Health and
Safety
Commission

Advisory Committee on Major Hazards

First report

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FIRST REPORT

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Preface

As the Foreword to its report explains, the Advisory Committee on Major Hazards was set up by the Health and Safety Commission towards the end of 1974, to consider the safety problems associated with large-scale industrial premises conducting potentially hazardous operations. The Committee has now presented its First Report to the Commission and the Commission has accepted the Committee's suggestion that it be published straightaway so that public discussion of the basic philosophy and recommendations can take place at the earliest possible stage.

The Commission welcomes the report as making an important contribution to current thinking about the safety of hazardous industrial operations in this country and sees considerable merit in the general approach put forward, including a fairly wide notification scheme, leading to closer scrutiny of selected installations identified as offering particularly difficult problems, and special planning controls linked to the notification scheme.

The Commission has invited bodies primarily concerned to comment on the Committee's general approach, but would at the same time welcome the views of any other body or individual. In the light of reactions received, the Commission would then want to consider what action should be taken. The Commission would then initiate the usual more formal consultative processes at that stage.

Any comments should be sent in writing to Mr H E Lewis, Health and Safety Executive, Baynards House, 1 Chepstow Place, London W2 4TF before 31 December 1976.

W J SIMPSON

Chairman, *Health* and Safety *Commission.*

The Advisory Committee on Major Hazards

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Contents

Foreword

The origin of our Committee lies in the disastrous explosion at Flixborough on 1 June 1974. At that time the Secretary of State for Employment instituted a full public inquiry to investigate the causes and circumstances of the Flixborough tragedy and at the same time suggested that while the Court of Inquiry would be concerned with the immediate lessons to be learnt, the wider problems created by developing technology should be investigated by a committee of experts which would in due course report to the Health and Safety Commission (then in process of formation as a result of the Health and Safety at Work etc Act 1974).

Towards the end of 1974 our Committee was appointed by the Health and Safety Commission, and we first met in January 1975. We were given the following terms of reference:

"To identify types of installations (excluding nuclear installations) which have the potential to present major hazards to employees or to the public or the environment, and to advise on measures of control, appropriate to the nature and degree of hazard, over the establishment, siting, layout, design, operation, maintenance and development of such installations, as well as over all development, both industrial and non-industrial, in the vicinity of such installations."

To facilitate progress, we consider it expedient not to attempt to cover at this stage the complete range of "major hazards" which might be encompassed by our terms of reference. We have therefore taken as our first priority those installations which could present a major threat to the safety of employees or the general public arising from explosion, the sudden release of a toxic substance, or cataclysmic fire. At a later stage we propose to examine the implications of the increasing use of cross country pipelines. Although we are fully aware of the possible threats arising from the transportation of potentially hazardous substances between sites, we have not yet been asked to consider this problem.

Four working groups were formed at the second meeting of the Committee to deal with:

Group **1** Identification of major hazards
(Chairman **F.** R. Farmer)

Group *2* Reliability
(Chairman Prof. **F.** R. Lees)

Group **3** Limitation of exposure and interaction
(Chairman Prof. **J.** L. M. Morrison)

Group 4 Planning controls
(Chairman **J.** M. Miller)

The results of the deliberations of these groups form the basis of this first report.
We are very conscious of the preliminary nature of some of the work done so far. There is need for further discussion in depth and, above all, for research into some of the fundamental problems. Nevertheless, we feel it is right to present this first report at this stage for the following reasons: firstly, we consider that the Commission and the public are entitled to a concise progress report on our deliberations at an early date; secondly, we think it will be useful to those concerned with these problems, both inside and outside Government, to see the direction of our thinking; and thirdly, even though our present recommendations are preliminary, there is every advantage in the process of consultation and public debate starting as soon as possible so that the results can be fed back into our discussions at this formative stage. We therefore recommend publication of this report. Meanwhile we are pursuing our enquiries in greater detail. Some of our next tasks are mentioned in the body of this report.

The problems before us are complex and our discussions will not yield straightforward solutions. Our terms of reference perhaps assume too readily the future prospect of industry operating in an atmosphere of orderly and controlled development, but we are faced with a vast range of existing installations. Most of them are already of an acceptable standard, although not always ideally located, but some are not completely satisfactory, often because of their age, and in some cases there is a need for better management. All provide employment and have an economic importance.

Drastic improvements to existing plants cannot be made overnight but phased changes and improved methods of operation need not be unduly delayed. Implementation of more fundamental recommendations will be easier to effect at new installations. However the public at large are far more conscious of and hence more concerned about what is already going on in their neighbourhood.

In the first chapter we highlight some of the challenges which present-day society has to face if it is to come to terms with the hazards associated with

large-scale industrial activities. In Chapter 2 we consider the nature of those hazards: we make no apology for this lengthy statement of the problem facing the Committee in its difficult task of identifying major hazard installations. In Chapter 3 we discuss how the installations should be brought to the notice of the Health and Safety Executive for the purposes of control. In the succeeding chapters we consider the directions that a system of control might take. In the final chapter we summarise the recommendations we are making at this stage.

In response to our general invitation we have received contributions, both oral and written, from various sources; we are grateful to those who have taken the trouble to send us information or to apprise the Committee of their views. Some of the data may in due course be published on our behalf by the Commission or other bodies. We would welcome further exchanges on the general principles of any aspects of our work.

Finally we are grateful to our Secretary, Mr H E Lewis, and his staff, for their valuable help in preparing this report.

27 *May 1976*

Summary

Chapter 1 The nature of the problem

This chapter highlights some of the challenges which present-day society has to face if it is to come to terms with the hazards associated with large-scale industrial activities, new processes and the growth of technology; there are now many plants throughout the world where a critical first mistake can result in disaster. Spectacular events, such as major explosions, evoke a public reaction of considerable intensity whereas the loss of life in industry as a whole, on the roads and in the home, generally attracts much less public attention.

Safety needs to be balanced against other factors. Industry already devotes considerable resources to the reduction of hazard, and greater safety can only be achieved by further, perhaps very heavy expenditure. Where there are well established processes providing economic benefit, local communities may have to face restrictions on the uses to which adjacent land can be put. The Health and Safety at Work etc Act 1974 provides a basis from which a system of controls can be evolved to keep pace with technological developments.

Chapter 2 Identifying major hazards and assessing risk

As a first step two broad categories of major threat have been considered. The first arises from the massive escape of volatile liquids, or gases, forming a large cloud of flammable vapour which may then explode. The second arises from the large release of toxic materials which could remain lethal for up to 20 miles from the point of release. Some installations present threats of both kinds. In practice the full potential of the hazard seldom materialises but the Committee are concerned that hazards should be minimised. The risk of failure of plant cannot be completely eliminated and the Committee will be considering some quantitative objective.

Chapter 3 Notifiable installations

This chapter suggests a scheme for the notification, survey, assessment and appraisal of various categories of installations, listed in the chapter, for the purposes of identifying major hazards. It is proposed that a company operating a 'Notifiable Installation' should be required to submit to the Health and Safety Executive a survey of the hazard potential of the plant and the procedures and methods which have been or will be adopted to deal with the hazards. In time a study by the Executive of these initial surveys would enable them to select, on behalf of the Committee, those installations which required a more elaborate assessment. This would reveal those offering the highest risks.

A new unit should be set up within the Major Hazards Branch of the Health and Safety Executive to carry out this work. Application of the normal controls might well prove entirely adequate for the general run of notifiable installations.

Chapter 4 Application of controls to major hazard installations

The dominant factor is management. It must satisfy itself and the Executive that its arrangements are adequate. No method of control should in any way dilute the prime responsibility of management. Methods of control to which a company operating a major hazard plant could be subjected would range from codes of practice and regulations to licensing, and may cover any aspect of its safety policy. Whilst no new installation should be allowed to operate below any standard which is set, existing installations should be brought up to an adequate standard with an urgency determined both by the degree to which they are substandard and by the severity of the hazard.

Chapter 5 Planning controls

The threat to safety which may arise from the siting of potentially hazardous developments cannot be divorced from other planning considerations. Informal consultations between the Health & Safety Executive and Local Authorities prior to the granting of planning permission for certain developments should be made a legal requirement. Planning controls do not however apply to some variations in industrial processes which may introduce or increase the degree of hazard at existing installations. The Committee proposes to investigate whether controls over such variations could be achieved through the planning system. The application of restrictive planning controls may involve local authorities in having to meet claims for compensation. The practical issues involved are of such difficulty of application and importance that the Committee proposes to hold further discussions with the Department of the Environment.

Chapter 6 Conclusions and recommendations

This chapter contains a summary of the Committee's conclusions and recommendations.

1 The nature of the problem

1 The Second World War stimulated a significant acceleration in the rate of technological development, the results of which were applied for industrial and commercial purposes after the war. As a result, throughout the world, there have emerged new materials, new processes, even whole new industries. The post-war world has also been strongly influenced by two other factors. The first is the very strong commercial pressure to improve technological efficiency. The second is the significant change in public opinion as to what is acceptable or unacceptable in terms of everyday working life or the environmental background, a consideration often referred to as the "quality of life".

Increases in the size of plant and pace of development

2 Although many mistakes have been made in small-scale manufacturing operations, they have usually had limited consequences. The pressures for greater efficiency have led to the growth of capital intensive new plants (for example, the capacity of some hydrocarbon processing units has increased tenfold in the last 20 years), increases in size of many traditional plants, the grouping of associated processes in one area, and the difficulty of isolating them from centres of population. This has brought about a very significant increase in the number of people, whether employees or members of the public at large, who could be endangered at any one time should anything go wrong. Moreover the pace of change associated with modern technology allows less opportunity for learning by trial and error. It is increasingly necessary to seek to get design and operating procedures right first time. Because of their present-day size and throughput there are now many plants throughout the world where a critical first mistake can result in disaster.

Society's reaction to technological development

3 Society's reaction to these developments has been equivocal. Widespread improvements in standards of living in the industrial nations have been largely derived for the new technologies which have transformed everyday life, not only in terms of economic advantages, but by replacing many traditional materials with new ones. The community as a whole is now heavily dependent upon these new technologies. Further development is seen by many as a vital factor, both in terms of economic survival and of continuing improvement in living standards: other sections of the community dispute the wisdom of continued technological expansion.

4 There have grown up strong, though not always very logical, challenges in the public mind as to the value of this kind of technological development which a single event, such as the Flixborough disaster, crystallises into a vocal demand for greater control over, and indeed in extreme cases cessation of, certain types of manufacturing processes.

5 Throughout our deliberations we have been aware that spectacular events, such as a major explosion, evoke a public reaction of considerable intensity. We think it relevant to point out that industry continues to take a toll of human life in ways which do not always attract public attention or lead to an outcry for exceptional measures of control. Even so the number of injuries and fatalities from all such causes, major catastrophes and continuing industrial accidents combined, is small compared with those caused by accidents on the roads and in the home. Nevertheless we would not wish to suggest that public concern for disaster and multiple deaths is wrongly evoked. But such concern is only one factor which must be taken into account in relation to potential disaster. It may be a valuable pointer as to what the highest acceptable level of risk should be, and leads straight into the problem, set out in the next chapter, of identifying major hazards. These considerations represent to some extent the kernel of our deliberations, since all that follows depends upon the possibility of identifying with some precision where new initiatives are needed and where traditional precautions remain satisfactory.

6 While the probability that any individual worker will be involved in a fatal accident has notably fallen, the chances that a plant failure will involve many deaths have at the same time increased, and the risk of involving the public at large in an industrial accident has become considerably greater. It seems to us that the potential involvement of larger numbers of the public and the greater potential for multiple deaths of employees which new technologies have now engendered, have changed – and rightly changed – society's attitude to manufacturing hazards.

The need to balance safety against other factors

7 Some of the questions which consideration of

major hazards poses should not be answered by committees of experts alone. For instance, political decisions will be needed if it is thought that the benefit for the community as a whole which may arise from a particular hazardous activity, should be allowed to override safety considerations. Thus it is vital that those who have to take such decisions are fully briefed about the safety considerations relevant to each case.

Furthermore, these decisions will not bear exclusively on industry: local communities may well have to face restrictions on the development or redevelopment of land for purposes such as housing and schools which may be incompatible with a well established process providing employment in the area.

8 We are therefore deliberately confining our proposals to setting out what might be described as 'basic ground rules' which would enable decisions to be taken with the object of making certain hazardous activities significantly safer. We recognise at the outset that industry already devotes considerable effort in terms of both manpower and money to the reduction of hazards, and that greater safety cannot be achieved, at least in the short-term, without involving further expenditure, perhaps very heavy, by certain branches of industry. It may well prove uneconomic in certain cases and involve unemployment.

The need for new kinds of control for a new kind of industry

9 In this introduction we have drawn attention to the fact that society must accept some level of risk if it is to reap the advantages of modem technology. Nevertheless, we are equally conscious of the fact that, while developments in manufacturing technology have raced ahead, the methods of ensuring safe operation, indeed the appropriate legal mechanisms for enforcement of safe standards, may not have kept pace. The Health and Safety at Work etc Act 1974 covers all people at work, except domestic workers in private employment. It is aimed at people and their work activities instead of premises and processes. The legislation includes both the protection of people at work and the prevention of risk to the health and safety of the general public which may arise from work activities. The Act therefore provides the means for the introduction of controls across the whole field of our enquiries. The task we face is to suggest how, on these foundations, a system of control may be built that can keep pace with technological developments.

2 Identifying major hazards and assessing risk

10 As mentioned in the foreword, the task of identifying those types of installation which may present a major threat is an extremely difficult one. We have therefore adopted a pragmatic approach. We have begun by focusing our attention on certain of the more obvious threats to safety, that is those which arise from the escape of significant quantities of flammable and/or toxic materials as a consequence of loss of plant integrity or loss of process control. Installations where such materials are present depend upon proper containment for their ultimate safety and this is the heart of the problem. A century ago the problem of boiler explosions was tackled in a forceful manner and this led to a dramatic improvement in the situation. We must take equally vigorous action now with the aim of ensuring that large quantities of dangerous chemicals do not escape.

The threat from flammable materials

11 In the case of flammable materials, the greatest threat arises from the sudden massive escape of those volatile liquids, or gases, which could produce a large cloud of flammable, possibly explosive, vapour. If the cloud were ignited, the effects of combustion would depend on many factors including wind speeds and the extent to which the cloud is diluted with air. The worst consequences could be large numbers of casualties and wholesale damage on site and beyond its boundaries. Nevertheless where combustion has taken place it has generally been on or in the immediate vicinity of the site. An important feature of this threat is the small time interval between the initial escape and the fire or explosion, which could be less than a minute. Thus there is little time for the implementation of prepared emergency arrangements, but notwithstanding this, they are essential and have proved their value in the past in limiting the escalation of a disaster, and injury to people on and off the site.

The threat from toxic materials

12 With toxic materials, the sudden release of very large quantities, if windborne, could conceivably cause even larger numbers of casualties than a flammable escape. In theory such a release could, in certain weather conditions, produce lethal concentrations in places 20 miles from the point of release but the actual number of casualties (if any) would depend on population density in the path of the cloud and the effectiveness of the emergency arrangements which might include evacuation.

Escalation of the threat

13 Some installations or groups of installations pose both types of threat. Moreover blast and missiles from an explosion can affect the integrity of other plants containing flammable and toxic materials thereby causing an escalation of the disaster – sometimes called the "domino effect". This situation may for example occur where industry is sited in groups because of the attraction of power, water, or a pool of suitable labour. This grouping can facilitate the transfer of supplies and products from one site to another. Indeed it is not uncommon to find three or more separate but contiguous installations presenting a combination of explosion and toxic hazards along, for example, a river bank or estuary or near housing developments.

Probability and consequences of loss of containment

14 It is sometimes possible to calculate, by making a series of pessimistic assumptions, that loss of containment would lead to a major disaster, but in practice the full potential of the hazard seldom materialises. The actual consequences in terms of death or injury depend on many factors (touched on in the next chapter) which will vary in their effect from site to site. For example in Illinois (USA) a massive cloud of propane escaped from a train badly damaged by derailment. The train was carrying 800 tonnes of propane which, if the circumstances had been different, could conceivably have killed up to 1000 people. In this particular incident, subsequent fires and explosions caused damage estimated at 3 million dollars; yet no one was killed or seriously injured although at least 1000 of the people at risk were taken to a disaster centre. Several accidental releases of toxic gases have also been reported from abroad. In one case the gas literally poured into a valley which was unpopulated; in another the escape occurred on the down-wind side of a town.

15 These and other examples from overseas seem to show that major incidents do not usually generate their ultimate potential in that they seldom combine all the features which together would give the worst consequences. This leads on to the question whether the relationship between the hazard potential and the most likely consequences could be quantified in

some way since this might at least provide a pointer to identifying major hazard sites.
This might be possible, but first one has to consider the probability that an incident and its particular consequences will occur, and this gives rise to the problem of deciding what level of probability should be assumed. As an illustration of this, we understand that the Dutch, in considering the appropriate height and standard of construction of their sea defences, had first to decide whether they should protect themselves against conditions which might occur once in 1000 years, or once in 10,000 years or some longer period. It appears that the probability of a wave of a certain size occurring influenced the choice of the eventual height of the dykes, and we believe that this has implications for our approach to the problems with which we are concerned.

16 Practical considerations dictate that there must be a limit to the level of probability and the extent of the consequences which can reasonably be catered for. We have concluded that there is generally little to be gained by taking into account and guarding against events which have a very remote probability – although they could happen tomorrow. For example, in the UK the probability of a severe earthquake or of an aircraft crash affecting a site (unless near an airfield) is less than once per million years per site.

Levels of technology and size

17 Advanced levels of technology and the size of plants and installations are not necessarily infallible pointers to the existence of a major hazard: for example, a continuous flow process often has marked advantages over a batch process in respect of its controllability and the quantity of material in process. Larger plants mean fewer installations in total; a concentration of specialised management; and reductions in the numbers of hazardous operations (e.g. cleaning out) compared with those for several smaller plants of equal throughput.

18 On the other hand, whilst the control equipment in a large plant tends to increase in elaboration and contribute to safety as is intended, it is possible to lose some of the advantage which a smaller plant may have because if control is lost the operators may have less chance of intervening effectively. In addition, large quantities of materials in storage or process can mean that the magnitude of possible accidents increases and hence larger numbers of people are at risk if things go sufficiently wrong. Indeed the limitation of inventory and the control of damaging interactions should be key design constraints: these are just two of many possible approaches aimed at reducing the potential consequences of a hazardous activity.

Reduction of failure rate

19 The problem of quantifying the reliability of a typical process plant involves aspects such as equipment reliability, for which methods of assessment are still being developed, and consequently only tentative conclusions may be drawn. Since we cannot achieve or expect to achieve no risk of failure in any of these areas discussed, we feel bound to put forward some quantitative objective. If, for instance, such tentative conclusions indicated with reasonable confidence that in a particular plant a serious accident was unlikely to occur more often than once in 10,000 years (or – to put it another way – a 1 in 10,000 chance in any one year), this might perhaps be regarded as just on the borderline of acceptability, bearing in mind the known background of risks faced every day by the general public. Disciplined effort may achieve even lower risk of failure – in favourable cases very much lower than the figure just indicated – leading to a very much lower risk of causing death or injury. We hope to refine our thinking in this area.

20 Concurrently many major industries have endeavoured to improve the reliability of their plant or product and have been developing techniques to enable them to assess the chance that plant or machinery might fail, or that the product or material in process might hurt people. The latter is typically the concern of pharmaceutical manufacturers, the Medical Research Council, and the International Commission on Radiological Protection in relation to exposure to risk. The aircraft industry, the US National Aeronautics and Space Administration, the nuclear industry and, to some extent, the chemical industry, have increasingly considered forms of reliability analysis of which the prediction of failure forms a part.

21 Most codes of practice aim to ensure that new buildings, machinery etc are at least as good as or better than most now in use, and it might be argued generally that where accidents have occurred, any new activity should offer a smaller risk than that which it replaces. Such a criterion is inapplicable to totally new processes. A number of organisations are considering the social and other problems involved. Improved reliability and the consequential improvement in overall safety have to be paid for either in direct money terms or in more subtle ways such as limiting the use of the most advanced technologies, or in extreme cases the actual abandonment of projected or existing processes and installations. But the benefits are not only to be found in improved safety for workpeople and the environment in general. The disaster at Flixborough was not only a human disaster. It also had significant economic effects: for the Company, for the local population in terms of lost jobs, for the insurance industry, and even for the balance of payments. Improved reliability and safety lead to improved financial performance in the long run. As the insurance industry may well be the first to carry the financial burden it could provide a stimulus, and we

would like to discuss the implications of major hazards with them.

The pragmatic approach to identification

22 It is already clear that the hazard associated with certain materials, processes, etc cannot be quantified in the abstract and that a precise definition of the term major hazard is out of the question. As a means of identifying major hazard installations, therefore, we propose to develop the pragmatic approach adopted at the beginning of this chapter by listing various types of activities which appear to contain the potential to present a major threat. This will be intended to set the lower limits above which major hazard installations will lie. Compilation of the list itself involves making some judgements as to probabilities and consequences but these are essential preliminaries to evolving a set of general criteria, with the aid of which individual installations may be identified.

3 Notifiable installations

23 In the previous chapter, we have tried to identify some of the more general, and to an extent some of the more theoretical, issues which must be considered if we are to evolve criteria as to what constitutes a major hazard. But whatever the theoretical problems may be to which we give attention, if our work is to be of practical value to industry and the community, we must identify in simple and practical terms what parts of industry and what processes should attract special attention.

24 The problems resolve themselves into three main categories which can be simply stated in the following three questions:

(a) How can those installations which may need special attention be identified

(b) What can be done to ensure that both existing and proposed installations are made as safe as possible

(c) What can be done to ensure that, despite all efforts to prevent a major accident, the consequences affect as few people as possible.

We attempt to answer questions (a) and (b) in this chapter and in chapter 4. The answer to question (c) involves both the people on site and the public at large: the limitation of exposure of site personnel is considered in chapter **4;** protection of the general public also involves planning controls which are considered in chapter 5.

Notification

25 While we have been able to make use of the information which the Factory Inspectorate have gathered over the years in order to deal with major hazards on an ad hoc basis, we are concerned that there is no systematic evocation and collation of this kind of information on a natioanl basis. There are legal requirements for the notification of certain potentially hazardous activities such as those involving explosives or petroleum spirit. There is also the initial requirement which applies to all factories, to give the Health and Safety Executive one month's notice of an intention to occupy a factory. But none of these requirements go far enough for what is now needed. We believe that notification of the hazard in some detail is absolutely fundamental to any improved mechanism of control and we have formed definite views as to how this should be done. We are also conscious that the lack of comprehensive information makes our task extremely difficult and indeed in some parts of our recommendations we are unable to offer more than interim and tentative solutions pending a more comprehensive review of the additional information to which our first proposals will give rise.

26 We therefore recommend that the occupiers of certain types of installations, as set out at the end of this chapter, should be required to send to the Health and Safety Executive specified details of their activities. This should apply both to proposed and existing installations including those where a proposal to make changes would give rise to a notifiable activity. We recommend that this be made the subject of regulations which should be brought into force as soon as possible. We believe that the net must be fine enough to catch all major hazard installations. Inevitably this will gather in many installations which will eventually be found to give rise to little concern. All installations will be subject to review though not all will necessarily call for any new or more stringent precautions than those already applied. Most of these installations will of course already be known to the Executive as a result of enforcement of existing safety legislation and no doubt the Factory Inspectorate will play a part in drawing employers' attention to the fact that their installation may fall within one of the categories we list, particularly in borderline cases.

27 The phrase 'major hazards' we believe to be unsuitable as a description for all the installations with which we are currently dealing. The use of this term can give rise to unnecessary public alarm and we propose that the term 'notifiable installations' be used to describe all those installations which are candidates for the initial notification scheme.

28 Our approach to the compilation of a list of 'notifiable installations' has been essentially pragmatic, leaning heavily on historical evidence of incidents involving hazardous materials, and the industrial experience of our members. The list at the end of this chapter (para 48) is in no sense final. We will be constantly reviewing it in the light of further experience, our own deliberations, changing technologies and the results of research.

Hazard surveys

29 Much of our thinking has been influenced by the spirit of the Robens report and by the legislative form which has been given to it in the Health and Safety at Work etc Act. We believe that it is the duty of the

company operating a notifiable installation to survey the hazards to which its undertaking gives rise, to identify its own problems and to set up appropriate machinery and procedures for solving them. The notification procedure should therefore go well beyond a mere identification of the problems, and the company should be required to make a survey of the hazard potential of its plant and to inform the Health and Safety Executive not only of the hazards identified but of the procedures and methods which have been or will be adopted to deal with them. This might well require expert help from outside. We recommend that the requirement for a hazard survey should also be made a statutory duty in the 'notification regulations'.

30 We have already emphasised that the degree of hazard which dangerous materials actually pose depends on many factors – quantity, physical state, type of usage and where used. The sole criterion of quantity could be misleading. Ten tonnes of a gas such as chlorine will generally be safer in cylinders in a well designed store than in a process. Similarly, liquefied gases in bulk are generally more safely stored under refrigerated conditons than under pressure. Moreover if an accident occurs, the consequential hurt to people will also depend on the protection provided for workers on the site, the distribution of population around the site, wind, weather and the topography of the surrounding area.

Detailed assessment

31 The company's survey will however be only the first step. In time each survey will have to be examined by the Health and Safety Executive. In some cases, following study by the Executive of this initial survey, a more elaborate assessment will be called for, particularly in those cases offering the highest risks or involving novel or rapidly changing technologies. This assessment should be applied as appropriate to design, manufacture, construction, commissioning, operation and maintenance, as well as to subsequent modifications whether of the design or operational procedures or both. In such cases, management will have to satisfy the Executive that it possesses the appropriate management system, safety philosophy, and competent people, that it has effective methods of identifying and evaluating hazards, that it has designed and operates the installation in accordance with appropriate regulations, standards and codes of practice, that it has adequate procedures for dealing with emergencies, and that it makes use of independent checks where appropriate.

32 The request for this type of assessment will again have to be supported by legislation and we therefore recommend that the regulations we have proposed should include a requirement that, when asked by the Executive, the Company shall provide it. There may have to be some statutory limitation as to what information has to be provided but we think that the requirement should be as wide as possible.

Health **and Safety Executive action**

33 While the first purpose of the initial survey referred to in para 29 would be to ensure that management carries out a review of its safety problems and notifies the Executive that it has done so, it would also supply information on which we could base further advice, both on identification of classes of installations requiring further scrutiny and on the nature of the controls which may be appropriate for each class. There will be some notified installations, albeit small in number, which on scrutiny will be found not to come within the list of notifiable installations set out at the end of this chapter. The management of such plants should be told of this. All notifiable installations accepted as within the guidelines should attract the procedures outlined in chapter 5. In many, perhaps in the majority, of cases notified to the Executive as a result of our proposals, it will be found, after examination by the Executive of the information supplied, that the application of the appropriate controls under the Health and Safety at Work etc Act 1974, and their continued enforcement by existing procedures, will be all that is needed. In the first instance, the Executive will be appraising the information supplied, not so much for purposes of enforcement, as to enable them to select on behalf of the Committee those installations calling for the more elaborate assessments referred to in para 31. In the period before further guidance can be promulgated in later reports, in codes of practice, or in regulations, the controls exercised under the existing legislation by Inspectors in the field must, we would emphasise, continue to operate as at present.

34 As we have already mentioned, the threat presented by hazardous installations will vary according to circumstances, and the system of supervision over such installations must therefore be flexible enough to ensure that each installation attracts the control measures appropriate to its potential hazard. To be effective, it must therefore provide for different levels of intervention depending on the severity of the hazard. Provided that the arrangements for the provision of information which we have outlined in paragraphs 29 and 31 are given statutory force, we do not believe that in the majority of these cases any further statutory controls such as licensing will be necessary. The advice which the Executive gives and improvements which it requires, can, we think, be enforced by the procedures of the Health and Safety at Work etc Act 1974, namely the use of improvement or prohibition notices and, if necessary, by prosecution under the Act.

'Major Hazard' installations

35 There will remain some installations, perhaps not numerically very large, offering the highest risks

and representing the major hazards with which we are principally concerned. These we think may not be capable of being satisfactorily controlled by existing procedures alone, and will need some kind of specific intervention in the form of a licence or authorisation and will need to be under closer supervision by the Executive than those already mentioned. We discuss this aspect of our proposals in the next chapter.

Health and Safety Executive resources for conducting appraisals

36 The Major Hazards Branch of the Executive was set up to develop policy on the control of major hazard installations. Apart from servicing our Committee, one of its prime functions is to co-ordinate the advice given by the Executive to local planning authorities in connection with risk appraisals of proposed developments involving, or in the vicinity of, major hazard installations (this arrangement is described in Chapter 5). This co-ordination is achieved through the medium of a Group, known as the Risk Appraisal Group, which holds one half-day meeting per week, to consider the contents of appraisals prepared initially by the appropriate Specialist Inspectors. The Group consists of those Senior Inspectors concerned with explosives, other explosive and flammable materials and toxic substances, drawn from the appropriate sections of the Factory Inspectorate, together with a Nuclear Inspector and members of the Major Hazards Branch. This enables the advice on any particular issue to be determined by a Group representative of the wider range of expertise now available within the Executive and against the background of this Committee's thinking.

37 The need for examination of what will be a very large number of surveys received as a result of our proposed initial notification scheme will, however, put a considerable extra burden on the Executive and, when further information is called for, there will be an even greater need within the Executive for very specialised and detailed knowledge, particularly of the process industry. The proposals for close liaison with the planning authorities contained in Chapter 5 will also increase the workload to be carried by the Executive. We think therefore that specific arrangements must be made to strengthen the resources of the Executive in this field by attracting to its ranks additional highly qualified, trained and experienced people able to cope with the problems involved and, in particular, the dangers inherent in novel situations. There may be some temptation to try to absorb this new burden within the existing staff framework. In view of its obvious connection the work must be carried out in close conjunction with that of the Risk Appraisal Group. It would clearly be inappropriate for it to be undertaken by the Risk Appraisal Group itself which in any event is barely adequate to cope with the existing commitment to provide advice to local planning authorities. We strongly recommend therefore that a new unit be set up within the Major Hazards Branch specifically to scrutinise the survey and assessments forwarded by companies as previously recommended.

38 Because of our proposals that the company should be required to indicate its own problems and to shoulder the burden of solving them for itself, we think they will make a smaller, though still significant, demand on these important and limited manpower resources than would some alternative schemes which would impose heavier duties on the Health and Safety Executive and fewer on the Company.

39 We do not think that the Executive could reasonably be expected ever to acquire the enormous range of expertise needed to deal with all the problems which we expect to arise at major hazard installations. We therefore propose that the Executive should be able to call on outside help when it needs it.

40 We also think that the new Unit which we propose, should be able, indeed be encouraged, to make frequent outside contacts on general matters and to be able formally to call on such services, where necessary on a consultative basis, and pay for them. In this way it will be possible to make use of the valuable experience and skills of people outside the Executive who are intimately involved with the problems of design, construction or operation.

41 We believe that the Health and Safety Executive will need to have access on a formal basis to a group of experts who would be able to advise on specific issues arising from developments in hazardous industrial operations and to give their views, when asked, on any case where the Executive felt the need for a second opinion. In addition, in the case of some very large installations, particularly where something approaching an integrated complex of industries was involved, the Executive might need help and advice on particular cases. From time to time also, a real difference of opinion between the Unit and a company wishing to pursue a particular activity might arise. We believe that it would be an invaluable asset to the Executive if it were able to refer such cases to an independent body of experts. We therefore recommend that there should be set up a permanent advisory committee to provide the Executive with a nationally accepted body to which it could refer some of the problems.

42 Even so we do not think that the new Unit which we propose can operate for all time on an ad hoc basis though it may well have to feel its way at the beginning. We therefore believe that an attempt must be made to distil, from past and current experience, criteria for the assessment of particular plants and processes, not only to expedite the consideration of proposals, but also to ensure as far as possible that there is a consistent approach to all plants.

Hazard assessment criteria

43 Experience will dictate to a degree how assessment criteria are to be formulated, and this is a matter to which we will return in the course of further deliberations. In the meantime, we believe that there are already a number of important considerations which provide initial guidelines, for instance:

(a) the flow and dilution of toxic gases having regard to density, temperature, weather and topography

(b) the toxicity of the material at different concentrations

(c) the flow and dilution of flammable gases and the form of possible explosions or deflagrations

(d) the response of surrounding structures to shock or flame

(e) the likely effectiveness of emergency procedures.

44 Enough is already known to enable an estimate to be made of the possible distribution of casualties which, after a major accident to an installation, may range from less than 10 to over 1,000. Of course, the upper part of this range is improbable as it requires the unlikely combination of many independent factors.

45 On the other hand, we are unhappy about the lack of knowledge in some areas. We know there is an absence of basic data on the behaviour of massive releases of toxic and flammable gases when they are heavier or lighter than air. At an early stage in our work we requested the Health and Safety Executive to set up experiments to clarify the large areas of doubt which exist, so that the concept of limitation of inventory and quantity in process could be used to better effect, and to enable sophisticated advice to be given to local planning authorities in the matter of development in the vicinity of notifiable installations. We believe that there is a continuing need for research of this nature which should be pursued as quickly as circumstances permit. In making this recommendation we fully appreciate that the research needed may be expensive and difficult to conduct.

46 To further the acquisition of information known to be available, we recommend that the Executive should investigate the possibility of access to data banks on dangerous occurrences, both at home and overseas. This would provide data on toxic releases, explosions, and cataclysmic fires.

47 We believe that the collection of information within industry about what are best described as near misses would also be of value, both to the Executive and to the operators of plant. We have in mind such events as significant excursions of temperature or pressure in a plant, the release of toxic or inflammable liquid or gas on a significant scale, and any loss of containment due to mechanical failure of the pressure system. One way of achieving this would be by amending the Dangerous Occurrences (Notification) Regulations 1947, but we are aware that making this a statutory duty might inhibit the supply of information. The terms would need careful definition and we would propose to investigate this concept and make recommendations in a later report.

List of notifiable installations

48 At this stage in our discussions, we propose that the following list should constitute notifiable installations:

(a) Installations storing or processing toxic material where, if containment is lost, there can be an emission of toxic gases or vapours equivalent in effect to more than 10 tonnes of chlorine.

(b) Installations storing or processing flammable materials where, if containment is lost, there can be rapid emission of flammable gases or vapours of more than 15 tonnes.

(c) Installations storing or processing materials which are intrinsically unstable or of very high exothermic reactivity where the total inventory is more than 5 tonnes. Examples are ethylene oxide, acetylenes, organic peroxides.

(d) Installations with a large inventory of stored pressure energy, typically process operations at 100 bars or above using gas phase reactions.

(e) Installations storing or processing flammable materials which have a flashpoint of less than 73°F (22·8°C) where the total inventory is more than 10,000 tonnes.

(f) Installations storing or processing liquid oxygen where the total inventory is more than 135 tonnes.

(g) Installations storing or processing ammonium nitrate where the total inventory is more than 5,000 tonnes.

(h) Installations storing or processing materials which, in a fire, can cause an emission of toxic gases or vapours equivalent in effect to more than 10 tonnes of chlorine.

Notes

(i) This list would apply to both existing and proposed installations.

(ii) ***Installation*** includes any outlet remote from the storage or processing activity, where temporary connections are provided.

(iii) The basis of the calculation of quantities should be the total amount of materials that could be stored and/or in process within the boundaries of an installation.

(iv) We recognise the difficulties of applying some of the criteria in the list, for example the equivalent in effect of other toxic materials with that of chlorine – 'the chlorine equivalent'.

Toxicity depends on a number of factors and no simple hard and fast rules can be laid down. The mode of action depends not only on the nature of the

chemical but upon the dose received and the time scale of exposure. Strictly speaking the term 'chlorine equivalent' can be given relevance only in connection with slow, corrosive irritant chemicals having similar solubility in inhalation. Chemicals such as sulphur dioxide, ammonia, acrolein and nitrogen dioxide are all irritant yet have such different sites of action and variable effects as to make even an approximate calculation of a 'chlorine equivalent' difficult. The problem becomes even more difficult when one considers the potential toxicity of chemicals such as carbon monoxide which are not predominantly irritant. Mechanisms of toxicity are almost as varied as the classes of chemicals which could be released. Although we have not yet investigated in detail the range and effects of potentially toxic chemicals found in bulk quantities, we think that we will want to focus our attention on those which cause immediate short-term effects, rather than those, for example carcinogens or potent sensitizers, which cause long-term effects. We expect to study the information that is being gathered on an international basis.

4 Application of controls to major hazard installations

49 In the previous chapter we set out a method of identifying and notifying potentially hazardous installations. We also outlined a suggested procedure and organisation for appraising the surveys and assessments which must follow the notification of such installations. We now consider in somewhat greater depth the factors which influence or may be made to influence safe operation of **all** plants, but in particular those plants which will emerge as major hazard installations by the application of the procedures outlined in the previous chapter. These factors relate not only to the arrangements to ensure safe operations which must be made by a company, but also to the procedures which may be necessary to enable the Health and Safety Executive to ensure that the company shoulders its responsibilities in a satisfactory manner.

Accountability of management

50 In our consideration of the control of these hazards we have concluded that the dominant factor is management. We agree with the **Robens** Report that two essential ingredients in this respect are explicit policy objectives and effective organisation in which individual responsibilities are clearly defined. Management must manage the hazard and be ready to account for its performance at all times. It should be made mandatory for a company which operates or proposes to operate an installation offering the highest risk, to demonstrate to the Executive that it has the appropriate safety philosophy, the technical and human resources (in particular competent and experienced managers) and a sound management system. The responsibility must be for ***management*** to satisfy ***itself*** that its arrangements are adequate. Our recommendations for legislation outlined in the previous chapter should result in statutory responsibility being laid on the company to do just that.

Methods of legal control

51 In comparing the methods of control provided by the Health and Safety at Work etc Act 1974, we believe that it is of fundamental importance that no method should be adopted which in any way dilutes the prime responsibility of management for the safety of the installation. Nor should the requirement be made too specific; otherwise compliance would be matched to specifics and the comprehensive control which we require would be weakened. The obligation should be to satisfy the Executive on the adequacy of such matters as the management system, design, operation and maintenance arrangements, rather than on compliance with a set of static and rigid rules.

52 The **Robens** Report commented that traditional regulations **". . .** have an intrinsic rigidity, and their details may be quickly overtaken by new technological developments**''**. Given the current level of technology and rate of advance of modern industry, we see no prospect of adequate control being achieved merely by production of regulations of the traditional type containing specific requirements with which compliance, but not necessarily safety, can be claimed. Not only does this detailed approach conflict with our view that management must manage, but such detail, as pointed out by **Robens,** would rapidly become out of date and, worst still, seem to provide a quite unwarranted sense of security. In the previous chapter we recommended the making of regulations in a form which would require management to prepare for the Health and Safety Executive, statements of its assessment of the hazards of its undertakings and how it controls them. This is nothing more than asking it to justify the safety of the operation and the installation in use or proposed. We regard this type of regulation as **''**inductive**''**, since it requires management to think out its own situation and present its solution which must be to the satisfaction of the Health and Safety Executive.

53 We support the **Robens** view that encouragement should be given to the production of codes of practice. There are many excellent examples of these at present in use in the industries with which we are concerned, and we would expect the Executive to foster and give every assistance to the production and adoption of such codes. We would also expect management, in presenting its statement under the types of regulations we have in mind, to undertake to abide by the codes of practice specified. Management should also be required to state where an existing code of practice has not been followed and the reasons for divergence; in some cases compliance may not be essential but any alternative should have to be shown in writing to be no less effective.

54 Another form of statutory control is the specific authorisation for prescribed activities which is in effect a licensing system. There are many kinds of licences: it is possible to licence people or **organisa-**

tions, or more traditionally the plants themselves, but the models we have considered in some detail are those applied to nuclear installations and to drug manufacture. The former is in many ways a special case, reflecting the particular kind of potential hazard, novel technology and uncertainty associated with the early stages of development of nuclear energy. Thus we prefer the latter as a more appropriate model. We have discussed at length the pros and cons of licensing. Three disadvantages of licensing have been put to us. Firstly, that it usually calls for considerable technical manpower, both on the part of the Company to prepare the detailed technical submissions and on the part of the regulating authority to examine their validity. Secondly, any departure from the conditions of a licence must be by permission of the regulating authority in the form of a legal approval or consent; this also takes up manpower. Thirdly, the system almost inevitably tends to transfer responsibility from the Company to the regulating authority.

55 However, the advantage of a licence system is its flexibility to match the controls to the individual hazard. We can foresee a limited number of hazardous processes which may have special problems of, for example, novelty or depth of technology, large inventories, high pressures or temperatures, plant complexity or fast process response times, and/or location. The standards of management and its safety framework are likely to be crucial in these cases and although existing and proposed regulations, codes of practice etc would still apply, we believe that they may well prove inadequate on their own. In such cases we would recommend the use of some type of licensing system: the application of the licence or authorisation could, depending on the circumstances of the case, be limited to a particular hazard, process or area of operation and its management.

56 We have not put forward specific proposals for a licensing procedure as we propose to consider this when we have access to the further information supplied as a result of our recommendations in Chapter **3,** which should enable us to identify the types of installations which might attract this form of control. Any system of licensing will need to take into account the planning considerations mentioned in Chapter 5.

57 The needs which will have to be met, whether they take the form of compliance with a formal licence or whether they form part of the statement of intent which a company will have to provide, are in fact much the same. No-one should feel that he must await any further proposals for controls of any kind from this Committee before looking closely at his own problems in the light of the following paragraphs which deal with various aspects of management control.

Safety framework

58 Every company is obliged by the Health and Safety at Work etc Act 1974 to show that the management affords proper priority to safety and that it has a safety policy and a comprehensive plan to ensure a high standard of safety throughout the life of the installation. But in the special circumstances of major hazard installations we think that the safety plan, which should be a formal one, and subject to joint consultation, should include among other things the regulation of safety matters by company procedures, the safety role of the design and development team, the production management and the safety officer, training for safety, measures to foster awareness of safety, and feedback of information on safety matters.

59 Important aspects to be covered by procedures include identification of hazards, control of maintenance through clearance certificates, permits to work etc, control of modifications which may affect plant integrity, emergency operating procedures, and control of access to the installation. We think that safety documents covering both design and operation of the installation are necessary. In addition management should have **a** proper system for auditing critical safety features and the principle of independent assessment should be used where appropriate.

Safety representatives

60 Safety representatives will have a special rôle to play in major hazard installations because in addition to their normal functions as outlined in the consultative document containing draft Safety Representatives and Safety Committees Regulations, they will be expected to take part actively in the formulation and application of additional controls which we suggest – for example safety audits and emergency procedures.

Recognition and surveillance of hazards

61 The progress of technology has made the very important recognition of hazards more difficult; in modern installations it is not possible to rely solely on visual inspection. On the other hand there is now available a whole range of techniques (hazard screening of chemicals, checklists, operability studies, safety audits, non-destructive testing and condition monitoring) which may be applied to the different stages of a project from research and development to operation. Management of major hazard installations will have to demonstrate that it possesses and uses a selection of techniques appropriate to its particular problems.

Operating and maintenance personnel

62 We think that management should have to demonstrate that the operators and maintenance staff at a major hazard installation have sufficient training to ensure a thorough understanding of the routine work and its importance in maintaining plant safety. In the case of operating instructions for the process worker it is important that these are written carefully

so that they are easily understood, and that aspects of the operation having vital safety implications and any consequent action are clearly indicated. Training and retraining will be necessary to make sure the operators do understand the instructions. Particular attention should be paid to the need for all people associated with the plant to be on the alert for unusual conditions or perturbations in the operation of the equipment, and to take appropriate action in order to preserve continuity of safe operation. It is considered that a well-trained and alert team of employees moving constantly around the plant provides the best means of preventing threats to safety arising both from technical failures and from any unauthorised interference with the equipment. This latter point has an added importance in relation to the general position on national security at the present time.

63 The rarity of major disasters tends to breed complacency and even a contempt for written instructions. We believe that rules relevant to safety must be everyday working rules and be seen as an essential part of day-to-day work practice. Rules, designed to protect those who drew them up if something goes wrong, are readily ignored in day-to-day work. Where management lays down safety rules, it must also ensure that they are carried out. We believe that to this end considerable formality is essential in relation to such matters as permits to work and clearance certificates to enter vessels or plant areas. In order to keep strong control in the plant, the level of authority for authorisations must be clearly defined. Similarly the level of authority for technical approval for any plant modification must also be clearly defined. To avoid the danger of systems and procedures being disregarded, there should be a requirement for a periodic form of audit of them.

Pressure systems

64 As mentioned in Chapter **2,** containment is the very essence of the problem of control of dangerous materials, and therefore we regard the integrity of pressure systems as of the highest importance. It is not without value to consider that 100 or so years ago steam boiler explosions were common occurrences and exercised the public mind much in the way that major hazards do at the present time. The fact that this danger was brought largely under control resulted from arrangements which ensured that steam boilers were properly constructed and properly maintained. A most important aspect of boiler legislation is that it places upon the user the duty periodically to provide evidence that his plant is in a sound and safe condition; it puts no duty on the enforcing authority to inspect his plant. This is entirely in line with our own thinking.

65 Scrutiny of incidents suggests that the outright failure of properly designed, constructed, operated and maintained pressure vessels is rare, perhaps because of the lessons learned over many years from steam boiler practice. It is pipework, valves, pumps, etc which are vulnerable and much more prone to failure. Therefore we recommend that these as well as the vessels themselves be treated as part of pressure systems in future legislation.

66 One of the basic aids to continued safe operation of boilers is the periodic internal examination, but such a requirement is not easily extended to pressure systems containing toxic or flammable materials. Obviously there are difficulties: for example, the contents are not so easily disposed of as from a boiler; they must be transferred safely and held safely somewhere else. In addition, in spite of the thorough precautions that must be taken before these vessels are opened up and entered, some residual risk remains and a serious accident could result from a human error. We think that there is a need for the continuing development and application of techniques whereby convincing evidence can be obtained from outside the vessel or pipe of the condition of the inner surface.

67 Though we are impressed by the improvement in boiler safety achieved over many years by the application of legal requirements and the applied experience both of industry and the boiler inspecting agencies, we foresee difficulties in applying legislation designed for steam boilers or air receivers to pressure systems for hazardous materials. Nevertheless we do not think that the principle of periodic thorough examination should be abandoned. We know of companies which have written procedures for the periodic examination and testing of pressure vessels and systems which form part of the plant. The frequency and type of examination is decided according to the characteristics and history of their vessels. There is also the need to keep in line with international and other standards. We believe that there is urgent need for further legislative provision, a development envisaged in the Report of the Inquiry into the Flixborough disaster, and we recommend that 'inductive' regulations for pressure systems be drawn up for application to all notifiable installations. These considerations should apply to all containment systems for dangerous materials.

Exposure of personnel

68 One of the most effective means of reducing the accident toll is to reduce the number of people exposed to risk. Management should limit the number of people at any one time in areas of high hazard to a minimum consistent with safe operation. This is important because the number of people can be quite large when account is taken of operating personnel, maintenance and modification teams, contractors, drivers, and visitors, with a possible doubling at shift changeover.

Building construction

69 Management should have to ensure that on-site

buildings have been located and designed with full regard to their structural integrity and the safety of their occupants and of vital equipment in the event of a major explosion, fire or escape of toxic material. Such buildings could be ranked according to their siting needs, the underlying object being to ensure that no building is any closer to a hazard area than it has to be having regard to its functions etc. Where for example buildings housing vital equipment, and control rooms have unavoidably to be sited in the immediate hazard area, then this will call for special attention to be paid to the nature of their construction. Much information on the design of these buildings is already available and we are seeking the advice of specialists. We intend to set down guidelines for building construction in a later report, but it might be remarked in passing that brickwork is totally unsuitable for control rooms which could have to withstand severe explosive effects. There is not much doubt that such buildings should be single-storey and of reinforced concrete construction with an integral roof, but other forms of construction are being examined and our interest may reveal the need for research to determine an ideal form of construction for the situations we are considering. Window areas too might well have to be severely limited. The quality of window glazing in any building, old or new, should be reviewed to reduce drastically the potential for injury or death from severe glass fragmentation. Buildings should be designed to exclude toxic atmospheres although the area potentially involved is very great and a limiting definition of hazard area would be required. The research we have requested should yield helpful information in this respect.

Existing installations

70 Some of our recommendations relating to plant and buildings can only be applied with difficulty to existing installations. We shall find, no doubt, that in many respects the standard of safety precautions already prevailing in many responsible industrial quarters is entirely satisfactory: in other respects we may find that our proposals demand higher standards. In some quarters the standards have been too low and the fact that changes cannot be made overnight does not make us ready to condone lower standards. We therefore recommend that no new installation or construction be permitted below any standard which is set, and that existing installations be brought up to an adequate standard with a degree of urgency which would vary with the degree by which the existing installation was sub-standard and the severity of the hazard. In particular, any installation in which large quantities of flammable substances are maintained as super-heated liquids, or as gases under considerable pressure, or as refrigerated liquefied gases, or from which considerable quantities of toxic substances could be liberated, should receive early consideration.

Further work

71 Clearly the implications of these proposals need to be pursued in far more detail and we have already turned our attention to a number of particular aspects **e.g.** such matters as the need for procedures to identify hazards at all stages of a project, measures designed to reduce hazard, methods of reliability assessment and systems which assist the learning process. We have also studied the more specific recommendations stemming from the report of the Flixborough Court of Inquiry. We propose to develop our thoughts on these topics in subsequent reports, leaving this first report to concentrate on our general approach and the outline of a framework of control, since it seems to us important for our thinking on this to be ventilated.

5 Planning controls

72 We now consider what planning controls should be applied to the siting of a notifiable installation, to any modification which would convert an existing activity into a notifiable installation, and to any development in the surrounding area. It might be argued that the siting of potentially hazardous installations should be controlled by the Health and Safety Executive as part of their application of comprehensive safety controls in general, but we hold very firmly to the view that siting of all industrial developments should remain a matter for planning authorities to determine since the safety implications, however important, cannot be divorced from other planning considerations.

73 The two aspects are clearly inter-related and it is a matter for consideration whether they should be formally linked to ensure that an approach on the one side triggers off consideration of the other, i.e. should an applicant for planning permission for development involving an existing or proposed notifiable installation be required to produce evidence that he has satisfied the Executive as to the acceptability of his proposals from their point of view? We can see no positive gain from formally linking the two aspects of control in this way. We understand however that it is already the practice of some applicants to pursue both aspects more or less simultaneously and we commend this parallel approach.

Planning decisions

74 It is vital that planning authorities should reach decisions on the basis of full information about the hazards associated with proposals for new installations; for changes at existing premises which involve the introduction of or alteration to hazardous activities; or or for developments in their vicinity. Informal arrangements already exist whereby local planning authorities are asked, before granting planning permission for developments involving certain specified activities, to consult the Factory Inspectorate.*

75 The advice provided by the Factory Inspectorate may include recommendations about siting or lay out of the plant in the interests of safety. These arrangements provide a means whereby planning authorities can obtain the best available advice on the technical implications of the proposed development, but there is no guarantee that they will always seek such information. We consider it absolutely essential that in any such case the planning authority should consult the Executive and we therefore recommend that the Town and Country Planning General Development Order should be amended so as to provide that on all applications involving, affecting, or affected by a notifiable installation, local planning authorities should be required to consult the Executive. It will be equally essential that the Executive's advice should be in a form appropriate to planning authorities who do not themselves possess the necessary expertise. We therefore consider that it would be helpful to planning authorities if the advice from the Executive included a grading of the hazard potential involved according to some numerical system of classification, with the main part of the advice comprising a narrative assessment. We propose to develop this system in our subsequent deliberations. We shall also consider whether it would be possible to make this advice more generally disseminated.

76 The hazard potential will largely determine the extent of the area around a notifiable installation within which Health and Safety Executive advice should be sought on proposed developments. Topographic, atmospheric and demographic factors must also be taken into account. We consider that some general advice to planning authorities would also be beneficial even if it merely listed desirable general objectives in regard to the siting of new installations. So much depends on the precise nature of the development concerned, and on the actual features of the proposed location, that it would be wrong to lay down any hard and fast rules, and it will be necessary to give further consideration to the safety factors which such general advice should cover.

77 We have considered the remote possibility that in some instances a local planning authority may not feel inclined, for a variety of reasons, to follow the advice of the Executive on particular applications for potentially hazardous developments or other developments within their vicinity. We therefore recommend that the advice given by the Executive to the local planning authority should be copied to the appropriate Regional Office of the Department of the Environment or the Welsh or Scottish Offices. This will ensure that these planning Departments are kept informed of safety factors in all proposed

***Department of the Environment Circular 1/1972**
Welsh Office Circular 3/72
Scottish Health and Home Department Circular 58/72

developments involving potentially hazardous installations so that 'call-in' action may be considered. If the Executive consider that a particular application could involve unacceptable risks, they should, when giving their advice, request the local planning authority specifically to refer back to them if the authority are minded to grant permission. The Executive would then be able to make representations to the appropriate planning Department that the application in question should be called in for decision.

Developments affecting notifiable installations

78 After determining the siting and considering the hazard potential of a notifiable installation, local planning authorities have the continuing task of keeping a close watch on proposed developments nearby so as not to permit incompatible types of development. We also consider that the Executive should advise local planning authorities, and the Government Departments concerned with planning, of the location of all existing notifiable installations in their area so that they may, if necessary, review their planning policies.

79 Hazard potential can of course extend across local authority boundaries. Under the arrangements already mentioned local planning authorities are requested to inform neighbouring authorities about installations, close to those authorities, which may present potential hazards. This ensures that they are not overlooked when development applications in the area are being considered and advice is sought from the Executive. We consider that the notification of neighbouring authorities in these circumstances should also be made a mandatory requirement.

Changes in use

80 We have noted that planning control does not apply in some variations in industrial processes which may introduce an additional degree of hazard at existing installations. This is because it is only material changes in the use of land which constitute development requiring planning permission. In planning terms the question of what is a material change of use is both a matter of fact and degree and always depends both upon the particular facts and the circumstances of each case. Some changes of process might, in certain circumstances, be held to constitute a material change of use of the premises as a whole for planning purposes, but many of the changes which take place in a factory or plant (including such things as increases in the scale of intensity of operations) are unlikely of themselves to involve a material change in the use of the land. The Town and Country Planning (Use Classes) Order **1972** groups together in classes those uses of land which have similar planning implications, and provides that a change from one use to another use within the same use class does not involve development requiring planning permission. The Use Classes Order does not specify what is or is not a material change in use – changes from one class to another or even to a use not mentioned in the Order (of which there are many) may not necessarily be material changes in the use of the land. To amend the Use Classes Order, for example by singling out certain types of industrial processes into use classes of their own, would not necessarily mean that changes involving such processes would need planning permission since they still might not involve material changes of use. We propose to investigate whether controls over variations in processes which introduce or increase the degree of hazard at existing installations could be achieved through the planning system and if so, whether it would be useful to provide these in addition to the controls envisaged in Chapter **3.**

Compensation

81 The practical application of restrictive planning control to areas around potentially hazardous installations may well involve the local planning authority in having to meet claims for compensation. While it is generally the case that a refusal of planning permission does not give rise to financial compensation, in some circumstances the local planning authority can become liable to pay compensation, for example when permission is refused for development which is normally allowed by the General Development Order (following a direction under Article 4 of the GDO which removes the general permission granted by the GDO for certain types of development) or when existing permissions are revoked or modified or existing uses discontinued. Also there are financial considerations when a refusal leads to a purchase notice being served, which, if accepted or confirmed, would oblige the local authority to buy the land in question from the owner on the grounds that it had become incapable of reasonably beneficial use. Although much depends upon the circumstances of the particular case the sums involved could be substantial – possibly running into millions of pounds in the case of revocation of an existing permission for large industrial developments and even larger sums in the case of discontinuance of existing installations.

82 We foresee that these compensation considerations are likely to present much greater difficulties at existing hazardous installations than for new installations. In the vicinity of many existing installations there are bound to be established uses of land or as yet unexercised permitted extensions of such uses under the GDO which might no longer be considered as compatible with the hazardous installation. The problems arising at existing installations may be further complicated by the fact that some large industrial complexes contain a number of separate plants which may or may not be hazardous. There may also be not just one potentially hazardous process but several (which may or may not be inter-related) and each may need to be subject to an appropriate,

possibly differing, level of control.

83 Moreover it should not be assumed that because a hazardous process is being carried on in some part of a site the whole site should be classified as hazardous. Each installation will need individual consideration and appropriate treatment. Any action under planning powers to close down such existing uses or to revoke unexercised permissions would involve the payment of considerable sums in compensation. We have given a good deal of thought to these compensation questions and consider that the practical issues involved are of such difficulty of application and importance that we propose to consult the Department of the Environment further on these matters.

84 The problems associated with proposed new installations should be easier to deal with because there is the opportunity to consider at the outset all the questions concerning siting and compatibility with existing uses of land. The implications of the possible need to prevent incompatible types of development from encroaching in the future upon a hazardous installation would also be recognised at the outset. We suggest that local planning authorities should be reminded of their power to negotiate agreements with the applicants for hazardous installations where appropriate. Such agreements might provide that the operator obtains control over the use of surrounding land; or indemnifies the local authority in the event of their having to pay compensation as a result of any planning action they might take to safeguard the area around a hazardous installation, or of their having to meet the costs of a purchase notice.

6 Conclusions and recommendations

Notifiable Installations

85 Occupiers of certain types of installations (described at para 48) should be required to send to the Health and Safety Executive specified details of their activities. This requirement will apply both to proposed and existing installations including those where a proposal to make changes would bring an installation within the notifiable list. This should be made the subject of regulations to be brought into force as soon as possible (para 26).

86 Such installations should be described as 'notifiable installations' (para 27).

87 Notification should be accompanied by a survey of the hazard potential of the activity and the company should also inform the Executive of the procedures and methods which have been or will be adopted to deal with the hazards. The requirement for a hazard survey should be made a statutory duty in the 'notification regulations' recommended in para 26 (para 29).

88 In some cases and particularly in those offering the highest risks or involving novel or rapidly changing technologies, a more elaborate assessment will be called for by the Executive following their study of the initial survey (para 31).

89 The request for this type of assessment will again have to be supported by legislation and we therefore recommend that the regulations we have proposed should include a requirement that when asked by the Executive, the company shall provide it (para 32).

90 In the period before further guidance can be promulgated in later reports, in codes of practice, or in regulations, the controls exercised under the existing legislation by Inspectors in the field must continue to operate as at present (para 33).

91 There will remain some installations offering the highest risks and representing the major hazards with which we are principally concerned. These will need some kind of specific intervention (para 35).

92 There will be a need within the Executive for very specialised and detailed knowledge of the process industry, and its resources must therefore be strengthened by attracting to its ranks highly qualified, trained and experienced people. We strongly recommend that a new unit be set up within the Major Hazards Branch specifically to scrutinise the surveys and assessments forwarded by companies (para 37).

93 The Executive should be able to call on outside help when it needs it (para 39).

94 We recommend that a permanent advisory committee should be set up to provide the Executive with a nationally accepted body to which it could refer some of the problems arising from developments in hazardous industrial operations especially in complex cases where a second opinion would be useful (para 41).

95 On the basis of past and current experience, criteria should be formulated for the assessment of particular plants and processes (para 42).

96 Research should be conducted as quickly as circumstances permit into the behaviour of massive releases of toxic and flammable gases, when they are heavier or lighter than air, to assist in assessing hazard potential (para 45).

97 We recommend that the Executive should investigate the possibility of access to data banks on dangerous occurrences (para 46).

Application of controls to major hazard installations

98 A company which wishes to operate a major hazard installation will have to demonstrate to the Executive that it has the appropriate safety philosophy, the technical and human resources, and a sound management system (para 50).

99 No method of legal control should be adopted which in any way dilutes the prime responsibility of management for the safety of the installation (para 51).

100 We support the Robens view that the production of codes of practice should be encouraged and we would expect the Executive to foster and give every assistance to the production and adoption of such codes (para 53).

101 Some type of licensing system will be necessary for a limited number of major hazard installations (para 55).

102 In the special circumstances of major hazard installations the safety plan should be a formal one, and subject to joint consultation, and management should have a proper system for auditing critical safety features (para 58).

103 Safety representatives will have a special role to play in major hazard installations (para 60).

104 Management of major hazard installations will have to demonstrate that it possesses and uses a selection of techniques for the recognition and surveillance of hazards, appropriate to its particular problems (para **61).**

105 Management should also have to demonstrate that their workforce has sufficient and on-going training (para **62).**

106 Rules relevant to safety must be everyday working rules and be seen as an essential part of day to day work practice (para 63).

107 As containment is the very essence of the problem of control of dangerous materials, the integrity of pressure systems is of the highest importance (para 64).

108 Pipe work, valves, pumps etc are more vulnerable and more prone to failure than properly designed constructed, operated and maintained pressure vessels and we recommend that they as well as the vessels themselves be treated as part of pressure systems in future legislation (para **65).**

109 There is a need for the continuing development and application of techniques whereby convincing evidence can be obtained, from outside the vessel or pipe, of the condition of the inner surface (para **66).**

110 We recommend that 'inductive'' regulations for pressure systems be drawn up as a matter of urgency for application to all notifiable installations. These considerations should apply to all containment systems for dangerous materials (para **67).**

111 Management should limit the number of people at any one time in areas of high hazard to a minimum consistent with safe operation (para **68).**

112 Management should have to ensure that on-site buildings have been located and designed with full regard to their structural integrity and the safety of the occupants, in the event of a major explosion, fire, or escape of toxic material (para **69).**

113 We recommend that no new installation or construction should be permitted below any standard which is set, and, that existing installations should be brought up to an adequate standard with a degree of urgency which would vary with the degree by which the existing installation was sub-standard and the severity of the hazard (para **70).**

Planning controls

114 The siting of all industrial developments should remain a matter for planning authorities to determine since the safety implications cannot be divorced from other planning considerations (para 72).

115 We recommend that on all applications for developments involving, affecting or affected by a notifiable installation, local planning authorities should be required to consult the Executive (para **74).**

116 General advice about the siting of new installations would also be beneficial to planning authorities (para **76).**

117 We recommend that the advice given by the Executive to the local planning authority should be copied to the appropriate Regional Office of Department of the Environment, or to the Welsh or Scottish Offices (para **77).**

118 The Executive should advise local planning authorities, and the Government Departments concerned with planning, of the location of all existing notifiable installations (para **78).**

119 Notification by local planning authorities to neighbouring authorities of notifiable installations close to those authorities should also be made a mandatory requirement (para **79).**

120 We propose to investigate whether controls over variations in processes which introduce or increase the degree of hazard at existing installations, could be achieved through the planning system (para **80).**

121 The practical issues of compensation arising from action under planning powers to close down existing installations or parts thereof, or to revoke unexercised planning permissions are of such difficulty of application and importance that we propose to consult the Department of the Environment further on these matters (para **82).**

122 Local planning authorities should be reminded of their powers to negotiate agreements with applicants for hazardous installations where appropriate (para **84).**

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