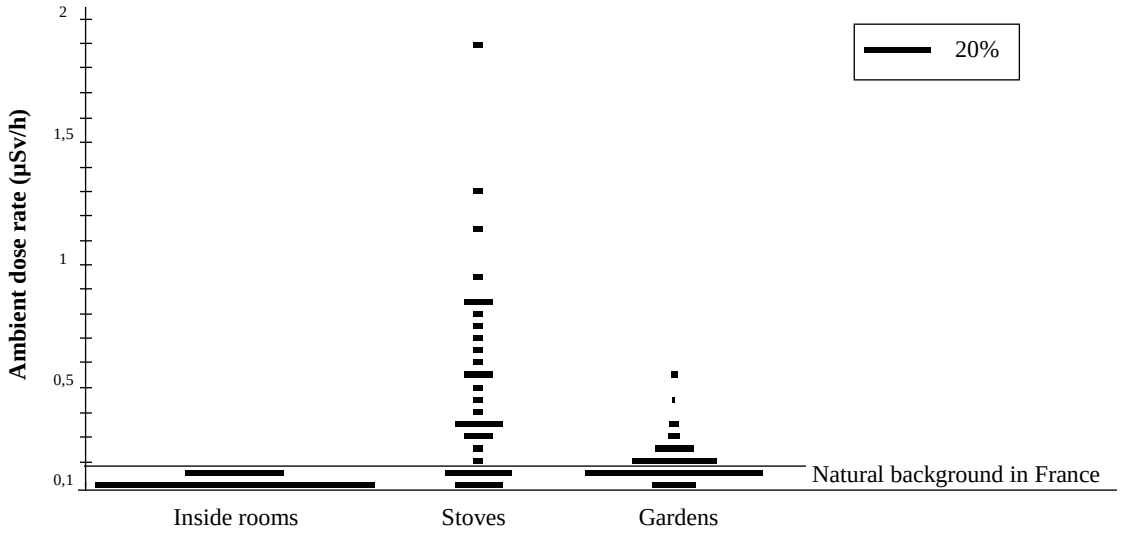
During the first stage most interviews performed by the ETHOS team members to establish contacts with the population of the village pointed out a strong concern about the health of children because of the day-to-day exposure to radiation. During the first meetings with about 10 voluntary mothers, the discussions revealed the very approximate understanding by the mothers of the exposure pathways (external and internal) affecting their children. The lack of information to assess the radiological situation was also clearly identified as a factor favouring the feeling of anxiety and

powerlessness among the mothers. The first action was devoted to gather data about the daily diet and activities of the children.

Assessment of the situation

The data were analysed during a series of meeting of the working group and it became evident for all participants that the collected data should be put in relation with the radiological situation concerning each family. A measurement campaign was then organised to collect information about the ambient dose rates in houses and gardens where children used to play and about the concentration of caesium in the food they eat. Following first measurements together with the ETHOS team, the mothers took the decision to perform themselves further measurements concerning their homes and the food products using the local measurement equipment and devices provided by the ETHOS team. About 20 houses have been screened by the group within a few months: dose rates inside rooms, near the stoves and in the gardens have been measured by the mothers themselves and reported on plans they keep at home and they can discuss with other friends (see Figure 1).

Figure 1. **Distribution of measured ambient dose rates inside rooms, near stoves and in gardens**



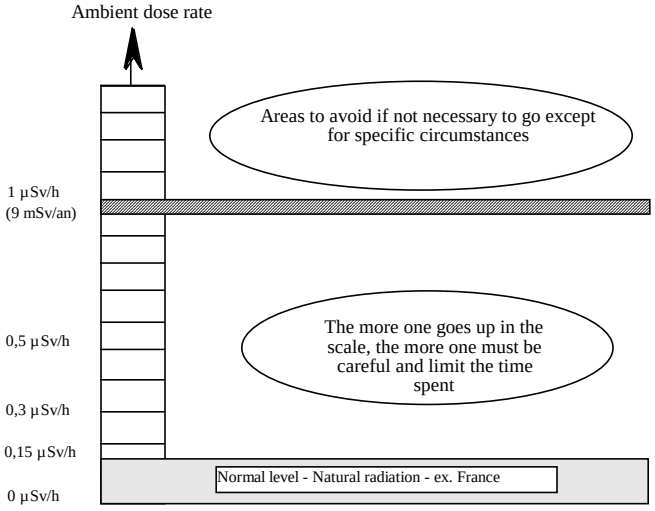
An effort was also made by the group to spread the experience and the results throughout the village. Measurements were shown to the population, and discussed in the course of meetings with inhabitants. Information on the activities and the results of the group were also continuously transmitted to the different actors interested in the development of the project at the local, regional level (authorities in the district) and national level (Ministry of Chernobyl).

Identification of means of improvement

The information collected by the mothers group have revealed that the situation was far from homogeneous within the village. This resulted in the identification of positive aspects when low-level ambient dose rates, or categories of food with low contamination levels, were observed.

Meanwhile, problematic situations were also pointed out in certain families, where categories of food more sensitive to contamination were measured. The measurements continuously performed by the mothers group, in addition to those of other groups in the village, have constituted a basis of information on which the mothers were totally relying, and from which they could base their choices for the children's protection. After having introduced the information about the natural background in France, the group was able to elaborate a dose scale that gave, in a comprehensive way, direct information on how to behave for a given dose rate, in regard to the time spent (see Figure 2).

Figure 2. **Dose rate scale performed by the mothers group**



The analysis of the results on food contamination and on the children's diet brought the group to a better assessment of the daily intake of radioactivity. It appeared that the situation was different for each family, and that the daily intake of radioactivity was very sensitive to some categories of foodstuffs – milk, berries, mushrooms –, which directly influenced the total ingestion by several orders of magnitude for the same diet. This evaluation had direct consequences in the attitude towards the children's diet. The mothers reached a stage where they are able to manage the daily ingestion of contamination of their children, by selecting food with a lower contamination rate. The acceptance or the rejection of a food product because of its propensity to be highly contaminated became a responsible choice, belonging to the family.

Construction of autonomy

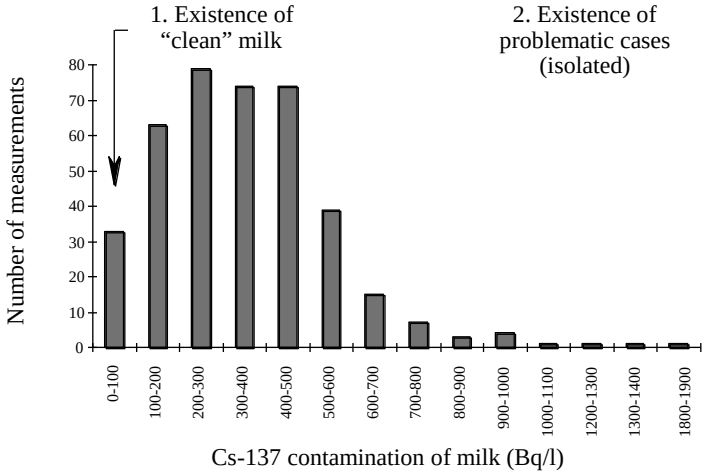
Up to now, the work performed by the mothers group has shown that it is possible to regain control of the management of the radiological situation at the family level through an individual approach. The mothers have built a common picture of the situation in their houses, and this re-construction of quality at home has brought about real changes in the way of perceiving and managing the radiological risk. The group has also discovered that individual choices as regards the contamination were possible to improve the situation. These choices can be, for example, to adapt the time spent by children according to dose rates measured, or to have direct control on the ingestion of contamination through the food given to children.

3.3.2. The clean milk group

First contact with private milk producers and first elements of re-assessment

During a first stage, direct interviews with the population of Olmany, and a series of meetings with private milk producers, revealed a strong concern with respect to the daily consumption of contaminated milk by babies and children. A group of several voluntary producers and members of the ETHOS team collected the existing information on the contamination of private milk in the village for the year 1995. The results (Figure 3) have shown a large proportion of very contaminated samples but also that "clean milk" was available in the village.

Figure 3. **Distribution of milk measurements performed in Olmany in 1995**



The idea to isolate the clean milk progressively emerged from the discussions. 10 voluntary producers decided to embark themselves in an attempt to establish a "map of the milk" of the village to identify from where the clean milk was coming from.

The collective learning assessment process through measurements

In a second step, the producers involved in the milk group focused their efforts on the measurement of the contamination of milk, hay and pastures. As far as possible, local measurement equipment was used. A key factor at this stage was the progressive construction of a local know-how in the field of radiation, shared by all the participants in the project, and on which the group was relying. Meetings were hold during which results from measurements were systematically discussed. Scientific and technical dimensions were solved through the elaboration of protocols of measurements, constituting guidelines on which the milk group and the ETHOS team could rely on.

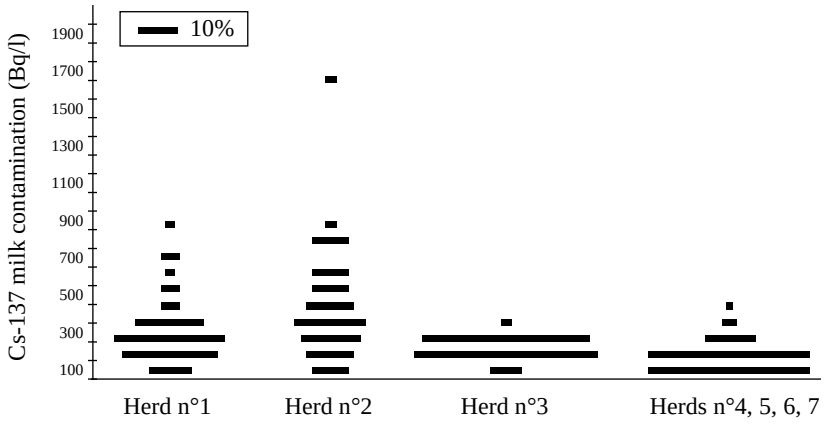
Besides the radiological aspects, the results of the "milk mapping" allowed a better appraisal of the whole organisation of the private production and its strong interactions with the collective farming. In particular it revealed two distinct organisations according the seasons. In winter each producer has an individual management of its resources. In summer, private cows are rounded

up into 7 herds for which pastures are allocated by the collective farm. The better comprehension of the situation led to a tightening of the objectives with the possibility of implementing concrete actions with local available means. Furthermore, it broadened the panel of involved actors opening new opportunities for negotiations and improvement actions at different levels – local (kolkhoze), regional (district) and national (Ministry of Chernobyl).

The re-construction and improvement process

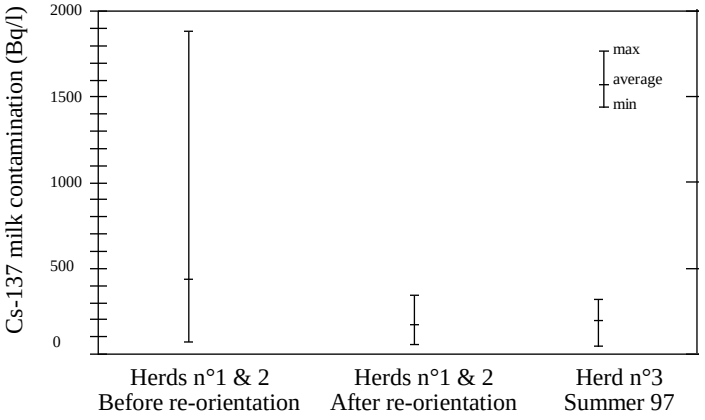
The re-assessment process led up to envisage concrete actions such as looking for new "clean" pastures for the herds of concern, creating sub-pastures with the less contaminated parts of the existing "grazing routes", setting up a sub-herd devoted to the production of "clean milk" for children. All these concrete solutions were more or less acceptable to the producers taking into account their respective cost, complexity and expected effectiveness.

Figure 4. **Comparison of the distribution of milk measurements during the summer period for the 7 private herds in Olmany**



During the summer period, the information collected by the producers with regard to the milk contamination pointed out specific problems concerning two of the 7 herds in the village (see Figure 4), due to the fact that they were grazing on non-improved pastures. After negotiations between the private producers and the kolkhoze, herds n°1 and 2 were re-oriented in August 1997 towards improved pastures. This re-organisation was made possible because of the consensus obtained between all the concerned producers and between the producers and the head of the kolkhoze. Significant improvements were already observed by the end of the summer (see figure 5).

Figure 5. **Distribution of milk measurements during the summer period for herds n°1 and 2 before and after their re-orientation in improved pasture and "milk mapping" of the pasture for herd n°3**



During the winter period, each producer having an individual management of his resources, a different organisation has been elaborated by the group.

4. Perspective

The first achievements of the ETHOS project can be summarised as follows:

- In terms of radiological safety culture, the involved inhabitants (about 1/4 of the adults) together with the ETHOS team have built common representations of the radiological situation pervading in the village.

- In terms of quality of life in the village, inhabitants have discovered significant means to reduce their radiological exposure. Private farmers have identified actions to improve the radiological quality of their production through a better use of available resources.

- In terms of self government of the local population, inhabitants of the village have voluntarily participated in working groups for which objectives have been collectively set up. They have taken initiatives for successful actions they previously thought impossible. There is a growing self confidence in the population of the village.

- In terms of co-operation and social trust, there is an observable effect of the ETHOS project on the social climate in the village. The project allows a better co-operation between the local actors and the existing administrative framework.

However, it should be kept in mind that the conditions of reproducibility of the approach have to be developed and demonstrated.

THE CURRENT ISSUES IN A CONTAMINATED TERRITORY OF BELARUS

by

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As a result of the accident in the Chernobyl nuclear PowerStation 27 456 hectares of farming land and 42 243 hectares of forest are concerned with radioactive contamination.

68 towns and villages with a population of 79 300 people (among them 22 300 children) were covered with radioactive ashes. 18 towns and villages with 16 500 people (among them 5 400 children) compose the zone where evacuation is optional. 62 300 people from 51 towns and villages (among them 16 900 children) live in the zone with a periodic control.

Almost all farming lands concerned with radioactive contamination, apart from 189 hectares, are still used for agricultural production. All farming enterprises own a part of radioactive land.

Contaminated territories are referred to five different zones according to the density of contamination in the soil and to the degree of risk for human health. These zones are defined on the basis of the norms, edicted in the law of the Republic of Belarus on “the juridical system of the contaminated territories following the accident in the Chernobyl nuclear PowerStation”. The Council of Ministers of the Republic of Belarus designs and refers each territory to a particular zone on the basis of the data on radiation density in the soil, delivered by the General Hydrometeorological Department, and on the basis of radiological studies on the main food produces and the annual contamination dose-equivalents, delivered by the Ministry of Health of the Republic of Belarus.

Territories where the average annual contamination dose for the population is likely to exceed 1 mSv are referred either to the zone of compulsory evacuation or to the zone of optional evacuation according to the density of contamination in the soil. Inhabitants of these territories as well as people who have decided to relocate get allowances, worked out in the Belarus law on “the welfare of Chernobyl victims”. As far as the Stolyn district is concerned the list of the contaminated territories fitting the zone of optional evacuation relates to 18 villages. In our district the 17 farms of the Ustili village were evacuated and were relocated in a new built locality in the clean zone.

Ten years after the accident in Chernobyl children morbidity has tripled. It has doubled as regards adults. Children cancer rate raises quite worrisomely. The increase of thyroid morbidity, particularly in the population of children, is alarming. Twelve people are now monitored because of thyroid cancer. This disease was unknown to the district until 1986. Eleven tumours of blood and lymphatic scar are registered – three of them are related to leukaemia. Birth rate has decreased while mortality has increased.

A systematic control over child health is being processed in the district. Educational discussions are held with children and parents with the aim to specify the good habits required under the new living conditions. Children are regularly sent to sanatoriums and health centres. They also go abroad to get some rest.

Funds for radiological protection are taken from the national budget. The Stolyn district program of protection actions was awarded nearly 10, 000 million roubles in 1997. This money was allocated among the following measures:

- liming of acid soil;
- addition of mineral fertiliser;
- creation of fodder farming lands;
- cesium-reducing chemicals and ferrocyne-added fodder;
- working clothes and individual means of protection;
- herbicides and others.

In the district various actions are set up to decrease the contamination of produces and to specify new specialisation trends for production. The district is regularly provided with information by the Scientific and Educational Centre for Radiation Protection, Energy and Radioecological Formation of Belarus. It receives also a Handbook of agricultural management in contaminated lands, worked out by the Ministry of Emergency Situations, the Ministry of Agricultural Production and the Academy of Agronomic Sciences.

Radiation still has a harmful effect on the daily life of the population in the district. Because of the wide contamination of our land getting clean produce is an acute problem, especially for breeding. This is due to the lack of clean fodder land for grazing and fodder as regards both the community cattle and the people's private ones. The district has no opportunity to operate any new agricultural specialisation as requires the Handbook. It is located in lands liable to flooding which leads to a constant migration of radionuclides. The district is a complex one because of this location. Therefore the explanations and propositions contained in the Handbook don't totally fit our agricultural features.

As a consequence, the main issue in the agricultural field is to get clean produce. To achieve this goal all the measures proposed by the Handbook are applied. Some are very successful, others are less. All the district power structures, its population and its workers try to solve these problems.

The presence of contamination didn't change the relationships between the towns and villages of the Stolyn district and those of the other districts in the Brest region. All the issues and emerging conflicts are addressed in common.

In the future all the questions mentioned above – the continuous radiological control, as well as the financing of protection measures, the production of clean produce and other issues – are expected to remain acute problems.

THE DECISION-MAKING PROCESS IN DEALING WITH POPULATIONS LIVING IN AREAS CONTAMINATED BY THE URANIUM MINING RESIDUES IN EASTERN GERMANY

by

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1. Introduction

The radiological intervention situation created by uranium mining and milling residues cannot be seen in isolation. It is part of a more general problem: mining and other industrial residues with exposure to enhanced natural radiation. Already that part of the decision-making that should follow the principles of the radiological protection system is far from being a pre-established process. Criteria and reference values to be applied are still under discussion. That is why in the following paper problems connected with the justification and optimization of remediation measures, the establishing and meaning of action levels, as well as legal and institutional problems will be discussed. They are the basis of considering the societal aspects of decision-making. The appropriate involvement of the affected local population in the decision process and whether it should be legally based is a major issue. The impact of public concerns on the decisions and their relation to the historic and social heritage and economic situation on the one hand, and experiences with different attempts to influence public attitudes towards radiological risks and decisions to be made on the other hand are dealt with.

2. The Wismut heritage and its influence on decisions regarding rehabilitation of uranium mining and milling sites and evaluation of mining residues

Uranium production by the former Soviet, later Soviet-German Wismut Company amounted to approximately 220,000 t during 1946-1989. With this output East Germany ranged third world-wide behind the USA and Canada. Uranium mining and milling began under post war conditions in the Soviet-occupied zone, with the aim to produce as fast as possibly the uranium needed for the Soviet nuclear weapon programme. This resulted in areas seriously affected and devastated which were located at different sites in a densely populated region of about 10,000 km^2. Wismut was working all the time under military conditions of total secrecy and was not controlled by the national

regulatory authorities, even if the Company was obliged to meet the radiation protection regulations since the 70s.

After the reunification the German federal government was faced in the Wismut area with one of its largest ecological and economic challenges. In 1990 Wismut turned at once from the production to the decommissioning phase without any preparation or preplanning. There were big concerns within the local population on possible radiation detriments because no information on radioactive contaminations and resulting exposures had been passed to the public. These concerns were significantly enhanced by some media that were characterizing the situation in the region as a second Chernobyl or even worse. Altogether there was an urgent need for large scale remediation.

In 1991 Wismut was legally changed into a company of western law (Wismut GmbH). As the sole shareholder the federal government has committed to fund the costs of decommissioning its uranium mining industry and to conduct the associated rehabilitation. The duration of this rehabilitation project was estimated at 15 years and the costs at DM 13 billions. The intent is to restore the areas to an acceptable environmental level with an appropriate balance between ecological, economical and social values [1]. The requirements of radiation protection within this programme are covered by the continuing application of relevant former East German regulations, as the German Radiation Protection Ordinance stipulations on enhanced natural radioactivity are missing. In the radiation protection system a clear classification as intervention situation or practice is not possible. Under consideration of the history the German Commission on Radiological Protection (SSK) has recommended to deal with the remediation of Wismut sites as an intervention.

This Wismut rehabilitation project covers only those sites which were in 1990 still under responsibility of the Wismut Company. However, in the early 60s numerous facilities and their sites were transferred from Wismut after decommissioning to communities, enterprises and other regional bodies or citizens for further different use or for safekeeping, *i.e.* before any national radiation protection regulations or controls came into force. Being neither sufficiently investigated nor taken care of from the viewpoint of modern radiological requirements, they have to be identified and evaluated as to their radiological impact [2]. Of course, the serious public concerns about an unknown radiation danger were extended also to this part of the Wismut heritage. These residues of different types can be clearly classified as intervention situations. Their identification, investigation and evaluation were therefore regulated in an amendment to the Radiation Precautionary Law after the reunification of Germany, and the responsibility for this task was passed on to the Federal Office for Radiation Protection.

In contrast to the Wismut sites owned by the federal government, the financial responsibility for the remediation of this second group of residues is still open. However, before any ultimate remediation decision on a site, a complete overview of these sites and their radiological relevance should be provided. For that purpose a federal project “Radiological Registration, Investigation and Evaluation of Mining Residues” (RREM) was urgently launched and commenced in 1991. All results are immediately made available to the local authorities and the public. It became soon obvious that residues of former mining for silver, cobalt, tin and other ores with a high uranium mineralization dating back to the middle ages result in analogous and even higher radiological impacts. The same is true for coal mining in the uranium mining area and the copper mining region in Eastern Germany. That is why the project was extended to all radiologically significant mining residues in Eastern Germany [3].

3. Progress of the Wismut rehabilitation programme

The extent of the area affected by past mining and ore processing activities and still under the responsibility of the Wismut Company amounts to approximately 35 km^2, of which 1 100 hectares are covered by waste rock piles, 700 hectares by tailings ponds, and 3 480 hectares by facilities of 9 former mine operations. The remediation objects are spread around two federal states and may be grouped into underground workings, mine shafts, exploratory shafts, waste rock piles, an open pit mine, building structures of mining and processing facilities to be decommissioned and demolished, areas contaminated by spread radioactive material, as well as tailings ponds and other residues from uranium processing or leaching. The size of the remediation task makes Wismut one of the largest rehabilitation projects in the world. A rough assessment of the expected remediation costs per ton of uranium produced shows that they are in the same order of magnitude as the costs of the similar Uranium Mill Tailings Remedial Action Project (UMTRA) of the US Department of Energy [4].

Table 1 gives a concise overview on the progress of the Wismut rehabilitation project until 1996 [5,6]. Approximately 5 billion DM have already been spent. The large progress is easily visible in the affected territories and has been acknowledged by the population in this area.

Table 1. **WISMUT: Progress of remediation 1991-96**

Remediation activity	All residues	remediated residues	percentage of total (%)
Close-up mine drifts	1 396 km	1 270 km	91
Backfilling of • mine openings (underground)	4.8 Mio m^3	4.7 Mio. m^3	98
• shafts	1.24 Mio m^3	860 000 m^3	69
• open pit	84 Mio m^3	23 Mio m^3	27
Flooded mine workings	209 Mio m^3	20 Mio m^3	10
Waste rock pile removal	119 Mio m^3	25 Mio m^3	21
Dismanteling/demolition • steel scrap	175 500 t	78 000 t	44
• rubble	707 000 t	295 000 t	42
Tailings ponds - covering of beaches	724 ha	280 ha	39
• interim covers	7.3 Mio m^3	2.4 Mio m^3	33
• final covers	13.4 Mio m^3		0

Practically the justification of the remediation, *i.e.* in the terminology of radiation protection the intervention, has been decided by law, which was the basis for establishing the Wismut rehabilitation project. In initiating this project the radiological impacts were emphazised. However the justification is based on a variety of impacts and incentives. Some of them are like radiation of a technological or "objective" type: chemical pollutants such as arsenic, lead and other heavy metals, hydrocarbons, or pyrite, mechanical instabilities of waste rock piles, tailing pond dams, or open pit mine walls, risk of surface subsidence due to mine workings, *etc*. Others are rather based on societal or "subjective" aspects: recovery of the damaged infrastructure, restoration of the landscape, support of the economic development in the region after the serious impacts of a fast change to market economy, and last but not least response to the big concerns in the local population for the unknown radiation exposure or more generally for the future life.

Logically it is attempted to base the selection of the optimum remediation option on an integrated risk approach, using radiation protection tools such as cost-benefit-analysis as guidance [7]. This may help in making the decision process more transparent than simply relying on best available and proven technology. However, there may be a danger that the parties involved in the decision-making, among them even the authorities in the Federal States responsible for licensing and supervision, interpret the results of a quantitative optimisation as an "objective" decision. The inherent uncertainties of any risk assessment in the low exposure range with the associated problem how small individual doses should be taken into account when collective doses are calculated, and the non-quantifiable social aspects to be taken into consideration in the decision process must not be overlooked. For large and complex remediation tasks, like in the Wismut rehabilitation project, expensive expert analyses such as quantitative integrated risk assessments are helpful if their results are not used as the decision itself. For a large number of small residues as they are registered in the other federal project RREM on evaluation of the second group of mining residues a simpler and legally more unambiguous approach may be preferable [8].

4. Progress of the Federal Project on Radiological Registration, Investigation and Evaluation of Mining Residues (RREM)

Radiological evaluation criteria

Just because of the societal implications of this project a certain kind of evaluation of the registered residues was in the focus of the work from the very beginning. Guidance for dealing with these clear intervention situations was laid down in recommendations of the SSK [9]. The basis was the establishment of a reference level of 1 mSv/a caused by mining residues as a radiation exposure in addition to the geogenic background, considering all exposure pathways except radon in homes. If this value is not exceeded, any remediation is not justified. That means that 1 mSv/a is rather a "non-intervention level" than an intervention level. This distinction is very important since it allows a quick evaluation of non-relevant sites with immediate positive social and economic consequences. For radon concentration in the outdoor air in settlements near mining residues, a reference value of 50 Bq/m^3 with the same meaning was established, assuming that source related radon concentrations outdoor and indoor are equal.

This separation of radon and all other radiation exposures is still controversial. However, this proposal has a main merit, namely to avoid some of the difficulties in the grey area between acceptability of radiation doses associated with long-term countermeasures on the one hand and public dose limits for practices on the other hand. The reference value of 1 mSv/a corresponds to the

public dose limit, and the reference level of 50 Bq/m^3 is consistent with further recommendations of the SSK on acceptable total indoor radon concentrations in Germany. Both primary reference levels, together with the clear definition of their meaning, were expressively not derived from quantitative risk assessments but from an estimation of the variation of the geogenic natural background in the affected area. However, they are at least not inconsistent with risk assessments.

A rather complex set of action levels for measured values of dose rate, activity concentration of radium in soil assuming radioactive equilibrium with the other radionuclides of the uranium-radium decay chain, and of activity concentrations of different radionuclides in drinking water, as well as of radon concentrations in outdoor air, were derived taking the primary reference levels into account. They are adapted to unrestricted use or different use restrictions of the site. An example is a soil contamination of 0.2 Bq/g Ra for unrestricted use. Only if these action levels are exceeded, a site specific analysis has to be carried out in order to check whether the primary reference levels themselves are really exceeded. This analysis has to be as realistic as possible. One of the major difficulties in this assessment process is to differentiate between geogenic background and anthropogenically enhanced natural radiation. Another problem is the establishment of numerical parameters to be obligatorily used in the exposure calculations for all relevant exposure pathways. More details cannot be discussed in the framework of this paper.

The 3 stages of the project

For the project a multistage procedure with increasing thoroughness of investigations has been developed, with the intention to exclude as early as possible non-relevant residues and to identify those objects which have to be considered as relevant sources of environmental contamination and radiation exposure of the public [10]. There may be a difference to similar decision processes in the late phase after a radiation accident. People living in an area with an enhanced level of natural radioactivity are normally either unaware of the radiation risk in their region, or they are simply worried that they may live under unacceptable conditions. They are mainly interested not in a “return to normality” by establishing acceptable living conditions in an actually adversely affected area, but in the confirmation that they can continue their normal life either without any additional activities or, if absolutely necessary, after some remediation measures. The confirmation that no remediation is required is an important precondition for the economic development with promotion of investments in the area.

In the first stage of the project, 34 areas of former mining activities had been spaciously defined as “suspected areas” using available information on regions where uranium ores and other ores with uranium mineralization were mined, as well as where gamma dose rates which exceeded a specific value derived from the reference levels of the SSK, had been previously detected by aerial exploration measurements. The total “area of suspicion” was about 1 500 km^2. For these areas, all existing data relevant to a radiological evaluation were compiled. In this way about 8 000 mining-related objects of different kinds had been identified and registered in a database, most of them being waste rock piles. The entire area occupied by the objects or characterized by high gamma dose rates amounts to approximately 250 km^2. Further investigations were concentrated on these “investigation areas”, *i.e.* only on a small part of the territory with originally suspected radioactive contamination. This was a first essential step to eliminate unjustified concerns in the public.

Many of the registered data and information were obsolete and did not permit a proper radiological assessment. Additional efforts to verify and to complete the registered data were required

and carried out in a second phase of the RREM project. By field inspections the information on the state of each object and site was updated and all data needed for the radiological assessment were checked, revised and completed. All tailings ponds are assessed as relevant without any investigation at this stage of the project, and the shafts were separated for involvement in a specific partial programme investigating their use for water supply. Screening measurements of the gamma dose rates on the remaining approximately 6 000 sites and on their unaffected surrounding countryside were executed. These dose rate measurements were used for an exclusion of radiologically non-relevant objects and sites using criteria derived from the reference levels of the SSK. In addition to the measured local gamma dose rates, information on the volume of the disposed material, the dimensions of affected grounds and the thickness of the non-contaminated cover layer had to be used. About 57% of all objects could be classified as "non-relevant", *i.e.* further investigations are not required as long as no changes of use of the site take place. The others are assessed as "possibly relevant". Again in a significant part of the region radiological concerns disappeared.

In the third stage of the project intensive measurement programmes for the "possibly relevant" objects are being carried out. They provide comprehensive information on dimensions of contaminated areas, thickness of contaminated layers, concentrations and inventory of radioactivity, radioactivity released and spread (*e.g.* radioactivity in seepage waters), relevant pathways and radiation exposure to the public. Altogether nearly 300 000 dose rate measurements, 5 000 bore hole drillings to determine the depth of the contaminated layers, 10 000 analyses of radioactivity content in all types of samples, 1 000 long-term radon measurements in air and 500 measurements of radon in soil air were executed. The project will be finished in 1998 after investigation of 5 300 objects. Comparing the measured data with the whole set of reference levels a next classification step is possible. At the present time it is expected that nearly 60% of the objects are usable with no restrictions, 25% with restrictions, and only in 10-15% of all cases the necessity of remediation measures has to be checked.

Decision making

One should note that the ultimate decision on remediation is left to the responsible authorities in the Federal States. Extent of the provided data and additional information as contained in the huge database of the developed geoinformatic system (GIS) will certainly make possible this final assessment without significant additional measurement efforts. In any case the final decision should be the result of a site-specific analysis. Actual remediations will be left to the time after the revised radiation protection legislation with relevant regulations has been passed, except a few cases with an acute and unacceptable risk as later on will be discussed. This caution is justified by the fact that these new regulations have to be applied to the whole German territory. The experiences already gained will, of course, support the development of the new regulations.

Even if the decision on remediations of objects will be made after the evaluation programme is finished, the sorting out of non-relevant objects during the work with the programme has been already a decision. The precondition for this efficient and useful procedure was the fact, that extreme radiation exposures with urgent need for actions were very improbable. The results of the extensive measuring programmes have confirmed these initial assumptions which, of course, were also based on provisional measurements in the whole area.

Generally one can conclude that mining residues do not cause wide-spread significant contamination of the environment. Radon seems to be a minor problem and has to be taken into

account only at a few sites. In limited areas, however, exposures clearly exceed established reference levels. Serious contaminations resulting in annual exposures in the order of 5 mSv (radon excluded) were found on delimited grounds and properties such as:

- grounds formerly used for uranium production (milling) and not carefully cleaned;
- uncleaned roads and railroads formerly used for transport of uranium ores or wastes from mining and milling;
- sites where mining wastes (mostly low level activity) were used for landfilling, covering places, paths, roads or for other building purposes;
- sites where ashes and slags from hardcoal burning or residues from copper smelting were dumped or used.

In these cases, the competent authorities and the owners get a fast announcement and should make appropriate immediate decisions.

One problem in characterizing an object or a site as non-relevant is the uncertainty of the long-term development. Any classification refers only to the present situation. In the future barriers may be damaged, leaching and spread of radioactive substances may change, the utilization of the site may change and human intrusion may occur. Non-relevant objects or sites may be grouped in: 1) non-relevant under any foreseeable conditions (*i.e.* also suitable for unrestricted use), 2) possibly relevant if the use changes, 3) possibly relevant because long-term changes cannot be excluded. That means that with regard to mining residues some kind of institutional control inevitably has to be maintained, *i.e.* additional investigations at later times and long-term monitoring programmes cannot be completely avoided. By the way, this problem is also faced after any successful remediation. If this institutional control is carried out reasonably and with a minimum of expense as it seems to be possible, it has no negative impact on the further life in this territory. This has been already demonstrated by the institutional activities to secure former mining areas against potential consequences like subsidence.

At the end it should be emphasized that in principle only the justification of an intervention has been discussed. For a large number of smaller residues this is more important than optimisation since the basic decision on the financial resources to be spent for remediation essentially depends on the number of sites to be remediated and less on the remediation options. However, the ways how to select remediation options is an important part of the decision-making as well, and the radiation protection methods, criteria and reference levels (“remediation targets”) to be used in the optimisation as part of the decision-making are still under discussion. They should be part of the new regulations which are to be prepared. Any remediation programmes will only commence after the new regulations are in force.

5. Information of the public and involvement in decision-making

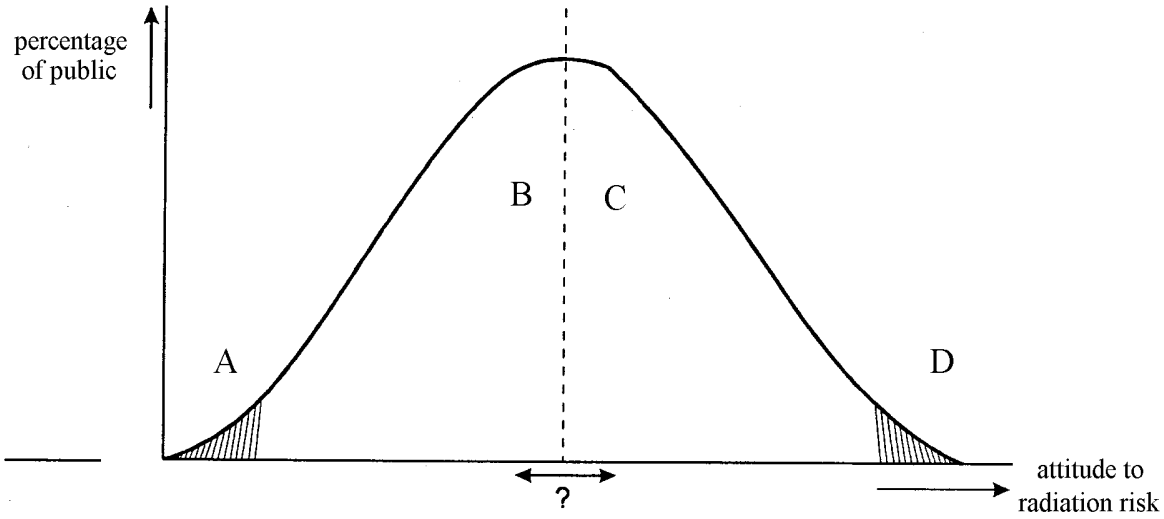
In the preceding sections it has been shown that there is not yet available an agreed basis for decisions purely from the viewpoint of the radiation protection system. For involvement of the public or the attitude of the affected population this is of minor importance. People are anyhow confronted with actions or no actions as proposed by the authorities and do normally not realize uncertainties in the scientific basis for these proposals. Up to now in the work on both projects (Wismut

rehabilitation, RREM) there were no attempts to include the public in decision processes before the responsible parties had come to definite proposals for available options meeting the presently agreed radiation protection requirements.

Inhomogeneity of the public attitudes

Dealing with the public means to realize the wide spectrum of attitudes and opinions on the radiation risk as demonstrated in Figure 1. Group D is in fundamental opposition to any proposal of an authority. They always assume that authorities underestimate civilisatory risks in favour of the economic development. For their anti-nuclear campaigns they try to exaggerate the radiation exposure in the uranium mining areas in order to discriminate the front end of the nuclear fuel cycle. This group is over-represented in the mass media and was the main reason for the unrealistic, already mentioned over-estimation of the exposure in the uranium mining area in 1990-1991.

Figure 1. **Hypothetical distribution of attitudes of the public to the radiation risk**



A: risk expressively neglected

B: no concerns, decisions of authorities accepted

C: growing concerns, doubts and mistrusts in decisions of authorities

D: conscious opposition against the official scientific basis of radiation protection and any decision of an authority (antinuclear movement)

Group C is concerned about possible radiation impacts and has varying mistrust in the responsible authorities, their statements and decisions. This was the attitude of the majority of the local population before and shortly after the German reunification because of the already mentioned total secrecy with regard consequences of the Wismut activities over decades. Group B is aware of the radiation risk but generally trusts the authorities and their experts and accepts the decisions made. If they have doubts they turn to established bodies and try to get information on the basis for the decision and ask for being involved in the decision process. One could say that this group reacts ideally in a system of representative democracy. The dividing line between B and C is fluid. The main

emphasis of interaction with the public and of an open information policy should be directed to move group C in the direction of B.

The other extreme and rather small group A neglects any radiation risk at least in the low dose range. They usually defend their point of view with their own experience that they were never faced with radiation effects in their family and neighbourhood, even if they were informed of an unacceptable risk. Their attitude is certainly linked with economic concerns. An illustrative example is a subsidy project for radon in homes launched by the Saxonian Ministry of Environment and Regional Development. Already in the first phase, a measuring campaign free of charge in an area with suspected indoor radon concentrations up to 50 000 Bq/m^3 and even more, there was a disappointing small willingness to participate. For the second phase (remediation) the Ministry could only offer 30% of the total remediation costs, initially for homes exceeding 15 000 Bq/m^3. Since there were no(!) applications at all, the subsidy radon level was later on reduced to 1 000 Bq/m^3, with the disappointing result of only 2 responses.

Certainly remediation costs are high, and in an area with economic difficulties reflected in an unemployment rate of 25%, for the majority even 2/3 of the remediation costs appear as too high, especially in case of a risk that is still under discussion and that has mostly been in existence in the affected houses for centuries. Another problem is loss of property value if high radon concentrations were detected. This is a view on remediation totally different from what is to be expected after an accident. Obviously again the dividing line between groups A and B is fluid. If in the future costs for remediation of mining residues should be borne by the owners, group A may increase.

Information of the public

Immediately after the political change in 1990 in East Germany, full information was provided to the public about the radiological impacts in the uranium mining area. For example 2 mobile laboratories were located in the region and samples which people had collected were measured (and interpreted) on the spot. Some programmes for measuring food contamination were based on samples which critical groups of citizens had collected. The samples were analysed under strict quality assurance. Thus the expected result became credible: restrictions on consumption of local food were not necessary.

Countless discussions and information meetings were organized, and Wismut as well as the Federal Office for Radiation Protection are operating information centers in the territory. All measurement results are made available on request. Moreover, the public is aware of the tremendous efforts within the Wismut rehabilitation project. All these activities have significantly changed the attitude of the majority of the local population. In general they accept the rehabilitation measures of Wismut and the message from the Federal Office on the radiological relevance of the other objects and sites. Surprisingly the local mass media, although asking critical questions, support more or less the authorities. Surely the unstable economic situation contributes to this situation.

Experiences with involvement of the public in decision-making

All attempts to involve the public in the decision processes have been made by Wismut and the authorities in the Federal States on a voluntary and not on a legal basis. Usually local authorities or responsible people of the affected communities are involved in the decision-making process. This may be explained with the actual situation at 3 sites.

The community of Oberrothenbach is located immediately downstream of a main tailings pond dam. This tailings pond contains more than 60 million m^3 of free water and sludges. Problems with dam stability and potential radiation exposures led to a dry remediation option with enclosure of the radioactivity on the spot. Different landscaping models with different reuse approaches were developed and discussed at a public meeting with residents of Oberrothenbach and representatives from nearby communities. After this meeting the models were placed on public display for interested citizens to stimulate public comment and response regarding the proposed remedial action. Wismut was trying hard to accommodate expressed suggestions and preferences within reasonable technical and financial limits, again in a developing dialogue with people. The competent authority, the Saxonian Ministry of the Environment, was informally in continuous contact with the local authorities and Wismut during this phase. Moreover it organized many discussion meetings with inhabitants of other near-by communities and reacted on any request for information. The people of Oberrothenbach are very interested in all issues concerning the clean-up at Helmsdorf, were very active and represented by a competent and engaged mayor. The other communities a little more away from the tailings pond, but at a similar risk, showed considerably less interest in these issues. When the construction of a pipe conveyor transporting material from the Crossen rock pile up-hill towards the tailings pond was in preparation, again some information meetings were organized to convince the interested people that all necessary and affordable measures for noise abatement and radiological risk reduction were taken.

The situation in the towns Schlema /Aue is different. Flooding of the mines is well under way and not disputed at all by a population living in old mining traditions. Even the interest in the way the main clean-up activities, *i.e.* stabilization and cover of the numerous rock piles, are carried out is limited. However, people are keen on speeding up all clean-up activities and are interested in concepts for reuse. Schlema was before World War II a famous radon spa that shall be reactivated. The main interest of the local population is a non-contamination image of the town and region. Moreover, they feel themselves adequately represented by their extraordinarily active and tricky mayor. This is why direct contacts with people of Schlema are not of real importance in contrast to contacts with the local representatives who take part in all essential consultations of Wismut and State Authorities.

The situation in Königstein, a special mine with “in situ block leaching”, is more complicated. One of the aquifers running through the Königstein site is a potable water source of regional importance which, in some distance from the mining site, provides the large cities of Dresden and Pirna with drinking water. The main task at the Königstein site is to prepare the mine for flooding in a way that will protect the aquifer lying above the mine works from contamination. These issues are highly dominated by complicated technical expert discussions. A considerable risk for people and towns near-by does not exist. That is why only twice a year regular meetings of Wismut and the authorities involved with local environmental councils and representatives of critical citizens take place in order to discuss the clean-up problems with the public.

As a summary one may state that the public´s attitude towards Wismut remediation highly depends on the local situation. Wherever people in the region regard the situation as more or less dangerous (like in Oberrothenbach) they are strongly engaged; if they don´t regard the clean-up as their problem (like in Königstein) they are more reserved. The efforts to involve the public in decision-making should be adapted to this main attitude. However, total openness, willingness to discuss all tabled problems and to show to the affected population that their concerns and proposals are taken serious is of utmost importance. In this way a culture of involvement of the public in

decision-making has been voluntarily developed by all authorities and Wismut, having contributed to a rather satisfactory acceptance of the decisions by the affected population.

Use of a legal basis for involvement of the public in decision-making

In the German legislation a formal environmental impact assessment ("Planfeststellungs-verfahren") was established with the aim to involve the public in the decision for introducing a new practice with impacts on the environment. In 1996 there was a motion of about 70 members of the German parliament to establish expressively such a formal procedure for the Wismut clean-up activities instead of the voluntary efforts mentioned above. The parliamentary group had discussions with the Saxonian authorities, the Federal Environmental Ministry and local representatives. In the end the group withdraw their motion. Obviously they became convinced that such a formal environmental assessment impact will result in an obstruction of the decision-making. Needed fast decisions may become nearly impossible. Therefore the group´s motion was not backed by the local population and their representatives either.

However, even if the developed procedures for involvement of the public into the Wismut rehabilitation project are working well, it should be considered how in the new radiation protection regulations an obligation to inform the public on remediation measures, and to involve the affected population in a reasonable way into the relevant decision-making, should be laid down. Later on a big variety of different parties will have to take actions in numerous intervention situations as can already be derived from the results of the RREM project. There is every reason to require some suitable sort of legal regulation for involving the public in decision-making processes.

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of all OECD Member countries, except New Zealand and Poland. The Commission of the European Communities takes part in the work of the Agency.

The primary objective of the NEA is to promote co-operation among the governments of its participating countries in furthering the development of nuclear power as a safe, environmentally acceptable and economic energy source.

This is achieved by:

- *encouraging harmonization of national regulatory policies and practices, with particular reference to the safety of nuclear installations, protection of man against ionising radiation and preservation of the environment, radioactive waste management, and nuclear third party liability and insurance;*
- *assessing the contribution of nuclear power to the overall energy supply by keeping under review the technical and economic aspects of nuclear power growth and forecasting demand and supply for the different phases of the nuclear fuel cycle;*
- *developing exchanges of scientific and technical information particularly through participation in common services;*
- *setting up international research and development programmes and joint undertakings.*

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has concluded a Co-operation Agreement, as well as with other international organisations in the nuclear field.

THE ROLE OF THE MEDIA IN THE COVERAGE OF RISKS ASSOCIATED WITH NUCLEAR WASTE

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Introduction

No other issue has mobilized public opposition and outrage more than the siting of nuclear waste. All countries face a major crisis in finding public support for their waste disposal policies (*cf.* Kraft e*t al.,* 1993, pp. 5ff; English, 1992, pp. 2ff). There are controversies about the health impacts, long-term consequences, institutional trust, and economic benefits associated with nuclear waste repositories. The main focus of the debate is, however, on the long-term risks for humans and the environment (Slovic *et al.,* 1993, pp. 64ff). Risk perception and evaluation is hence the driving agent of the nuclear waste debate.

Nuclear waste has become the prime target for an increasingly concerned public over the acceptability of technological risks. The scale and potential impact of technological developments and the increased sensitivity to health and safety hazards have put risks and environmental quality among the top concerns of the public in almost all European countries and North America (Dunlap, 1987; Fietkau *et al.,* 1982; Kessler and Tischler, 1984). This concern highlights, according to the German sociologist U. Beck, a gradual change of the predominant social conflict in this century (Beck, 1986; *cf.* Schnaiberg, 1986). The primary conflict in the early 20th century was focused on the distribution of wealth among different social groups; after the second world war, and particularly in the 1960s, the focus changed to the distribution of power in politics and economics; in more recent times the major conflict is about the distribution and the tolerability of risks for different social groups, regions, and future generations.

This shift of focus implies new forms of conflict resolution and underlines the importance of communication as a necessary, though not sufficient, step towards a social equilibrium (Luhmann, 1986). In addition, the capability of societal institutions to tame powerful natural sources for economic purposes and reduce the concomitant risks of potential side effects to human health and the natural environment depends largely on communication among institutions and groups (Habermas, 1984) and the formation of specialized risk or danger cultures (Rip, 1985).

As a consequence of this prominence, interest of public institutions and academia in risk communication has considerably grown during the last five years. Risk communication has become a popular topic in the literature. Although originally conceptualized as a follow-up of risk perception studies, the work on risk communication has surpassed the limited boundaries of giving public-

relations advice for information programs on risk, but extended its focus on the flow of information between subsystems of society (Kasperson, 1986, p. 275; Jasanoff, 1987, p. 116; Zimmerman, 1987, p. 131; Plough and Krimsky, 1987; Renn, 1992).

Risk communication can serve many purposes ranging from enlightenment, to inducing behavioral changes, to conflict resolution. The following sections will address the crucial issue of how the media shape the perception of risk among individuals and social groups and of how trust and credibility have become major agents in the public communication process. The paper ends with some advice for risk managers, in particular those dealing with nuclear waste, about potential improvement in their risk communication efforts.

Role and Functions of the Media in Shaping Risk Perception

All mechanisms of risk perception are contingent on information derived from either personal experience, interaction with others or intermediary sources. A vast amount of information about risks stems from intermediary sources. People develop attitudes and positions with respect to risky technologies and or activities on the basis of second-hand information. This information is transmitted by the media. Many beliefs about risks and risk sources are hence shaped or at least influenced by the information and evaluations that the media transmit to their consumers. The media perform a dual role in the communication process: first, they collect information from primary sources and process this information by applying professional and institutional rules that govern the selection of received messages and their interpretation. Second, they send information to the final receiver. The re-coding of messages involves conscious or unconscious changes of the original information material. Messages from several sources may be integrated into one new message or comments may be added.

The transformation process of messages during transmission has been a popular topic of communication research. From a theoretical point of view, many different concepts about the nature of this transformation have been suggested in the literature (Peters, 1984; 1990; Peltu, 1985, pp. 129-130; 1989; Sood *et al.*, 1987, p. 30; Shoemaker, 1987, p. 125; Lee, 1986, p. 175). The basic differences between these approaches may be confined to two major questions: First, are the media creating new messages or are they reflecting existing messages; second, how biased are journalists in their coverage vis-a-vis their own social convictions and external pressures? Both questions have not found a final answer yet (Peltu, 1985, pp. 140-141; Mazur, 1987, p. 86; Lichtenberg and MacLean, 1988, pp. 33-48).

With respect to the first question, the literature suggested a strong influence of the media on public opinion in the early years of communication research. Through extensive testing, however, this hypothesis was later substituted by the hypothesis that the media set the agenda, but do not change the attitudes or the values of the audience with respect to the issues on the agenda (McCombs and Shaw, 1972; Peltu, 1985, p. 140; Lichtenberg and MacLean, 1988). Only in the long term have media a lasting effect on the attitude and value structure of their consumers.

With respect to the second question evidence has been gathered to support almost all possible viewpoints. Political and commercial pressures have been detected in media coverage as well as courageous news reports in conflict with all vested interests. Cultural biases within the journalistic community have been found, but also a variety of different political and social attitudes among journalists. Some journalists perceive their job as a mere translation of events into verbal or visual expressions while other believe they should play a more active role in shaping and explaining the

issue (cf. the controversy about the studies of Kepplinger in the review by Lichtenberg and MacLean, 1988, pp. 37-45; Köcher, 1986; Peters, 1990; 1991).

In short: the extremes that media are mere reflectors of reality or that they are docile instruments of social pressure groups may occasionally be true, but they are not the rule. In reality, the situation is more complex: Media coverage is neither dependent on external pressures nor an autonomous subsystem within society (Lowry and DeFleur, 1983; Raymond, 1985). It reflects internalized individual values, organizational rules and external expectations. It depends on the issue itself, the institutional context and the political salience of the issue which of these three factors is likely to dominate the transformation process. A universal theory of how this transformation takes place is therefore not likely to evolve. Some of the common characteristics of media coverage deserve some attention, however:

- Media construct reality as well as readers construct their understanding of the media report (Dunwoody, 1992). These constructions are results of mental and professional frames that journalists use in selecting and recoding information. Construction does not imply that the coverage is independent of the real events. But there is ample evidence that the media amplify some elements and downplay others when processing information (Willkins and Patterson, 1987; Sood *et al.*, 1987). For example, the number of fatalities is a rather weak indicator for amount of coverage in risk issues, while the degree of social conflict arising from a risk debate correlates high with media coverage (Adams, 1986).

- Media direct their attention to events, not continuous developments. An accident-free performance of a technology over many years is not newsworthy, unless it is framed as an event (such as a public celebration). Likewise slow changes of the climate become hot news issues only if they can be linked to a conference, an exceptional hot summer (such as 1988 in the Unites States) or political statements (Peltu, 1989).

- Media have no internal mechanism to resolve conflicts among experts. Journalists have neither the time nor the qualification to find out who is right in a scientific debate. The most frequently used method to handle competing scientific evidence in the media is to give each side room to state or justify claims (Akademie, 1992, p. 272ff; Peters, 1991). Most journalists have lists of people who will provide counter-statements to any statement that they encounter when working on a story. Neither quality of evidence nor proportionality (with respect to number of dissidents or professional qualification) determine the amount of coverage that each side will receive. The amount is either equally distributed among camps or biased towards the preferences of the journalist or towards the editorial style of the respective medium. Media in a pluralistic society tend to reinforce diversity, dissent, and relativity of values (Rubin, 1987, p. 53).

Is there any evidence about specific media treatment of risk-related information? The media collect information from direct eyewitnesses of hazard events (anecdotal evidence) as well as systematic information from risk management institutions (Renn, 1991). Displaying anecdotal experience (such as losing property or being injured) contrasts with the statistical evidence provided by risk experts. This contrast reinforces the constructive nature of media coverage and its reception (same event through two very different lenses), and often contributes to the erosion of trust in experts (see below). In addition, the nature and the magnitude of the original hazard are only of minor interest to most journalists. They prefer to focus on the way institutions handle risks and communicate about

their activities. As Singer and Endremy have pointed out, the media emphasize hazards that are relatively serious and relatively rare; it is the combination that gives them their punch (Singer and Endremy, 1987, p. 13). For example, the Chernobyl accident with 31 acute deaths cases received 129 minutes of CBS News coverage while the 1976 Tandshan earthquake leaving 800 000 people dead received less than 9 minutes on the average TV evening news (Sood *et al.*, 1987, p. 37).

The literature contains endless lists of factors that are assumed to determine the attractiveness of risk-related messages for transmitters. Such factors include: technologically induced hazard (versus natural hazard), possibility to blame someone for the outcome (Sandman *et al.*, 1987, p. 105), cultural distance from the place of occurrence (Adams, 1986), human interest component, drama and conflict, exclusiveness of coverage (Peltu, 1985, pp. 137-138), proximity to politically hot issues, prestige of information source, and degree of conflict among stakeholders (Peters, 1984 and 1990).

Reviewing the abundance of theoretical suggestions and partially confirmed empirical results, one might come to the conclusion that the information processing in the media is almost random or at least void of any systematic pattern. However, some insights have been gained as a result of the media studies undertaken so far. The major components of risk studies, probabilities and magnitudes, seem to play only a minor role in the media coverage; they are hence attenuated. Intensified, however, are messages relating to conflicts among social groups (assigning blame), competing claims of evidence, risk events that could have been prevented or mitigated, and the involvement of individuals or organizations with high prestige and political influence.

Interaction among transmitters, plural input from different sources, the co-existence of personal, professional, and institutional selection and amplification criteria, and interaction among different target audiences create enough complexity and uncertainty that the final effect of the communication process can hardly be measured at all, let alone be effectively controlled. Reception studies of media coverage are therefore rare and often very restricted in the experimental design. It is clear, however, that people tend to form opinions and attitudes by a selection process in which parts of news stories are taken out and rearranged in accordance with personal preferences, existing attitudes, and values (Dunwoody, 1992). Media consumers create puzzles constructed by many elements (cognitive and evaluative) from a variety of media reports. It is not so much the intention of the message that consumers take for granted, but their pre-existing viewpoint that make them select and interpret the messages. This is why in some experiments individuals draw different, sometime even opposite conclusions from identical new reports to which they were asked to write comments (Lichtenstein and MacLean, 1989).

Trust in Institutions and Information Sources

Since most information about risk is not learned through personal experience and senses but through “second-hand” learning, media coverage has been the most eminent influential factor in risk perception. With the advent of ever more complex technologies and the progression of scientific methods to detect even smallest quantities of harmful substances, personal experience of risk has been more and more replaced by information about risks and individual control over risk by institutional risk management. As a consequence, people rely more than ever on the credibility and sincerity of those from whom they receive information about risk. Thus, trust in institutional performance has been a major key for risk responses. Trust in control institutions are able to compensate for even a

negative risk perception and distrust may lead people to oppose risks even when they are perceived as small.

Trust can be substructured in five components (Barber, 1983; Lee, 1986; Renn and Levine, 1991). These five components are listed and explained in Table 1. Trust relies on all five components, but a lack of compliance in one attribute can be compensated for by a surplus of goal attainment in another attribute. If objectivity or disinterestedness is impossible to accomplish, fairness of the message and faith in the good intention of the source may serve as substitutes. Competence may also be compensated by faith and vice versa. Consistency is not always essential in gaining trust, but persistent inconsistencies destroy the common expectations and role models for behavioral responses. Trust cannot evolve if people experience inconsistent responses from others in similar or even identical situations.

Table 1. **Components of Trust**

Components	*Description*
Perceived competence	degree of technical expertise in meeting institutional mandate
Objectivity	lack of biases in information and performance as perceived by others
Fairness	acknowledgement and adequate representation of all relevant points of view
Consistency	predictability of arguments and behaviour based on past experience and previous communication efforts
Sincerity	honesty and openness
Faith	perception of "good will" in performance and communication

Trust on a personal level is a subjective exception that a person will refrain from behavioral options that may harm the trusting person. Trust necessarily entails risk-taking, but, in contrast to the scientific endeavour of predicting the probability of identified outcomes, trust implies that the selection of options is left to the entrusted person or institution. Due to the perceived competency and honesty of the entrusted entity, one does not need to bother with assessing the outcomes of actions and with controlling the decision making process of that entity (Luhmann, 1980, 1973). This saves time and effort.

On a more aggregate level, trust denotes a generalized medium of social differentiation and division of labor (Parsons, 1960). The performance of specialized institutions in economy and government relies on a prior investment of trust by those who are served by this institution or finance its functioning. Total control would imply that the control agencies would need the same expertise and the same time allocation as the performing institution. Such an arrangement would neutralize the desired effect of social differentiation and ultimately lead to a society of intimate clans performing all necessary social, economic, and political functions simultaneously. By shortcutting normal control

mechanisms, trust can be a powerful agent for efficient and economical performance of social tasks. Durkheim's analysis of organic solidarity as a major structural variable of modern societies focused on trust as one of the predominant media that helped to shape the division of labor and to differentiate societal functions (Luhmann, 1973).

The relative value of trust varies over time, as empirical surveys clearly indicate (Lipset and Schneider, 1983). In some periods, people tend to invest a large amount of trust in institutions and it takes many disappointments before they withdraw this investment. In other periods, people tend to be extremely cautious with the investment of trust, placing more emphasis on functional equivalents, such as more organized control or increase of participation. Trust can partially be substituted by other generalized media, such as sharing power or control, but not totally replaced.

It is obvious that modern societies face difficulties in providing sufficient trust for reaching consensus on its complex and differentiated activities. All public institutions have lost trust and credibility over the last two decades except for the news media (Lipset and Schneider, 1983; Renn and Levine, 1991). Trust and credibility losses are high for industry, the political system, and many government agencies. Science still has a high degree of credibility although much less than two decades ago. Most sociologists believe that the decline of confidence in public institutions is partially a function of better education and the increase of public aspirations with respect to their share of public resources and welfare (Lipset and Schneider, 1983; Katz *et al.*, 1975). In addition, the complexity of social issues and the pluralization of values and lifestyles may have contributed to a growing dissatisfaction with the actual performance of institutions (Wildavsky and Dake, 1990). But at the same time, most people are confident in the governmental and economic system and do not support fundamental changes in the organizational structure of society. Therefore, the confidence crisis is less a system than a performance or competence crisis.

Lack of trust does not indicate, however, a declining relevance of trust for governing modern societies and managing technological risks. The contrary is true. The reliance of the technological society on trustful relationships between and among its subsystems has never been stronger than today. However, such a need for trust makes people more and more sensitive towards situations in which their investment of trust has been factually or allegedly misguided or exploited. The more trust is needed for implementing co-operative efforts or for coping with external effects of social actions, the more cautious are people in assigning credibility to those whom they are supposed to trust.

In risk debates issues of trust evolve around institutions and their representatives. People's responses to risk depend, among others, on their confidence that they have in risk initiating and controlling institutions. Since the notion of risk implies that random events may trigger accidents or losses, risk management institutions are always forced to legitimate their action or inaction when faced with an accident. On one hand they can cover up mismanagement by referring to the alleged randomness of the event (labelling it as unpredictable or an act of God), on the other hand they may be blamed for events for which they could not possibly provide protective actions in advance (Luhmann, 1986). Lack of trust has been specifically prominent in the area of nuclear waste disposal. The trust in the ability of risk management institutions to control nuclear waste risks over long periods of time has been the most influential factor in shaping peoples' opinion on nuclear waste facilities, such as Yucca Mountain in Nevada (Slovic *et al.*, 1993).

The stochastic nature of risk demands trustful relationships between risk managers and risk bearers, since single events do not prove nor disprove management failures; at the same time they

provoke suspicion and doubt. The slightest mistake by a risk management agency can be sufficient to destroy the delicate balance of trust. The handling of risk by private corporations and governmental agencies has been crucial for explaining the mobilization rate of individuals for taking actions. The more individuals believe that risks are not properly handled (in addition to being perceived as serious threats) the higher is the likelihood that people will be politically active. It has been shown that in the nuclear case the disillusionment of the US-population with the nuclear option as well as the number of people becoming political advocates of antinuclear policies grew simultaneously with the growing distrust in the nuclear regulatory agency (Renn and Levine, 1991). Negative attitudes are a necessary but by far not a sufficient reason for behavioral responses. Public confidence in institutional performance is another and even more important element in triggering behavioral responses.

Lessons for Risk Communication

The common thread running through most risk communication studies is that public understanding is hampered by the complexity of the risk concept (Short, 1989). Transmitters and receivers reduce complexity by simplifying the message and focusing on those aspects that they regard as relevant. This is part of the communication reality in modern societies and provides the social framework in which messages are sent and received.

Risk communication is particularly difficult for high consequence low probability risks, which are associated with involuntariness, dread, lack of control, and unfamiliarity. To address these negative risk characteristics, it may be helpful to point to functional equivalents of these characteristics in a broader societal context. Potential equivalents are the assurance of a democratic decision-making process to counteract the impression of involuntariness and, as a replacement for personal control, the independence and impartiality of operating and regulating institutions. This may produce trust in their capability to monitor routine emissions, check safety devices, and intervene if safety in the risk producing facility is not managed properly (Lipset and Schneider, 1983). In addition, unfamiliarity can partially be compensated by better functional knowledge about the risk and the associated technology.

With respect to the transmitters, risk communicators should be aware of the major selection rules of the media. Media report about events, not continuous performance. Hardly any journalist is interested, for example, in writing a story about a long safety record of a hazardous waste facility. If such a facility, however, faces an accidental release of hazardous material, one can be sure that this event will become headline news. To get a message across, communicators need to link their message to events, not necessarily physical events. Social events such as a celebration of 25 years of safe performance or a completion of a scientific study can also meet the event requirement.

Another major characteristic of the media is their interest in eyewitness reports. These testimonies relate abstract issues or events to unique human experiences (which journalists assume help readers to identify with the victims or managers of the risk). Information that emphasizes the human component and personalizes abstract material is more likely to be accepted by the media than documents about the sequence of events or organizational competence (Peltu, 1989). However, risk communicators should be aware that “packaging” the information for the purpose of pleasing the transmitter always faces the risk of creating suspicion and distrust. Transmitters often associate good packaging with the intent to manipulate the audience. One should never forget that social institutions devoted to information processing are not computers or radios that operate according to prestructured

rules (Rayner, 1988), but they constitute thinking beings who reflect the messages they receive and change their selection rules to fit the circumstances.

In addition to these media-related guidelines, risk managers should follow the following major guidelines for successful risk communication (see also: Covello, 1988; Hance *et al.*, 1988; Renn, 1992):

1) *Be clear about your intentions and make them the central message of your communication effort.* As obvious as this may sound, many risk information attempts are clear violations of this principle. Many agencies are forced to react before they have made up their mind about an issue. Sometimes different departments voice different opinions and the text of the information constitutes a poor compromise between the diverse viewpoints. If a fast reaction is required, the message of the first response may be that there is still too much uncertainty about risk to produce sound judgments and that the institution needs more time to assess the data. Although this message may not be very attractive, it still is better than pretending to have a degree of certainty which is unjustified. Clarity and unequivocal position are two major conditions to pass the attention filter of the respected audience.

2) *Simplify your message as drastically as you think you can do without being inaccurate.* Messages will be simplified regardless how well written the text may be. Rather than have the transmitters and final receivers simplify the text their way, the sender may perform a more accurate simplification in accordance with his/her original intentions. Simplification is a very delicate job and needs careful editing and re-editing. Factual information should be made as simple as possible, but information about the decision process, the values that were used to assign trade-offs to different options, and the remaining uncertainty should not be omitted, as this information is crucial for building credibility and trust.

3) *Place your simple messages in the beginning of a text and gradually add the complex issues.* Although simplicity is a virtue for the whole information process, it is advisable to start with the simple and easily understandable messages and add more complex and detailed information at the end. This structuring of the information serves two purposes: gaining the attention of the only peripherally interested audience and at the same time pleasing the centrally interested audience, which expects detailed argumentation and sufficient evidence. One way to please both audiences (aside from splitting the information) is to give the general information first and add the specifics later.

4) *Anticipate the interests of your target audiences and design your communication program to match their needs.* This guideline is the most often violated rule in risk communication. Experts in institutions often yield to the irresistible tendency to package a whole education program in each attempt to communicate with the public. But most people have neither the desire nor the time to become nuclear engineers, immune system specialists, or experts on radon. Most people want to know the consequences of a risk, the circumstances of its occurrence, the possibilities for mitigating the risk, and the management efforts by the respective institutions. Depending on the level of the risk debate, the communication should focus on the

scientific evidence, the management record of the institution, or the world views and philosophies that govern the institutional performance.

5) *Devise different communication programs for different target audiences but do not change the message.* In addition to structuring texts, a communication program can operate with different packages containing the same message, but using different channels for transmission. A message to the national wire services should contain only the basic facts and some general conclusions, a press release to daily newspaper may also incorporate some discussion of the results, anecdotal evidence if suitable and reference to actual events (otherwise it will not pass the selection filters of these transmitters). Manuscripts for science supplements in newspapers or specialized journals should be more problem oriented and offer a novel or interesting perspective in the analysis of the issue.

6) *Messages should be distributed on different channels and feedback communication should be stimulated and encouraged as much as possible*. A good communication program should not only address different audiences by using different transmitters, but should also take advantage of the different available channels. Press releases are one major medium for communication, but press conferences, participation in talk shows, appearances at hearings and public events, letters to the editor, and direct mailings are often complementary ways of conveying a message. Press conferences and talk shows allow immediate feedback from the transmitter so that the information can be better tailored to the needs of the receiver. Sending out brochures with reply envelopes is another method of collecting information about the communication needs of the public and bypassing the transmitters. Models for public involvement have been proposed and tested to assure constant feedback from the risk bearers or bystanders. In addition, monitoring the process of re-coding (through content analysis of media messages) and of receiver's responses (through evaluating letters to the editor or direct survey methods) provides valuable information about the comprehensibility of the original information and its effects on the receiver.

7) *Be honest, complete, and responsive in the composition of your message.* Honesty is a vital condition for gaining credibility. Honesty will not automatically be rewarded, but dishonesty will certainly create negative repercussions among transmitters and final receivers. The same effect will take place when sources withhold relevant information or tell only one side of the story. The goals of honesty and completeness include another, often overlooked aspect. Institutions with vested interests should put their cards on the table and justify their position. Credibility is often assigned by speculating about the true motives of the source. If profits or other vested interests are obvious motives, it is better to address these issues and make clear that such interests do not automatically preclude public interest or the common good. Industries could for example make the argument that companies with a good risk reduction and control program are more likely to attract better qualified personnel, to enhance their corporate reputation, and to avoid costly litigation.

8) *Try to escape from role expectations by using a personal approach and by framing the communication to the personal experience of the addressed receiver.* Receivers, in particular peripherally interested persons, are inclined to select information that contains surprises or unexpected insights. Even if the material of the message does

not offer anything new, communicators can attract attention by avoiding the stereotypes their role and by personalizing the message. This is particularly effective in face-to-face interactions, press conferences, or talk shows. Without denying their home institution, communicators may report about their personal feelings and what kind of actions they took to protect themselves. They even may convey their own concerns and show compassion for the anxieties and worries of the addressed audience. In addition, avoiding role stereotypes confronts the audience with some cognitive dissonance that may be resolved by accepting the new message. To be honest is an absolute condition for such an attempt because most people have developed a good sensitivity for detecting acting or fake feelings.

9) *Allocate enough time for packaging your message, but do not change your message in order to make the package more attractive.* The packaging of the message is important for the success of the communication effort. A good package implies that the formal requirements for a news story are met and that the message contains the relevant clues that are attractive to your target audience. But packages are not ends in themselves. If the message has been simplified and tailored to the needs of the receiver, it should not be further compromised by adjusting it to the most attractive package. This is the major difference compared to advertisement where people do not expect truthful information but entertaining persuasion.

10) *Be careful in selecting the right cues for appealing to the peripheral audience without offending your central audience.* Peripheral cues should be confined to commonly shared symbols, appealing formats, and surprises in openness and honesty. They should definitely avoid negative labelling of potential opponents or typical advertising gimmicks. Peripheral cues are important for successful communication, but they have to be selected carefully to please the peripherally and centrally interested audience alike.

11) *Explain the risk rationale to your audience and demonstrate the logic and adequacy of this rationality without claiming superiority*. Explaining the rationale of risk analysis and its role for risk management prepares the audience to acknowledge the basic principles of risk management decisions. The decision-making process and the past record of the institution should also be included in the message so that people can assign competence to the actors and get a better feeling of the trade-offs that had to be made in meeting the specific objective. Evidence of competence, fairness towards other viewpoints, and references to commonly shared values and beliefs will make a message more attractive and could help to address the centrally and peripherally interested audience at the same time. Conveying probabilistic information is a real challenge, but can be done in reference to everyday experience of budget constraints and consumer products. Furthermore, evidence of successful use of risk analyses in hazard management can serve as demonstration to define the role and limitations of risk analysis in improving public health and the environment.

12) *Place risk in social context and report numerical probabilities only in conjunction with verbal equivalents.* The functioning of the intuitive heuristics and biases in processing probabilistic information mandates a verbal explanation of numerical probabilities since most people have difficulties in understanding the meaning of probabilities and tend to focus on the maximum perceivable consequences. This

verbal explanation should attempt to put risk in perspective to other risks. Risk comparisons create often confusion and are likely to be rejected by the audience if they do not match the receivers' perception of comparable risks. Therefore a few rules for using these comparisons are appropriate (*cf.* Crouch and Wilson, 1984; Merkhofer, 1987; Covello, 1992):

- Risk comparison should rely only on risks that are perceived as comparable by the public. Risks with identical benefits are certainly better suited to risk comparisons than risks with divergent benefits. The major point is the purpose of risk comparison. Comparisons should only serve the purpose of illustrating the meaning of abstract probabilities. Risk comparisons for the purpose of suggesting judgments about acceptability should be avoided because they are neither logically defensible nor convincing in the eyes of the public.

- Risk communication must address the basic qualitative properties of different risks such as dread and personal control and explain how deficiencies in those qualities have been compensated or will be compensated.

- It may be useful to insert anecdotal evidence or report about identifiable victims when communicating about familiar and unspectacular risks, such as radon or high blood pressure (publicly attenuated risks). Attention is almost assured if the receivers perceive the risk as a potential threat to themselves or their primary group.

- It seems advisable to use both, numerical probabilities and verbal expressions of likelihood or risk comparisons. The perception of probabilities is characterized by so many biases that verbal explanations help to put risks in perspective. The more interested and well-educated audience demands also numerical information and will suspect an attempt to hide relevant facts if the numerical data is withheld.

13) *Institutional performance is the major key to trust and credibility. The more you can demonstrate that you did a good job the more you can expect trust in your message.* Confidence has to be gained by meeting the institutional goals and objectives. Credibility is linked to the evidence of being cost-effective and open to public demands. These two goals are often in conflict with each other (Kasperson, 1987), but they have to be treated as complementary, and not as substitutional goals. Fairness and flexibility are major elements of openness. In addition to assuring sufficient external control and supervision, public participation may be implemented as a means to demonstrate the compliance with the political mandate and to avoid the impression of hidden agendas. On the premise of good performance, communication programs can be designed that reflect these accomplishments.

14) *Risk managers have to learn from the public as much as the public can learn from them:* Risk communication has to address public expectations and public knowledge about the risk management rationale first before it can deal with actual management results and before it can ask for trust in the management effort. Such an educational approach is only acceptable to most people if the education process is mutual and if the essence of public concerns is adequately addressed (Covello *et al.*, 1986;

Zimmerman, 1987; National Research Council, 1989). Two-way communication is clearly a prerequisite of successful information campaigns, but it is often hard to implement and requires flexibility and the willingness to adapt to public concerns on the side of the communicating institution.

15) *You can convince the receivers of your message only if it addresses their concerns and interests.* Try to investigate in advance on what level the risk communication will occur. If public concerns are focused on technical issues, your message should contain mainly factual evidence. Communicators on this level should be technical experts. You should be aware, however, that many risk debates appear to be on the technical topics, but the underlying conflict is about issues of trust or values. A debate on trust has to address the institutional qualifications and the past performance record for risk management. The desired communicators here are the institutional policy makers or risk managers. Risk debates on values and worldviews require a consensus building exercise focusing on values and fundamental policy directions. Most institutions will have problems to conduct such exercises; a political facilitator or mediator may be needed to initiate a discourse aimed at a consensus building (Renn *et al.*, 1993).

These suggestions should not be regarded as recipes, but as normative information of what to take into account when approaching the public with risk-related information. Social interaction is too complex for designing "fool-proof" guidelines. Different hazards and risks demand different approaches. But the most important reservation is that the best communication process will not lead to any success if it is meant to compensate shortcomings or failures in the task performance of the communicator or to hide management mistakes.

Interaction among transmitters, plural input from different sources, the coexistence of personal, professional, and institutional selection and amplification criteria, and interaction among different target audiences create enough complexity and uncertainty that the final effect of the communication process can hardly be measured at all, let alone be effectively controlled. Even the rather simple step of making a message known to and understood by the target audience faces the chaotic conditions of the communication market. Guidelines and recipes to improve risk communication can help to increase the probability that a message will reach its audience, but will never guarantee its success.

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PERCEIVED RISK AND PUBLIC CONFIDENCE

by

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Introduction

Risk is important. So are benefits. However, risk is often more important for decision makers and for the public than is benefit. The reasons for this asymmetry are obscure, and they may reside in biological factors; possibly it has had greater survival value to prudently avoid possible danger than to opt for maximum gain [69].

Table 1 shows the outcome of a number of regression analyses of the attitude to various kinds of energy production technology. The attitudes were rated on a scale going from "very bad" to "very good" and they were related to simple ratings of risk and benefit of the technology in question.

The data on which Table 1 is based were obtained from a large representative sample of the Swedish population. It can be seen that risk was given a larger weight in determining attitude, with the sole exception of wind power. In the CEC project (RISKPERCOM) which produced these data similar results were obtained in 4 more Western European countries.

Table 1. ***Regression analyses of attitude to various energy production systems, N=820***

Energy technology	*b, risk*	*b, benefit*	R^2_{adj}
Hydro power	*-.43*	*.26*	*.32*
Wind	*-.20*	*.39*	*.21*
Biomass	*-.49*	*.30*	*.42*
Natural gas	*-.56*	*.15*	*.39*
Nuclear power	*-.63*	*.27*	*.63*
Oil	*-.57*	*.23*	*.46*
Coal	*-.53*	*.21*	*.39*

Risk is a very salient aspect of policy making. A study of the private bills submitted by Swedish MPs showed that they currently are about risks of various kinds as frequently as 30% of the time [85]. This figure is up from about 11% 30 years ago. The economic priorities reflected in various political and administrative decisions were found to vary enormously, from less than 1 million SEK

for a human life to several billions [60]. Many more types of evidence could be cited in support of the assertion:

RISK IS A CENTRAL CONCEPT IN CURRENT DEBATE AND POLICY CONCERNS

The present paper develops the theme with respect to risk perception and social trust. I first review work on risk perception, then on trust and its relations to risk perception. The purpose of the paper is not to give merely a summary of work on these topics, but to analyse that work in a critical way, pointing to the shortcomings of much of the received message in the field and also pointing to promising new developments. In many cases, the points I make will be illustrated by our own empirical work. The references usually cover much work carried out by other research centers.

Risk perception

Traditional models and their shortcomings

Risk perception emerged in the 60's as a crucial aspect of technology and environment policy [90; 99; 100]. At a general and somewhat vague level of discourse, it seems obvious that the public's risk perception is or should be important to take into account for policy makers. Emerging opposition to technology was often phrased in terms of risk, and still is.

Risk is a slippery word. Its etymological roots are unknown and its current meaning often unclear. It can refer to the probability of harm, the severity of harm, should it occur, or a combination of the two. Drottz-Sjöberg studied risk definitions and found them to be related to risk perception [18]. The most common definition seems to be to equate risk with the probability of harm. In the present paper, I will accept that definition provisionally, and will then move on the other construals of risk.

The first question to ask about risk perception is what relation it has to real risk, or, to be more specific, what is the relation between real probability and subjective probability? The notion of real or objective probability is of course problematic, but let us assume it for the time being. It is then found that people make, on the average, rather correct judgements of the probabilities of illnesses and accidents which are common and well known [51]. However, this finding is not quite relevant to the discussion of many technology risks since the latter are very small and little known (to the public). We shall deal mainly with that case in the present paper. Here, probability becomes a problematic concept. It is hard to grasp, intuitively, very small probabilities and differences between small probabilities. Such differences may be quite important for policy. Furthermore, small probabilities are most often assessed on the basis of models (by definition, there is little empirical evidence) and models must make simplifying assumptions. Such assumptions can be contested by other experts than those who formulated the models. Thus, a debate arises and the public will surely note that experts disagree. This is another factor which downgrades the credibility of small estimated probabilities.

Hence, the small probabilities that experts estimate are often not believed and the public upgrades them to higher values. This is in contrast to lifestyle risks (smoking, alcohol, *etc.*) where experts often estimate the risks to be large while the public downgrades the probabilities, at least with regard to their own personal risk.

What, then, accounts for risk perception and risk acceptability? Three major attempts have been made to answer that question: Heuristics and Biases [102], the Psychometric Model [33] and Cultural Theory [17; 105]. As we shall see, they have all failed.

Heuristics and Biases were proposed in the 70's by Tversky and Kahneman as a way of explaining subjective probabilities. The basic thrust of this work was to compared subjective, or intuitive, probabilities with those prescribed by probability calculus, in well-defined problems where calculus could be applied. Often, people made gross errors in such judgements. However, the relationship to risk perception is tenuous. Perceived risk is not necessarily the same as subjective probability, and risk perception of interest occurs in situations where there is no well-defined correct answer to be derived by means of probability calculus. Risk perception also occurs in a context of decision and policy, while the work on heuristics and biases was largely hypothetical in nature [3], and emotional factors were ignored [66; 67].

The major conclusions from this early work concerned the proposed “heuristic” of availability. People are said to judge the probability as larger of events that more easily come to mind, that they have more often heard of, *etc* [101]. There is an obvious link here to a social analysis by means of media effects [11]. In a small-scale study, Combs and Slovic appeared to have demonstrated this effect: risk perception is driven by media coverage. However, this study has not been univocally supported by later work [1]. The relationship between media contents and risk perception, if any, appears to be varying and weak. Experimental work has not supported the thesis of an availability heuristic [2; 32], and a lack of relationship to mainstream work on memory is apparent here.

A further development in this tradition is the so called “Social amplification of risk” theory [9; 48; 61]. This is an attempt at a large-scale analysis of the entire social stage when it comes to risk perception and risk reactions. Very little data are, however, available and the theory is mostly a conceptual scheme. The data are to a large extent hypothetical or conjectural.

The Psychometric Model [33] is a compilation of variables suggested to account for risk acceptability by various authors who worked under the influence of Starr's [100] seminal work. Two major dimensions emerged: New risk, and Dreaded risk. Nuclear technology was found to be perceived, by US convenience samples around 1980, to be high both in Dread and Newness. Hence, opposition to nuclear technology appeared to be explained. However, the relation between individual risk perception data and societal or otherwise collective action [10] was never dealt with in the tradition of the Psychometric Model. Furthermore, when adequate statistical analysis was carried out, it was found that the model accounted for merely a very minor share of the variance of risk perception, about 20% [41; 75]. Still more damaging, newer research has shown that the model missed at least one major aspect of risk perception, viz. Tampering with nature and Immoral risk [77; 79]. When that factor was introduced, the explanatory power rose considerably, and it absorbed what explanatory power could be found in the traditional dimensions. Nuclear technology is not seen as new, nor is it extremely dreaded. Opposition to nuclear technology seems rather to have to do with notions of morality and “Nature”. These findings point to the importance of analysing conceptions of “nature” and to relate them to crucially important attitudes and risk perceptions; see [21] for ongoing work with this orientation.

Cultural Theory assumed that risk perception is determined by group membership and certain abstract properties of groups. Four types of people emerged in the theory: Individualists, Egalitarians, Hierarchists and Fatalists. These types were transformed to attitude scales by Dake [13; 14], and tested empirically. Some weak trends have appeared in such work to partly support the

theory [78; 84; 105]. However, only about 5% of the variance of risk perception is explained in by the variables based on Cultural Theory. When added to other models, almost no improvement in explanation of risk perception is found due to Cultural Theory. In addition, the theory has been subjected to strong criticism also from the standpoint of anthropological theoretical analysis [5].

"Culture", in a vague sense, is obviously all-important. However, this does not imply that a particular theory, misnamed as the Cultural Theory of risk perception, catches the role of culture in risk perception. Indeed, the assumptions of group characteristics on which the theory is based have never been supported in empirical work. Failed attempts have tended to remain unpublished, as so often is the case with failure to confirm popular theories.

A central tenet of Cultural Theory is that of "myths of nature" [15]. It is asserted that there are four different conceptions of nature: robust, capricious, tolerant and fragile. This assertion, as others made by theory, is untenable. In a major survey study, Drottz-Sjöberg found that only 212[8] of 713 respondents could be classified in one and only one of the four categories [21]. All others had more complex beliefs about nature. Drottz-Sjöberg also found that conceptions of Nature had low correlations with most other variables. They seemed to constitute an independent cluster of beliefs.

Data in the behavioural and social sciences very rarely allow for a clear-cut typology of the kind postulated by Cultural Theory. Typologies are unlikely to ever give a good fit to data.

Both the Psychometric Model and Cultural Theory of risk perception have enjoyed considerable credibility, in spite of their weaknesses when it comes to empirical data. Why?

Reasons can be found at many levels. One is that of statistical analysis. The Psychometric Model was originally, and in many subsequent applications, based on correlations between means. Such correlations are regularly much higher than correlations at the observational data level. They get to be higher and higher as the size of the sample increases. This is because the means get to be determined with increasing precision. The fact that a high level of explained variance could be found for perceived risk or risk acceptance by Fischhoff *et al.* was a mere triviality, explained by the data manipulation they carried out. Clearly, a finding that is mostly due to the size of the sample is an artefact.

A second statistical triviality is that correlations vary among different dependent variables. In a typical study, many hazards are investigated and rated as to, say, perceived risk. When all these hazard ratings are analysed with regard to the Psychometric Model, some of them will be better explained than others. To boost belief in the model, one might single out the highest levels of explained variance as "achievements" of the model, as done in a recent paper [52]. The fact that, in some cases, some 50% of the variance is explained says very little, since, in other cases, virtually none of the variance is explained. The average level of explained variance is the appropriate measure to use and that is typically found to be about 20%. Marris *et al.*, working with a small convenience sample, did no better.

A third statistical trap is to be found in erroneous use of statistical inference [64]. It is an elementary thesis of statistical analysis that "significance" cannot be equated with "importance" or power of explanation. Statistical significance is largely a function of the size of the sample and says

8. Of these, 166 checked that they saw Nature as "fragile". Only a handful checked any other alternative as fitting "absolutely" to their beliefs.

nothing about how much is explained of a dependent variable. Many researchers may pay lip service to these notions but nevertheless err in practical use.

An example of the varying attitudes to statistical evidence is provided by a paper by Peters and Slovic [56][9]. They used some Dake items and some additional ones to measure cultural biases. Peters and Slovic investigated correlations between the scales and various risk judgments and found a number of, mostly very weak, but often statistically significant correlations, which they describe in the text in an exaggerated optimistic manner. For example, the correlations between the egalitarian subscale and technology concerns were -0.22, -0.10, -0.01 and 0.02, a not very impressive set of correlations. Nonetheless the authors wrote "these data confirm the hypothesis that the Egalitarian factor will be strongly related to concerns about technology ..." (p. 1439, emphasis added). It is hard to understand how these correlations can be described as "strong". Other examples of optimistic bias in interpretations in their paper could be given, see [78]. Another example of misuse of statistics is found in the often cited by paper by Wildavsky and Dake, where they present an empirical test of Cultural Theory [105]. They presented only "significant correlations", leaving out a large share of all the hazards investigated in the results section and giving a false impression of the power of the theory. They also failed to describe their methods in full, making an exact replication impossible [84].

It is common for researchers to insist that, even if Cultural Theory variables are only very weakly correlated with risk perception, the correlations are still "significant". But such low correlations can have any number of alternative explanations, which seldom or never are checked, such as gender differences. (It is very well known that women tend to give higher risk ratings and that they are also often more egalitarian than men).

The fourth weakness to mention is the belief that weak results are due to measurement errors. The effect of random measurement errors can be estimated, using traditional test theory methods, and it turns out to be negligible. Another issue altogether is the question of validity of the measures. It is of course always possible that some other, as yet unspecified, way of measuring the constructs will give different results more supportive of the theory. It seems to me that this argument is empty as long as such better measures have not been developed, however.

A fifth weakness, especially salient in the case of Cultural Theory, is the prevailing emphasis on anecdotes, anthropological case studies and the like. Of course, cases can always be found which can be interpreted as support for virtually any theory, or any prejudice, be it Cultural Theory, Jungian psychodynamics or some form of Existential psychology [53]. Even if such case and anecdotical studies can be of value to formulate hypotheses they cannot be used as evidence for a theory. Besides, psychoanalysis and Jungian psychology are in disrepute [12; 44; 54] and few serious researchers in psychology have much confidence in them.

A sixth weakness is the reliance on convenience samples or samples with very low response rates. A case in point is a paper where the French public is said to be investigated in the title of the paper; on reading it turns out that data were obtained from a convenience sample of graduate students [46]! Response rates well below 40% are not uncommon and have apparently not deterred researchers and editors from publication. Even with higher response rates, around 60-70% as often achieved in our Swedish studies, there is usually a bias towards too many respondents with a higher than average level of education. This is unfortunate but not fatal, since level of education usually correlates very weakly, around 0.1, with risk perception data. There seem to be special difficulties in obtaining a high

9. Results are from a large-sample survey study with a rather low response rate. The authors do not state if the respondents were biased with regard to education and income.

response rate in many countries, Scandinavia being an exception. Yet, there are methods for getting better results [16], even with mail surveys, and careful work, *e.g.* in the USA, has produced quite impressive results [57], in line with standards of telephone interviewing [43; 49].

The empirical bases of the prevailing theories of risk perception tend, thus, to be weak and they can only be made to look impressive by means of misleading or erroneous statistical analysis or highly subjective and conjectural case studies. Applications of these theories, see *e.g.* [63], are quite premature and likely to fail since the theories explain so little of risk perception. Sandman has launched the concept of "outrage" as a summary for the psychometric dimensions + trust but no data support the view that psychometric dimensions are of any help in risk communication. Indeed, there are many facets of risk communication and trust is not always the best strategy [50].

To add to the present critical analysis of risk perception research, important distinctions have often been overlooked in such research. Researchers often ask their subjects to judge "risk" without specifying to whom risk is to be assessed. It is very easy to show that risk to one's own person is judged much lower, and with a different rank order among hazards, than risk to others [19]. Personal risk and risk to others appear to have different roles in policy attitudes. This enormously important distinction is still frequently overlooked in empirical work on risk perception[10], see Viscusi [103] for an example. Another important distinction is that between risk and worry and other emotional reactions to threats. Risk perception is only weakly related to worry [24; 82]. Risk perception is the outcome of an intellectual judgment, not an emotion, and the sometimes heard claim that people are "radiophobic" is unjustified [22]. On the other hand, the issue of morality is a central one in risk acceptance [68; 93] but has been very little attended to. This is perhaps partly because researchers have concentrated on "risk" or "hazard", not on action which brings risks about or mitigates hazards.

Group differences

It is well-known that women give higher risk ratings than men do; this result is found in virtually every study of the matter. However, careful design is again called for. The gender difference is pronounced for general risk, but much smaller for personal risk [70]. Most studies also find that the gender difference exists for all social strata and in many cultures.

Age and educational level are of less importance [88]. However, interest in a line of study turned out to be, in a group of high-school students, strongly related to risk perception [25]. The latter finding may be related to the difference between experts and the public which is found when it comes to nuclear technology [91]. On the other hand, average risk ratings of politicians turned out to coincide with those of the public [77], politicians also being more polarised than the public.

Socio-economic status and culture have also been investigated. Extreme poverty can be associated with elevated levels of all types of risk perception [55], but in some work this expectation has not been supported [92]. The idea of a Maslow type need hierarchy which would predict less concern with long-term environmental risks in the very poor and in developing countries has not been supported by data [26; 76]. In the latter study, even gross religious differences (Catholics *vs.*

10. "Risk to you and your family" is often specified as the target in rating instructions, but personal risk and risk to family are rated differently and the combination gives results hard to interpret. When no target is specified, people seem to interpret their task as calling for ratings of general risk.

Muslims) did not seem to correlate with risk perception. So far, the most powerful group variables in risk perception research have been gender and educational orientation.

A special tradition is that of cross-country comparisons in risk perception. See Boholm [6] for a review. Few generalisations can be made on the basis of that work, which lacks in theoretical coherence and is largely exploratory. However, some interesting findings have been reported, among them the high level of perceived risk observed in Eastern European transition societies [92], as contrasted with the low level of risk in the previous communist states [31]. Drottz-Sjöberg found very low levels of trust in her study of people in the south of Russia in the beginning of the 90's [23]; apparently a problem in the aftermath of Chernobyl and the overwhelming historical experience of a closed society.

New and powerful models of risk perception

High levels (50-65%) of explanatory power with regard to risk perception, mostly in the nuclear field, have been obtained with a new type of model [91]. When measurement error of the dependent variable is taken into account little of the true variance remains to be explained beyond what is achieved by these models. Basically, three types of predictors occur as determining risk perception.

First, risk ratings are clearly correlated across many very different types of hazards. People tend to see all risks as large or small. This could perhaps be a case of acquiescence bias, *i.e.* a case of habit of using the rating scales in a consistent way and thereby to fail to make distinctions that are called for and would reflect true perceptions. However, the correlations are restricted to a given type of risk rating. Acquiescence would require a much broader type of rating consistency. Hence, I have discarded that explanation and concluded that there is what could be called risk sensitivity. Some people are very prone or perceive risks as large, others see all risks as small. One could call this a personality variable and it does account for a sizeable proportion of perceived risk in any particular aspect.

Second, a very pervasive factor in risk perception is attitude to the risk generating agent. In the case of nuclear waste, the global attitude to nuclear power seems to be an important determinant. It correlates strongly with perceived nuclear waste risk, and structural equations models show that it fits best when introduced as a factor prior to perceived risk, rather than the other way round. In other words, attitude seems to determine perceived risk [72]. This aspect is one of ideology, but note that more general measures of ideology or basic values seldom succeed in accounting for any sizeable portion of specific attitudes, or risk perception [84].

Third, a very important factor is specific fear, which can be put in concrete terms *e.g.* as fear of background radiation [75] or specific types of illness such as cancer. There is a factor of fear of radiation which can be found in all investigated sources of radiation, which in themselves are rated at very different levels of risk, *e.g.* X-rays and nuclear waste [81]. This factor is a belief factor.

Further complications: consequences of perceived risk

It is often believed that level of perceived risk is closely connected to demand for risk mitigation. This may, indeed, seem to be a self evident truth. However, counter examples are easily

found. A trivial risk, such as catching cold, can be seen as larger than a fatal risk such as being infected by the HIV virus [73].

In many studies, I have furthermore found that demand for risk mitigation is not strongly related to perceived risk or perceived probability of harm bit to the severity of consequences. This fact may seem surprising, at first sight, since there are many everyday risks, potentially fatal, which are dismissed. It may therefore be the case that the predominance of severity of consequences is at hand mostly for supra-threshold, non-dismissed risks. However that may be there have been virtually no exceptions to the dominance of the severity of consequences in my studies. Previous beliefs that probabilities dominated were based on very few, and highly idiosyncratic data, see *e.g.* simple gambling experiments by Slovic which are often cited by him this context [96]. Gardner and Stern [42], in a recent textbook, build upon this received and erroneous view.

Hence, risk perception research designs need to be expanded to consider explicitly demand for risk mitigation and the dimensions of that construct are in need of further empirical work. So far, it has turned out that it is much harder to account for than risk perception per se [74].

Wishful thinking and risk perception research

As a way of rounding up our discussion of risk perception, let us further consider some methodological traps. Basically, people can be made to appear to agree with various policies without really doing so. It is always tempting to see what one wishes to see. Psychological research has demonstrated the prevalence of wishful thinking [87].

Two Swedish examples can be cited, both from polls conducted by a leading Swedish polling firm called SIFO. As is well known, there is strong local opposition towards the siting of nuclear waste repositories in most, or all, of the world, see *e.g.* [30]. Sweden is frequently mentioned as an exception to this general rule [35; 36]. The basis for this statement is probably polls made by the Swedish polling firm SIFO, based on a single crucial question, which allegedly show that a majority of Swedes are ready to accept a nuclear waste repository in their local community [65].

SIFO asked the following question:

> *"If it is judged that the best place for a high-level waste repository is in your municipality, can you accept or can you not accept that waste is deposited in your municipality?"*

This question has been put to samples of the Swedish population a number of times. Typical SIFO data have been widely quoted as supporting the thesis that Swedes are now ready to accept nuclear waste – and a SIFO press releases have made exactly that assertion ("A Note the leading character of the question, which assumes a non-controversial assessment of what is "the best place", and which asks for "acceptance", an unclear concept in the present context.

The SIFO data were obtained in in-home interviews, with very few "don't knows". The number of "don't know" answers increased drastically when the question was administered in mailed questionnaire administered by us [89; 91]. A majority in the mailed questionnaire study rejected a local repository. Hence, it is by no means clear that Swedes accept a nuclear waste repository in their

local community. Besides, very few indicated that they would vote in favour of such a repository in a local referendum. Only 20% said they would surely or maybe vote in favour of a local repository.

In-home interviews have a high level of (undeserved) face validity. Much research has demonstrated the strong interviewer effects. In addition, respondents cannot be anonymous in in-home interviews. Mailed surveys are better, as well as cheaper, especially for sensitive questions [104].

When it comes to reality testing, the people of two Swedish communities have rejected a local repository for high-level nuclear waste in local referenda: 72% in Storuman in 1995 and 54% in Malå[11] in 1997.

Another, still more striking, question has been worded thus by SIFO (our translation):

> *"High level nuclear waste from the nuclear power plants will be deposited somewhere in Sweden. To find a suitable site it is necessary to obtain facts about geology, soil conditions, transportation facilities and other information from different municipalities in Sweden. Is it your opinion that your municipality should agree to such studies or is it not?"*

According to SIFO, 83% agreed in a poll carried out in November of 1994. Only 6% were hesitant or did not know. The result was widely advertised in the media.

In our study, the above question was modified for half of the sample. The last sentence was made more explicit and read:

> *"Is it your opinion that your municipality should agree to such studies in the municipality or is it not?"*

The response alternatives repeated the added contents as well, making it very clear to the respondent that the preliminary investigations under discussion would be carried out in their own community[12].

In our mailed questionnaire, the 83% reported by SIFO fell to 24%, when it was explicitly pointed out that the question concerned an investigation in the respondent's own community. Again, these data agree much better with the outcome of local referenda than the optimistic conclusions drawn by SIFO.

The point of these examples is that survey methods can easily be designed so as to give desired responses – but little is gained by such strategy, which on the contrary tends to create problems because of the illusions it fosters among policy makers. A similar case can be made for data and observations collected in different traditions, such as the clinical or anthropological ones.

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11. Malå and Storuman are very small communities in the far north of Sweden.
12. It seems clear that the original version indeed intended that meaning to be communicated and so have the results been interpreted. It would not be clear at all what could be meant by one's community "accepting" studies to be carried out somewhere else. Yet, when the implication was not explicitly mentioned it may simply not have been in the minds of many respondents.

Conclusions about risk perception

Summing up, what have we learnt about risk perception from the research carried out since the beginning of the 70s, cp. [80]? Five conclusions are offered:

1. Cognitive biases play a minor role. Risk perception is influenced by attitude, rather than the other way round. Risk reactions are much influenced by moral aspects, and quite different if there is a responsible human agent or not.

2. Level of perceived risk is only a partial explanation of demand for risk reduction. Risk is closely related to probability of harm, and demand for risk reduction is related most strongly to severity of consequences.

3. Attempts at distal explanations of risk perception have failed. Models of perceived risk which account for a major share of the variance can be constructed, but not if they are based on explanatory variables which are very different as to contents. Cultural Theory is a prime example of such a failed attempt.

4. Groups which are different with regard to education, interest and employment differ greatly in how they perceive risks. Explanations of such differences have not yet proceeded very far; simple notions such as variability of level of knowledge fail to account for the whole picture.

5. Powerful models based on risk sensitivity, attitude and specific fear appear to offer a promising future development.

The studies of risk perception serve as an introduction to the crucial topic of trust and I begin with a brief review of research on that issue.

Trust

Research review

Previous research has suggested that trust is an important factor in risk perception and risk tolerance [28; 29; 34; 37; 38; 39; 40; 47; 62; 94; 97; 98]. Most of this work has been concerned with trust in the government and authorities, and in the media. Indeed, trust is a main factor in a common approach to understanding risk perception, by Sandman termed “outrage” [63].

Many papers on trust and risk perception treat the matter mostly as a theoretical issue and present no data. It seems to be simply assumed that the relationship is very strong. I have been able to locate only a few examples of empirical investigations of the matter. Pijawka and Mushkatel [58] studied risk perception of nuclear waste and trust in federal government, agency and state and local government. They specified trust as trust that decisions taken will protect public safety (probably in general). The correlations with risk perception expressed about 5-10% explained variance in perceived risk on the basis of trust. The same level was reported by Bord and O'Connor [8] in a study of a hazardous waste site. Trust measures were general. Hallman and Wandersman investigated a hazardous waste landfill, with specific measures of trust and risk [45]. They obtained about 16% explained variance of risk perception. An unusually strong relationship was found (specific risk and trust factors) in a study of a high-level nuclear waste repository [4], about 35%. Strong correlations

(about 35%) were also found in a study by Bord and O'Connor [7], with specific risk and trust items concerning food irradiation.

Careful reading of original research reports is called for. Bord and O'Connor [7] found strong correlations for two out of three items between risk perception and behaviour intentions on the one hand, distrust on the other. With only two items giving positive results, caution is called for. Furthermore, the item not showing a strong correlation with trust was one related to policy attitude, the other two were concerned with consumer behaviour. Perhaps distrust is more important for individual consumer behaviour than for policy attitudes.

It is often claimed that trust can easily be lost and is hard to gain [95]. This may be true, but empirical research on the matter is not convincing. For example, Slovic asked a group of students what events they believed would lead to decreased or increased trust [94]. Of course, the data show only what “folk psychology” has to say about trust, not necessarily how trust really would be affected.

The data so far indicate that trust in general is less clearly related to risk perception than specific trust. Furthermore, there is a suggestion that policy attitudes may be more clearly related to trust than risk perception per se.

Lack of trust is frequently held to be important for understanding risk perception and risk acceptance. This factor may, however, be of limited generality and its effects sometimes paradoxical. Trust has been mentioned as an important factor in a comparison of risk perception in France and the United States [59]. In that study trust was related to lower perceived risk within countries but between countries a paradoxical relationship was found. The French were more trusting than the Americans, yet perceived larger risks. This is a paradoxical result since one would expect higher trust to be associated with lower perceived risk. The finding can serve as a reminder that little about trust is self-evident.

Trust may differ between countries for, among other factors, historical reasons. Sweden is a relatively well integrated society with a long history of peace and successful resolution of conflicts, both internal and external. Authorities are considered, by the public, to be competent and non-corrupt, even if politicians are seen in a different light, including how they view their colleagues [77].

When it comes to nuclear waste, several studies carried out in the USA have shown that lack of trust in the Department of Energy is an important predictor of perceived risk and risk acceptability [27]. However, our Swedish data show a much weaker relationship, even if it is in the expected direction [83].

Much remains to be done when it comes to understanding risk perception [18]. The traditional psychometrics+trust approach accounts for, at the most, some 25% of the variance of perceived risk [75]. In addition, trust has possibly many other aspects to it not yet investigated thoroughly. The present paper will briefly describe an attempt to develop a multidimensional concept of trust [83]. This approach has some similarity with an independently developed analysis by Peters, Covello and McCallum [57].

Further developments on trust

If there are hazards in society, they are to some extent man-made. If they are man-made, somebody is responsible. They are due to lack of competence, negligence, indifference or malevolent intent [71]. I develop this notion further and specify four facets.

One primary aspect is the image of man that is subscribed to. Is man good or bad? Are people in general honest and to be trusted? The first trust dimension is perception of general honesty.

A second aspect is the state of society. Is it relatively harmonious or is it full of conflicts? The second trust dimension I propose is the perception of social harmony.

There are also actors which may or may not be seen as having some responsibility for hazards. The first is that of politically responsible persons. Trust in politicians is my third trust factor.

The fourth and final[13] trust factor treated here is trust in corporations and businessmen. Corporations are responsible for running much of society and surely they contribute to the hazards that we encounter.

I developed scales for measuring four dimensions of trust and perceived social conflicts: trust in corporations, trust in politicians, perceived social harmony and perceived general honesty of people. In addition, Cultural Theory (CT) scales according to Dake were used to measure egalitarianism, individualism, hierarchy and fatalism. The scales were related to perceived risk of 35 hazards, and to concern over 33 societal problems. It was found that trust scales accounted for about 10%, on the average, of perceived risk and concern over social problems. For perceived risk, trust in corporations and perceived social harmony were the most important factors, while all 4 trust dimensions entered in models of concerns. Cluster analysis showed, furthermore, a stronger relationship between trust and demand for risk mitigation for about 70% of the subjects. CT scales performed at a lower level as explanatory constructs. Demand for risk mitigation of the 35 hazards was harder to account for by means of the trust dimensions and CT scales.

Demand for risk mitigation was furthermore clearly more related to severity of consequences than to probability of injury or perceived risk. Both level of perceived risk and demand for risk mitigation could be well (50-60% explained variance) accounted for by models introducing risk sensitivity and specific fear (or corresponding mitigation measures). Trust or CT added significantly but weakly to these models. CT scales were, in addition, more strongly related to background data and political attitude (left/right) than the trust scales. Partialling out demographics and political attitude, CT scales accounted for considerably less of social concerns than trust scales.

It was concluded that trust, as measured here, plays a significant but rather modest role in risk perception, and that policy implications of perceived risk need to be related to notions of severity of consequences, not so much to risk/probability.

There was some support in the data for the notion that low trust is sufficient to create a high demand for risk mitigation, while high trust is not sufficient to create the opposite, only necessary. In turn, this means that simple correlations are not sufficient to analyze the relationship between trust and risk acceptance. Cluster analysis enabled me to identify about 30% of the subjects as having different dynamics than the postulated one between risk acceptance, trust and risk perception. When

13. Trust in media was also investigated but is excluded here since it had no relation to risk perception.

these subjects were deleted, trust had a stronger impact on demand for risk mitigation. In addition, perceived risk was much better explained by trust scales in this subgroup than in the whole sample. In turn, this could mean that trust is quite important for a majority of subjects even if it is not for a large minority.

Hazards may be seen as caused by various agents and circumstances. Here I have dealt with such agents at three different levels: people in general or human nature, the state of society and corporations/government. There could be other sources of hazards, such as individual people or ways in which they are affected, *e.g.* by drugs. There is also the possibility of ill will or even evil intentions, not covered here.

In a study carried out by Drottz-Sjöberg [20] in Storuman in the aftermath of the 1995 local referendum she found that people did not really distrust the nuclear industry or the Government. They just did not like nuclear power and wanted none of it in their community. They wanted to go on living like they had always done. And they questioned whether industry experts could guarantee what would happen in the future, how well a repository would be managed then. The complexities of societal response to a siting initiative are discussed in a recent study dealing with nine Swedish communities which have, for different lengths of time, considered hosting a repository [86]. Economical and political structure seems to have no predictive power. Little is known about risk perception and related attitudes in these communities and it would be interesting to investigate this matter further.

When it comes to demand for risk mitigation it is also likely that responsibility and competence of the government must be measured if that variable is to be better understood. However, it is quite clear that risk perception per se is insufficient to cover the policy implications of beliefs and attitudes about hazards.

Trust needs to be investigated in a more comprehensive manner than has previously been done. In particular, the legal system differs greatly between countries and may well play an important role in promoting or undermining trust in society and its risk management processes.

Conclusions

Risk is a central concept in current policy debates, and it appears to be a perennial concern of humankind. Benefits also are of importance for decision and action, but less so than risk.

Traditional models of risk perception have failed, when assessed with regard to their empirical power. Many applications appear to have been premature. To explain risk perception, one needs to consider specific attitudes, personality (risk sensitivity), and specific fear factors. The traditional models have failed partly because they attempted to explain all risk perception on the basis of general factors.

Several proposed determinants of risk perception have turned out to be more or less useless. It must also be realised that risk perception is an intellectual, not an emotional, process. General and personal risk must be distinguished.

Risk is not the primary determinant of a policy attitude such as demand for risk mitigation. It is rather the severity of consequences that is important.

Trust has only rarely been studied in relation to perceived risk. General trust measures explain some 10% of the variance of perceived risk, seldom or never more. Specific trust may explain more but may be semantically overlapping with perceived risk. Trust needs to be described in a multidimensional and more nuanced manner than in most previous research.

Trust may be necessary for risk acceptance but probably it is not sufficient. US data are probably misleading if applied in a European context because there is more mistrust in authorities, and perhaps also in industry, in the USA than in Europe. There are, in turn, probably many reasons for such a state of affairs, such as historical development of nuclear technology and its management and the legal system. The outcome of too much reliance on the American experience is that the importance of trust is exaggerated. Our Swedish data suggest that trust may be present but opposition will still prevail – for many other reasons than mistrust.

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INVOLVING COMMUNITIES IN ENVIRONMENTAL HEALTH STUDIES

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In the latter part of the 20th century, the U.S. nuclear weapons complex is in the process of a major transition from nuclear weapons research and production to site remediation and waste cleanup. Concerns have been expressed by residents of communities near these facilities that there have been offsite exposures of radiation and chemicals that may be responsible for cancer or other illnesses. This concern resulted in the development by the Department of Energy (DOE) of major research initiatives with State and Federal health agencies to support independent environmental health studies programs.

The first initiative was established through agreements between the Secretary of Energy and the Governors of various States. The second initiative was the development of a Memorandum of Understanding between the Secretary of Energy and the Secretary of Health and Human Services through the Centers for Disease Control and Prevention (CDC). In both the State and Federal initiatives, the environmental health studies component focused on addressing health concerns of residents living near a DOE site.

The studies undertaken by the States reflected the needs and concerns of the residents of specific communities, and thus, varied with the facility. In one State, for example, the health study conducted by the State investigated a reported cluster of brain cancer in residents of communities near the site. In another, the decision was made to develop a cancer registry for the counties surrounding the site, as well as evaluate the feasibility of establishing a birth defects registry for the region. In a third State, it was decided that a health study of workers would be the best indicator of whether there would be the potential for health problems in the community. Three other States undertook historical offsite dose reconstruction projects, a process of estimating doses of radionuclides or chemicals to the public from past releases to the environment.[1]

In each of these State projects, public involvement was an important component of the program. DOE required each project funded under this program to establish an advisory panel to guide all aspects of the study and review and approve all study reports. These panels are an integral part of each step of the study process. The panels are comprised of representatives from the community, including local residents and health-care professionals, current or former workers,

environmentalists, scientists from the local area, and others, such as representatives from the municipalities affected by DOE activities.

As these projects usually take 3-7 years to complete, the panel's commitment to the process is vital to its success. Typically, study advisory panels meet 3-4 times each year, with meetings of 2-3 days in duration. All advisory panel meetings are open to the public and the media, and questions about the study come both from the panel and members of the public. In addition to the advisory panel's working meetings, public information meetings are held regularly, in which panel members and researchers update the broader community on the study's progress and any preliminary results that have become available. The advisory panel members often take the lead in these meetings, explaining the study to other community members. The meetings are usually held in the evening and rotated among various local communities to allow maximum community participation. There is often press coverage of the meetings. In addition, newsletters and other informational materials are developed to keep the community informed of project activities, and in some instances, information is available over the internet.

At some sites, panel member activities have expanded considerably beyond this. In one project, for example, the local community became involved in the data collection aspects of the project and prepared their own study report, highlighting the important role that the community can play in an area that might be perceived as requiring considerable technical expertise. As in any dose reconstruction project, in this study there was reliance on existing information about site operations, records of chemicals and radionuclides used in plant processes, and releases from the plant since operations began. There was, however, considerable public mistrust of the information on releases from the site and measurements of contaminants in the environment made by a variety of agencies and researchers over the years. In this dose reconstruction project, the primary radionuclides of concern were plutonium with interest also in ^{241}Am, ^{137}Cs, and ^{90}Sr. As these radionuclides would still be present in the environment due to their long half-lives, additional sampling of the soils around the site could be undertaken to supplement historical soil sampling data. It was decided by the advisory panel for this study that a citizen's soil sampling program would be an important component of the soil sampling effort. This sampling would be both designed and managed by interested members of the public.

An open invitation was issued to public interest group leaders and citizens to form a group to design and conduct a sampling program. The group named itself the “Citizen's Environmental Sampling Committee.” The group, with input from the advisory panel, arranged for presentations and consultations on scientific issues, selected the contaminants of interest, identified sampling sites, chose the laboratory to conduct the analyses, assessed the results, and prepared the final report.[2] The sampling program found elevated levels of some radionuclides near the site, a finding consistent with previous measurements of contaminants in offsite soils and sediments. This community-directed project added new measurement data to the information available to the dose reconstruction project, increased confidence in previously collected measurements, and most importantly, made a significant contribution to the overall success of the dose reconstruction project.

The second initiative begun by DOE in 1990 was the development of an agreement with CDC. Under this program, CDC conducts a number of studies throughout the nuclear weapons complex. Through the Federal Advisory Committee Act, CDC worked with the Agency for Toxic Substances and Disease Registry, which also has public health initiatives at DOE sites, in establishing official advisory committees. Membership on these committees is composed of those in the affected community or those who have strong ties to environmental and occupational issues in the greater

community. Membership includes scientists and professors from local colleges and universities, physicians, nurses and other health-care providers, former or current public health officials, lay people, and representatives from local government. The process allows the CDC to obtain consensus advice. As this advice comes from committees of local community members with diverse backgrounds and often divergent opinions who have reached compromise on a difficult issue after sometimes a year of numerous meetings, it is taken very seriously.

Over the years, both within many of the CDC committees, as well as among the active members of the public, there has evolved a strong desire to have an even more active role with greater control over the direction and conduct of studies about their communities and their health. They often express the point that in health studies done to benefit the affected population, sponsored by the Government, and paid for by tax dollars, the public should share ownership of the studies with the investigators and Government sponsors.

A recent National Research Council Report [3] emphasized that nonspecialists within the community may contribute substantively to the risk assessment process, the study design, and conduct of the study:

1. Identifying aspects of hazards needing analysis.

2. Raising important questions that have not been addressed.

3. Offering knowledge about specific conditions that can contribute more realistic assumptions for risk analysis.

CDC is involved in environmental health studies around a number of U. S. sites, including the Hanford Nuclear Reservation (Washington), the Fernald Facility (Ohio), the Savannah River Site (South Carolina), and the Idaho National Engineering and Environmental Laboratory. This research program has focused on the reconstruction of historical exposures and doses, [4] assessing the risk associated with these exposures, and on relevant epidemiologic studies that may follow or take place in parallel.

In all these projects, two issues are primary: first, assuring the soundness of the science, and secondly, ensuring public credibility of the studies. Health matters often raise fears, concerns, and emotions among people. For researchers to undertake studies with scientific or technical issues only in mind, not recognizing the extent to which people feel strongly and acknowledging their concerns, is usually a mistake. It is critical to bring the affected community into the process. Regardless of the quality of the science, without community involvement, the findings of the study will often not be accepted.

In this era of active public involvement, CDC is dedicated to seeking answers to the question, “How can lay people within the community become more involved in the “science” of the environmental health research?” The following examples from projects at the Fernald Facility in Ohio and Hanford Site in Washington State illustrate some ways this has been achieved. At the Fernald Facility near Cincinnati, Ohio, several hundred tons of uranium oxide were released to the atmosphere, mainly during the 1950s and 1960s. In addition, significant quantities of radon escaped from underground silos where tailings from uranium ore left over from the Manhattan Project had been stored. In explaining these releases and discussing with the advisory committee issues such as feasibility of an epidemiologic study, statistical power, *etc.*, it became clear that some of the committee members could benefit from specific training in epidemiologic methods. CDC took

advantage of a university program that offered distance-based learning via satellite to health officers around the State. The university agreed to provide an introductory epidemiology course via satellite for four committee members. The committee members spent 2 hours one evening per week for 3 months receiving instruction and interacting with the university's epidemiologic faculty on the basics of epidemiology. With this training, these committee members were in a better position to evaluate the technical issues involved in deciding whether and how to conduct an epidemiologic study. The training also allowed the community to expand a previous "grass roots" effort in tracking cancer cases in the area. A CDC epidemiologist worked with one lay committee member and her neighbors to put the information into a geographic information system (GIS) mapping program that combined geographic features, census data, and Environmental Protection Agency environmental data. The staff epidemiologist also worked with the community members to provide assistance in interpreting the information and to explain some of the shortcomings in self-reported data. Later they presented a jointly authored paper on the project at an annual public health association meeting.[5]

Another example of community involvement in the conduct of a study comes from projects underway at Hanford. Significant quantities of ^{131}I were released from the Hanford Nuclear Reservation primarily during the 1940s and 1950s. These releases led to concern about hazardous exposures offsite and downwind from the site. During the conduct of the dose reconstruction and thyroid disease epidemiologic studies at Hanford, it became clear that exposure pathways differed for Native Americans living in the area, based to a large extent on differences in dietary patterns (especially, greater fish consumption). Thus, a distinct need arose to provide the nine Native American tribes and nations in the area with an opportunity to participate in the study and to collect their own data about their own historical lifestyles and diets. This information would provide substantive data for determining their doses from Hanford environmental releases. In addition, basic training and education was provided to select members of each of the tribes on topics, such as epidemiology, statistics, radiation physics and biology, and general public health training. This training will hopefully be useful to the tribes in the future for tracking and dealing with other environmental health issues they may face.

In conclusion, for the success of any health study, it is critical that residents have an active role in the health research of their communities. As the examples from this paper indicate, this involvement can take many forms, but without such involvement, studies run the risk of not being accepted by the communities they serve, no matter how sound the science.

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ENGAGING THE PUBLIC IN DECISION-MAKING: A SWISS APPROACH

by

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Introduction

Switzerland is known as the democratic land per excellence, which is called direct democracy: public votes about new laws, referenda against decisions of the legislative chambers, initiatives to force a vote at the cantonal or national level. Our system responds completely to the injunction of the WHO-European chart "Environment and health" (8.12.1989) which states that every person has the right to take part in the decision-making process.

The Swiss public is still involved in main decisions which may be concern them. The nuclear industry knows a lot about the difficulties of advancing with projects such as repository or new plants. The temptation is very high to change the existing law to simplify the procedure of authorisation. But this would be a very bad way to circumvent the distrust of public against nuclear projects. Fatalism and resignation are certainly not a solid base for the realisation of mistrusted projects: there will always be a deep unease which may explode any time.

Everywhere today politicians are promoting the empowerment of responsible citizens: in health care, consumers decision and so on. In the domain of nuclear concerns this empowerment is extremely important: especially in this field the public has rights and needs which must be taken into account.

Risk assessment: Experts with public

The disasters at Bhopal (1985), Seveso (1984), Chernobyl and the fire at Sandoz near Basel (1986) have destroyed the trust of the public in the industry as a whole and in the so called experts in particular. This loss of credibility explains to a large extent the scepticism of public towards each new technology. Industry tries to compensate this mistrust by applying a new type of evaluation, the so called technology assessment, resulting in contradictory studies often based on analysis down to the last measurable molecules. The sustainability of our society will not be achieved through technology alone. It's really time to go from pure technical over to more human considerations.

A 1992 survey of 8 000 Europeans has shown that the majority of people perceived the chemical industry as a threat to the environment. Despite the efforts of the industry to improve environmental performances, many people continue to distrust it. This gave a new impulse for industry to consider public trust as a business issue. The biggest companies introduced the notion of

Responsible Care and developed programs that are now an integral part of each quality management system. One of the issues that sets Responsible Care, apart from internal environmental programmes, is that it recognises the need to bring the public into the decision-process. With or without involving it, over short or long time the public decides.

Technology is inherently unpredictable: statistically calculated possible events may happen every time even if the probability is very small and beyond that level there still remains the so called residual risk. Acceptance of such risks is not only a question of quantification, neither in terms of frequency, nor in terms of effects. A technic will be regarded as "safe" by public opinion as soon its risks are accepted. The main question is: "For what (these risks)?", which don't only ask for a rational answer, but also for human beings like fears, hopes, emotional and ethical view points. Such irrational aspects can't be discussed to the end using rational *i.e.* technical arguments usually brought by scientists. Irrational aspects can best be understood by and brought into discussion through emotional persons. A public representative would bring these human dimensions within decision-making bodies. "A person who is not scared is stupid, but the person who is most scared is not the cleverest" (Behavioural-Biologist Professor Hubert).

There are several ways to involve the public. A number of chemical companies institute a neighbourhood relations policy and involve neighbours as legitimate partners within so called neighbourhood task groups. At a national level, the needs of involving the public has been recognised and led to nomination of representatives from the public in committees. So for the fields of biotechnology the questions about security, ethics and laws are now discussed within a commission where the industry, universities and environmental groups are represented. In Basel, the problems of risk assessment especially in relation to chemical industries, are debated by a special risk-commission (RISKO), where public representatives have the opportunity to express the fears and the expectations of the public. If necessary, our decisions for enforcement of the Swiss Ordinance on Protection against Major Accidents are presented in advance to that commission. This commission has been working for more than 6 years and has mainly contributed to the acceptance by all partners of decisions of great concerns as for example by setting the limits of acceptable risks in terms of square kilometres of contaminated areas or number of deaths.

Nuclear events can affect a very large area so that not only the direct neighbourhood must be involved in decisions, but the community, which could be defined as a geographical, administrative area, or as specific groups.

These 1:

The public is the risk expert, which must be involved in decisions about risk management strategies and aftermath major events.

Management of crisis: first public fears, then economy

By complex radiological aspects no one expert is able to predict the development of the situation, at least not with the awaited accuracy. The public needs very precise answers, which often not can be given, neither scientifically, nor politically because policy copes badly with scientific uncertainties. However, these uncertainties have to be communicated very openly. The worst thing to do is to try to assuage the anxiety of people with comforting statements. Decision-making persons

should have the courage to worry people. The fears have to and will break out and it is important that people have the opportunity to express their concerns, which must be taken very earnestly.

These 2:

Have the courage to worry

The immediate decisions must be taken by the emergency staff alone. The public requests first a total (*i.e.* risk zero) safeguard for people and doesn't care about the economical consequences of such decisions. I remember very precisely my spontaneous reaction at the 1 May 1986 at 8 p.m. after looking the measured gamma-spectrum of a grass sample in our laboratory in Basel: "All cows back in the cattle shed!". Not really a thoughtful reaction but surely a very healthy one. There was enough hay in the farm for feeding the cows a couple of days more and the loss for the milk market would not have been higher that it was any way. The trust of people in their authorities would have been reinforced and not as it happened completely destroyed through the adoption of soft or carving strategies.

Also the contamination with Sr-isotopes was very soon declared as not relevant before having been measured in food samples. Together with the Institute of Radiophysic in Lausanne we needed 6 days to provide data of the required quality on the content of Sr-isotopes in milk and other food samples. Fortunately the contamination levels were lower than theoretically calculated. In retrospect it can be said that the decisions taken by the Swiss authorities were radiologically correct. But this optimisation had been achieved at the cost of public trust in their authorities. And this is much more expensive than the saved money.

The emergency staff must first take very harsh decisions and only with full knowledge of the situation should the excessive counter-measures be relaxed. For long terms decisions that is enough time to convocate the whole staff with the public representatives. The daily problems will be better realized concerning feeding people, disposing of the contaminated foods, going outdoors and so on, so that recommendations or decisions involving some risks will be better accepted.

These 3:

First strictly, than loosely

Reality to day: economy first, public thereafter

If we view to an actual problem of public concern, *i.e.* the mad cow disease, we must notice that the decisions have been taken so far and continue to be taken by primary considering the economical aspects. In GB, the first case of BSE in cattle was diagnosed in 1986. Overall, before the introduction of the specified bovine offal ban in 1989, 480 000 infected animals were slaughtered for consumption. Since the incubation period of vCJD is unknown, it is not possible the estimate the number of persons who may develop vCJD. Since mid August 1997, 1 422 890 cattle have been culled in GB and 2.2 million more should be slaughtered during 1998. This counter-measure would not have been so hard if a restrictive care politic had been taken very rapidly and effectively enforced.

Now we hear about the possible transfer of the infecting agent by the bone marrow. Logically should T-bone steaks, ribs and oxtail be banned from the market. GB has taken this hard decision but not Switzerland! And yet my predecessor at the head of the laboratory in Basel warned the Veterinary Office in Bern by 16 November 1990 that spilling of bone marrow during slaughtering could contaminate the meat.

Last but not least, in the December issue of *Nature* the directors of centres that treat haemophilia accuse the British government of foot-dragging, exposing haemophiliacs to an avoidable risk of infection with the vCJD from contaminated blood products. Given the high level of exposure of the UK population to BSE during the 1980s, and the long incubation period of spongiform encephalopathies, many seemingly healthy donors may be harbouring the disease.

To conclude my presentation, I want to mention a statement from Mark Twain, that it is not really what we think we know which is risky, but that which we wrongly believe to know.

THE ROLE OF THE EXPERT

by

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1. Expert

What do we understand by "expert"?

The term allows us to give various definitions, all of them having some common points, such as *competence* and specialised character of the subjects dealt with. To this – usually and especially in the field in which we are operating – some essential presuppositions can be added: the recognised character of the competence, the assumed objectivity of the advice given and the possibility to act as an arbiter, who is supposed to be neutral and impartial.

From this statement we can, at this point, deduce that the expert's role – when limiting us to the competence and specialisation – can be played by numerous interveners in the decision-making process: specialists from research institutes, teaching staff from universities, experts from national or international organisations, but also experts called for consultation or working for different private or political associations. We do not speak any longer of "the" expert but of experts.

If the implicit demands for recognition, objectivity and neutrality are also taken into account, then it can easily be understood why the intervention of experts is in practice usually discordant. Who chooses the expert and who pays him? Does the expert have total freedom of expression? Is his neutrality guaranteed and to what extent? What are the criteria for recognising his competence? Is this recognition not in fact directly or indirectly related to those who exercise power and have, as such, interests in the conflict? More fundamentally: what is objectivity and what are the measuring standards? Are some experts more objective than others? Furthermore, how can one "objectively" decide on problems which are more or less coloured with ethical aspects? In this talk, at first, we will bring up these different points one by one; then, we will conclude with some practical suggestions by means of which one can try to avoid the obstacles described here.

2. Mandates

Problems such as those dealt with today are good illustrations of situations where important things are at stake and where the above considerations are quite relevant. These situations show that a whole series of individuals, organisations and associations intervene, from within the field of their

own expertise, in the decision-making process, often placing different accents: the “expert quarrels” are not rare. In this sense, it is by no means a problem specific to managing complex radiological situations where an intervention is needed. It can be found – identically so – within the organisation of radiological practices in normal situations and in non-radiological situations and it questions, more broadly, the relationship between knowledge and power and between science and society.

Maybe today, more than in the past – is probably related to an active mediatisation – the “civil” society is more conscious of this ambiguity in the relationships between science and power, which may explain the increasing demand for experts who are credible in the eyes of all the parties. This is a goal which can only be achieved with difficulty and experts usually start with serious handicaps as a result of their institutional position.

Whether we want it or not, everyone of us, including experts, addresses the public with a different mandate, the nature of which influence the primary goals which are aimed at; This can obviously affect the expected degree of neutrality.

The multiplicity of contexts and mandates probably contributes in a significant manner to the fact that the content of the messages given – even of the scientific ones – differs sensibly. These contradictions in the messages – even though they are very logical, and even to be expected, in particular for the reasons mentioned above – are quite irritating. The reason is that they arouse a certain amount of confusion and by this a certain mistrust by the public. Adding to this confusion, the journalists, who have to report in the media though it is their job – a variety of opinions, sometimes take the liberty – and this is contrary to the deontology of their profession and to the dignity of their task – of publishing not verified texts, containing mistakes which could have been avoided quite easily.

3. The positivist reaction

Facing confusion, scientific experts as well as lots of the politically responsible people usually have the reaction to appeal to Science (with a capital S) in order to arbitrate and to come to a general agreement. This is the well known positivist reaction: everything can be explained (or will be explained) by science: the truth is unique, why does it have to come from different mouths/ one will suffice. Let us concentrate the information, appoint an expert who is “more expert” than other experts and let us charge a central organisation with the diffusion of the Word by means of an official speaker.

This perspective is frightening: from whom will the one and only truth come; who will make this selection; will the particular “mandate” of this super-expert have no influence whatsoever; moreover, is there such a thing as one truth; and if there is, is it to be found exclusively by the scientists?

4. Way to knowledge

A few years ago, while I was nosing about in a bookshop, I came across a book – of which I do not remember neither the author, nor the title – who spoke about knowledge and who quoted “Saint-Bonaventure” (13th Century). Quoting this Saint has impressed me and so I remembered. There are, so he said, different ways of entering the human knowledge: he called them the eye of flesh, the eye of reason and the eye of contemplation. This way of looking at things has not yet lost

touch of reality. The eye of flesh allows us to observe immediately what can be observed, measured, quantified; the eye of reason takes over when the eye of flesh has gone blind, its domain being that of reasoning, of logic, of theoretical constructions; and we will always arrive at a point where man is confronted with mystery; this is the domain of human rights, of ethics, the domain of the sacred for the believers, of "essential" values for the agnostics: the eye of contemplation.

The existence of ethical problems is not limited to obvious subjects such as *in vitro* fertilisation, genetic engineering or cloning. They can be observed on all levels, including in the domain in which we operate: we will later give some examples.

The thing on which we have to focus her, is the existence of the ethical problems in the area of the recommendations of experts and of the decision-making process: this domain is not strictly reserved to the scientific expertise, and if there is one and only truth, here, it is not the scientific approach which will allow us to apprehend it.

These ethical problems can be sources of varying opinions, including from "neutral and objective" experts, opinions that have to be accepted and respected.

Problems arise when the specificities of those ways to knowledge are denied. Making a biased presentation of scientific observations may be a temptation for the one who sees in these observations an insult to the "sense" he gave to reality; this explains the negative reactions in the history of the church towards certain scientific discoveries. A rejection of observations (unexplained recovery, ...) which are apparently incompatible with an established theory, has also to be avoided. As regards the scientist, nowadays at the top of social prestige, he has to fight against this natural tendency of leaving his domain and of using his authority in certain areas in which he is no more competent than other people, such as ethical ones.

5. The scientist: a subject studying an object

We have seen that different clues to reality or interpretations of reality – which may lead to varying recommendations or decisions – may result from the specific mandate and from the interference of ethical problems.

But when I presume I am free of all obligations, of all mandates, and if I limit myself to my scientific field, *i.e.* the observation of reality – a photography of reality, said Claude Bernard – would it not be possible for me, then to come to one and only truth in this particular field? This is not sure ... modern reflection about science has clearly shown that the role of the subject who observes (as an isolated individual or, more often, as a representative of a current of thoughts) is essential, whether this is in the process of selecting observations, or in the formulation of hypotheses or in the theoretical construction. To take up again the photographic analogy, we are not all cast in the same mould: we do not make a photograph, we can only interpret.

The problem, the deviation is that a part of society wants to grant a mythical status to Science, by starting with the expert representing it, and in particular if he has a prestigious "halo". His word becomes "indisputable", the contradictory "sacrilegious" or coming from not educated people. Society in general is often presented as not educated. "Since our societies want to be democratic, since they no longer recognise (officially) an authority greater than the will of the populations, the only authoritative argument, as regards what is possible and what not, will always come, in one way or another, from Science" (I. Stengers, Sciences et pouvoirs, Labor, 1997).

If, despite everything, contradictory messages subsist, one then appeals to the consensus of the scientists as a condition for objectivity. Doing so, one forgets that the scientific experts, coming from the same melting pot, often share the same interpretative language, the same paradigm (a whole of reference presuppositions which are often unconscious). Let us remember that, at the beginning, unanimous aggressiveness if often opposed to scientific turning points.

Becoming aware of this should contribute to the "vaccination" of the experts against the temptation of a certain authoritarianism.

6. Application in the domain of radioprotection

In the field we are operating in, we will find the problematics described above. Let us now rapidly go through the evident fact that everyone speaks from a different place and with a different mandate: it is sufficient to be clear about the existence of this mandate and to claim, on ethical bases, freedom of expression. The transparency at this level is a prerequisite for credibility.

This being said, where will the concepts described above be applied in the field of radiation protection? I am tempted to say: everywhere. Some points deserve to be raised, because they are particularly important and they do serve as an example.

Risk evaluation

The formulation of recommendations, within the framework of the evaluation of interventions in a complex radiological situation, as in the case of normative recommendations in a routine situation, implies taking stand on tow issues.

On the one hand, it is necessary to evaluation the detriment caused by the dose received through different options; on the other hand, one cannot avoid to express a value judgement with regard to the acceptability of the detriment encountered.

The evaluation of the detriment as well as the judgement about its acceptability are the fruits of an intellectual brainwork which is not uniquely scientific but has also an ethical aspect.

Indeed, we know that the determination of risk factors for radiation-induced effects is only partly based on observable scientific data. Very rapidly, one needs to appeal to hypotheses, to steps based on different types of reasoning, and this to arrive a the "best possible estimation". But, in the end, the scientist is confronted with ethical choices. When the facts and their limitations are identified, how then does he have to react facing the residual uncertainties; should he not opt for carefulness, and next to that, how far does he have to go? When he is looking for a larger consensus, is it not to give himself the illusion of a grater certainty?

Searching for a consensus at the stage of these residual uncertainties is no longer the task of the scientists only, because the ethical questions do not belong only to their competence. they may of course take a stand – they are often asked to do so – but they no longer do this as experts but as mere interveners in a social debate. Nevertheless, in order to make this debate possible, the expert has a specific responsibility, namely that of making clear, honestly, what those uncertainties on risk factors are exactly and what is at stake. He also has to translate the terms of this issue in a language accessible to the actors of the debate. This is a far more difficult exercise than it seems.

If all this is true in the case of the evaluation of radio-inducted effects, then it is certainly so when taking a position regarding the more or less acceptable nature of a risk or of a detriment. As regards the acceptability of the risks, it is sufficient to insist one more on the fact that this choice is not to be make by the experts in radiation protection, but by the social group that is concerned. Here again, the scientists can only offer help, by trying to provide some judgement criteria. In this context, risk comparisons are useful instruments, but they are also susceptible of being used in a way which is not neutral ethically speaking.

Protection of the unborn child

A second example in which the weight of the ethical factor is preponderant, is that of the protection of the unborn child.

Is the embryo a person? At what age does it become one? At three months? On the point of being born? Has it any rights? Has it the right to be protected? Does it have to be protected as a member of the public involuntarily exposed to ionising radiations? Or, does it have to be "better" protected, because it runs an even greater risk, specifically at the level of cerebral neurons?

A first question has to do with the scale of these effects, in particular at low doses. On this point, scientists are divided. Ethical issues relate her to the insufficiency of available human and even animal observations.

Next to the scale of these effects, there is the question of the acceptability of such effects, or of the risk that they can be possibly produced. This example shows clearly that the evaluation of a risk also includes what was called its "existential significance" (P.P. Druet, P. Kemp, G. Thill, Technologies et sociétés, Galilée, 1980).

Other examples of ethical interferences

We do not have sufficient time to go over all the questions of radiation protection where the recommendations, at first sight strictly scientific ones, are actually more or less coloured by ethical choices. Let us just quote some:

- the explicit or implicit use of an alpha value, quantifying human life; in the process of optimisation, in the choice of action levels;
- the use of average values, whatever the range or the diversity of the distribution curves;
- the fact of taking into account the average population, and not critical groups, in order to justify a step or an intervention (*e.g.* to establish maximum tolerable contamination of foodstuffs);
- the "weight" of curable cancers, of painful therapies, of the suffering caused, the importance of the age at which a disorder occurs;
- the weight of detriments affecting the next generations due to decisions taken only for the benefit of present generations;
- if the hypothesis is confirmed, and if tests allow us to discover a HLA system or another determining a genetic predisposition to radiation-induced cancers, the protection that needs to be given to this sensitive fraction of the population or of the workers.

Epistemological questions

Next to these ethical questions, there are others, more methodological ones or epistemological ones, which interfere also in the field of radiation protection. As an example, I would like to take the question of induction of severe mental retardation by irradiation of the foetus.

The observed data (during the critical period) have a stochastic side, in that sense that the probability of their apparition increases with the dose (with a dose/effect relationship compatible with a linear response) and that they already appear in the case of relatively low doses, without a statistically demonstrable dose threshold.

The situation clearly has a stochastic side, but the mechanisms involved in order to explain it, are of a deterministic nature (dose-linked decrease of IQ). The explanation assuming a deterministic mechanism with a shift of the Gaussian IQ curve, actually implies an increased probability of severe mental retardation in line with dose together with an apparent absence of a threshold, in the sense that it is individuals with a low IQ who may be pushed over the borderline and suffer effects that are clinically more pronounced.

This explanatory hypothesis supposes a classical mechanism based on a direct relationship between the severity of an effect and the number of cells affected; it implies that a potentially intelligent human being will not become retarded after having received a low dose and that only those who are less intelligent to begin with are at risk (but does that mean that it is less serious?).

In the other hand the biological effects involved are probably not limited to cell death, as in the classic deterministic mechanisms, but also include failures in migration or errors in synaptogenesis. The work of Rakic and other researchers indicate that the cortex might be a collection of developmental columns each arising from a specific proliferative unit. In this framework; the loss of a few cells could result in the loss or compromise of specific brain functions.

This raises an epistemological question. Are the conclusions drawn by some from the Japanese data not based on a false premise, *i.e;* that the radiation-induced mechanisms are either stochastic or deterministic.

Reality may sometimes be more complex and, in this case, there may be a combination of deterministic effects based on the quantity of the cells affected, and of random effects based on the quality of the cells affected or the mechanism disturbed.

Whatever the solution of this problem might be, I would like to place emphasis on the following point: identical facts can lead to various interpretations which are equally scientific, even if not classic. The weight of the theoretical classic distinction between long-term stochastic effects through mutation, and non-stochastic effects through cellular inactivation, and the weight of the scientific consensus on this should not result in a sort of anathema denying the existence of other interpretations of the observed data.

The paradigm of the "man-complex system"

The epistemological questions cited here are, in a certain sense "easy", this in so far as they are conflicting and consequently "recognised": they are consequently occasions for a possibly fruitful debate. Other interpretations of reality come from unconscious paradigms which are shared by a

whole class of persons: on these grounds, they are not seen as subjective and have in their eyes an indisputable value.

Jean-François Malherbe, who was professor of medical ethics at the Faculty of Medicine of the UCL, places emphasis on the fact that, in modern medicine, the human beings are "constituted as objects". Biomedical sciences have "abstracted it from its history, its subjectivity and from its existence". They have "deprived it from what it is: a subject". This is what he calls the systemic reduction of man.

If this paradigm of "man, a complex system" already dominates the world of medicine, it is not at all surprising that this is also the case in the field of radiation protection. There, the shift is even more profound. If medicine neglects the suffering man, because it is only interested in the sick man, radiation protection forgets the sick man and limits its self to the dead one: it is the mortality caused by cancers which has been chose as the measuring instrument for the risks of ionising radiations. Worse: from the fact of the death of human beings, we have shifted to the price of their death, *e.g.* in optimisation calculations or in opting for intervention reference levels. To paraphrase J.F. Malherbe, we could speak of a financial reduction of man.

Without going as far as utopian affirmations in the style "health has not price", we should question ourselves about the pertinence of this way of thinking in radiation protection. The worst is perhaps that we all find this "quite normal" or obvious.

By way of conclusion

By way of conclusion, I would like to provide food for thought, in a few words, by means of a few conditions which should be a part of the expert's deontology. The scientist, who makes recommendations, should pursue the following objectives/to explain his mandate clearly, to limit himself to his specific field of knowledge, to recognise the ethical aspects and to bring them to light, to respect all the observations, to recognise the possible diversity of interpretation of the data, and to be open to interdisciplinary.

To finish, I will quote a renowned Belgian political person who has been asked some time ago about the extent of political responsibilities facing great challenges involved in the protection of the environment nowadays.

If, in his answer, the personality in question places emphasis on the necessity of being attentive to anxieties and to questions of the public opinion and to have the courage of deciding on necessary measures, in a vision including the long term perspectives, another necessity is invoked: that of having the possibility to appeal to experts who are – I quote "at the same time, real humanists".

THE ROLE OF THE DECISION MAKER: WHOEVER THAT MIGHT BE

Experiences from the Siting process for a Spent Nuclear Fuel Repository in Sweden

by

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Introduction

It is common knowledge that there are great difficulties in convincing the general public and their democratically elected representatives that final disposal of spent nuclear fuel can be made in a safe way. The uneasiness of many of those involved in the project – be they elected politicians on national or local levels, administrators, regulators or implementors – concern mainly the decision-making process.

Do people in general have a fundamental trust in this process? Is the decision-making process "fair" and "transparent"? If people tend to answer these questions with a "no", the project may be a total failure. WHO MAKES WHICH DECISIONS WHEN?

I am not sure if experiences from the present process in Sweden to site a repository for spent nuclear fuel have any relevance for the theme of this workshop, *Societal aspects of Decision Making in Complex Radiological Situations.*

The implicit goal of constructing a final repository for spent nuclear fuel is obviously to *avoid* a complex radiological situation in the foreseeable future. However, such a repository represents a "complex radiological situation" in the sense that the problems to be handled are those that concern people today, although they will most certainly not appear until in the far future. There are profound difficulties to imagine which scenarios one needs to take into account. Special problems for the decision-makers are created by the demands put on today's generations to make a responsible risk assessment in an area with genuine uncertainties and characterised by many expressions of lack of confidence in social institutions.

Therefore, I hope that the following comments may have some relevance also for the situations which this workshop focuses on.

All viewpoints in this contribution are personal and must not be considered as "official" in any sense of the word.

Background: Roles and responsibilities in the siting process

The current siting process in Sweden takes place within the framework of a legal system based on a fundamental principle: the owners of the reactors are fully responsible for the safe handling and final disposal of the nuclear waste. This full responsibility includes to find a satisfactory technical solution, to implement the solution and to carry the costs. This is a clear application of what is generally known as "the polluter pays" principle.

The reactor owners fulfil their responsibilities through the Swedish Nuclear Fuel and Waste Management Co (hereafter referred to as SKB), which they own to 100%. It is the task of SKB to produce the necessary and suitable technical solutions and to convince the Government and the regulatory authorities that this solution should be accepted. SKB is expected to apply for the necessary permits for siting a certain type of facility at a certain place somewhere in Sweden, and the Government and the regulatory authorities will eventually decide if such permits will be granted.

The Swedish Minister for Environment has recently[14] used essentially the following words when describing the division of responsibilities:

> *The Government does not and should not have any responsibility for the siting process initiated by SKB. It is not the task of the Government to single out a suitable site for a final repository, or to announce which sites might be less suitable. Instead, the task of the Government is to examine and decide upon an application made by SKB according to established provisions in the legislation. When considering an application, the Government will especially check whether SKB´s site selection has been based on the statements the Government has issued in connection with its reviews of SKB's research and development programmes.*

What has now been said may give an impression of intentionally passive governmental authorities, unwilling to act until an application is submitted. But the reality is different. The regulatory authorities have for some years been studying various aspects of spent fuel disposal, and they are having a continuous dialogue with other experts, including those of SKB. There are legal provisions to make sure that regulators and the Government have insight into and influence over the general direction of the work of SKB. According to these provisions, SKB every third year is obliged to present to the Government its programme for research and development[15].

These programmes are thoroughly reviewed by the nuclear regulatory authorities. As a part of the review these authorities ask for advice from other government authorities and from universities. Comments are also invited from environmental organisations and from municipalities which are directly affected by the work of SKB.

Based on recommendations by the nuclear regulatory authorities and ministerial advice, the Government decides to state its opinion about the general direction of SKB´s work. These recurrent government statements have an important influence on the work of SKB. The statements mainly concern the general direction of this work. But the Government may also state its opinion on separate parts of SKB's programmes and plans.

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14. Letter 3rd December 1997 to the Chairman of the municipal board of Oskarshamn (one of the municipalities directly affected by SKB's activities).

15. Since 1992, SKB uses the term RD&D-Programme (Research, Development and Demonstration).

The latest Government statements on these matters were issued in December 1996, May 1995 and December 1993. SKB´s next programme (RD&D-Programme 98) is scheduled to appear not later than September 1998.

It could be worth mentioning that the more important documents are available also in English.

Phases of the siting process

The present siting process has evolved during a period of some years, SKB being influenced by Government statements and discussions with the regulatory authorities. The process may be described as a step by step approach with phases that are fairly separated from each other.

These phases are termed *general siting studies*, *feasibility studies*, *site investigations* and *a detailed site characterisation.* According to Government statements, SKB is expected to carry out between five and ten feasibility studies and at least two site investigations before applying for a permit for a detailed site characterisation. Given that the result of the detailed site characterisation is favourable, that site will be developed into an operational repository. During a first period the repository will be operating on a small scale and retrieval of the disposed spent fuel could be done without major difficulties. The experiences from this period will form the basis for a decision whether to continue disposal activities or not.

This is illustrated by the following two figures (borrowed from SKB).

Figure 1. **Siting of a deep repository**

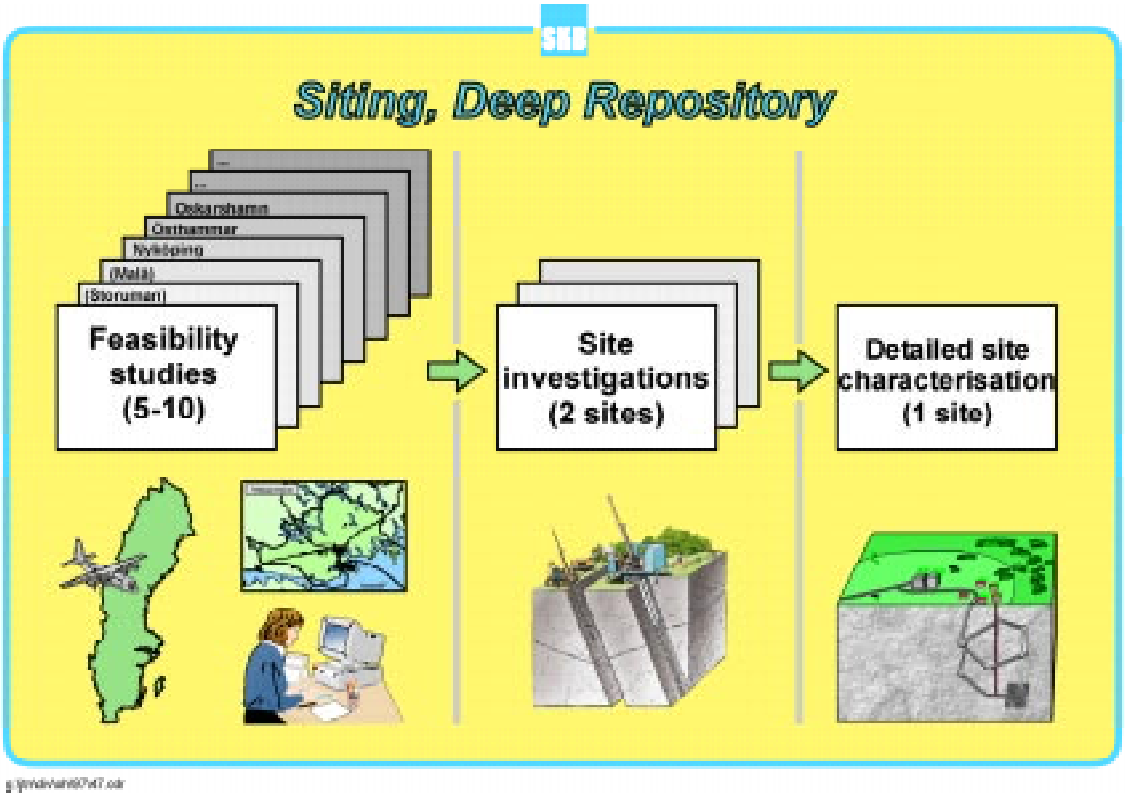
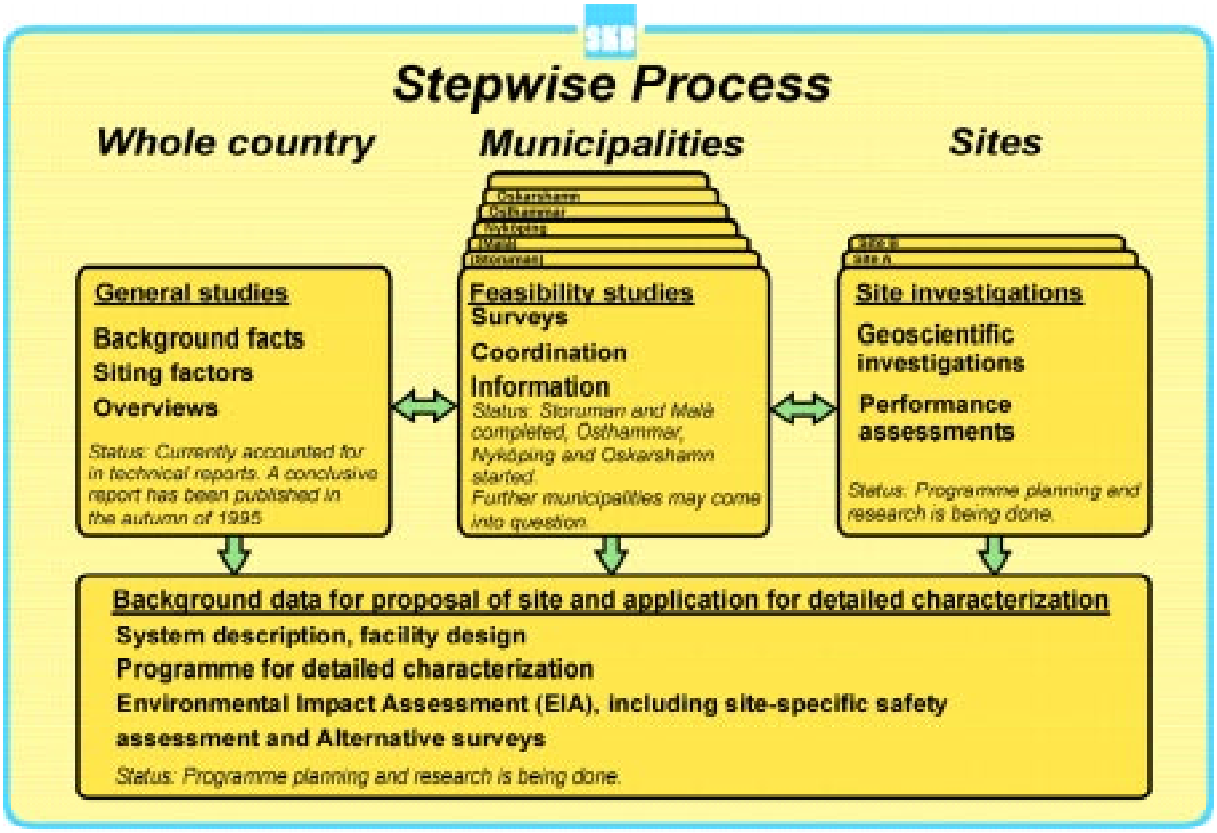


Figure 2. **Stepwise process**



SKB does not need any formal permits by the Government, any government authorities or any concerned municipality to carry out the general siting studies, the feasibility studies and the site investigations. Only when the siting process reaches the phase of detailed site characterisation an application needs to be made to the Government. From this phase on, the decision-making process is regulated in detail.

There is one underlying and important assumption behind SKB's site selection activities. This is the assumption that the selected site should be suitable for deep geological disposal according to the KBS-3-method.

Both the Government and the regulatory authorities have accepted the KBS-3-method as a main alternative when reviewing SKB's research and development programmes. However, neither the Government and regulators nor SKB, have taken a final position on the issue whether final disposal is to be carried out according to the KBS-3-method, or if any other strategy or method should be applied. It follows that the matter of method for disposal is an open issue. The view of both the Government and the regulatory authorities seems to be that a final position on that issue will not be taken until SKB has submitted a formal application for detailed characterisation of a particular site. This will presumably not happen for some years.

The Government has urged SKB to state its reasons for preferring the KBS-3-method more clearly than has been done so far, and also to specify in detail the implications of a zero alternative in

the environmental impact assessment, *i.e.* what would happen if no measures are taken. SKB's response is expected to appear in RD&D-Programme 98 (in September 1998).

The critics in Sweden of the present siting process point at this situation when they claim that the process suffers from a total lack of credibility. According to them, it is fundamentally wrong to search for a site when the method which would be applied has not yet been decided. They seem to favour some sort of prolonged storage.

Issues for discussion

The seemingly simple siting process illustrated in OH 1-2 contains decision-making problems for all parties involved. These problems are particularly visible when the siting process moves from one phase to another. Some of the problems have already been experienced. Others will probably be seen more clearly as the siting process continues.

The list of issues for discussion is as follows:

1. Why feasibility studies in the five municipalities of Storuman, Malå, Nyköping, Östhammar and Oskarshamn – and not elsewhere? Who made which decision?

2. What are the local implications of being a "feasibility study municipality"?

3. Are there any economic incentives for a municipality to volunteer for a feasibility study?

4. Is it possible for a municipality first to volunteer but later to withdraw from the site selection process?

5. Is it possible for a municipality to have an influence on the work that is done during a feasibility study?

6. Two feasibility studies have been completed, after which the affected municipalities (Storuman and Malå) have decided not to be a candidate for a site investigation. What were the reasons? Who was the decision-maker?

7. Which decision-making problems will have to be faced by SKB and the affected municipalities when selecting "at least two sites" for site investigations?

1. Why feasibility studies in the five municipalities of Storuman, Malå, Nyköping, Östhammar and Oskarshamn - and not elsewhere? Who made which decision?

Since the middle of the 1970s, SKB has been collecting geological data about the Swedish bedrock in different parts of the country. Test drillings were made in the late 1970s and early 1980s. Some drillings were disturbed, or could not be carried out, because of strong local opposition. Around 1985, SKB concentrated its siting programme on desk studies in order to identify areas with a potential for a final repository.

A general siting study covering the whole area of Sweden was presented by SKB in 1995. The main conclusion to be drawn from this study is that some parts of Sweden are *not* suited for a final repository for spent nuclear fuel. However, in many parts of the country conditions were considered suitable.

The following map of Sweden gives the names of certain municipalities (borrowed from SKB).

Map 1. **Specific municipalities of Sweden**

The preparatory work with this general siting study led, in October 1992, SKB to write a letter to each of the about 280 municipalities in Sweden, describing the planning situation with regard to the siting of a final repository for spent nuclear fuel. Contacts were established with a number of municipalities who expressed interest in further discussions on the possibility of a feasibility study. In 1993, agreements were reached between SKB and two municipalities, **Storuman** and **Malå**. Feasibility studies started as soon as possible in these two municipalities and were completed in early 1995 and early 1996, respectively.

During the first part of 1995 SKB, carried out a special study on the general conditions to locate a repository in any of the five municipalities hosting nuclear reactors and other installations. Beside the fact that some of the necessary infrastructure for a final repository already exists in these municipalities, they also have a population which is more familiar with nuclear activities than is the case in other parts of the country. The municipalities of **Nyköping**, **Östhammar** and **Oskarshamn** were considered by SKB as particularly interesting for a feasibility study. SKB turned to them and all three responded positively. Feasibility studies are now under way in these three municipalities, but are in different stages of completion.

Who was the decision-maker in these five cases? Formally it was only a matter of SKB deciding to carry out the study. No formal permits by the Government, its authorities or the affected municipality were required. But in reality SKB had to consider the opinion of the concerned municipality.

SKB also had to take into account the fact that many reviewers of the RD&D programmes had stressed that a certain number of feasibility studies was needed as a basis for the continued site selection process. The Government's opinion was formally expressed in a statement in May 1995, according to which SKB is expected to base its selection of a site for a repository on five to ten feasibility studies.

As the municipalities of Storuman and Malå later have decided against more detailed studies as a result of local referenda (see below), there is a general feeling that SKB should start more feasibility studies. This is an opinion clearly held also by the three municipalities where such studies presently are being made. And I believe that affected government authorities and the Government itself share this opinion.

What about the prospects for more feasibility studies? During 1997, there have been discussions with two other municipalities (far in the north, not on the OH3-map; Gällivare and Pajala). There is a possibility that SKB and one of these, Pajala, will continue their discussions during 1998.

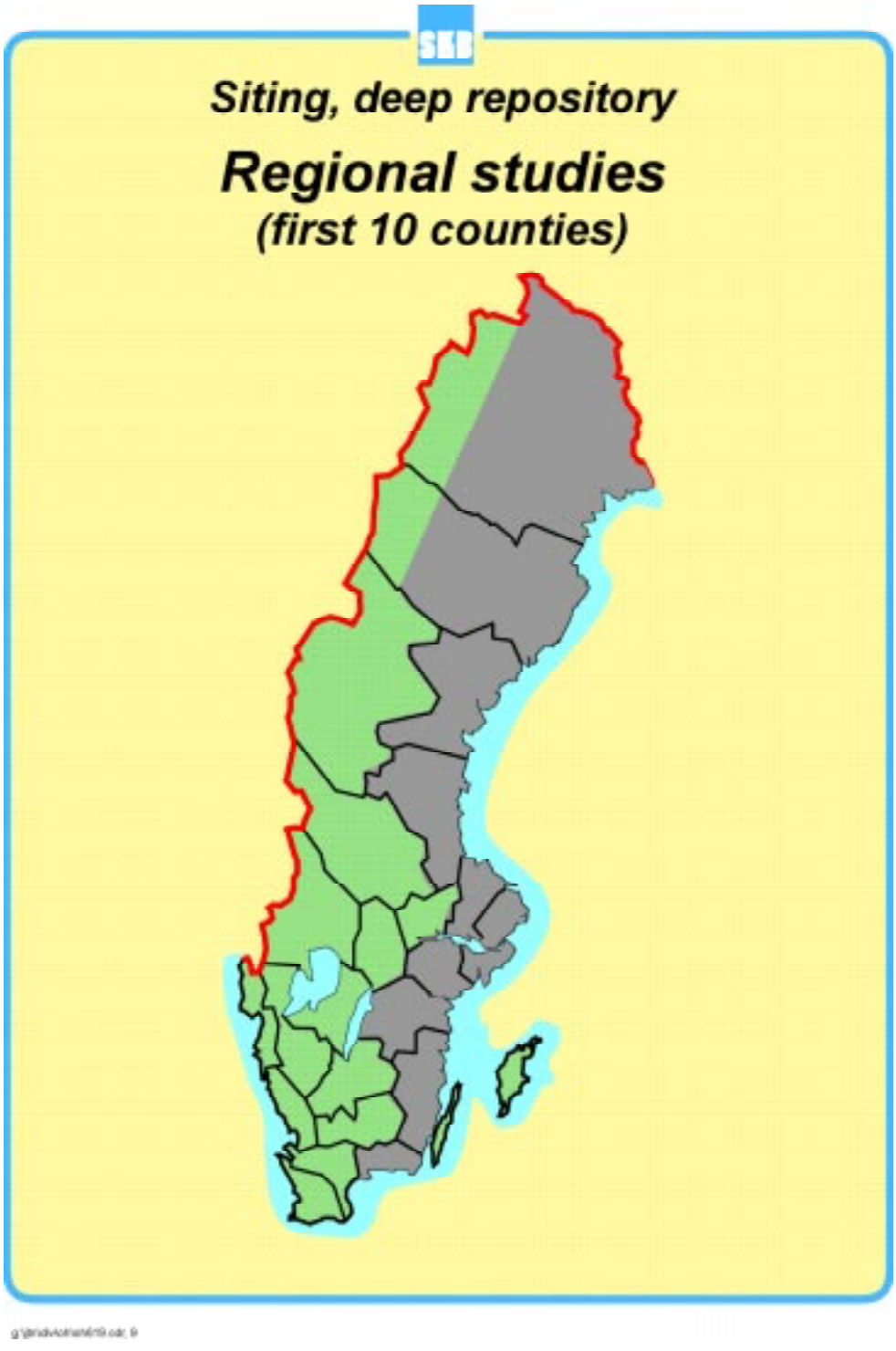
But further feasibility studies are also dependent on the results of the *regional siting studies* that SKB presently is undertaking in all areas along the Baltic coast. This is illustrated in map 2.

It is tempting to reflect on the reasons why SKB around 1993 was invited to start feasibility studies in the two northern municipalities of Storuman and Malå, but not elsewhere. Of course there are no simple explanations. And it should be stressed that there was a significant opposition in both municipalities from the very start.

In all of the municipalities where preliminary discussions between SKB and the municipality started, the reason was that some of the locally elected leading politicians and some administrative officers of the municipality regarded the idea of a feasibility study as an interesting

project for the municipality. But when the idea became discussed among members of the political parties and the general public, the opposition started.

Map 2. **Regional studies** (borrowed from SKB)



The media picked up the news that a "nuclear dump will be constructed" in X municipality. Lots of questions were asked. Serious doubts about safety were expressed. It soon became obvious that different attitudes towards the idea were held in most political parties. Pressure on leading local politicians increased. In many cases, there was only one way out to avoid a situation which might lead to a major confrontation both inside the political parties and between different parts of the local population. And that way was to simply drop the issue from the agenda.

This seems to have been the case in the municipalities of Överkalix, Arjeplog and Tranemo – and later, during the spring of 1997, also in Gällivare. Prominent local political figures who initially supported the idea of a feasibility study felt – or concluded – that they could not get enough support from party members or from the general public. The idea had to be dropped – and the decision-making machinery of the municipality could stop working; no formal decisions had to be made.

A major explanation for the difficulties that the local political leadership met in 1992-1993 was probably the total silence by politicians on the national scene. Nothing that could be interpreted as some sort of endorsement of SKB's activities (which may be regarded as a national project) was heard from Government ministers or from members of the Parliament (not even those living in the area).

A special study has been made to examine how citizens, politicians and other stake holders in the three northern communities of Storuman, Malå and Överkalix reacted politically when the issue of a feasibility study came up in 1993. In the municipality of Överkalix, the formal decision-making process was stopped just before the issue was to be brought to a final vote in the municipal council. The traditionally dominating political force in Överkalix was the Social Democrats. But a strong opposition emerged among the population and spread to party members. In the end, the local leaders of the party were forced by its grassroots members to withdraw the issue. The findings of the study indicate, that the whole issue of a feasibility study was handled too long in an insufficiently open way by the local leadership of the Social Democratic party. As an outside observer one gets the feeling that people reacted against what they experienced as a case of manipulation.

2. What are the local implications of being a "feasibility study municipality"?

An obvious fact is that the municipality gets – for free – an in-depth review of existing data on geology, present and planned land-use, infrastructure, prospects for industry and business, population development *etc.* This is a material that can be of value for municipal planning within many areas irrespective of the results of the feasibility study.

There might be differences between implications for municipalities already hosting a nuclear installation and other municipalities.

One implication is obvious: To be a "feasibility study municipality" demands dedication, commitment and time. The pressure is high on all elected representatives. Knowledge must be acquired. Much time must be used for internal discussions, with experts and with voters. In the case of a small municipality, the issue of a feasibility study may overshadow most other business which leading politicians and administrative officers also have to attend to.

Especially in smaller municipalities like Storuman and Malå, elected representatives and the whole population tended to be "exploited" by the mass media on the regional and national level. This

could be observed during the referenda in those two municipalities and when important decisions were to be made by the municipal council. Some media coverage seemed to convey a message saying that the nuclear industry (acting through SKB) was planning to rape an innocent municipality with political leaders who did not understand what was going to happen! Such allegations naturally put pressure on the local political leaders, especially as the project was not clearly endorsed by politicians on the national level.

But the media coverage may also be advantageous for a municipality, especially a small one. The municipality suddenly becomes known all over the country. My personal feeling is that most Swedes living in the more densely populated south and central parts of the country had but a vague idea about the existence of Storuman and Malå. Some might have heard that the internationally famous downhill skier Ingemar Stenmark came from a village in Storuman. Very few had any idea that Malå hosts high technology industries in timber-processing and in the manufacturing of special instruments for geological activities (mining, radar equipment *etc.*).

Another implication of being a "feasibility study municipality" – which has been demonstrated in the case of Storuman – is, that acrimonious discussions between proponents and opponents could create deep and lasting "scars" in the local community. In the case of Storuman, the issue led to boycotts of shopkeepers, harassment of political leaders by anonymous telephone calls and broken ties between friends and family members. Some of the bitterness between people may still remain. In Malå, both political leaders and people in general were aware of the problems that Storuman had experienced. During the referendum campaign, many voices were heard urging restraint in the campaign and sending the message "we have to live together after referendum day irrespective of the outcome". Certainly the losers were disappointed in Malå, but the local community seems to have avoided lasting bitterness.

Another experience, both from Storuman and from Malå, is that dedicated outside anti-nuclear activists appeared suddenly. Especially Greenpeace was campaigning very actively during the weeks before both the referenda. Their message was, in essence, that it would be irresponsible to continue investigations for a site using the KBS-3-method, which Greenpeace claimed to be far too risky. It seems, at least in the case of Malå, that the local opponents of continued investigations were not entirely happy with this outside help, which they did not ask for.

Being a feasibility study municipality also means that local self-government, in principal based on a representative system with local elections, meets difficulties. Demands for local referenda are raised and may be difficult to handle. The idea of a referendum being a higher form of democracy than a representative system is not undisputed. But perhaps such referenda are unavoidable on issues like a nuclear repository. If so, at which phase of the siting process are they to be held? And which question should be asked to the voters?

There seems to be a tendency that people who from the start are decidedly opposed to the very idea of a feasibility study are eager to demand a local referendum. Proponents of the study tend to respond that local referenda need time for the acquisition of knowledge, so that people really understand the issue. Proponents also seems to argue that a local referendum should be used first at a later stage of the siting process, namely when the accomplished investigations provide enough facts to judge if a particular site really is considered as suitable. This would imply that a local referendum should not be held before the phase of "site investigation" or even the phase of "detailed characterisation".

These reflections refer mainly to experiences from two northern and "non-nuclear" municipalities, Storuman and Malå. We still do not have much experiences from the three ongoing feasibility studies in "nuclear" municipalities. There are, however, reports from Nyköping and Östhammar about difficulties to catch the interest of the population for the issue. I will later describe the sophisticated organisation for democratic involvement in the feasibility study that has been elaborated in Oskarshamn.

3. Are there any economic incentives for a municipality to volunteer for a feasibility study?

The answer to this question is NO. However, Swedish municipalities may be reimbursed for their expenses as a "feasibility study municipality". Examples of such expenses are costs for information and education of citizens and their elected representatives (including travel costs for participating in meetings and conferences on nuclear waste management issues). Also costs for hiring experts to advise the municipality when discussing with SKB and to assist when the work of SKB is under review could be reimbursed. The maximum amount per year and municipality is SEK 2 000 000 (approx. USD 250 000).

The costs are covered from the Nuclear Waste Fund (which is financed by fees from the producers of nuclear power). It is the task of the Swedish Nuclear Power Inspectorate to settle issues of reimbursable costs.

Would a system with economic incentives make it easier to find interested municipalities? The idea of introducing such a system has not been discussed very much in Sweden. There seems to be a feeling of general discomfort when the subjects is brought up. Hesitation might depend of fear that such a system could lead to allegations of "bribery": the nuclear power industry and/or the Government is bribing poor municipalities with a high rate of unemployment but with questionable geological conditions to accept a repository.

It should be noted that the idea of economic incentives is *not* supported by any of the present "feasibility study municipalities" (Nyköping, Östhammar and Oskarshamn).

A different approach to the problem has been discussed by leading representatives of the municipality of Malå together with the County administration of that part of Sweden. According to this idea, an incentive system should be based on the view that if feasibility studies are made in ten municipalities, only one of these will be a "winner" and host to the repository. The remaining nine will be "losers". The losers ought to be compensated for all the work and "political energy" that they have put into a project of national importance.

4. Is it possible for a municipality first to volunteer but later to withdraw from the site selection process?

The question implies that there could be a risk for a municipality to volunteer for a feasibility study. This risk would be that the Government would not respect the legal right of a municipal council to say NO to a future siting application by SKB for a repository (the municipal veto).

The basic provision in the legislation forbids the Government to grant the necessary permission to site a facility of this kind without the consent of the municipality council. True enough,

there is a provision in the law enabling the Government under very special conditions to overrule such a municipal veto. But this provision seems to be very hard to use for any Government, given the traditional strong position of Swedish municipalities granted in the Constitution and in the special legislation on municipal self-determination.

As has been mentioned earlier, SKB does not need any formal permits by public authorities to carry out a feasibility study. The company has chosen to carry out feasibility studies only in those municipalities where SKB, based on results from the national siting studies, makes a preliminary assessment that safety demands will be satisfied *and* that the municipality demonstrates a sufficient positive interest for the study. Unless both these two prerequisites exist, there will be no feasibility study.

Let us assume that a feasibility study has been made and that it shows that areas in a municipality have been identified where general conditions indicate that the area might be suitable for a repository. To find out more, a site investigation must be made. Which decisions and considerations has a municipality to make in such a situation?

A first step is to review the feasibility study SKB has produced. Are all facts correct? Are there more items that the municipality feels should be discussed? Such a review was carried out in Malå and will most likely take place also in the three "nuclear" municipalities where feasibility studies presently are under way.

At any time during this phase, the municipality is able to withdraw from the siting process.

There are no rules about how the opinion of the municipality should be expressed. The most likely scenario, given the importance of the issue, is that the matter is discussed by the municipal council, followed by a council decision. There is also a possibility that the municipal council decides to arrange a local referendum on the issue.

The referendum in *Storuman* in 1995 had been decided by the municipal council already in 1993, probably feeling the pressure from voters who were very divided on the issue. According to this decision, a referendum should be held as soon as the feasibility study was presented by SKB. The municipality did not initiate a review of the feasibility study report. As the outcome of the referendum was decidedly negative, SKB started to pull out from the municipality the following day, according to commitments made during the campaign. At a later meeting, the municipal council made no other decision than to note the result of the referendum "as the will of the people".

In *Malå* the municipal council decided already in 1993 that a referendum should take place "after" the feasibility study. The exact date for the referendum (21 September 1997) was set by the council in January 1997. When this decision was made, an independent municipal review of the feasibility study was in progress, and the results were estimated to appear in due time before the referendum, which also happened. Thus the voters in Malå had access to both the results of the feasibility study and an independent review of the study. As the result of the referendum was announced late in the evening of 21 September 1997, SKB declared that they would not continue the search for a site within the municipality. In November 1997, the municipal council made a formal decision "to disengage from the project in an orderly manner".

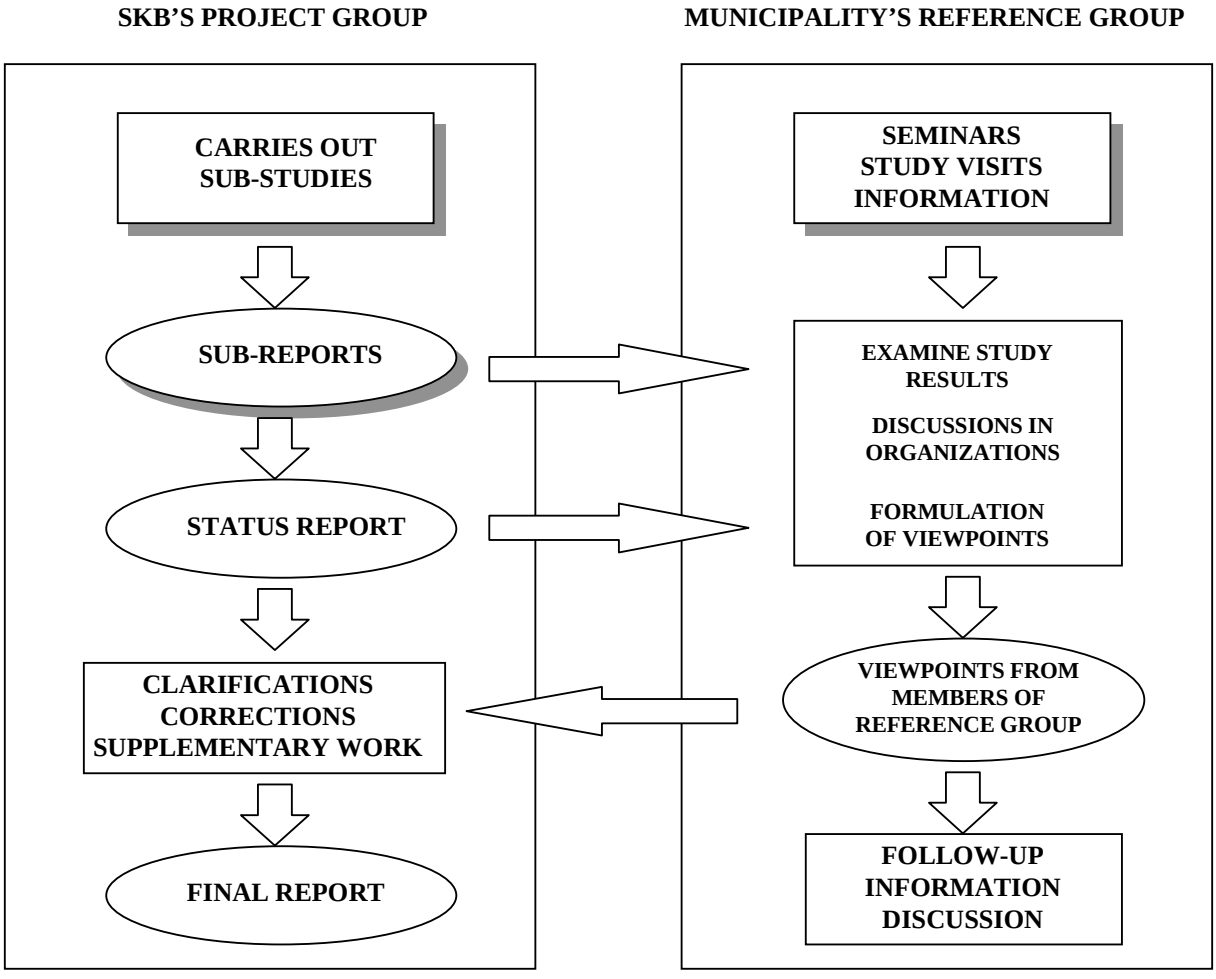
5. Is it possible for a municipality to have an influence on the work that is done during a feasibility study?

The answer to this question is YES. The following overview illustrates how this has been done in four different cases.

Malå. The municipal council decided in November 1993 to ask SKB to carry out a feasibility study. The voting results in the council clearly indicated that the members were very divided on the issue: 14 yes, 14 no, 3 abstained. The casting vote of the chairman settled the issue. It was clearly stated in the decision that "yes" to this study did not mean "yes" to nuclear waste management within the municipality, and that the municipality would arrange a local referendum after the feasibility study had been carried out.

Forms for the interaction between SKB and the municipality of Malå during the feasibility study are illustrated by figure 3.

Figure 3. **Activities during the course of the feasibility study in SKB's project group and the municipal reference group (MALÅ)**



In early 1994 an agreement was made between the municipality and SKB. The company was responsible for the feasibility study, but the municipality should closely follow the study and be given the possibility to continually influence it. The municipality formed a "reference group" with 22 members from 6 different political parties and 16 members from different interest groups and associations within the community. The task of this reference group was to follow the work, disseminate information and contribute viewpoints and ideas.

The final version of the feasibility study was presented in March 1996. But already in mid-1995 the municipality had decided that the study should be reviewed and started to look for outside independent experts for assistance. The responsibility for the review work was given to a "local working-group", consisting of representatives for political parties, local unions, local business, Laplanders, local tourism, local sport associations, senior citizen associations etc. The group was chaired by a former Director-General of the Swedish Environment Protection Agency. The organised opponents of the feasibility study were invited to participate in this review work, but preferred not to be involved. However, the Chairman of the local working-group insisted that all documentation from the review work should be distributed also to these opponents.

This a "local working-group", formed four committees concentrating on the areas of Environment/Safety, Geology/Hydrology, Transport/Facilities and Socioeconomics. Experts were engaged to review SKB's studies within these areas and to report to each committee as a basis for further discussions in the committee. All views which were brought up during this process were made available to the general public before the referendum was held in September 1997. One result of the review was that issues were identified where the "local working" group felt a need for further clarifications or further studies. It seems fair to assume that, if the outcome of the referendum had been "yes" to further investigations, these views would have been noted carefully by SKB.

My impression is that there is no doubt that the municipality of Malå and its population have influenced the feasibility study.

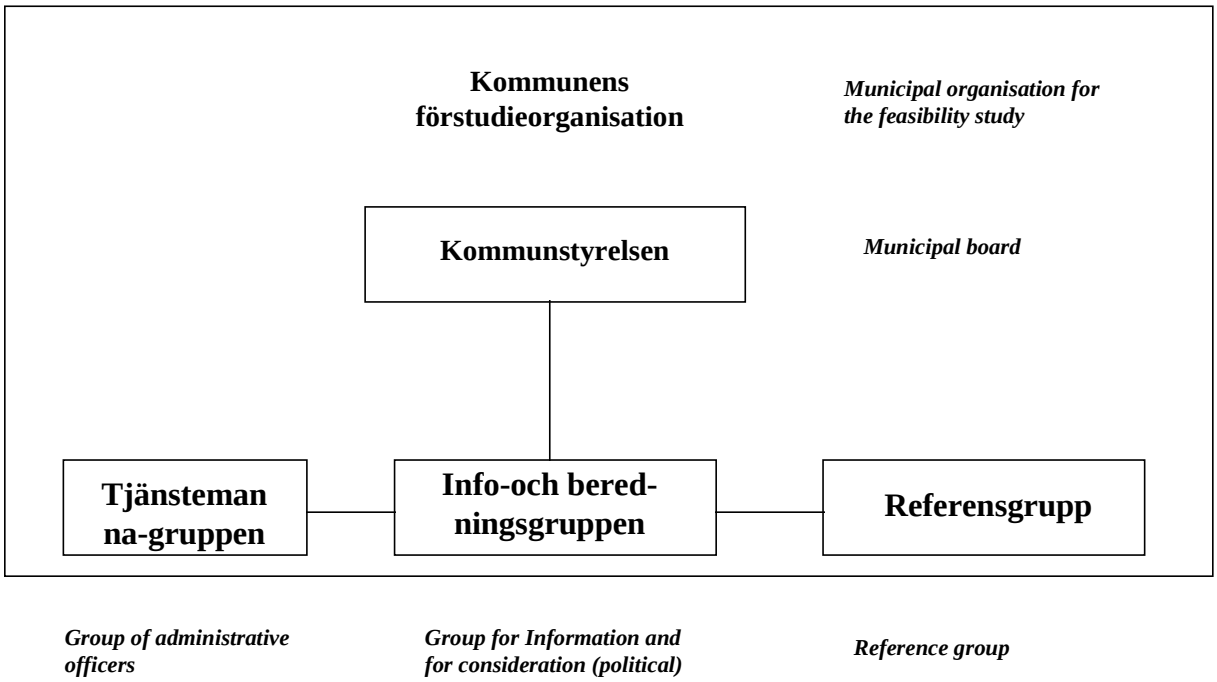
Nyköping. A *preliminary* version of the report from the feasibility study in the municipality of Nyköping was presented by SKB in May 1997. The interaction between SKB and the municipality during the preparation of this study is has been rather informal.

A starting-point was May 1995, when SKB wrote a letter to the municipal board of Nyköping saying that the company was interested to carry out a feasibility study covering the municipality. The municipal board answered that the municipality had no legal power to prevent SKB to carry out this study, at the same time declaring that they were not negative to the idea. The board also declared that the municipality was ready to form municipal working-groups to follow and review the study and to assist SKB with available information. Later in 1995 the municipal board appointed two working-groups. One was a so-called "Group for information and consideration" with elected local politicians representing all parties in the municipal council. The other was a group of leading municipal administrative officers. Early 1996, a third group, the "Reference-group", was created. This group consisted of people representing different interest-groups and associations within the municipality. The tasks of all three groups have been to follow and discuss the feasibility study, to inform the public about what is going on and to contribute to the work with views and ideas.

During this process, the issue was not put on the agenda of the municipal council.

These three groups in Nyköping are illustrated by figure 4.

Figure 4. **Nyköpings kommuns förstudieorganisation**



As a basis for the May 1997 version of the final report, SKB first worked out separate reports on different subjects. These separate reports were presented by SKB's experts in the different municipal working-groups, where questions were asked and discussions took place. Another basis for the preliminary version of the report was a series of public meetings organised by the municipality and held in early 1997 at different places within the municipality.

Consultations and information have also taken place at some meetings organised by the County Administration. Invitations to these meetings have been distributed to representatives of neighbouring municipalities, the nuclear regulatory authorities, other government authorities in the region, regional environmental protection associations, SKB and others. These meetings have been organised to meet Government demands on County administrations to take an active part in co-ordinating work in connection with the environmental impact assessment that SKB will have to present in connection with a future application for a siting permit.

When SKB had presented its preliminary version of the final report of the feasibility study, the municipality hired independent experts to review the report. The findings of the experts will be discussed in the municipal working-groups. Findings and views will be presented to SKB for consideration. Based on this material, SKB is expected to present the *final* version of the feasibility study, probably during 1998.

The municipal council of Nyköping has not yet made any decision on the issue of taking part in a siting process for a nuclear repository. Probably the issue will come to a head if SKB, based on the results of several feasibility studies in the country, concludes that they want to select Nyköping as one of the municipalities for a site investigation.

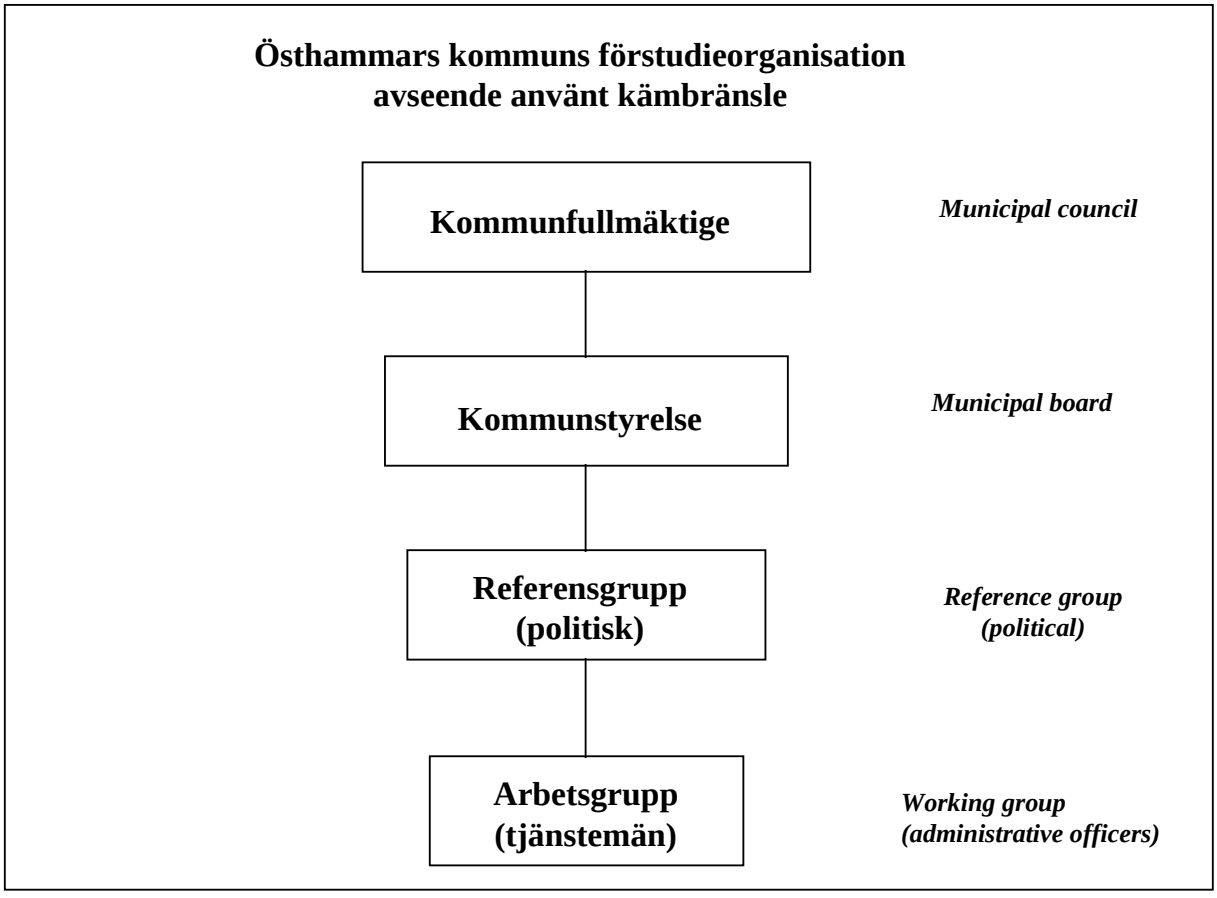
To conclude: Although the municipality of Nyköping has chosen less formal ways of interaction with SKB, the municipality has had no problems in conveying their views to SKB.

Östhammar. The interplay between the municipality of Östhammar and SKB has both similarities and differences with that of Nyköping and SKB. The start was similar, with SKB in April 1995 writing a letter to the municipal board explaining its interest to make a feasibility study in the municipality. After SKB had presented the issue more in detail to the municipal board and to the municipal council, the latter decided in June 1995 that SKB was "allowed" to make the study. Thirty-six members of the council were in favour, while 12 voted against.

An agreement was made between the municipality and SKB later in 1995. SKB would be responsible for the study, but the municipal board appointed a "reference group" with the task to follow and review the feasibility study, to inform the public about what is going on and to contribute to the work with views and ideas. Members of the "reference-group" are 7 elected local politicians and 7 deputy members (from each of the 7 parties represented in the municipal council). The municipality also appointed a working-group of four municipal administrative officers.

The municipal organisation for the feasibility study in Östhammar is illustrated by fig ure 5.

Figure 5. **Östhammars kommuns förstudieorganisation**



Similar to what was done in Nyköping, SKB's experts presented separate reports on different subjects to the "reference group" for information and comments. Also in Östhammar, the municipality arranged public meetings for information and discussions. In September 1997 SKB presented a *preliminary* version of the report from the feasibility study.

As in the case of Nyköping, consultations and information have also occurred at meetings organised by the County Administration. These were made to meet Government demands on County administrations to take an active part in co-ordinating work in connection with the environmental impact assessment that SKB will have to present if an application for a siting permit later will be submitted. However, the forms of the meetings slightly differ from each other. In the Östhammar case, the County administration has chosen to chair a "reference-group for information concerning the current feasibility study in the municipality of Östhammar". Members of this group are representatives for the municipality, adjacent municipalities, the Åland regional and municipal authorities (on the other side of border line at sea between Sweden and Finland), the nuclear regulatory authorities, several other regional and central government authorities, SKB and others. These meetings are held with regular intervals.

The municipality of Östhammar is presently hiring independent experts to assist with reviewing the preliminary version of the report. The forms for interaction between these experts and the representatives of the municipality and between the municipality and SKB during this phase have not yet been decided. The preliminary report will be circulated for comments among different municipal boards, political parties, local authorities and other organisations.

The time needed for this review is an open question. Local elected politicians have indicated that at least a year will be required. This might mean that the municipality of Östhammar will not arrive at a decision until late 1998 or early 1999.

Oskarshamn. SKB's work on a feasibility study started as late as in August 1997. What happened before the start of the feasibility study is, however, interesting seen from the point of view of municipal decision making and influence on SKB.

The municipality of Oskarshamn is faced with a particular situation, as being the host for CLAB (the central interim storage facility for spent nuclear fuel from all Swedish reactors) since 1985. The implication of this situation is that the municipality will be stuck with all the spent nuclear fuel in case of a "zero alternative" (defined as indefinite prolonged storage at CLAB). The elected political leaders in Oskarshamn are quite aware of this situation.

When in 1992 SKB announced plans to construct an encapsulation facility for spent nuclear fuel close to CLAB, the municipal representatives realised that they had strong reasons to be informed about and to exert influence on these plans at an early stage. A "forum" for consultations was set up consisting of representatives of the municipality, SKB, the nuclear regulatory authorities and the County administration (supplying Chairman and secretary for the meetings). During frequent meetings with this "forum", all matters in connection with the plans for the encapsulation facility could be discussed. One aim with the meetings has been to reach a consensus on which issues should be investigated by SKB as part of a future siting application. Minutes from the meetings show in detail what is agreed between the parties and what is not. Minutes have been made available to the general public and distributed within the municipality.

Encapsulation and final disposal must be considered as integrated parts of the same disposal system. Therefore a close connection exists between the plans for an encapsulation facility and plans

for the siting of a final repository somewhere in the country. It seems reasonable to assume that the encapsulation facility should be located either close to the CLAB facility or close to the final repository. SKB is planning for the CLAB-alternative. The municipality of Oskarshamn found that it would not be ready to take a position on the issue of the encapsulation facility unless more progress had been made in the site selection process.

Thus the municipality of Oskarshamn was already involved in this process when the municipal board was formally contacted by SKB in the spring of 1995 about a feasibility study. The representatives of the municipality thought that a broad debate and information within the community was needed before any decision was made. A consultation process involving various parts of the municipal administration and a vast number of local interest groups of different kinds was organised. Special measures were taken to involve young people (age 15-30) in the process. In October 1996, the municipal council decided, by a clear majority, to "allow" SKB to go ahead with the feasibility study. However, the decision was dependent on some important conditions.

One condition was that the municipality should have every opportunity to influence which issues should be covered during the feasibility study and to decide on suitable forms for interaction with SKB and with the concerned government authorities. The municipal council would act as "reference group" for the study. During 1997, the municipality set up a number of working-groups with the task to closely follow SKB's work. These groups consist of elected politicians and representatives of different interest groups in the community.

The rather sophisticated organisation in Oskarshamn for municipal influence based on democratic participation is illustrated by figure 6.

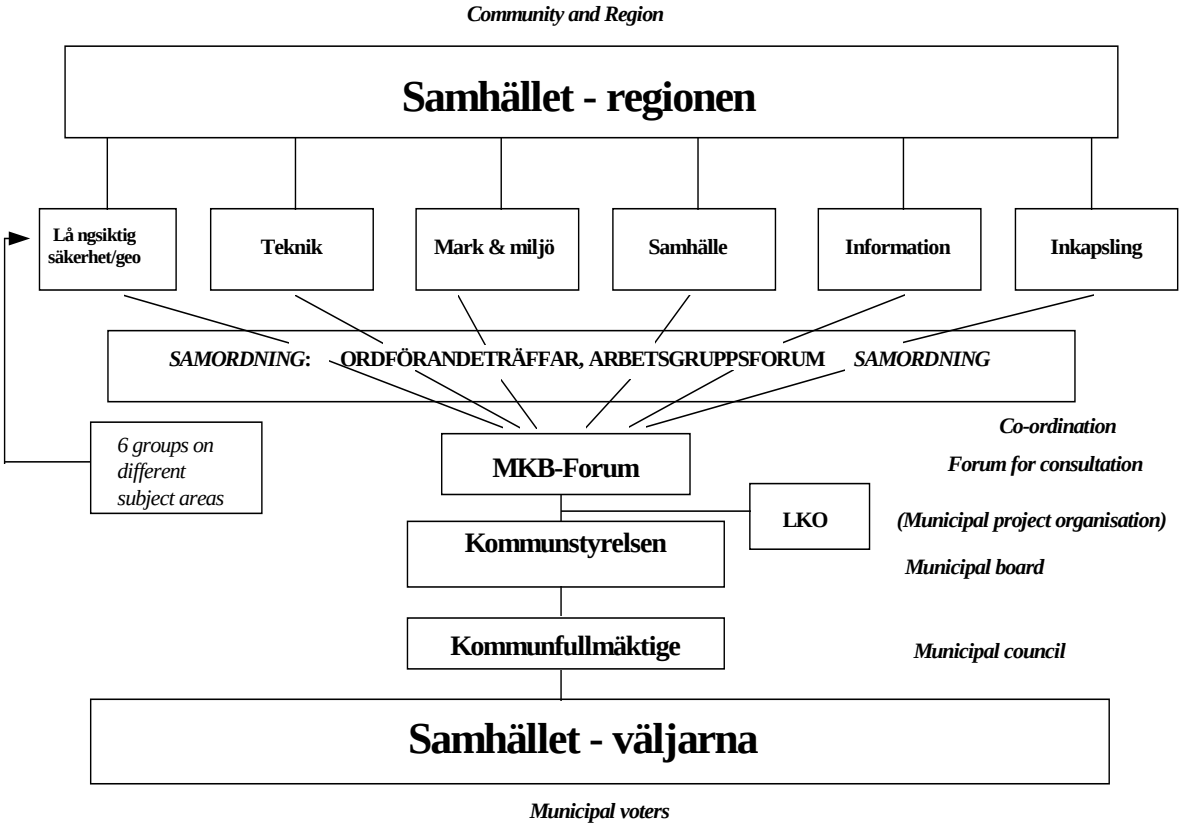
In addition, the earlier mentioned "forum" should also be used for frequent consultations in this matter. This means that the "forum" also serves as the means for the County administration to take an active part in co-ordinating work in connection with the environmental impact assessment that SKB will have to present in connection with a future application for a siting permit.

From the point of view of influencing the feasibility study, the following excerpt from the municipal council decision of October 1996 may be of interest (translation published by the municipality of Oskarshamn):

> *Feasibility studies are an important step in the process which SKB has commenced in order to investigate the suitability of municipalities for the siting of a deep repository for spent nuclear fuel.*
>
> *In a feasibility study the prerequisites for and the consequences of a possible deep repository will be analysed. A proposed programme for the feasibility study shall be issued by SKB for subsequent discussion and approval by the municipality. The feasibility study should be devised in such a manner that it gives ample possibilities for the development of local competence within the area of nuclear waste. A comprehensive illumination of the positive as well as the negative consequences of a deep repository for the municipality should be included. The geo-scientific parts in a feasibility study are based on a summary of existing material as well as certain field studies at ground level. Deep investigations in the form of drilling are not included. Drilling will take place first in the site investigation stage.*

The feasibility will be carried out with complete openness and wide participation will be offered the inhabitants of the municipality during the implementation. Following a completed feasibility study a comprehensive review will be carried out.

Figure 6. **Projekt kärnavfall i Oskarshamn**



It should be noted that the municipality of Oskarhamn has not made any formal agreement with SKB. The municipality seems to have found it sufficient to state unilaterally its conditions for co-operation, thus stating its independence. And this has been accepted by SKB. As a close observer of the interplay between the municipality and SKB, I can verify that the municipality of Oskarshamn has no difficulties in influencing SKB's work with this feasibility study.

Consultations on the national level. The four municipalities involved in SKB's current or planned feasibility studies asked the Government in late 1995 "to appoint a national co-ordinator in order to facilitate the siting process" until a formal siting application is submitted. A "National Co-ordinator for Nuclear Waste Disposal" was appointed in the Spring of 1996 and started work in September 1996. I am the present holder of this office.

The key words in the Government's terms of reference for the National Co-ordinator is that he should promote *"the co-ordination of information and investigation work which is found to be necessary by the municipalities involved in SKB's siting studies"*. As a result from discussions with representatives of the "feasibility study municipalities" a National forum was instituted late 1997. This forum is chaired by the National Co-ordinator and will serve as a discussion forum on issues of

interest or importance for all “feasibility study municipalities”, all concerned County administrations, the nuclear regulatory authorities and other particularly concerned central government authorities, the Federation of Swedish municipalities and SKB. It is primarily up to the participating municipalities to initiate which issues should be brought up for discussions. A first working session with this forum is planned for February 1998.

Summary. It is interesting to compare how the issues of municipal influence have been handled by each of the four municipalities of Malå, Nyköping, Östhammar and Oskarshamn.

Firstly, it should be mentioned that some sort of formal agreements have been set up between SKB and the municipalities of Malå and Östhammar. The municipality of Nyköping has chosen less formal ways for interaction with SKB. The municipality of Oskarshamn has not made any formal agreement with SKB. Instead that municipality has stated unilaterally its conditions for co-operation, thus demonstrating its independence.

In all four cases the municipalities have formed some sort of “reference groups” with the task to follow and discuss the feasibility study, to inform the public about what is going on and to contribute to the work with views and ideas.

When a final version of the feasibility study on Malå was presented by SKB, the municipality had hired its own experts to review the study. The experts reported to the municipal reference group. The result of the discussions was intended to be conveyed to SKB – but the voters of Malå said “no” to SKB in a referendum and further discussions with SKB were cancelled. Municipal reviews of preliminary versions of the feasibility study on Nyköping and Östhammar will soon start (the feasibility study on Oskarshamn is still ongoing, in an early phase).

In all reference groups there are members representing the local political parties. In most cases, people representing different interest groups and local associations of many kinds also have been invited to participate actively. Especially in Oskarshamn, the municipality has set up a sophisticated organisation for municipal influence based on democratic participation by many citizens.

On the initiative of the concerned municipalities, a National forum for discussions on issues of importance for all “feasibility study municipalities” was instituted late 1997. This forum can also be used as a means of influencing the work that is done by SKB during a feasibility study.

6. Two feasibility studies have been completed, after which the affected municipalities (Storuman and Malå) have decided not to be a candidate for a site investigation. What were the reasons? Who was the decision-maker?

The question asked in both these two referenda was whether SKB should be allowed to continue with its activities within the municipality in search for a suitable site for a repository. But it seems that many voters felt that actually it was a matter of yes or no to a repository based on the KBS-3-method in their municipality. This was certainly how the active opponents chose to present the issue.

Who was the decision maker? The answer is easy: the inhabitants of the two municipalities acting through a referendum. The legitimacy of the result can hardly be questioned, as the election turnout was high and the majority clear. In Storuman 71 % of the votes were negative, in Malå 55 %.

Storuman. There is a scientific study, financed by SKB, describing which arguments were decisive when people in Storuman made up their minds. According to this study, the main argument for "no" was that the KBS-3-method and the necessary transports were not considered safe enough. It was also felt that a repository might make the area less attractive for wilderness tourism. Matters of equity were mentioned, for example "the waste is produced in southern Sweden – why transport it for burial in the wilderness of northern Sweden?" Other typical attitudes may be summarised as follows: "Is our municipality responsible for the waste once a repository has been sealed?", "Our municipality has been selected without a due site selection process taking into account the natural conditions in all Swedish municipalities".

Who were the NO-voters? According to the same study, the referendum was partly an issue of conflicting ways of life. The idea of a repository in the area was considered as a threat from the industrialised parts of Sweden against one of the last remaining wild regions, populated by people with other values in life than those which dominate in other parts of the country. Earlier anti-nuclear feelings (demonstrated in the national referendum of 1980) and earlier resistance towards hydro-power developments in the region, also seem to have played a role.

Local opposition towards the idea of a repository in Storuman may also have been fed by what was perceived as an alliance between leading local politicians and SKB. Storuman was the first municipality to enter an agreement on a feasibility study with SKB. Both parties had difficulties to find suitable forms for their interaction, and their different roles in the work may not have been made quite clear. Also the nuclear regulatory authorities had difficulties in explaining their roles in connection with the siting process. Some confusion may also have been caused by the fact that there are linguistic resemblance in Swedish between the acronyms used by the two regulatory authorities – SKI (the Swedish Nuclear Power Inspectorate) and SSI (the Swedish Radiation Protection Institute) – and that used by SKB (the Swedish Nuclear Fuel and Waste Management Co).

The dominating group among YES-voters was the small scale entrepreneurs (but not in the tourist trade). It is interesting to note that the best results for YES – although still a minority – turned out to be the central locality of the municipality, while all remote villages and areas massively voted no.

One result of the referendum was, that the local community – whether in favour or opposed to the idea of a repository – felt abandoned by politicians on the Government and Parliament level.

The referendum showed that a clear majority of voters in 1995 rejected the opinion expressed by their representatives on the municipal council in 1993, when a clear majority in the council had decided to invite SKB for the feasibility study. At the general election in 1994, some persons and some parties were punished for their engagement in the project.

Also in **Malå** the outcome of the referendum was clear, but more even. It seems as the attitude between proponents and opponents in Malå was not as uncompromising as in Storuman. People held very different views – but they made real efforts to avoid deep wounds in the community as a result of the outcome of the referendum.

A report from a scientific study about the campaign and why people voted the way they did is expected to appear in February 1998. My personal view is that the explanation for the more positive outcome in Malå than in Storuman could be sought among the following factors:

- the nuclear waste management issue is generally better known in 1997 than in 1995;

- in Malå there is an industrial tradition – recently closed down copper mines, small high-tech industry specialising in mining equipment;

- no natural conditions for wilderness tourism as in Storuman;

- massive information campaign by SKB, including study tours for ordinary citizens to nuclear installations of different sorts;

- an ambitious study work on the nuclear waste management issue, organised by the municipality.

7. Which decision-making problems will have to be faced by SKB and the affected municipalities when selecting "at least two sites" for site investigations?

The step from a feasibility study to a site investigation is important for a municipality. As perhaps only two municipalities will be selected, a site investigation could mean that there will be 50% probability that the site will demonstrate its suitability for hosting a repository.

Both SKB and the elected representatives of an affected municipality will have strong reasons to make sure that general opinion in the municipality is in favour of the project.

The most probable scenario is that some sort of agreement will be made between the municipality and SKB, and that such an agreement will guarantee the municipality every opportunity to follow the investigation closely and to have municipal views fully considered. Although drillings require only permission of the land-owner, some municipal building-permits might be needed for installations of various kinds.

Which basis will there be for a municipality to decide whether it is positive or not if SKB indicates interest for a site investigation?

Primarily, the basis will be the different feasibility studies that SKB has produced. These are structured in a similar way to facilitate comparisons.

But the Government has also made some guiding statements as to what SKB should achieve before starting the site investigations:

- an analysis of the long-term safety of the repository should be carried out;

- the municipality should have access to all reports on general studies, feasibility studies and any other background material and comparative information which SKB has used for its conclusions;

- SKB should be able to specify criteria for the evaluation of candidate sites and specify which factors will determine whether a site will be excluded from further studies;

- SKB should consult with the nuclear regulatory authorities on the premises which should apply in the investigation work.

By making these statements, the Government has strongly advised SKB not to start site investigations until the issue of a system for the disposal of spent nuclear fuel has been penetrated in more detail than has yet been made. The statements also indicate that the Government is anxious to ensure that the concerned municipalities will have access to a comprehensive basis for their own decisions if faced with the issue of a site investigation.

Some final remarks

This paper has covered seven issues with a bearing on the decision-making in connection with current work in Sweden to select a site for a final repository for spent nuclear fuel. The comments are intended to have relevance also for the theme which this workshop focuses on.

There are, of course, more questions to be asked and issues to be discussed in this context. The following examples indicate the diversity of issues that must be handled by decision-makers, administrators and implementors – in addition to all technical issues.

- What about the general credibility of authorities and political decision-makers in risk issues?

- Inevitably there exists a genuine uncertainty when predicting what will happen in the long run. How should this situation be handled?

- Which risks do people in the concerned areas regard as being particularly imminent? How should a responsible decision-making machinery react if ordinary people's view of risks differs completely from the views of a more informed public?

SUMMARY AND CONCLUSIONS

by

R.E. Cunningham
Rapporteur, United States

During the workshop, Mr. R. E. Cunningham acted as Rapporteur, as he had for the WGSA. This section is a summary of the various workshop sessions, a discussion of the conclusions reached by the workshop participants, and a summary of subsequent conclusions and recommendations which were made to the NEA's Committee on Radiation Protection and Public Health (CRPPH) which sponsored the workshop.

1. Keynote Address

In his keynote address, Dr. Serge Prêtre identified the main groups involved with decision making in abnormal radiological situations as being governmental authorities, experts, the affected population, the non-affected population, the media and critics, and international organisations. He then reviewed the questions and issues related to decision making (*e.g.,* who decides? when? and how? Centralised *vs.* decentralised management; how to respond to fear?) and offered his opinion about how some of these should be treated. He also posed a fundamental question about decision making which was at the heart of much of the subsequent discussions, namely: is the issue one of integrating societal aspects into radiation protection decisions or, integrating radiation protection into societal decisions?

2. Case Studies

In his opening remarks, Dr Abel González, Session Chairman, questioned whether or not the issue confronting the radiological protection community is more social than technical. He noted that safety is a perception, but that we need to be better able to talk about a "safe" dose. However, there are gaps in the technical approach to this problem. Part of the problem is that the idea of a dose limit or action levels is very obscure in that they cover only dose added by a practice or from chronic exposure in de facto situations. This has not presented much of a problem for practices, but for averted dose through intervention there is a need to consider total dose, *i.e.* including pre-existing background dose, in order to deal realistically with the problem. Dr. González indicated that only when total dose is brought into perspective can the question of "is it safe" be treated more realistically. Answering questions about "safe" dose is more fundamental in arriving at solutions to de facto chronic exposure situations than is the democratic process of decision making.

The three case studies were concerned with chronic exposure due to past practices or an accident. The Marshall Islands case involves the resettlement of indigenous populations to areas contaminated by nuclear weapons testing in the 1950s. The Chernobyl case treats the post accident problems of a community attempting to cope with living in a contaminated environment. The Eastern Germany case concerns the problem of uranium residues from past practices. The social settings of these cases are quite different from each other. Collectively, they illustrated the varied nature of their social aspects and the approaches to achieving accepted solutions.

In the Marshall Islands case, decisions about resettlement are in the hands of the affected island communities. The issues are complicated by an exploding population growth since the time of relocation in the 1950s. The islands will no longer support today's entire population. The US Government provides assistance to the Marshall Islands communities in making its decisions by helping exposed communities rebuild infrastructures through financial and other support, performing environmental characterisations, developing and implementing dose mitigation technologies, and enhancing community understanding of options. Bikini, Enewetak, Rongelap and Utirik, are separate islands within the Marshall Islands group. Societal and environmental conditions vary among the islands. Community decisions made thus far are not the same among the islands; some being more successful than others. In addition to any technical issues that may remain, the cultural changes, dietary changes, increased population, *etc.* that has taken place over the years contribute to the complexity of the problem.

The Chernobyl case study addresses the social and technical dimensions of the post accident situation in a small community; the village of Olmany, Stolyn district, Belarus. The report stems from a pilot research project on rehabilitation of living conditions sponsored by the European Commission.

At the outset of the study there appeared to be a general fear of contamination and its health effects, particularly on children. There was a distrust of authority and experts, and a general feeling of loss of control. The concept of "intervention levels" was rejected by the population for the post emergency phase of the accident. As a consequence of these kinds of concerns there was a general depreciation of societal values.

The path toward overcoming many of these concerns was to establish learning and accounting groups with specialised interests or objectives. For example a "Young Mothers group" was established to jointly collect information and to share experiences. Members of the local population made some radiation measurements for the group. Working as a group along with an expert, the group learned of things to avoid, built trust, and generally become more comfortable with the existing situation. Through working in groups such as this, there evolved in the village a spirit of co-operation. There was an improved understanding of radiation consequences and the application of some intervention techniques to reduce dose. While these efforts did not constitute a "return to normality" they have led to improved living conditions, including dose reductions and an improved social atmosphere.

The Eastern Germany uranium mining residues remediation programme is being undertaken within a basic radiological reference level of 1 mSv yr^{-1}. This level is established by law and authorities in Federal States make the ultimate intervention decision. Intervention below 1 mSv yr^{-1} is considered to be not justified. There is a large number of small residues scattered over a very large area. Therefore, justification for intervention is considered to be more important than optimisation. There is, however, some serious contamination requiring intervention and it is inevitable that institutional controls will be needed in some situations. There is a wide range of public attitudes about

the radiation risks from the residues, and the trust in the authorities concerning its decisions. However, the bulk of the public either have no concerns and accept decisions of the authorities or have growing concerns, doubts and mistrust. There have been no attempts thus far to include the public in the decision process before authorities have come to definite proposals for available options within the established radiological criteria. In general, the relatively low public reaction to the chronic exposure situation may be due to the acknowledged high level of government effort to address the problem, being very open with information, explaining the situation to the public and favourable media coverage.

The last paper in Session 1 treated the influence of the media on public perceptions. It starts by explaining how the media selects sources of information, how it processes and transmits information, and how it targets its receptors, *e.g.* the public. The public, and in turn the media, is more interested in events rather than continuos developments. News-worthiness depends on the sensational, the unexpected or the emotional. The media amplifies conflicting elements, and searches for blame or hidden agendas. It covers that which is likely to arouse interest and treats it in a way to maintain interest. The paper describes in some detail the relationships and interactions of the media with its information sources and its audience. It also explains how information is obtained, manipulated and transmitted.

3. The Decision Process: Thematic Papers

This session contained five thematic papers which covered certain aspects of the decision process in depth. It was followed by a round table discussion led by Dr. J. Lochard, who had chaired the session.

"Perceived Risk and Public Confidence" by Professor L. Sjöberg provided a critical review and analysis of work on risk perception and trust. It covered traditional and new models used for analysis. A few of the key more common findings that emerge from the various analytical methodologies are:

- risk is a central concept that is of more importance than benefit for decision and action;
- it is the severity of consequences rather than risk which is the primary determinant of policy attitude such as a demand for risk mitigation;
- trust may be moderately important to risk perception, but not completely and;
- trust may be necessary for risk acceptance but probably not sufficient.

"Involving Communities in Environmental Health Studies" by Drs. H. Stockwell and J. Smith covered methods being applied to engage local communities in decisions on the conduct of health studies of the impact of offsite releases from the former activities of the nuclear weapons complex. Community involvement starts at the outset of the project. Advisory panels comprised of local citizens and scientists are formed to guide conduct of these studies. These panels review each step and make recommendations for further work. The aspects of the study in which the communities become most involved are determined by the type of project(s) being funded and the community concerns at that site and, therefore, vary somewhat from site to site. Of special concern to communities are the impacts of chronic exposure to the foetus, infants and children and the efforts for retrospective analysis of doses to these and other potential special risk groups.

"Engaging the Public in Decision Making: A Swiss Approach" by Dr. A. Herman noted that the Swiss public has traditionally been involved in the main decisions which concern them. While it may be attractive to pass laws which simplify decision making for technologies such as nuclear power where there is some distrust in the technology, circumventing the public would create more problems than it would solve. The paper offers the thesis that the public is the risk expert, which must be involved in decisions about risk management strategies. It follows that in a crisis management situation it is important to address public fears first and economics later. The paper provides examples where approaches have been just the opposite, *i.e.* consideration of economy first and the public thereafter. The paper uses the case of BSE (mad cow disease) to demonstrate how the economy first approach can, in retrospect, lead to more costly and less satisfactory solutions.

"The Role of the Expert" by Dr. P. Smeesters first discusses the problem of defining an "expert". There are various definitions of an expert but all share some common points including recognised competence of a specialised nature, an assumed objectivity and neutrality. Within these attributes, which are met to varying degrees, there is broad latitude to characterise persons as "experts". The result is to find experts in a common discipline having divergent opinions and providing inconsistent advice. Recognising the problem of defining who and what an expert is, it is suggested that an expert advisor in a scientific field, such as radiation protection, should clearly specify his/her mandate, limit advice to the specific field of expert competence, recognise and disclose the ethical aspects of the advise, be open to receiving information, and recognise possible diversity of interpretation of data.

"The Role of the Decision Maker – Whoever That Might Be" by Dr. O. Söderberg provides a detailed review of the effort in Sweden to site a spent nuclear fuel repository. In doing so the various responsibilities and decisions that are to be made in a chain of actions spanning from top management of the nuclear industry to local communities are illustrated. General regional studies identified a large number of sites in Sweden that might be worthy of further investigation for a repository. Two local communities invited feasibility studies. The studies were followed and reviewed by a group appointed by the local community. After completion of the studies, these communities decided through a referendum not to be a candidate site. The vote result was clear but the reasons why individuals voted no were varied. The reasons were believed to include a general anti-nuclear feeling, disruption of a wilderness region and a way of life, and some perception of alliance between local politicians and the nuclear industry.

The paper clearly illustrates that for complex problems such as siting a nuclear fuel repository, there is no single decision to be made nor are decisions made by a single group or organisation. There are many kinds of decisions to be made at various stages of development. Depending on the nature of the decision, it might be made by the local community, the industry or governmental authorities.

4. Discussion and Conclusions

There were three discussion sessions in the workshop, as well as discussion after each paper was presented. The discussion sessions were: a) a Round Table on the Decision Process; b) Lessons Learned, Conclusions and Recommendations and c) Commentary by a Panel of Radiation Protection Experts. These are summarised together because many of the issues and questions recurred in all three sessions.

Two broad conclusions emerged out of these deliberations and were supported by the various papers:

- International radiation protection recommendations for practices work well, and represent an approach to public and worker safety which has been accepted by experts, decision makers and the public. This is not the case for recommendations concerning intervention, which have unanimously been rejected by the decision makers and the public discussed in the workshop's case studies. It is noteworthy that in all the case studies presented, the responsible decision makers and affected publics agreed upon residual radiation exposures not exceeding 1 mSv above natural background. Although it was agreed that the focus should not be placed on numerical values, the tie made by decision makers and the public to "consistent" levels of what is "safe" was observed. There is thus a need to revisit the radiation protection framework in general, but particularly as it pertains to decisions concerning intervention and chronic exposure situations. The overall radiation protection framework has the appearance of not being coherent, particularly when the approach to practices is viewed against the approach to chronic and intervention situations; and

- The decision-making process must be open and transparent, and must include a wide variety of participants so that resulting decisions will be accepted. There is a clear need for early public involvement in the decision making process through some kind of organised system. This requires a better understanding of the contextual roles of all participants in the process, including those of the affected members of the public, expert advisors and governmental authorities.

Within the context of these two broad conclusions there were many statements made and questions raised which merit further deliberation:

- Is resolving chronic exposure situations complex because loss of trust in authorities; because people facing a new situation do not want to embark on solutions without extensive thought; because a suitable radiation protection framework is lacking; or a combination of these? Which of these dominates in any particular situation is important to determine.

- Should a revised radiation protection framework provide numerical guidance as a starting point for arriving at a solution which is satisfactory to the affected population? If so, how can flexibility be built into numerical guidance? Should total dose, *i.e.* including pre-existing background radiation dose, form the basis for numerical guidance?

- There is a largely held perception that dose limits define a boundary between safe and unsafe. If numerical guidance is provided for intervention while allowing flexibility in its application, how can this be rationalised in terms of public dose limits for practices?

- Identifying a decision-making process which can lead to a solution acceptable to all participants is very important, but there are a number of practical difficulties. How is the "public" identified? Who are expert advisors and how should the public go about selecting experts that are not part of the "establishment" and are neutral? What is the main role of governmental authorities in the process?

Through discussions, it was generally agreed that the decision-making process should take place within a framework, but the framework should not dictate the decision. Further, it was

recommended that the use of certain terms should be avoided when discussing intervention and chronic exposure situations and decision making. Radiophobia is one such term, whose use was seen as divisive, and as undermining legitimate concerns about exposure. The term "democratic participation" used in context of decision making should be avoided since it means many things to many people, and differs from country to country.

5. Proposals for Consideration by the CRPPH

Management of intervention and chronic exposures are complex issues which require close ties between public policy and the scientific aspects of radiation protection. Such issues are becoming increasingly important as many NEA Member Countries engage in environmental restoration of old nuclear sites and pursue siting of waste disposal facilities. Present international recommendations for intervention in chronic exposure situations have not been accepted by decision makers or the public. Also, the identification of participants and their roles in a decision-making process are not well understood.

The CRPPH is well suited to make a significant contribution in this area of radiation protection. It is the only standing international committee of radiation experts appointed by their governments, and whose members are closely tied to public policies and processes. Therefore, the CRPPH is in a good position to merge the scientific components with the societal components in an appropriate framework for radiation protection in intervention and chronic exposure situations.

Accordingly, it is proposed that the CRPPH establish a study group to examine the issues and propose, for consideration of the CRPPH,

- ways to improve the radiological protection framework governing intervention and chronic exposure situations, and how the application of radiation protection principles in these situations relates to their application in practices;

- definitions of the essential steps in a decision-making process, including the identification of who should participate, how such participants could be chosen and a delineation of the various roles of the participants;

- how such a decision-making process would operate within the radiation protection framework which it proposes, and;

- identification of "good practice" in decision making based on experience from case studies.

ANNEX 1

LIST OF PARTICIPANTS

BELGIUM

Dr. Patrick SMEESTERS **(SPEAKER)**
Ministère des Affaires sociales,
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ANNEX 2

MEETING SCHEDULE

Day One
13 January 1998

Session 1

CASE STUDIES AND THE INFLUENCE OF THE MEDIA

09:00 Registration and Coffee

10:00 Keynote Address: *Decision Making in Abnormal Radiological Situations*
by Dr. Serge Prêtre

11:00 Introductory Remarks *by* Dr. Abel Gonzalez

11:30 Coffee Break

12:00 Paper 1 *The Decision-Making Process in Returning Relocated Populations to the Marshall Islands*
by Mr. Tom Bell

12:45 Discussion

13:00 Lunch

14:30 Paper 2 *The Decision-Making Process in Dealing with Populations Living in Areas Contaminated by the Chernobyl Accident*
by Mr. Gilles F. Hériard-Dubreuil and Mr. Thierry Schneider

15:30 Discussion

15:45 Coffee Break

16:15 Papers 3 *The Decision-Making Process in Dealing with Populations Living in Areas Contaminated by the Eastern Germany Uranium Mining Residues*
by Professor Wolfdeiter Kraus

16:45 Discussion

17:00 FINISH Visit of HSK and PSI

17:15 Apéro

Day Two
14 January 1998

Session 1 (Cont'd)

09:30	Paper 4	*The Influence of the Media* *by* Dr. Ortwinn Renn
10:00	Discussion	

Session 2

THE DECISION PROCESS

10:15	Introductory Remarks	
10:30	Paper 5	*Public Confidence* *by* Professor L. Sjöberg
11:00	Discussion	
11:15	Coffee Break	
11:45	Paper 6	*Engaging the Public in Decision Making – An American Approach* *by* Dr. Heather Stockwell
12:15	Discussion	
12:30	Paper 7	*Engaging the Public in Decision Making – A Swiss Approach* *by* Dr. A. Herrmann
13:00	Discussion	
13:15	Lunch	
14:45	Paper 8	*The Role of the Expert* *by* Dr. Patrick Smeesters
15:15	Discussion	
15:30	Paper 9	*The Role of the Decision Maker: Whoever that Might be Experiences from the Swedish Siting-Process for a Spent Nuclear Fuel Repository* *by* Dr. Olof Söderberg

16:00 Discussion

16:15 Coffee break

16:45 Round Table on the Decision Process – Dr. Jacques Lochard, Discussion Leader

18:00 FINISH

Day three
15 January 1998

Session 3

COMMENTARY ON FINDINGS, LESSONS LEARNED AND CONCLUSIONS AND RECOMMENDATIONS BY A PANEL OF RADIATION PROTECTION EXPERTS

9:30 Part A *Lessons Learned, Conclusions and Recommendations*
by Dr. Abel Gonzalez

10:00 Part B *Commentary*
Panel of Radiation Protection Experts
Mr. Jose L. Butragueno, Consejo de Seguridad Nuclear, Spain
Professor Wolfdieter Kraus, BFS, Germany
Dr. Thomas O'Flaherty, Radiological Protection Institute of Ireland
Dr. Jacques Lochard, CEPN, France
Dr. Antonio Susanna ANPA, Italy
Dr. Annie Sugier, IPSN, France
Mr. Gilles Hériard-Dubreuil, Mutadis Consultants, France

11:00 Coffee break

11:30 Concluding Remarks
by Dr. Serge Prêtre

13:00 FINISH

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