Public responses to Chernobyl: lessons for risk management and communication

O Renn

This paper addresses the question of how the public in many European countries and the US perceived the danger of the radiation fallout from Chernobyl and how they reacted to the management of risk in each country. In addition, the lessons learned about communicating risk are discussed on the basis of studies of public attitudes and the effects of media coverage.

The reactor accident at Chernobyl in the Soviet Ukraine on 26 April 1986 led to the greatest release of radioactivity ever recorded in a single technological disaster. The event involved a 'worst case' accident scenario in which a large reactor with a mature fuel inventory breached containment and released several percent of its radionuclide inventory.

Favourable weather, relatively remote siting, effective evacuation of 130 000 people, and the dispersion of early releases to high altitude all contributed to containing the number of immediate casualties, 31 at the last report.[1] Air concentrations and ground deposits as far as 1000–2000 km away, however, frequently exceeded protective action guidelines applicable to the ingestive pathway. Fig. 1 shows exposure rates from the Chernobyl fallout expressed as a multiple of the normal background, plotted as a function of distance from Chernobyl.[2] The large exposure difference between rain and dry deposition emphasizes the potential for localized 'hot spots', and makes it clear that the risk management response had to be strongly tailored to local conditions.

Early collective dose estimates show that, although Chernobyl may impose an incremental cancer risk of less than 0.01% in most locations,[3] there were substantial variations in local exposure which made it necessary for managing institutions to provide different guidelines and to impose different protective actions in different regions. In some countries,

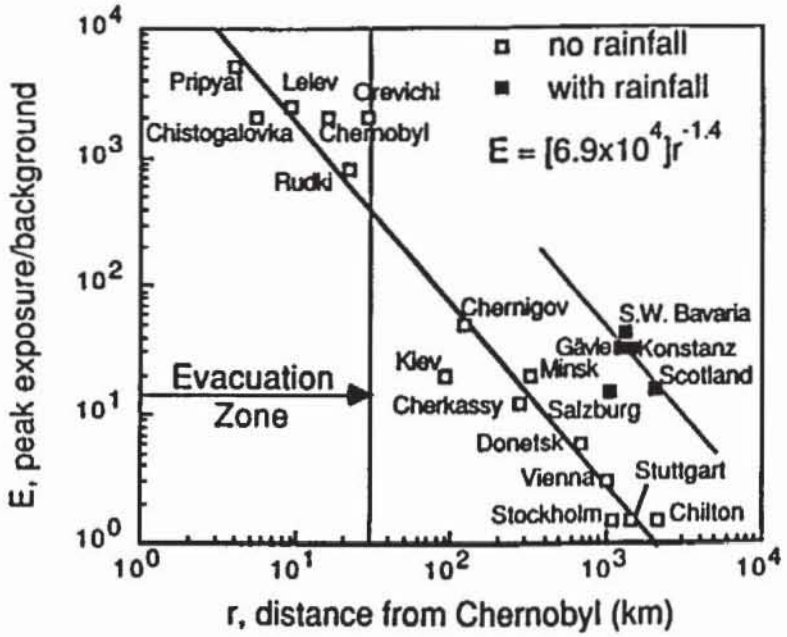

Fig. 1. Radiation exposure seven days after the accident as a function of distance from Chernobyl

emergency managers were able to communicate quite adequately the seriousness of the risk to the public, and to explain why the protective actions undertaken or suggested differed from one region to the other. In other countries, panic reactions, as in Greece, or distrust of public announcements, as in parts of the Federal Republic of Germany (FRG), were the predominant public reactions.

European risk management institutions were largely unprepared for an accident of the magnitude and transnational character of Chernobyl. It was therefore necessary to improvise appropriate responses to the fallout. A preliminary survey of the actions taken indicates that a wide range of responses was adopted, from officially planned food chain protection in the Netherlands[4] to spontaneously generated risk management efforts in South Germany.[5] Although overt panic reactions were not reported in the neighbourhood of the reactor, many countries saw responses which went far beyond the recommendations of the institutions in charge of emergency actions. In Germany and Switzerland, for example, many people removed the upper layer of soil from their garden in order to prevent radioactive material being absorbed by plants and vegetables.[6] In other instances, people disregarded warnings not to consume home-grown vegetables or collect mushrooms. Thus, in the aftermath of Chernobyl emergency management responses by public officials were met by spontaneous reactions from an often poorly informed public.

Public attitudes after Chernobyl

Opinion polls to investigate the public attitude towards nuclear energy were conducted after the accident in almost every country. Not surprisingly,

support for nuclear power declined in most countries and, in spite of some recovery in recent months, has not yet reached the level of approval of the pre-Chernobyl period. In 1982, 52% of respondents in the Federal Republic of Germany were in favour of the domestic nuclear programme and 46% opposed, while shortly after Chernobyl the corresponding figures were 29% and 69%.[7] Subsequently, support for nuclear energy increased by nearly 10%, but one year after the accident, it had not come close to the percentage reported in earlier years.[8] In the United Kingdom, a survey conducted in March 1986 showed 34% in favour of increasing nuclear power generation and 53% either for not developing further stations or for closing those already operating. In May 1986 these figures were reported as 18% and 75% respectively.[7] Even in the USA, which was scarcely affected by the fallout, public opposition to nuclear power gained another 5% to reach a peak of 49%, the highest ever reported. After the accident at TMI, public support was higher than in the aftermath of Chernobyl.[9] An even more dramatic change was that the opposition to a nuclear plant in the respondent's neighbourhood increased from 45% in 1976 to 60% in 1979 and 70% in May 1986. Recent polls confirm that the level of opposition has not yet decreased significantly.

Although it was not publicly revealed by opinion polls, observers of East European countries detected a growing opposition to nuclear power in Poland, Hungary, and particularly Yugoslavia.[10] In addition to concern about health effects, members of the public expressed anger and unease about the information and management policies in their respective countries.

In spite of the relative stability of anti-nuclear sentiments, even one year after the accident it is not yet clear whether attitudes to nuclear will remain negative or may change again. The accident at TMI proved to have only a limited effect on public opinion in those countries that were not directly affected and which had a low percentage of 'don't knows' or uncommitted opinions.[11] While US public attitudes after TMI became more critical and stayed that way, in Germany, France, the UK and most Scandinavian countries there was only a short period of increased opposition. Within a year, public confidence in nuclear energy reached pre-TMI levels or was actually even higher, for example in Germany, due to the Iran crisis in 1979. In contrast, the population of countries such as Spain and Italy, which had a high number of 'don't knows' or uncommitted opinions at that time, became more sceptical about nuclear power and consolidated this sceptical orientation over the following years. A theoretical explanation for this behaviour may be the 'inoculation effect' of forming an attitude and becoming committed to it. This effect makes individuals with a positive attitude feel almost immunized against negative incidents, while an uncommitted person may use the incident as an incentive to take sides in the debate.

The studies undertaken so far on the effects of the Chernobyl accident imply a similar pattern. Those countries less affected by the fallout and with highly structured attitudes prior to the accident, such as France, Spain and Ireland, exhibited much less public concern and opposition than Germany, Austria, Switzerland and Italy, which were much more affected by the fallout from the accident. In addition, Greece, although less affected by the fallout, had a strong proportion of uncommitted or 'don't know' positions in the nuclear debate and reacted with a dramatic change of attitude.[7] If this pattern prevails, it suggests that revealed attitude changes will only last in those countries which either were affected by the accidents or had a low inoculation effect. This would mean that public attitudes in the UK, France, Spain, Ireland and the USA will not be strongly affected by the Chernobyl accident in the longer run, whereas changes of attitude in the Central European, the East European and some Southern European countries will remain stable at the current level. The most dramatic changes are to be expected in countries in which both conditions were met, in particular Poland, Hungary, and Yugoslavia; unfortunately there are not sufficient data available to test this claim.

Public reaction is, of course, not just a function of impact and inoculation. As many studies have demonstrated, confidence in nuclear power is highly related to confidence in the institutions that manage and control nuclear energy.[12] In which ways did emergency management in Western Europe affect public attitudes and individual responses to the threat of radiation? Did the public follow the official recommendations or did they under or over react? How did the public perceive the efficacy of emergency management in different countries?

Public responses to Chernobyl

Most European countries introduced counter-measures to compensate for or control radioactive fallout, and issued special suggestions to their citizens about modifying diet or outdoor activities. The following list contains the most common measures or recommendations:

- keep children indoors during rainfall (Austria, FRG),
- avoid drinking rainwater (Austria, UK and others),
- wash fresh fruit or vegetables (Austria, Denmark, FRG, Greece, Sweden, Italy and others),
- restrict or ban the import of food from Eastern Europe (Austria, Denmark, FRG, France, Greece, Italy, Sweden, UK and others),
- restrict or forbid grazing of milking cows (Austria, Denmark, FRG, and others),
- monitor vegetables, fruit and milk (Austria, Denmark, FRG, France, Greece, Italy, Sweden, UK and others),
- restrict the sale of fresh farm produce (Austria, FRG, France (spinach), Greece, Italy, Sweden and others),

— delay the hunting season (Austria),
— monitor and restrict fishing (Denmark),
— close swimming pools, playgrounds and other public places (FRG),
— remove the thyroid glands of cattle (Greece).

The seriousness of the counter-measures was only partly related to the concentration of radioactive fallout or contamination. Due to local variations, average values for larger areas were often misleading when it came to designing and justifying counter-measures. As was reported in southern Germany, many people in non-contaminated areas were extremely worried and followed government advice to avoid contact with soil and rain, while people in particularly contaminated areas were not adequately warned and protected.[5] In addition, each country, and sometimes even local regions within countries, used different threshold values for protective actions. In particular, the intervention point for banning milk varied between most countries and led to confusion. Milk sold in Switzerland or France would have been banned in Germany, and milk sold in Bavaria would have been taken off the market in the state of Hessen.

Public officials had difficulties in explaining why counter-measures varied between countries and regions and on what rationale the protective actions were designed. The confusion was heightened by the inconsistent use of units of measurement, the politicization of the issue by specific interest groups (for example, environmentalists and industry), the stigma effect of radiation,[13] the difficulty of conveying probabilistic health effect models to the public, and overlapping responsibilities.[7] Thus an unequivocal and clear set of recommendations and actions was usually not issued. Frequently citizens were convinced that the government was withholding information and did not tell the truth (63% of the French population, for example). In Germany well-educated citizens complained that the Government did not give enough information or adequate information, while less educated citizens felt overwhelmed by the flood of information and opted for more consistent and understandable messages.[14]

Given all the confusion it is not surprising that many people overreacted and others did not follow even the simplest recommendations. Otway *et al.*[7] report the following spontaneous reactions that often led to a higher risk to the individual than the radiation risk averted:

— a sudden increase in the number of abortions (reported in Austria and Italy),
— panic buying of tinned, frozen and other long-life foods, reported in most countries, but reaching near-riot proportions in Greece,
— buying of radiation measuring equipment for personal use (reported in Germany and the United Kingdom),
— increased intake of potassium iodide (sometimes in large overdoses), reported in Poland, West Germany and Denmark,

— an increase in suicides, partly attributed to inability to cope with threat, partly attributed to the financial ruin of small farms (reported in Italy and Greece).

German newspapers reported other types of response, such as removal of the top soil in private gardens, staying indoors for almost two weeks, and burning clothes worn while there was fallout. Although such overreactions received substantial press coverage, they were not at all typical of the majority of the population.

An in-depth study[14] revealed that only 15% of a national sample of the German population was convinced that the fallout would result in a negative health effect on themselves, 46% denied that possibility, and 39% were not sure. Just 17% of all those questioned believed in any negative health effect on their diet at all. The diet of young children was altered by 54%. It should be remembered that the German Government, along with most interest groups, had recommended changes in diet in almost all areas of Germany. Preliminary investigations of the correlation between the frequency of diet changes and fallout dispersion indicated that those who needed protection most took no more protective action than those who did not. The reluctance to take protective action contrasted sharply with changes in attitudes. More than 70%, including a large fraction of those respondents who did not perceive any personal threat to their health, favoured policy options which would ban or at least freeze nuclear energy.

How do these results fit together? Although in-depth interview data are only available for Germany, an overall pattern does emerge in Europe. A small minority of the population was extremely worried by the fallout from Chernobyl and responded with extreme protective actions highly publicized in the media. The majority reacted with much more apathy and did not perceive an immediate need to protect themselves. The high percentage of 'don't know' and 'not sure' responses indicates a high degree of confusion and disorientedness usually resulting in passivity. If advice is controversial and not unequivocal, then either very cautious actions or apathy are likely responses. The anger and frustration resulting from confusion and uncertainty (and even bad consciences) about the adequacy of personal reactions were partly channelled towards the object that appeared to have caused all the upset. That is why attitudes towards nuclear power were much more affected by the accident than was personal behaviour. The reaction of using domestic nuclear power as a surrogate for the grief and confusion caused by flawed risk communication was facilitated by the impression that a reactor accident similar to the one in Chernobyl could also occur in one's native country. About 70% of Americans are convinced that a similar accident could happen in the USA.[15] Of 100 German respondents 25 believed that the accident risk from a Soviet reactor such as the one in Chernobyl was equal to the risk

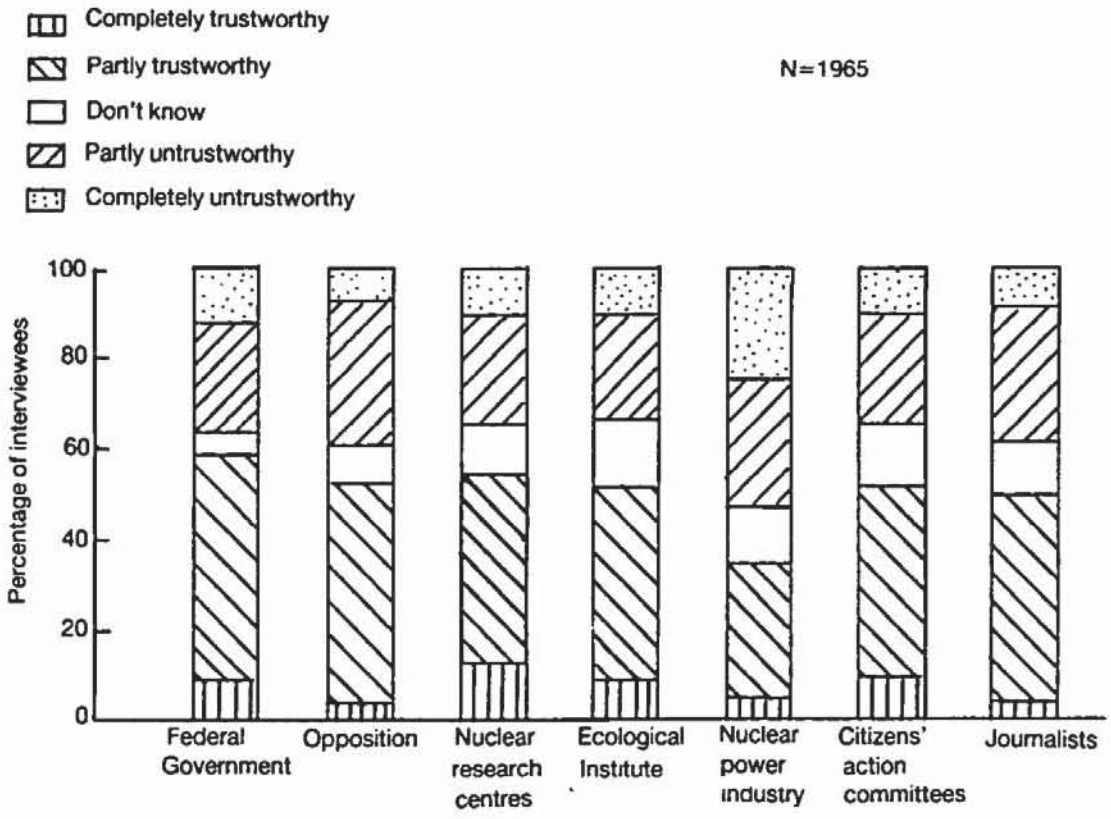

Fig. 2. Credibility of institutions and interest groups in the Federal Republic of Germany with respect to their information about Chernobyl

from the average German reactor. Another three perceived the risk as only slightly lower than in the USSR.[14]

Trust in emergency institutions and information

Another possible factor that may explain the low compliance rate with official recommendations is the loss of trust and belief in government institutions. For Germany and the USA, survey results have yielded a clear correlation between attitudes towards nuclear power and confidence in public institutions.[11] The study by Peters *et al.*[14] revealed an astonishing result for Germany. In spite of the confusion and contradictions created by the official emergency managers, around 60% of all respondents indicated that they found the Federal Government and other official institutions, such as the nuclear research centres, totally, or at least partially, trustworthy. This result may be typical only of Germany, since public opinion polls in Italy and France reported 70% or more of respondents feeling distrust towards and lack of confidence in the government. Trust in government was not high in these two countries before Chernobyl, and their rather restrictive handling of information may have aggravated this feeling. Although survey data are not yet available, the impressions gained in Sweden and the Netherlands support the notion that there was sufficient confidence in the emergency handling institutions.

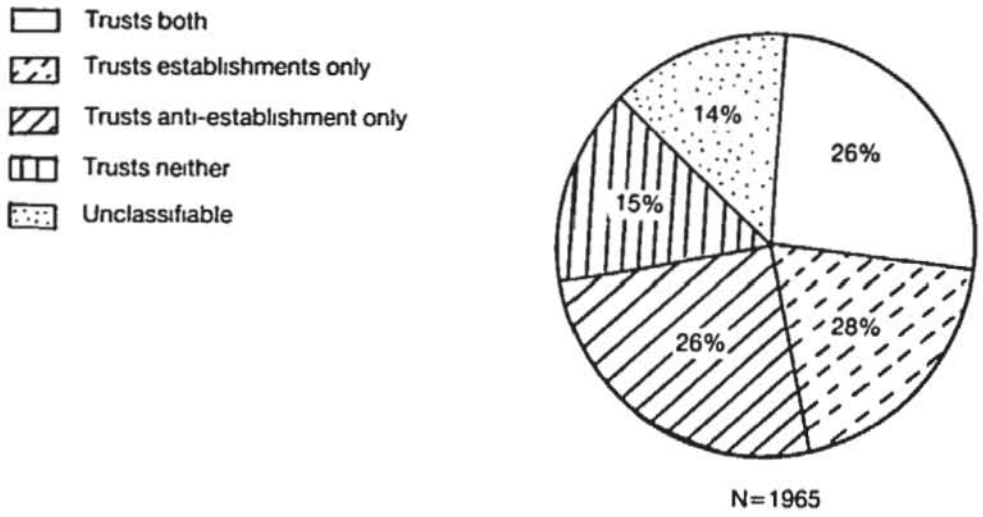

Fig. 3. Classification of respondent categories in the Federal Republic of Germany with respect to the trustworthiness of established and non-established information sources

Figure 2 illustrates the distribution of belief in the trustworthiness of different institutions and groups in Germany. The perception of credibility seems to exhibit an analogous paradox to the contrast between attitude change and behavioural stability. The (pro-nuclear) government and the nuclear research centres were trusted to nearly the same degree as their direct adversaries, the (anti-nuclear) citizens' initiatives and the ecological research institutes. Furthermore, those who trust the pro-nuclear information sources do not necessarily mistrust the anti-nuclear sources. As Fig. 3 indicates, almost a third of all respondents trust both camps equally, a quarter trust only anti-nuclear sources, a fifth trust only pro-nuclear sources, and 15% trust none of them. A large percentage of the population appears to believe that the often contradictory elements of information given by both camps contain a certain amount of truth, and that both sides do not lie deliberately but focus on those aspects that support their general viewpoint. Clearly, confidence in two antagonistic camps added to the confusion experienced in the aftermath of Chernobyl, and caused frustrations from listening to seemingly contradictory sets of recommendations from respected institutions.

The symmetrical distribution of beliefs in the trustworthiness of established and alternative scientific institutions is an indication of the perceived partiality of scientific institutions and the acceptance of a pluralistic model of scientific truth. The traditional role of science – playing an integrative role in conflicts by providing unbiased evidence has been exchanged for a model of advocacy in which evidence is provided for a specific case. This fundamental change in the perception of scientific institutions has made it difficult to use evidence as a yardstick to evaluate the 'true' dimension of the threat and to determine and communicate the adequacy of the selected counter-measures.

Most governments in Europe have been criticized by environmentalists or ecological science institutes for downplaying the threat of adverse health effects and for hiding relevant information. The only exception seems to be Denmark, where the domestic nuclear energy programme was abolished several years ago. Ironically, Denmark was one of the countries with the least stringent counter-measures. Obviously, nuclear opponents in countries with an ongoing nuclear programme used the opportunity to dramatize the effects of Chernobyl, while the nuclear industry and governments tried to convey the most optimistic outlook in order to avoid jeopardizing domestic nuclear programmes. The politicization of the determination of potential health effects and counter-measures not only added to the confusion of the public, but destroyed the potential role of scientific institutions: that of providing unbiased evidence for orientation and effective hazard management. It is doubtful, however, whether the politicization of scientific institutes can ever be reversed.

The media certainly played a major role in amplifying the dissent among scientific institutions and in taking part in speculation about potential health effects. The coverage of overreaction and the emphasis on inconsistencies between official recommendations were additional causes of public discomfort and scepticism. But all these phenomena were real and not invented by the media. Overlapping responsibilities, contradictory advice, inability to explain the meaning of specific counter-measures, and total chaos in the units and intervention levels characterized the European scene. Media coverage was merely a reflection of what actually happened in most countries.

A media analysis[7] revealed that there had been reasonably fair coverage of the event considering the time constraints under which journalists have to operate. Deicher and his German colleagues at the University of Konstanz[2] report a close co-operation between scientists and the local press in explaining the hazard and communicating counter-measures. Peters *et al.*[14] indicated that 43% of all respondents felt that the electronic media covered the incident and its consequences in a well-balanced and unbiased way: 14% regarded the coverage as too negative and 12% as too positive. Those who detected biases in the media were more than likely to be extreme proponents or opponents of nuclear energy, who usually reject anything as biased which does not support their point of view. Once again, the high number of 'don't know' responses is interesting, further proof of the uncertainty created by official risk communicators.

Lessons for risk management and communication

The truth about the risk management and communication efforts in most European countries is probably that they were disastrous. Not only were recommendations widely neglected, and so the chance of risk reduction was lost, but the public also reacted with anger and inappropriately. This in

part led to overt overreactions, but the predominant attitudes were passivity and apathy towards the recommended behavioural changes. In reviewing the Swedish situation, Reisch[16] notes:

> 'The various organizations not only reported different quantities (activity, dose rate, etc), but also used different units (rem, rad, gray, sievert, becquerel etc) and thus created an appearance of inconsistencies in numerical values and creating confusion.'

Otway *et al.*[7] as well as Peters *et al.*[14] list numerous examples of frustrations and misconceptions resulting from inconsistent advice and competing information content by adversarial interest groups. The misuse of Chernobyl to protect or attack domestic nuclear programmes left many citizens with the feeling that cynical leaders in government and stakeholder groups jeopardized public health and confidence for selfish political reasons. Although public confidence in official agencies and institutions continued to be high, counteracting sources of information were assigned similar credibility. Industry lost much of its credibility, according to the polls, and regulating agencies may soon follow.

Ways of creating a more effective and trust-building management style are not easily to hand. Anything nuclear or nuclear-related is associated with rising fear and anxiety and makes it difficult to introduce the concept of putting the risk in perspective. The perceived politicization of scientific institutions limits the scope for official bodies to provide evidence to support the interpretation of the hazardous situation and the choice of protective actions. In a pluralistic society, divergent views will always be voiced, and official recommendations will inevitably compete with advice from other sources. Furthermore, harmonization of standards and countermeasures cannot be determined in crisis situations, but has to be worked out in advance.

The Chernobyl accident, and its handling in Europe, is a perfect case study of the kind of mistakes and problems in nuclear emergency situations that should be avoided in the future. In fact, the lessons drawn from this case can also be applied to other supranational disasters such as chemical spills. Reviewing the first analyses of the communication and management efforts of European governments, and comparing these results with some guidelines developed in the context of risk communication,[17,18] suggests the following possible improvements in future emergency responses.

— The unexpectedly high variation in local exposure to radiation requires monitoring capability at the community or district level. In order to keep costs low, regional universities or schools of higher education should be equipped with measuring devices and exact guidelines on how to use them. If there is a nuclear emergency, the designated teacher or professor, assisted by students, would be expected to measure radiation levels in the local area. Soil, water, rainfall and food should be investigated. All measurements would

have to be reported to the appropriate emergency management institution according to a prearranged plan.

— Within each country or, even better, within the European Community or other international bodies (perhaps the IAEA), standards for radiation levels that require protective actions should be determined and promulgated. These universal standards should serve three functions: to facilitate the responses of regional management institutions by providing clear and unequivocal instructions; to ensure that no group of citizens will be exposed to greater risk than others; and to convey an easily understandable and comprehensible safety and protection rationale to affected citizens. The threshold for initiating actions should be low enough to convince the public that a sufficient degree of protection will indeed be achieved.

— The type of protective action should correspond to the activity level specified for intervention and be tailored to the exact nature of the local environment. Although a single set of protective actions for each intervention point would be most desirable from the point of view of risk communication, local circumstances and the specific characteristics of the affected region are likely to require differentiated sets of protective actions. Furthermore, the costs of protective actions may vary from one region to another so that a universal response set would lead to sub-optimal solutions. Therefore, responses have to be more flexible, but should be predetermined for each local area. The objective of the flexible response strategy is to accomplish an identical level of public protection using different means.

— In addition to public actions, all citizens should be given the opportunity to increase voluntarily their desired level of safety. This requirement implies first that all measures are publicized in the local media and second that recommendations about additional means of self-protection are communicated and explained. In this way, individual preferences can be taken into account and the probable wish of the more educated classes to undertake additional protective actions can be met. Leaving actions entirely to individuals would probably lead to an unacceptable violation of equity, because less educated people find it difficult to make voluntary provisions and so would be likely to face a much higher risk. Combining an adequate collective safety standard with the opportunity to further reduce risk at an individual level appears to represent the best trade-off between equity and freedom of protective action.

— Confidence in the above measures depends very much on the capability of the emergency manager to put the risk and the effectiveness of counter-measures in perspective in relation to other risk situations. Risk comparisons are not well received by most

members of the public, because they have been extensively used to justify nuclear power and other low probability/high consequence risks. Abstract risk figures, however, have hardly any meaning for most of the public. Furthermore, the way in which risk figures are presented (for example, in percentages of additional cancers or in absolute numbers of additional cancers) makes a strong difference to their public perception.[19] Hence, it seems advisable to use the abstract figures in combination with one or two other related risks. The most acceptable approach is to use a reference risk that is also technological in nature and involuntary, such as the risk from food additives or air pollutants. Publishing those risk figures prior to any emergency would be helpful in preparing the public to deal with probabilities and in soliciting responses by interest groups.

— For the purpose of gaining public confidence, institutional separation of emergency response activities and nuclear energy licensing or even promotion is essential. Public concern in Italy peaked when it became known that ENEA (Ente Nationale Energia Nucleare e Alternative) was responsible for both the licensing of nuclear power plants and the control of public safety.[7] Public recommendations were followed more often in those countries where the government was not perceived as an interested party in the nuclear debate. Consequently, a management agency, independent of nuclear commitments or government, would best serve this kind of function. Such an institution must, of course, fit into the political system of the particular country.

— Apart from any nuclear emergency, the handling of modern technological hazards requires a better understanding of the meaning of probabilities and the risk management process. In the long run, educational programmes for schools and professional training should be introduced so that probabilistic thinking is slowly incorporated into the generally accepted notion of commonsense. Deterministic heuristics, which still predominate in commonsense reasoning, prevent many people from evaluating risks consistently and responding to emergencies in a rational manner.

Even if all these suggestions are implemented, overreaction on the one hand and apathy on the other will still be likely responses to nuclear crises. But a more consistent approach to risk communication and a better preparation for nuclear emergencies could certainly increase the proportion of adequate responses and enhance public protection. Some countries, such as Germany, have already started to reform their emergency response system. Although the intended unification of intervention thresholds is going in the right direction, the drive to centralize the response system may result in inflexibility and inability to cope with high local variations in exposure. A viable compromise between centralized guidelines and

flexible reactions based on local conditions is probably the best solution.

Conclusions

The Chernobyl accident not only left its mark in the form of radioactive fallout in most European countries, but also had a lasting impact on public opinion and attitudes. Attitude theory suggests that in countries with less visible impacts and a low percentage of uncommitted or 'don't know' opinions, attitude changes will be merely temporary. However, even in these countries where changes in public attitudes are minor, the political repercussions of growing concern may well affect domestic nuclear programmes. In many instances, Chernobyl forced governments to respond immediately to public pressure and to reconsider or alter their existing nuclear policies. Soon after the accident, the Dutch Parliament approved a motion to suspend a decision on the location of two nuclear reactors until a thorough analysis and evaluation of the Chernobyl accident had been completed. In Yugoslavia, the Croatian Parliament voted to reappraise the Prevlaka nuclear power plant. Sweden reaffirmed its national policy of terminating nuclear energy in the future and Austria confirmed its decision not to use nuclear energy. The Federal Republic of Germany reacted with the setting up of a Federal Ministry for Environment and Reactor Safety.

The most striking political reaction in most countries was not to abolish nuclear power, but to reconsider and possibly delay the further construction of nuclear facilities. Only small fractions of the population favoured continuation of domestic nuclear programmes, but they seemed to accept a compromise of keeping the status quo until a thorough analysis of the domestic programme was completed. The public expected changes in domestic policies, in particular in redesigning emergency response systems. Although government institutions were still respected and perceived as at least partially credible, competing information from anti-nuclear groups was equally well-perceived and trusted. The official stance on nuclear energy is without doubt defensive and under severe scrutiny, but the case is certainly not lost.

It is essential that emergency managers learn lessons from Chernobyl because the public is highly sensitized and will demand drastic moves if there is another flawed emergency response. The survey results demonstrate the close link between crisis management and attitudes towards nuclear energy. If there is another nuclear accident, and if official emergency handling institutions do not succeed in communicating consistent and efficient protective actions, then it will not be the emergency systems that will attract public anger and criticism, but domestic nuclear power programmes. The major, politically relevant conclusion from reviewing public reaction is that performance in an emergency will determine the fate of domestic nuclear energy even if the emergency is

absolutely unrelated to domestic facilities. In the interest of optimal public protection, and in the interest of supporting domestic nuclear programmes, it will be essential for all European governments to reform their emergency response systems and learn from the mistakes and pitfalls of the Chernobyl accident. The public will certainly not give them a second chance.

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