

# **Health and Safety Science**

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Health and Safety legislation needs to keep pace with work place environments which are changing ever more rapidly on account of developments in technology. A greater quality and quantity of data on hazards and risks are continuously being assembled as a result of scientific research. This paper provides examples of science-based legislation and of the current research areas which could influence future changes.

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## Summary

The workplace health and safety system in Great Britain centres around the *Health and Safety at Work etc. Act 1974* and associated secondary legislation. Recent years have seen an agenda dominated by EC directives and a deregulation initiative aimed at simplifying and consolidating both primary and secondary legislation. The aims of this paper are twofold: to summarise how the system works and to indicate some of the ways in which science and engineering provide underpinning. The latter ranges from accident investigation to the compilation of occupational exposure limits for hazardous chemicals. However, the scope of what may be termed health and safety science extends well beyond such immediate applications. Long term research needs to anticipate the potential risks associated with emerging technologies, such as genetic modification. In addition, whole fields of research such as engineering materials, combustion chemistry, and biomedical sciences, are of general significance.

The first section of the paper describes the health and safety law in both Great Britain and Northern Ireland, and the methods of enforcement. Under section 11(2)(b) of the *Health and Safety at Work etc. Act*, the Health and Safety Commission has a statutory duty to make appropriate arrangements for research. It delegates this responsibility to the Health and Safety Executive, a body which was also established by the 1974 Act. The second section of the paper outlines the work performed by the Health and Safety Laboratory, an agency of the HSE which is one of the public sector laboratories subject to the Government's prior options review.

# I The health and safety system

## A. Legislation

Prior to the *Health and Safety at Work etc. Act 1974*, which implemented the Robens report<sup>1</sup> on health and safety law, legislation in the UK had been industry-specific. One example which comes to mind is the 1802 *Act for the preservation of the Health and Morals of Apprentices and others employed in Cotton and other Mills, and Cotton and other Factories* (Geo. 3, cap 73). This limited the working hours of pauper apprentices to 12 hours a day, as well as providing for other aspects of their welfare. Indeed it is described in *Redgrave, Fife & Machin: Health and Safety* (1993) as the first Act of Parliament intended to protect the welfare of people at work.

More recent examples include the *Mines and Quarries Act 1954* and the *Offices, Shops and Railway Premises Act 1963*. The *Health and Safety at Work etc. Act 1974* (cap 37) imposed a general duty on "every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees". In performing their work, both employers and employees also have general duties under the Act not to compromise the health and safety of members of the public. The Act also established the Health and Safety Commission (HSC) and the Health and Safety Executive (HSE). The Commission is appointed by the Secretary of State for the Environment (until recently, the Secretary of State for Employment had this role) to whom it submits proposals for new regulations. The HSC also prepares approved codes of practice which provide practical guidance as to how the requirements of regulations may be met. A complete list of health and safety legislation has been published by the HSE.<sup>2</sup> Enforcement of health and safety provisions is the main responsibility of the HSE, appointed by the HSC.

## B. Enforcement

Breaches of the *Health and Safety at Work etc. Act*, and regulations made under it, are subject to criminal prosecutions either by the Health and Safety Executive or by local authority environmental health officers. An injured party can simultaneously bring a civil action for damages by invoking the common law tort of negligence. The 1974 Act does not allow a civil action in respect of a breach of statutory duty, though regulations made under the Act do allow this, unless they expressly state otherwise.

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<sup>1</sup> *Report of the Committee on Safety and Health at Work* Cmnd 5034 1972

<sup>2</sup> *List of Current Health and Safety Legislation* HSE 1995

Enforcement mechanisms available to HSE and local authority inspectors, other than criminal prosecutions, range from providing advice to the issue of statutory improvement or prohibition notices. On serving an improvement notice, the inspector must specify a time period of at least 21 days within which the contravention is to be remedied. Twenty one days corresponds to the period within which an appeal may be lodged with an industrial tribunal.

Prohibition notices can take effect immediately, and are served only if an inspector thinks there is a risk of serious personal injury. A prohibition notice continues to apply even if an appeal has been lodged (unless the tribunal directs to the contrary).

### C. The European dimension

The Single European Act 1986<sup>3</sup> raised the profile of European legislative activity in health and safety by inserting Article 118A into the Treaty of Rome. This allowed health and safety directives to be adopted by qualified majority voting, and gave rise initially to the so-called "six pack" of EC directives. In addition to a framework directive (89/391/EEC) there were five daughter directives covering:

- the manual handling of loads
- display screen equipment
- the workplace
- the use of work equipment
- the use of personal protective equipment

Subsequent daughter directives have also been implemented, and Article 118A is a major source of new law. Perhaps the most significant feature of the new regulations is the emphasis placed on performing risk assessments in the workplace. A requirement on employers to perform risk assessments forms part of the *Management of Health and Safety at Work Regulations* SI 1992/2051 which implement the above-mentioned framework directive. The purpose of risk assessments is to help the employer or self-employed person determine the measures which are necessary to comply with duties under health and safety legislation.<sup>4</sup> Risk assessments place on a more formal and systematic basis the

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<sup>3</sup> implemented into UK law by the *European Communities (Amendment) Act 1986* cap 58

<sup>4</sup> *Management of Health and Safety at Work. Approved Code of Practice*, HSC 1992

steps needed to identify danger and to minimise the associated risk; an activity already implicit in the *Health and Safety at Work etc. Act*. Regulation 7 of the *Management of Health and Safety at Work Regulations 1992* requires employers to establish procedures to enable employees to escape from serious and imminent danger. Again, this makes more explicit the general duties contained in the *Health and Safety at Work etc. Act* (particularly section 2).

So far as the implementation of health and safety Directives is concerned, the indications are that the UK record is, for the most part, relatively good. By way of example, the UK was one of only three countries (the others were Denmark and the Irish Republic) to implement the six pack Directives within 3 months of their implementation date, 1 January 1993.<sup>5</sup>

An important qualification is that the UK has still not implemented Articles dealing with fire safety which were a feature of both the Framework and Workplace Directives. The difficulty has arisen because fire safety in the UK has been treated as being largely distinct from other health and safety issues, with different government departments taking a lead role in the associated legislation. We shall return briefly to this issue in section I(E) below.

The UK mounted a legal challenge (rejected in the Opinion of the European Court of Justice's Advocate-General<sup>6</sup>) to the EC Working Time Directive (93/104/EC) which was adopted by qualified majority voting under the provisions of Article 118A of the Treaty of Rome.<sup>7</sup> This provides a good example of a mismatch between UK and EC perceptions of what constitutes a health and safety measure. One argument is that working hours should be a matter to be settled by employer and employee and that Article 118A on health and safety should not be used as an instrument of social policy. On the other hand one could point to a variety of UK statutes which seem to acknowledge the role of working hours in health and safety, a recent example being regulation 4 of the *Railways (Safety Critical Work) Regulations SI 1994/299*.

Another recent development of interest in the EC context is the establishment of the European Agency for Safety and Health at Work.<sup>8</sup> This was launched in Bilbao, Spain on

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<sup>5</sup> *Croner's Health and Safety Special Report* December 1993

<sup>6</sup> "UK loses working time challenge" *Health and Safety Bulletin* April 1996

<sup>7</sup> For details, see library research paper 94/52, *The Working Time Directive*.

<sup>8</sup> Council Regulation (EC) No 1643/95, 29 June 1995 - amending Regulation (EC) No 2062/94, 18 July 1994

27 October 1995<sup>9</sup> and the Director was recently appointed.<sup>10</sup> In addition to encouraging improvements in work place health and safety, the aim of the Agency will be to provide EC bodies and Member States with relevant technical, scientific and economic information. The HSE is reported to acknowledge that the Agency could have a major role in helping to ensure consistent application of health and safety law throughout the Community.<sup>11</sup>

### D. Deregulation

An important development has been the *Deregulation and Contracting Out Act 1994* (cap 40) designed in part to allow the repeal of outmoded health and safety regulations. Section 37 allows for the repeal or revocation, without replacement, of health and safety measures following consultation with the Health and Safety Commission. The origin of the measures in the Act can most obviously be traced back to a speech by the Prime Minister at the Conservative Party Conference in October 1992 when he invited the then President of the Board of Trade to address the problems presented by the "burgeoning maze of regulations".<sup>12</sup>

Comprehensive reviews were performed by the Health and Safety Commission and seven business deregulation task forces, covering different industries, established by the President of the Board of Trade. The chairmen of the latter were appointed in March 1993 with a remit:

"To advise Ministers on priorities for the repeal or simplification of existing regulations and enforcement methods so as to minimise the costs on business; to advise Ministers on the best way of developing and maintaining consultation on the introduction and enforcement of new regulations including those arising from EC measures; bearing in mind the considerations of public health, safety and security which underlie the regulatory system."

The recommendations<sup>13</sup> of the business deregulation task forces were published on the same day as the *Deregulation and Contracting Out Bill*. These covered areas as diverse

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<sup>9</sup> European Commission: Europa world wide web server.  
internet address <http://www-mirror.europeonline.com/europa/en/agencies.html>

<sup>10</sup> HSE spokesman

<sup>11</sup> *Croner Health & Safety Briefing* 4 July 1994 p.6

<sup>12</sup> *Deregulation and Contracting Out Bill*, House of Commons Library Research Paper 94/16

<sup>13</sup> *Deregulation. Task Forces Proposals for Reform* January 1994

as financial services and health and safety.

In December 1992 the Department of Employment Minister with responsibility for health and safety (Mr Michael Forsyth) asked the Health and Safety Commission to conduct its own review of legislation. The Commission responded by establishing seven Task Groups of employers and employee representatives, whose subject coverage mirrored that of the business deregulation task forces. Examples of industries covered were communications and transport, engineering, and construction. The HSC's *Review of Health and Safety Regulation* was produced in May 1994 and summarised in a separate document of the same title.

Apart from removing any unnecessary burdens on industry, the purpose of the deregulation initiative in the health and safety context was to simplify and rationalise the law, a need acknowledged by the HSC even before its Review. The complexity of the law is largely a consequence of the historical legacy of industry-specific statutes. According to the former Minister of State for Employment (Mr. Michael Forsyth) proposals from the HSC have, since 1975, "led to the replacement of around 350 sets of old-style prescriptive sets of regulations with some 100 sets of modern goal-setting ones".<sup>14</sup> The key word in the preceding statement is "replacement". Section 1(2) of the *Health and Safety at Work etc. Act* (HSWA) specifies that replacement legislation should be "designed to maintain or improve the standards of health, safety and welfare established by or under" the existing enactments; these appear in schedule 1 of the 1974 Act. There have been widespread concerns that the *Deregulation and Contracting Out Act 1994* could compromise this general principle. The Chairman of the HSC, Mr Frank Davies, has in the past given assurances that:<sup>15</sup>

"I cannot conceive that the Commission will recommend anything which will lower health and safety standards overall nor could I believe that the Government would accept it if we did"

The first application of the powers in the *Deregulation and Contracting Act* as they apply to health and safety (section 37) were the *Health and Safety (Repeals and Revocations) Regulations* SI 1995/3234. The regulations repeal and revoke enactments and instruments

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<sup>14</sup> HC Deb 17 January 1993 c.427W

<sup>15</sup> "HSC to study deregulation bill and deregulation task force recommendations" Health and Safety Commission Task Force 19 January 1994

specified in two schedules; the most controversial repeals relate to home workers. During a debate in the First Standing Committee on Delegated Legislation (28 November 1995) Mr Ian McCartney argued against the removal of a link (section 133 of the *Factories Act 1961*) between the Health and Safety Executive, local authorities and people who work at home. One survey of 338 home workers found that only 11% had received any health and safety advice, information or training from their work supplier.<sup>16</sup> Further revocations have been proposed in the areas of textile factories and agriculture.

### E. Northern Ireland

Article 12 of *The Health and Safety at Work (Northern Ireland) Order 1978*<sup>17</sup> established the Health and Safety Agency which provides advice to industry and makes recommendations to government departments. Enforcement rests with inspectors appointed by the Department of Economic Development, the Department of Agriculture or the District Councils.<sup>18</sup> The Northern Ireland Health and Safety Agency approves codes of practice aimed at providing practical guidance for satisfying health and safety regulations. For example, during 1993/1994 the Agency approved two Great Britain codes of practice dealing with the transportation of hazardous substances, as well as three Northern Ireland codes of practice (two on gas safety and one on first aid).<sup>19</sup>

Article 13(3) of *The Health and Safety at Work (Northern Ireland) Order* allows the Agency to make appropriate arrangements for carrying out and publishing research. Recent research projects which have been commissioned have provided information on training providers, the cost of work related accidents and ill health, and the health and safety information and advice needs of business. The agency also monitors research work performed by the Health and Safety Executive, some of which is discussed in the section of this paper dealing with science and engineering.

### F. Fire safety

In the UK fire safety has been treated separately both from the legislative and enforcement standpoints. Policy responsibility lies with the Home Office, the Department of the Environment and the HSE. Given the complex and fragmentary nature of fire law<sup>20</sup>, it is a gross but useful simplification to say that the main legal instruments which concern the

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<sup>16</sup> "Working at home: out of sight, out of mind" *Health and Safety Bulletin* June 1996 p.4

<sup>17</sup> SI 1978/1039 (N.I. 9)

<sup>18</sup> *The Legal Framework of Health and Safety at work in Northern Ireland* Health and Safety Agency 1995  
<sup>19</sup> *Annual Report. Statement of Accounts 1 April 1994 to 31 March 1995* Health and Safety Agency

<sup>20</sup> "Shaping the future of fire law" by Dr Ann Rosemarie Everton, in *Fire Safety Legislation* (School of Business and Industrial Management conference, 21 February 1996)

three above bodies are, respectively, the *Fire Precautions Act 1971*, the Building Regulations 1991, and the *Health and Safety at Work etc. Act 1974*. This is in line with enforcement responsibilities: fire authorities issue fire certificates for designated premises in line with the provisions of the 1971 Act. Local authorities oversee the building control process based on the *Building Regulations 1991* and the associated Approved Documents, one of which is devoted to preventing the establishment and spread of fire. Finally, the general requirements of the 1974 Act imply the need to take fire precautions, though in practice the HSE confines its enforcement to industrial processes which present fire risks.

All the above aspects of fire law have been under review with the aim of achieving a rationalisation and simplification, and draft proposals for *Workplace (Fire Precautions) Regulations* have been issued for consultation.<sup>21</sup> Under the proposals, fire safety would continue to be treated separately and enforceable in the main by fire authorities. The aim of the new regulations would be to implement (late) the Articles dealing with fire safety which were a feature of both the so-called "Framework" and "Workplace" health and safety Directives discussed in section I(C) above.<sup>22</sup> The delay has been due in part to the withdrawal of two earlier sets of proposals on the grounds that they placed an unnecessary burden on business.<sup>23</sup>

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<sup>21</sup> *Proposals for Workplace (Fire Precautions) Regulations*. Home Office, deposited paper 3400(3S) 21 May 1996

<sup>22</sup> HC Deb 21 May 1996 cc100-2W

<sup>23</sup> *Proposals for Workplace (Fire Precautions) Regulations*. Home Office, deposited paper 3400(3S) 21 May 1996

## II Science and engineering

### A. Science-based legislation

Though the *Health and Safety at Work etc. Act* is clearly the mainstay of the British safety system, the *Control of Substances Hazardous to Health Regulations* SI 1994/3246 undoubtedly represent one of the more important pieces of secondary legislation. Indeed, Robens attributed the levelling off of workplace fatalities towards the end of the sixties as partly being due to "the rapid increase in the number of new chemical substances and mixtures being brought into use in industrial and commercial processes and the greatly increased scale on which they are used."<sup>24</sup> The so-called COSHH regulations, and the associated approved codes of practice<sup>25</sup>, are intended to provide a general prescription for protecting workers from a wide range of chemical and biological agents. The regulations include duties in respect of risk assessment, prevention or control of exposure, and the maintenance of control measures, the last line of defence being the issue of personal protective equipment. They consolidate the original 1988 regulations.<sup>26</sup> Substances which are covered by separate regulations include asbestos, lead, ionising radiations and highly flammable liquids.<sup>27</sup> There have recently been suggestions that regulations controlling lead and asbestos could be incorporated into the COSHH system, but this option would be at the expense of complicating the latter, while the asbestos and lead industries have plenty of experience in dealing with the more prescriptive regulations applying to them.<sup>28</sup>

A key feature of the COSHH regulations are the maximum exposure levels for individual substances which form part of the regulations themselves. By way of example, the long-term exposure limit for exposure to arsenic is 0.1 milligrams per cubic metre of air.<sup>29</sup> This represents the maximum permissible airborne concentration to which a worker may be continuously exposed over an eight hour shift.<sup>30</sup> The formal definition of maximum exposure limit is flexible enough to take into account a variety of different exposure levels during the course of the working day.<sup>31</sup> If it is reasonably practicable for an employer to reduce the exposure level further, he is under a statutory obligation to do so.<sup>32</sup>

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<sup>24</sup> cited in *Valedictory Summary of Industrial Health and Safety since the 1974 Act* John Rimington (Director General, Health and Safety Executive) 26 April 1995

<sup>25</sup> *Control of Substances Hazardous to Health Regulations 1994. Approved Codes of Practice* HSC 1995  
<sup>26</sup> SI 1988/1657

<sup>27</sup> *Tolley's Health and Safety at Work Handbook 1996*

<sup>28</sup> *The future of the lead and asbestos regulations* Discussion Document HSC 1996

<sup>29</sup> *Control of Substances Hazardous to Health Regulations 1994, Schedule 1*

<sup>30</sup> *Arsenic and You* HSE 1990

<sup>31</sup> *Occupational Exposure Limits 1996*. EH40/96 HSE

<sup>32</sup> *Control of Substances Hazardous to Health Regulations 1994, Regulation 7(6)*

A second type of occupational exposure limit is called an occupational exposure standard, details of which are published and updated annually by the HSE.<sup>33</sup> These apply to substances where certain levels of exposure can, on the available evidence, be safely tolerated indefinitely. The airborne concentration of such a substance needs to be reduced to its occupational exposure standard as soon as is reasonably practicable,<sup>34</sup> a phrase which crops up frequently in health and safety law. As noted in *Occupational Exposure Limits 1996* (EH40/96 HSE), occupational exposure standards and maximum exposure limits are set on the recommendation of the Advisory Committee on Toxic Substances. The committee's recommendations are based on an assessment by the Working Group on the Assessment of Toxic Chemicals (WATCH) of relevant toxicological, epidemiological and other data.

Over recent years there have been major advances in the techniques of genetic modification, popularly called genetic engineering. Genetic modification involves altering an organism's DNA<sup>35</sup> so as to change its characteristics. A good deal of background may be found in three library research papers: *Genetically Modified Organisms, Transgenic Animals and Animal Patenting*, Research Paper 93/55; *Gene Therapy*, Research Paper 93/66; *Genetically Modified Food*, Research Paper 94/74.

Genetically-modified organisms (GMOs) are now used, for example, to manufacture medicinal products such as insulin, blood factor VIII and human growth hormone which had previously been produced from humans or animals with an attendant risk of transmitting disease. Like any technology, genetic modification has certain risks and regulations have been drawn up in response to these. The risks include the possibility that some infectious or drug-resistant micro-organisms might be produced inadvertently, or that genetically engineered features that may be desirable for one organism could be transferred to another. An example of the latter could be the inadvertent transfer of genetic material imparting herbicide resistance from a crop to a weed.

The Health and Safety Commission's Advisory Committee on Genetic Modification has recently published a report<sup>36</sup> which summarises the current controls. In the context of genetic modification these comprise regulations governing the contained use and the release and marketing of GMOs. *The Genetically Modified Organisms (Contained Use) Regulations* SI 1992/3217 (as amended) were made under the *Health and Safety at Work*

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<sup>33</sup> *Occupational Exposure Limits 1996*. EH40/96 HSE

<sup>34</sup> *Control of Substances Hazardous to Health Regulations 1994*, Regulation 7(7)

<sup>35</sup> deoxyribonucleic acid; this is made of long molecules comprising (in humans) several billion atoms joined together. Some segments of the DNA molecules are genes which influence the characteristics of living organisms.

<sup>36</sup> *Genetic Modification. Risks and Safeguards* HSC 1995

*etc. Act 1974*, and require risk assessments, notification arrangements and suitable containment measures to be in place. The regulations constitute the UK implementation of Council Directive 90/219/EEC on the contained use of genetically modified micro-organisms.

*The Genetically Modified Organisms (Deliberate Release) Regulations SI 1992/3280*, made under the *Environmental Protection Act 1990*, implement Council Directive 90/220/EEC. Amendments were introduced by the *Genetically Modified Organisms (Deliberate Release) Regulations SI 1995/304* in response to Commission Directive 94/15/EC and Commission Decision 94/730/EC. The regulations require that, before a GMO is released into the environment, a dossier of information about the organism and its effects must be submitted to the Secretary of State and his consent given. *The Genetically Modified Organisms (Contained Use) Regulations SI 1993/15* were made, unlike the 1992 regulations of the same name, under the *Environmental Protection Act 1990*. They determine which organisms are subject to the risk assessments required by the 1990 Act before they may be imported, acquired, released or marketed.

This section has provided two examples of ways in which science impinges on health and safety legislation: hazardous substance control and the new technology of genetic modification. Further EC directives are under negotiation in both these areas, in response to developments in knowledge and technology. Domestic regulations are also being introduced or planned in response to privatisation and market liberalisation; examples include the *Mines (Special Hazards) Regulations*, the *Gas Safety (Management) Regulations* and the *Railway Safety Miscellaneous Provisions Regulations*.<sup>37</sup>

### **B. Research laboratories**

A large number of laboratories and organisations perform scientific research of relevance to health and safety. In addition to university departments and industrial laboratories, obvious examples from the public sector include the Building Research Establishment. The BRE, which includes the Fire Research Station, is an executive agency of the Department of the Environment.<sup>38</sup> Work performed by the Fire Research Station ranges from full-scale experimental fire tests, as well as computer modelling, aimed at understanding the variety of factors (such as the building materials used) which influence the spread of fire. Monitoring of evacuation exercises and human behaviour in these situations has also been undertaken. This work is of direct relevance to *Approved Document B* published to provide practical guidance on compliance with the fire safety

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<sup>37</sup> *Plan of Work for 1996/97 HSC 1996*

<sup>38</sup> *Building Research Establishment. Annual Review 1994*

aspects of the *Building Regulations* SI 1991/2768. Ongoing research will most likely influence any revisions of this document. Building Regulations Approved Documents also refer to British Standards, reports and other guidance; a fire safety engineering code in the form of a British Standard will eventually be one tangible result of recent BRE work.<sup>39</sup>

Further information on the Building Research Establishment and government plans to move it into the private sector appear in *Prior options review of public sector research establishments* (House of Commons Library Research Paper 96/69, 10 June 1996). This paper also provides a list of other public sector research establishments which have been reviewed in order to assess their suitability for privatisation. Among the examples with an obvious health and safety angle are the Medical Research Council's Toxicology Unit and the National Radiological Protection Board established by the *Radiological Protection Act 1970*.

The outcome of the prior options review in relation to the Health and Safety Laboratory, which was due to be completed by March 1996<sup>40</sup>, is currently with Ministers.<sup>41</sup> Formerly the Research and Laboratory Services Division of the Health and Safety Executive, this was given its present name in 1994 and became an Agency of the HSE on 1 April 1995.<sup>42</sup> The aims and objectives of the Health and Safety Laboratory are set out in its *Framework Document* (HSL, April 1995):

2.1 The Health and Safety Executive has a mission to ensure that risks to people's health and safety from work activities are properly controlled. It requires a reliable source of research, scientific services and intelligence to support this mission, and HSL's primary aim is to be a first choice supplier of such requirements.

2.2 HSL, as a laboratory-based centre of scientific excellence, will continue to be an authoritative generator and supplier of scientific intelligence in the areas of technology in which the Health and Safety Executive has long term interests.

2.3 HSL will also provide scientific services and advice connected with health and safety to other organisations.

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<sup>39</sup> "Part B of the Building Regulations: The Need for Change" lecture delivered by Anthony Ferguson (Building Regulations Division, Department of the Environment) at a conference on *Fire Safety Legislation* organised by the School of Business and Industrial Management, 21 February 1996

<sup>40</sup> HC Deb 23 November 1995 c.238W

<sup>41</sup> source: Department of the Environment spokeswoman

<sup>42</sup> *Health & Safety Laboratory. An agency of the Health and Safety Executive HSL 1995*

2.4 The core objectives pursuant of HSL's aims are:

- (a) to carry out and publish research and provide scientific and forensic services to high scientific and ethical standards to meet the needs of its customers in a cost effective way;
- (b) to continue to maintain and advance its scientific competence and expert knowledge of scientific developments relevant to health and safety world-wide to meet the needs of its customers;
- (c) to achieve the annual financial, efficiency and quality of service targets agreed with the Health and Safety Executive;
- (d) to achieve the effective exploitation of intellectual property, in conjunction with the relevant customers;
- (e) to improve the quality and effectiveness of services to customers by carrying out seed-corn research to maintain and develop its scientific capability and expertise in relevant key areas of technology.

2.5 The detailed requirements of these core objectives will be revised annually and published in an Annual Performance Agreement between the Health and Safety Executive and HSL.

The laboratory employs nearly 400 people, the majority being scientists or technical specialists.<sup>43</sup> In 1994/95 the Health and Safety Executive spent about £27.6 million on research,<sup>44</sup> with industry providing further funds. Most of this research is contracted out but having the "in-house" HSL will contribute to the Executive's ability to assess, interpret and direct the science which underpins much of its work. By delegating these functions to the HSE, the Health and Safety Commission aims to satisfy its statutory duty, under section 11(2)(b) of the Health and Safety at Work etc. Act, to make appropriate arrangements for health and safety related research.

The HSL has two sites: at Sheffield and Buxton, Derbyshire.<sup>45</sup> Work is organised into an Internal Services Group, a Corporate Support Group, and six Science Groups: Process Hazards, Explosion Control, Engineering Control, Biomedical Sciences, Workplace Control and Environmental Measurement. The laboratory's facilities are available to UK

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<sup>43</sup> *Health & Safety Laboratory. An agency of the Health and Safety Executive 1995*

<sup>44</sup> *Annual Report 1994/95 (HSC 1995)*

<sup>45</sup> *Health and Safety Laboratory. An agency of the Health and Safety Executive. 1995*

industry on a repayment basis, with the aim of recovering the full cost. Much of HSL's work is concerned with supporting HSE investigations of accidents, for example through the provision of forensic services. HSL contributed to the investigations which followed the Kings Cross underground fire, the Hillsborough football stadium disaster, and a range of fairground accidents among others. On one occasion, the HSE reconstructed a large scaffolding structure in order to determine the reasons for the collapse of the original.<sup>46</sup> Routine monitoring work, such as measuring radiation levels near nuclear plants, is also performed. Some case studies describing longer term research are described in the next section. During 1996/97, the HSL completed 72 projects and had 120 papers approved for publication in the scientific literature.<sup>47</sup>

### C. Case studies

Three years ago, the HSE organised a conference entitled "Science and the Advancement of Industrial Health and Safety, which took place during the British Association's Annual Festival of Science."<sup>48</sup> The conference included presentations entitled "Driving for better driver vision", "You can't trust dust" and "Bugs in the system". Below, each of these case studies is described in turn, drawing directly from the summaries produced at the conference.

Restrictions on a driver's field of vision have clear implications for road safety.<sup>49</sup> What the driver is able to see is determined both by the vehicle design and the environment in which it operates. One specific example related to a fatal accident which involved an underground mining vehicle where confined space and poor illumination were contributing factors. Following the accident investigation, the HSE constructed a three dimensional computer model of the vehicle, and a range of drivers differing in physique. The computer could simulate the view that any driver would have while in the vehicle, identifying blind spots. As a result of this work, which involved cooperation with the vehicle manufacturers, drivers and the mines inspectorate, design changes to the vehicle were recommended.

Collaborative work involving industry, the Institution of Chemical Engineers and the HSE has included studies of dust explosions.<sup>50</sup> Coal dust, flour, icing sugar and custard powder

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<sup>46</sup> "Science and the Advancement of Industrial Health and Safety" John Mason Conference, 3 September 1993

<sup>47</sup> *Plan of Work for 1996/97* HSC 1996

<sup>48</sup> "Science and the Advancement of Industrial Health and Safety" John Mason Conference, 3 September 1993

<sup>49</sup> "Driving for better driver vision" Dr Mark Boocock, John Mason Conference HSE 3 September 1993

<sup>50</sup> "You can't trust dust" Dr Geoff Lunn, John Mason Conference HSE 3 September 1993

are just four examples of dusts which can explode given the formation of a suitable cloud and a source of ignition. If measures to remove these risks fail, then the next link in the defensive chain will involve containing, suppressing or venting an explosion so that its destructive energy is channelled harmlessly. There are severe limitations on the extent to which a dust explosion can be simulated on a computer, particularly in the context of the contours of a real-world factory. For this reason, it is often necessary to perform actual experiments as a prelude to formulating safety guidelines.

Micro-organisms, such as bacteria, viruses, some fungi and parasites, are covered by the *Control of Substances Hazardous to Health Regulations* SI 1994/3246. The workplace risk associated with a given micro-organism will depend on its virulence and the scale of exposure.<sup>51</sup> Since there is little information on the levels of exposure in typical workplace environments, or of the exposure levels which pose a risk to health, a number of studies have been performed which use a variety of techniques to measure exposure. Furthermore, the ability of biological organisms to reproduce and infect at very small doses complicates the picture, and there are currently no set occupational exposure limits for any of these. In some cases this means that exposure should be reduced to any level large enough to be detected.<sup>52</sup>

A good indication of future research priorities in science with workplace safety applications may be obtained from the Health and Safety Commission's *Plan of Work for 1996/97*. The HSE and HSC together plan to spend about £25 million on research during this financial year; research which will be carried out by a range of contractors including the Health and Safety Laboratory, in several cases involving collaboration with industry, other government departments and the European Union. One project will look at how the material properties of the graphite present in some nuclear reactors change as a result of irradiation. This has implications when one comes to decommission the reactor at the end of its operating life. How compressed air environments, such as in tunnels, affect the spread of fire is another planned project, as is the computer simulation of underground fires. A range of research projects aim to assess the impact of interventions, whether these take the form of regulations or campaigns. In this category will be included evaluations of the *Manual Handling Regulations* SI 1992/2793 and the recent *Asbestos Awareness* campaign. Tests are to be performed on mining explosives and on smoke control systems in underground rail networks. Other projects relate to below-ground dust, hand-arm vibration, safety in the glass industry and work-related stress.

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<sup>51</sup> "Bugs in the system" Dr Brian Crook, John Mason Conference HSE 3 September 1993  
<sup>52</sup> *Control of Biological Agents. Approved Code of Practice* HSC 1995

### **III Further reading**

*Health & Safety Laboratory* HSE/HSL 1995

*Safety in Numbers?* (Report and Summary) Parliamentary Office of Science and Technology June 1996

Health & Safety Commission Annual Report 1994/95

*Valedictory Summary of Industrial Health and Safety since the 1974 Act* John Rimington (Director General of the HSE) 26 April 1995