Executive summary

Issues addressed in the advisory report

Hazardous substances that are released into the air during a disaster can threaten the health of people in the surrounding area. Gases or vapours of this kind can escape if an accident happens while hazardous goods are being transported, as a result of a fire in a large building, or by the failure of a storage facility.

Emergency services workers and their managers then need to assess as quickly as possible the risks caused to people around the source. After this, a decision as to the best course of action must be taken. This is always done in a situation where many things are unclear. In this advisory report, a Health Council Committee has looked at preparations made before, and decisions made after, disasters involving hazardous substances. There are two key issues here:

The utility of the intervention values

In the Netherlands we use a system of 'intervention values' to assess the risks that arise when substances are released into the air. These are values for concentrations of hazardous airborne substances that can cause various kinds of health effects. The lowest (notification guideline) value is the level at which people will be inconvenienced for a temporary period (for example, by something such as an unpleasant smell). They may also experience headaches or nausea. If the middle (warning threshold) value is exceeded, then the hazardous substance concentra-

tion is so high that serious and irreversible health damage may develop. At the highest (life-threatening) value, airborne concentrations are so high that people might die.

These three intervention values have been set for many hazardous substances. The effects that might result from specific airborne concentrations are stated for each substance. The concentration values used in the Netherlands are based on values established in other countries or on a self-devised, concise derivation method.

The first key issue to be addressed in this advisory report is the adequacy of the methodology used to derive the current Dutch intervention values. Does it produce values that are able to properly indicate when inconvenience is to be expected, when serious damage will occur, and when the concentration is high enough to prove fatal to people?

The decision-making process during a disaster

Once a hazardous substance has been released, calculations are quickly performed and possible measurements taken to determine the concentration in the area around the source. If the estimate indicates that an intervention value has been exceeded, then the authorities can take steps to protect public health as far as possible.

If the incident will only cause inconvenience, then the informing of local residents will often be sufficient. Options are often limited in a life-threatening situation. For example, it would not be realistic to attempt to evacuate people out of the way of a dangerous gas cloud. Things are different with a mid-range value. If the airborne concentration might cause severe health damage (or has the potential to do so in the case of a travelling toxic cloud), then the question that needs to be immediately addressed is whether people would be better protected by taking refuge in their homes or other buildings, or whether an evacuation is necessary. This is a difficult choice for managers.

The second issue addressed in this report is whether the current decision-making system, in which intervention values are the starting point of a complex process, is adequate to allow effective action to be taken.

The current intervention values are a useful starting point

The intervention values used in the Netherlands to take decisions on measures during a disaster involving gases or vapours are partly based on United States figures. The methods used to establish them are robust. However, reliable data is

unavailable for a large number of substances, which means that there is no certainty as to the effects that might follow a certain level of exposure. Nonetheless, they are useful as a starting point in deciding on action to take in response to a disaster.

The values derived in the Netherlands have less extensive support than the American values. Nevertheless, they are a useful tool until concentrations deduced on the basis of international systems become available. Newly derived international values may gradually replace the temporary Dutch values.

The Committee further recommends that potentially carcinogenic substances not be subjected to intervention values unless there are clear indications that brief exposure can in fact cause cancer, since the Committee holds that there is practically negligible risk of cancer developing at the warning threshold value.

The Committee makes the same recommendation for effects on offspring: these should be ignored when determining the warning threshold value unless there are clear indications that brief exposure can in fact have consequences for offspring.

However, more is needed to ensure an appropriate response to disasters

A public information drive is often sufficient when the notification guideline value is exceeded. In practice, the point at which measures need to be taken is if the warning threshold value is exceeded, which is the sign that severe health damage might occur in people who are in the area of a harmful gas leak. Measures might include sealing off or clearing a limited area, asking people in a wider area to stay indoors, or carrying out a full-scale evacuation. What factors need to be taken into account in this decision-making process?

Protocols need to prepare those involved to better deal with real situations

Intervention values can certainly be a useful guideline, but making decisions is far from simple in practice. Incidents are always unforeseen and always follow a slightly different course, so good decision-making in such an uncertain situation is a complex matter.

First, the extent of exposure is not known. The estimate of the distribution of hazardous substances from the source is based on models, and then used to determine whether the amount of hazardous substances that have been released in a particular area following a disaster means that an intervention value has been

exceeded. However, the models used in practice only give a very rough initial estimate, and managers must therefore realise that concentrations, and the path followed by the cloud of hazardous substances, may not be the same as predicted in the model. Measurements made in the area are of limited help as they only reflect the level of exposure at the specific place and time that the sample was taken, while the situation in a different location or a little later can be very different. On the other hand, it would be impractical to make large numbers of measurements throughout a wide area. This problem can be partly addressed by also taking other information into account, such as the incoming reports about health problems affecting people at varying distances from the source. Even here, the composition of the population (such as the presence of sensitive groups in the area) plays a complicating role.

Second, there are problems with decision-making during disasters. Disaster response is a highly complex undertaking, in which a large number of practical, organisational and logistics issues (available of people and equipment, provision of information, and time) have to be taken into account. This takes a lot of time, and that is precisely what is in short supply. Current practice takes too little account of the fact that delays can mean that some options, such as evacuation, are no longer possible past a certain point. Too little use is also made of what we know about how groups make decisions under conditions like these.

A third point is uncertainty over how people might behave during a disaster. People often respond to crises in unexpected ways. For instance, panic is a rare event. Decision-making emergency services workers and managers need to take account of the real behaviour of people in the affected zone, because only proper assessment of this will enable them to also be able to decide whether measures will be effective in preventing damage to health. It is pointless to issue instructions on health grounds only to have them ignored for psychological or social reasons.

The Committee feels that there is often too little understanding of these aspects and that practical improvements in decision making requires greater consideration of these factors. The Committee therefore recommends developing a protocol that reflects the complexity and uncertainty of the situation. In general, anything that has been considered in advance will be beneficial in the event of a disaster involving the release of an airborne hazardous substance.

However, it is a mistake to think that planning can cover every issue. By their very nature, catastrophes are events that unexpectedly develop. Decisions have to be taken quickly in the light of incomplete data. The best course of action only becomes clear with the knowledge that becomes available once the incident is

over. This means that people often conclude that the disaster was not handled as well as it could have been. Sadly, that is inevitable.

Shelter-in-place is the best option if there is a threat of serious damage to health

Partly in the light of the many uncertainties that accompany a disaster, shelter-in-place is the preferred option when people in a particular area are exposed to hazardous airborne substances that might present a serious threat to their health. The main message is: stay at home, unless otherwise advised. This advice must be publicised as soon as the medium (warning threshold) value has been exceeded.

This is because staying indoors is a very effective way of reducing exposure if the threat is of short duration. It is, though, also important for people to close their ventilation ducts, or tape any cracks or gaps in the façade of older houses. An important advantage of advising people to stay indoors is that it is then easier, from an organisational point of view, to manage an evacuation.

Staying indoors can also be the best option if airborne concentrations gradually rise to higher levels than expected or if the situation persists. It is then often too late to evacuate people, as they would have to pass through the toxic cloud to leave the area. Consideration can be given to partial evacuation from an area, but this message is not easy to put across to the population. Confusion can easily arise if the message is not clear.

The Committee is in favour of more information, training and exercises to ensure that staying indoors can be effectively implemented as a response measure. After all, the question of who is responsible for ensuring that local residents (but also people in offices, firms, schools and hospitals) take refuge is an important issue here. Responsibility for switching off ventilation must also be clearly assigned. A first step in the right direction would include training courses and practical exercises for health and safety coordinators, employees responsible for disaster response, and teachers that would help them implement the advice to take refuge.

Thus, shelter-in-place is the preferred option once the warning threshold value has been exceeded. Nonetheless, people can be advised to stay indoors and close their doors and windows even when the lowest (notification guideline) value has been exceeded. It is true that there is not a serious threat to health then, but such measures can help reduce or prevent unpleasant odours and transient health problems.

What if there are life-threatening airborne concentrations? As long as such concentrations remain only a prediction, populations can be evacuated. It must of

course be borne in mind that the evacuation itself presents risks, such as stress or accidents as people leave the area. This balance of risks is difficult, as the health damage varies according to the situation, but it is crucial to quickly make and implement a decision, since a toxic cloud can travel over ten kilometres an hour in a moderate wind.