REFLECTIONS ON PROCESS SAFETY

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In the United Kingdom it is the aim to achieve health and safety in the workplace by self-regulation. The controlling legislation is suited to this purpose and should be developed appropriately. Engineers have a significant contribution to make to self-regulation and this is amplified, particularly in the context of the containment of major hazards. Experts in process safety are increasingly required and there is becoming an urgent need for more systematic education and training. Some principles suggested by this requirement are discussed.

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SELF-REGULATION

Since the Report of the Robens Committee in 1972 it has been the recognised U.K. purpose to achieve health and safety at work by the method of "self-regulation". In the opinion of many, this is the only practicable way, and the alternative of detailed supervision by authority is unthinkable. But there are some, as discussion of the Health and Safety Commission's recently-published Plan of Work (1) has shown, who think that, even if self-regulation is an ideal, it is one that is not to be approached too precipitately.

The structure of our legislation is suited to the aim (2). We have main legislation - Acts of Parliament, represented by the Health and Safety at Work Act itself - which state broad principles and enable secondary legislation to be made, in the shape of Regulations, which can apply the purposes of the main Act to specific areas, processes and situations, but still in general terms. Their detailed application can be left to guidance documentation, including codes of practice, which are not mandatory, but are representative of the best current practice. The advantage of this arrangement is that

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it can accommodate advancing technology and apply continually updated methods to the attainment of health and safety, through a consensus between Industry and Government, and without frequent recourse to the Legislature, which is not well-equipped to handle technical detail.

A danger is that the legislative structure may not be used precisely in this way. Specifically, there may be a tendency to incorporate too much technical detail into the secondary legislation, thus rendering the system unable to respond easily to technological advance and to be sufficiently accessible to the influence of Industry itself in the pursuit of up-to-date methods of self-regulation.

A particular danger is that our system may become more rigid due to the influence of partners in the European Community whose system of legislative control of health and safety is more authoritarian than our own. Such influence is exerted through Directives which contain detail inappropriate to our situation, but nevertheless binding upon us. Examples can be seen in the recent major hazards legislation (3), amongst others. I submit that such influences should be resisted, in the appropriate manner and as far as possible.

THE ENGINEER'S ROLE

Safety and loss prevention specialists may feel that they can have but little influence in shaping legislation. This is not necessarily so. Through industry associations such as the Confederation of British Industries and the Chemical Industries Association, and through professional institutions, such as the Institution of Chemical Engineers, paths exist along which influence can be brought to bear on the Health and Safety Commission and the Legislature. We should exert ourselves to ensure that these paths are not only kept open, but are well-trodden.

Our more direct function, however, is to see that self-regulation works well and reliably, for we are responsible for the technical input that can bring this about. I would like to underline one or two points about the responsibility that we have and on which we are entitled to be heard.

First, let me face a question that is liable to weaken our contribution if it is not properly faced. It is often observed that process accidents are caused in approximately equal numbers, by technical faults and by operators' failings. As a matter of fact, if we exclude so-called "acts of God", all accidents are caused, in the last analysis, by human failure. Those that are nominally attributed to faults in design, construction or maintenance can be ultimately traced to the failure of someone to do something properly, or at all.

Bearing this fact in mind, Trevor Kletz, in a recent publication through the Institution of Chemical Engineers (4), has questioned what should be the attitude of engineers to human failure in the context of process safety. He rightly asserts that it is not in the province of engineers to change

human nature. Therefore, they must adapt themselves to it. They must design and construct plant, as well as operating and maintenance procedures, to take maximum account of human weaknesses.

They should not, of course, be expected to provide for human nature absolutely in the raw. There must be education and training to support human nature as fully as possible, and the engineer must be allowed to express an opinion as to the nature and strength of these props. It will be appropriate to return to this subject after some thoughts regarding the engineer's own contribution.

ELEMENTS OF PROCESS SAFETY

Until comparatively recently, process safety was thought of particularly in terms of the hazardous properties of process materials, including materials of construction. With the increasing size and complexity of plants, two particular problems have arisen : one, the effect of unprecedented scales on the actual hazardous behaviour of materials; and second, the safe operation and control of plants of increasing complexity. The latter has given rise to various methodologies of hazard analysis; the former to the practices of consequence assessment and quantitative risk analysis.

These are natural and proper developments, but it must be emphasised that they depend for their most successful pursuit on a thorough knowledge of the hazardous properties of materials. I sometimes feel that sight is being lost of this fact and that the flow of information concerning the behaviour of new and existing materials is in danger of drying up. This is partly because knowledge that exists is not well distributed; and partly because the knowledge does not exist, due to the preoccupation of research with other matters.

Arising from the increasing frequency of large-scale industrial disasters throughout the world, and especially, in the United Kingdom, from the explosion at Flixborough in 1974, much attention is being paid to the question of "major hazards". In the process industries this is seen as being mainly a question of the possible release of large quantities of toxic or flammable substances.

The defence against such hazards may be sought along two lines : reliable containment of the hazardous substances; or the separation by distance of the public from the source of industrial hazard. Up to a point, the latter is the easier course to adopt and much attention is being paid at present, in the implementation of the current major hazards legislation, to the subjects of consultation and separation distances.

As a solution to the problems however, this approach has a number of limitations. For one thing, it does absolutely nothing to protect the worker on the industrial site itself. This is hardly a tolerable situation.

In the second place, it creates many problems connected with development, and the use of land which, in a country such as the U.K., is an increasingly scarce commodity. These problems are likely to direct attention more and more to the other line of defence - the more reliable containment of the hazardous material.

This subject was addressed at a recent seminar of The Fellowship of Engineering, under the chairmanship of Sir Denis Rooke, entitled "The Containment of Major Hazards - a Challenge to the Engineer" (5). I suggest that we should consider the challenge to which reference is made, not limiting our thoughts only to major hazards. Engineers were reminded by the several speakers of the contributions that they may be able to make to hazard containment, in the coming years, through improved methods of design, choice of materials, techniques of construction and testing, condition monitoring and maintenance, and the control of operation. In connection with the last, they were advised that as the complete displacement of human activity appears to be an impossibility, attention should be concentrated on giving maximum expert support, particularly when abnormalities develop. In fact, this is an appropriate objective at the system-human interface of all activities, covering design, construction and maintenance as well.

SAFETY EDUCATION AND TRAINING

It has often been doubted whether process safety is a distinct subject from an educational point of view. The traditional engineer's opinion is that it is merely an aspect of good engineering practice, and it is undoubtedly true that they should be closely integrated. I have, however, long held the view that there is a distinct place for expertise in safety and that a certain number of careers should be devoted to it.

I think it has become increasingly clear, in recent years, that this is so. There are now, in fact, a number of clearly recognisable experts in the field. Indeed, the Institution of Chemical Engineers has pioneered a scheme of registration of such (6) and it seems likely that other qualifying bodies may follow suit.

Obviously the experts concerned have acquired their expertise in a variety of ways. The situation is very like that affecting chemical engineering itself before there were generally recognised chemical engineering qualifications : that is of a manifest demand for experts to fulfil a recognised function, but lacking an education/training system to generate the experts in sufficient numbers, or at all. In saying this, I am not unmindful of the initiatives that there have been in various universities, polytechnics and professional institutions. Having been very much involved personally in such initiatives, I may perhaps be permitted to describe them as sighting shots towards the fuller and more systematic approach that is now needed. May I therefore mention one or two principles that should, I believe, guide the future of education and training

in safety and loss prevention.

At the undergraduate stage, I think it is appropriate to impress the view that process safety has its foundation in sound design, but to generate an awareness that things can go wrong and to show, on as wide a front as possible, how this can happen. I therefore applaud the inclusion of safety and loss prevention in the Institution's syllabus and the inclusion of specific safety and loss prevention lecture courses in the curricula of various departments, some of which pre-date the Institution's guidance.

I do not, however, support any endeavour to create health and safety experts at the undergraduate stage. That is a matter for postgraduate, and even post-experience, activity. There are clear advantages in obtaining a certain amount of industrial experience before specialising in safety and loss prevention - certainly in its management aspects. On the other hand, there are benefits to be obtained in bringing fresh minds to bear on the subject, in connection with research and new developments. Post-graduate or post-experience may often be determined by practicabilities. Courses are needed that meet both situations, namely a full-time course for young graduates and those that can be released from industry for the necessary duration; and shorter concentrated courses for those less easily released. If the latter could form modules of the former, one scheme might be designed to serve all purposes.

The total course should embrace the hazardous properties and behaviour of materials, the identification and assessment of hazards and the management of industrial safety. This summary is deceptively brief!

Systematic education is supplemented by professional meetings and discussions, of which the symposia on process hazards organised by the North-Western Branch of the Institution of Chemical Engineers provide excellent examples. To such meetings are brought new information on hazard properties, new ideas for handling them within processes and practical situations, and opportunities for the exchange of news and views. I am sure that we appreciate the opportunity, as we should!

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