Health and Safety Executive Board			HSE/11/04
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TRIM Reference:	2011/32914		

Science Report 2011

Purpose of the paper

1. The Board has asked for an annual Science report to cover the use, efficiency and effectiveness of HSE's investment in science commissioned from the Health and Safety Laboratory (HSL) and external contractors. This is the third of these Science Reports.

2. The Board is asked to note and comment on the report and oral briefing from the Chief Scientific Adviser (CSA).

Background

3. HSE's mainstream budget for commissioned research and technical support in 2010/11 is ~ £38.7m[1]. In addition, about 1000 staff use their knowledge and skills to contribute scientific, engineering, technological and analytical expertise to the management of risk and development of evidence based policy.

4. The research and technical support develops HSE's extensive knowledge base and intellectual property, which gets national and international recognition for its quality and potential market value. This work is essential underpinning for HSE's role as an evidence based regulator.

5. The third annual Science Report for 2011 is at Annex 1.0 and describes:

- background information about HSE's scientific requirements;
- how HSE uses science and research in its work, with examples of recent applied research and investment in HSE's futures work;
- how HSE is working to demonstrate the value of its commissioned work;
- progress towards the rolling science plan 2011/14 and plans for longer term strategic work at HSL and;
- an update on governance including the CSA's second science review of HSL and the approach to efficiency in science commissioning and management;
- some emerging risks and future challenges.

Argument

6. The Science Plan for 2010-13 was prepared during 2010 and is based on the Strategy. The Plan is based on needs stated in business cases approved by

[1] This excludes funding for science to support the Nuclear Directorate and which has separate arrangements and the pesticides research programme that is funded by DEFRA.

programme directors. The Science Plan incorporates a strategic statement for science which is also included in this Science Report (annex 1.8).

7. Funding for the Science Plan was allocated from the mainstream research budget to meet reactive support requirements in full, before resources were allocated to research projects. Additional funding was available during 2010 for projects that would support the Strategy, including research into emerging energy technologies and the impact of interventions.

8. The Science Report 2011 explains arrangements for scientific work and includes examples of research completed and published in 2010 and describes the progress with respect to demonstrating the use and value of science. It provides an update on progress with the three year rolling science plan, including the development of a long term strategic programme of research at HSL. The report also provides information on the HSL Investment Research Programme and futures work. The preliminary work to increase efficiency in HSE's science governance arrangements is also set out.

9. The report also describes how the quality of scientific work at HSL is being demonstrated in terms of peer-review and independent expert science reviews.

Action

10. To note and comment on the Science Report 2011 and to continue to support the CSA in his approaches to long term science planning and improvements in commissioning science and to support the progress made with evaluating science.

Paper clearance

11. This paper was cleared by SMT at its meeting on 12 January 2011.

Annex 1.0

Health and Safety Executive

Science Report 2011

1 Introduction

1.1 This report covers HSE's use of commissioned research and technical support during the last year. It reviews key areas of performance, including progress on activities reported to the HSE Board in the Science Report 2010.

1.2 There are four sections:

- background information about HSE's scientific requirements;
- overview of the use and value of science commissioned in 2010/2011;
- progress on the rolling science plan for 2010/2014; and
- managing business risk and an update on governance including the Chief Scientific Adviser's (CSA) second science review of HSL, commissioning and management of science projects and capability issues.

2 Background

2.1 HSE commissions research and technical support to:

- support HSE's front line operational work, using forensic work and technical support for inspections, investigations and enforcement;
- acquire evidence to develop new ideas and knowledge about occupational safety and health;
- apply new ideas and knowledge to new regulations, policies, guidance, standards, inspections, enforcement methods and other interventions; and
- evaluate and disseminate the new knowledge and results of this work.

Support for operational and regulatory work

2.2 HSE's core requirement is for scientific, technological and engineering support for its operational and regulatory work. As in previous years, this requirement accounts for about 2/3 of our expenditure on commissioned science. It includes support for investigations and major incidents conducted by both HSE and Local Authorities.[2]

2.3 HSL is HSE's principal provider of forensic scientific support and has expertise and capacity in a wide range of disciplines. In 2010/2011, HSE commissioned ~ £7.5m support for investigations and major incidents from HSL. HSE also commissioned up to ~ £0.9m support from other providers where HSL has limited or no expertise.

2.4 HSE commissions ~ £18m planned support (mainly from HSL) which covers a range of activities, principally running operational and policy projects and developing HSL's capability. This is to make knowledge and information available to HSE to discharge functions such as developing early thinking on policy formulation.

[2] Annex 1.1 includes a glossary of definitions of reactive support, planned support and research

Research

2.5 HSE commissioned ~£10m of applied research in 2010/2011[3]. HSE does not normally commission pure academic research. There is 'futures' capability at HSL to identify emerging trends and technologies to inform HSE's future priorities and strategy.

2.6 Wherever possible, HSE aims to commission research in partnership with relevant industries and stakeholders, and collaborates with national, international and EU programmes.

Futures work

2.7 Futures work is becoming more embedded within HSE as it contributes to bodies such as the Strategy Steering Group and as specific studies are commissioned and used to help HSE business and research planning. Annex 1.3 describes the work of the Futures Group.

3 Overview and use of science in 2010/11

Mainstream research

3.1 As in 2009/2010, commissioned work is managed in four main science programmes:

- Justice - covering technical support for HSE's inspection, investigation and enforcement work, and for Local Authorities;
- Conventional Health and Safety – mainly research that supports the development and delivery of policy initiatives and operational interventions. It includes a small number of projects identified by Local Authorities;
- Major Hazards – support for HSE's work in the major hazards sectors: offshore and onshore, mines, explosives and biological agents; and
- Corporate – covering projects with a longer term or analytical perspective, important work not managed elsewhere, and currently includes resource to develop and maintain capability at HSL.

3.2 In July 2009 the CSA issued a call for proposals from HSE Directorates and science customers to be considered within a new 3 year rolling Science Plan. The 2010/11 Science Plan took account of the Strategy and of advice from workshops that involved policy makers, specialists from HSE and HSL.

3.3 During 2010 the science programmes have commissioned about 150 new projects and a similar number of small support projects costing < £30k each.

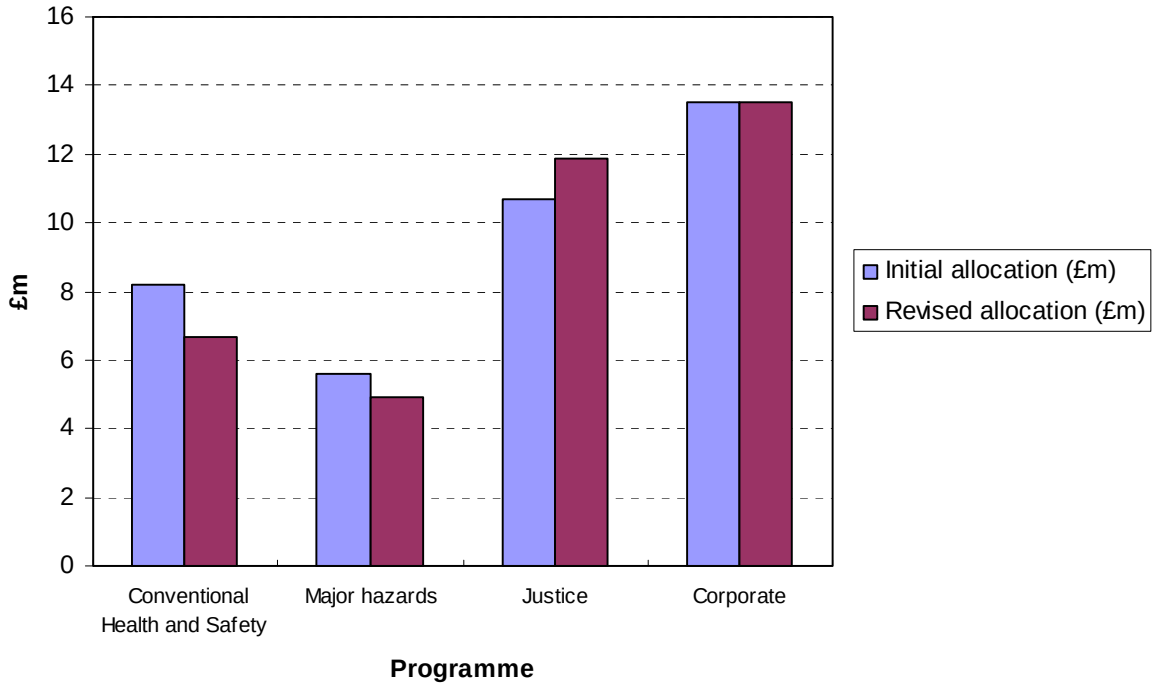
Finance and cost recovery

3.4 In 2010/2011 HSE planned to spend £29.98m with HSL and £6.39m with other contractors. An additional budget of £2.35m was allocated to fund projects that would support the Strategy, including research into emerging energy technologies and the impact of interventions.

[3] Annex 1.2 includes criteria for commissioning science

3.5 The chart below illustrates the initial and revised allocations of the mainstream science budget to the four science programmes. The initial allocations were based on the agreed Science Plan. The revised allocations represent reprioritisation in year – the most marked being an increase in funds for the Justice science programme. This was mainly due to increased activity in reactive support e.g. investigating incidents and Court work by HSL staff.

HSE commissioned science allocations (February 2010) and forecast (December 2010)



3.6 A number of on-going science projects are jointly funded with industry or have some collaborative funding. For example, there are 8 out of 25 extramural commissions in the Major Hazards science programme. The value of these is ~ £4m, with HSE's contribution being £360k, approximately 9% of total sponsor contribution. For the Conventional Health and Safety science programme, 9 out of 25 extramural commissions have collaborative funding. The value of these is ~£1.85m, with HSE's contribution being ~ £635K, or 34% of total sponsor contribution.

3.7 Approximately £2.1m of the allocation to Major Hazards science programme in 2010/11 is cost recoverable. This follows our policy to recover costs incurred in the operation of permissioning regimes, either as costs attributable to an individual company or as 'common good' work. This equates to approximately £1.3m of "common good" activity, together with £700k of COMAH assessments and £40k of offshore assessments which are directly recoverable from an individual site or dutyholder.

Examples of work commissioned in 2010/2011

3.8 The work includes a diverse range of topics and requirements. Annex 1.4 includes case studies of recent work, including:

- Risk communication in the 21st Century
- The burden of occupational cancer in Great Britain

- Offshore working time in relation to performance, health and safety
- Learning lessons for the London 2012 Olympic and Paralympic games
- Communicating health and safety messages to young learners in vocational education and training
- Tower crane incidents worldwide
- Ageing and work-related musculoskeletal disorders

3.9 HSE also contributes to HSL's Investment Research Programme (IRP). The IRP enables HSL to undertake innovative research, and develop links with other institutes, to develop new capabilities, methodologies and experimental approaches. IRP funding is allocated to: HSL's strategic programmes (about 40%); individual projects (about 40%); product development (about 10%); and scientific publications (under 10%). HSL's own contribution to IRP in 2010/11 will be approximately ~ £750k.

3.10 Recent IRP work includes:

- strategic programmes to develop capability on emerging energy technologies e.g. characterising 'hydrogen economy' safety issues, including developing the only high-pressure experimental facility in Europe;
- delivering solutions to virology challenges, including through the development of new virus culture systems;
- collaboration with NIOSH (US) on health investigation questionnaires;
- strengthening the fracture mechanics capability including the development of a more reliable toughness test for small specimens – an important area for incident investigations and;
- composites in safety-critical structures.

Nuclear and pesticides research

3.11 There are separate management and funding arrangements for science in the Nuclear and the Chemical Regulation Directorates. The Nuclear Directorate and nuclear licensees work together to manage a programme of support and research which is funded by licensees. The Chemical Regulation Directorate manages a pesticides research programme that is funded by DEFRA. There is increasing collaboration between these and the mainstream.

Demonstrating the use and value of work commissioned or completed in 2010/11

Reactive support

3.12 All reactive work to support investigations and enforcement activity, is managed by the Justice science programme. This work is next due to be evaluated (on a 3-year sample basis) in 2011/12 with the next report due at the end of 2012.

3.13 In the meantime the predominant view from customers is that HSL provides essential, high quality support for operational work – and that HSE accepts the cost incurred in ensuring that this support is available and delivered in a timely way.

3.14 Preliminary data from a review of reactive support show that support from HSL is requested for a relatively small proportion of HSE's operational investigation work. Feedback indicates that this support is for the more scientifically and technically complicated cases where success has a high reputational value for HSE:

- In budgetary terms, we have been spending ~ £5.0 - £6.0m per annum with HSL over the last 3 years, but a recent assessment puts the actual value at nearer ~ £7.5m.
- Most reactive support is concerned with incident investigation. HSE investigates around 4500-5000 incidents each year and HSL receives requests to support HSE's specialists in about 250 of these cases each year.
- HSE prosecutes between 500 – 600 cases per year. HSL provides support to at least 10% of these.
- At any one time, HSL may have up to 600 reactive support projects in progress. About 70% of jobs take less than 150 days to complete.

Research

3.15 Using the new contract management system, we have been able to identify variations in performance. Data on projects commissioned during 2010 show that ~23% of projects have been amended to reflect changes in time, cost or both, compared with ~25% of projects for the same period last year. Variations from plan are made to reflect changes in HSE's requirements, delays due to the suppliers or unavoidable circumstances (e.g. bad weather affecting outdoor experimental work and technical issues).

3.16 In the previous Science Report we acknowledged that procedures for demonstrating the value and impact of our science in the achievement of key business objectives needed improvement. Feedback from science customers provides consistent evidence that we receive high quality scientific outputs from HSL and external providers, but we recognise that we need better information about how these outputs are used by HSE and others.

3.17 The evidence from the most recent, albeit small, sample about projects with a total cost in excess of £2m, is that over 90% of respondents rank the work as either good or excellent.

3.18 This sample is also representative of the feedback received in response to questions about the utilisation and eventual impact of science outputs. We have reasonable data about published outputs (research reports, peer reviewed journal articles) which are listed in Annexes 1.5-1.7.

3.19 However we have less helpful information about how the results have been used and relatively little about estimated impact. The current question set asks science customers to reflect on these points, but there is often a break in the continuity required to provide longer term feedback. At best, the value can be inferred from what we know about HSE's activities.

3.20 The examples below give an indication of the diversity of work and illustrate the nature of current feedback on utilisation and impact. They highlight where further work could be undertaken in the years following completion to demonstrate impact in a more positive way.

- *Occupational Respiratory Disease*

A programme of work over ~ 2 years aimed to produce a standard of care for occupational asthma. HSL/HSE also produced a number of research reports, peer reviewed publications and presentations. Feedback in 2009 explained the intention

to extend the standard of care approach to COPD and to ensure that the messages in this work are embedded and behaviours changed in the appropriate target groups.

- *Accidents, ill health and lost time amongst construction workers*

This 'omnibus survey' has been in place since 2005 to provide sound statistical data about construction workers and rolling indicators of changing risk exposure and management practice. An evaluation of 'wave 2' supports its use as a standing survey, showing that the survey provides detailed information not available from other sources, including information about employment status, qualifications, experience and migrant workers. The full data set is reproduced on HSE's website and data are widely used by the construction sector, inside and outside of HSE. Wave 3 has been completed and HSE has recently agreed to continue the survey, although decreasing the frequency from annual to every 3 years – thus improving cost effectiveness whilst retaining the value of the trend analysis.

- *Poultry workers*

Two pieces of work have contributed directly to the control of exposure to dust on poultry farms. The first provided visual information to show the types of activity that produce dust, creating material for a talk for employees in the industry and a new guidance note ('Is poultry dust making you ill?'). The materials would be disseminated via HSE's website and to trade associations. The second contributed to the development of a bench mark standard for controlling exposure to dust on poultry farms.

- *Bioaerosols in composting*

This piece of work took about 2 years to complete (cost ~ £120k) and was designed to add to the sparse knowledge about potential health risks arising from the composting of green waste. It produced 'risk zones' based on the levels of bioaerosols at different distances from varying activities on composting sites. The results were presented to the Waste Industry Safety and Health (WISH) forum.

- *Developmental work into new analytical techniques.*

This project aimed to develop an immunoassay to detect isocyanate metabolites in order to measure exposure of workers in the motor vehicle repair industry. The work was exploratory and terminated early at proof of concept stage owing to difficulties with raising the appropriate antibody. HSL may choose to invest to produce a commercial product. This example illustrates the timescale for development work. A true indication of impact would be dependent on successful development and application that could take many years

Improving how we demonstrate the use and value of science

3.21 This year we have begun a programme of work that builds on the reports and research conducted in previous years and will deliver results over the next 18 months. We are revising the methods used to gather post project evaluation data from science customers and policy makers. In future, on project completion, we will expect all science customers to complete a short questionnaire about project management and output delivery. We will then follow up selected projects at intervals with face to face structured interviews to establish how the outputs are being used, and by whom, within the organisation.

3.22 We will also explore the merit of bringing together policy makers and specialists to produce overviews/case studies of science utilisation in specific topic

areas where we have commissioned significant volumes of research over a number of years. We aim to have the new questionnaire in place by the end of the financial year and pilot topic based science utilisation by summer 2011.

3.23 We could use this proposed approach to identify how other organisations have used our research and technical support. The main area where HSE can demonstrate the wider commercial value of its knowledge base and intellectual property is at HSL which currently generates over £8 m per year, which represents ~21% of its overall income from external customers in the private sector and other government departments.

Developing strategic research programmes

3.24 In 2009/10, £4.96 m was set aside in Core Activity Programmes (CAPs) to maintain HSL's skills and competencies in disciplines considered essential for HSE's requirements for frontline activities.

3.25 Following a review in 2010/11 this was capped at £2.5m. Some of the work funded under the previous CAPs is now funded directly by the appropriate science programme. New arrangements will be put in place from April 2011 to develop staff expertise by diverting their time and funding to a longer term Strategic Research Programme at HSL. This is intended to ensure that HSL staff develop their capabilities and knowledge and that HSE is better prepared for future changes in the workplace that may give rise to new risks. It will include: health surveillance, mathematical modelling and dose-response profiling. A separate staff development fund will allow HSL to provide training for staff which will enable them to work in other parts of HSL.

Communicating results

3.26 Publication in peer reviewed journals is an indicator of the quality of scientific work, and is recognition of the status of HSE and HSL in the science of health and safety at work. Together with papers in conference proceedings, these publications are also an important means of disseminating findings to and engaging with key stakeholders - in particular health and safety professionals in the major hazards industries, occupational hygienists and occupational physicians.

3.27 Annex 1.5 lists HSL's 2010 scientific publications from January to November 2010. These describe work undertaken for both HSE and external customers.

3.28 Peer-reviewed publications are particularly important where work provides part of the evidence base to inform significant policy or guidance development; is likely to be used to challenge information used by duty holders; or may be subject to challenge where it is used to inform responses to high-profile issues raised by interest groups. The Chief Scientific Adviser is championing the importance of peer-reviewed publications. The 'Added Value' initiative introduced by him in September 2008 following discussions with HSL's Head of Science is being used to fund the publication of work where there is clear value to HSE, but where a publication was not part of the original work commissioned: for instance lessons learned from a range of incidents. The 'Added Value' publications which appeared in print in 2010 and are listed in Annex 1.6.

3.29 Annex 1.7 lists publications prepared by external researchers following research commissioned by HSE with them. Following last year's report we have included clauses in our standard contracts requesting contractors to supply HSE with electronic copies of material published and resulting from research commissioned by HSE. There is no contractual requirement to inform HSE of publications following expiry of a contract, these are therefore difficult to trace.

3.30 This year we have adopted a simplified format to translate research findings into a more digestible format for policy/decision makers. The new 1-3-25 approach, (based on a system developed by the Canadian Health Services Research Foundation and increasingly used in UK government departments) now requires reports from HSL and external contractors, to be structured with one page of main messages, 3 pages of executive summary and up to 25 pages of findings, with any additional data attached in appendices.

3.31 During 2010 the value of our science has been recognised by others and a number of HSE/HSL staff have been presented with awards, these included:

- the award to HSE's Mike Bilio of the prestigious Frank Lees Medal by the Institute of Chemical Engineers;
- the British Occupational Hygiene Society Bedford Prize for the best paper published in 2008/9 which was awarded to an HSE/HSL collaborative European project on "Conceptual Model for Assessment of Inhalation Exposure: Defining Modifying Factors"
- the award to HSE's Ian Buckland of the Hutchinson medal by the Institution of Chemical Engineers for a paper he co-wrote with HSL colleagues on fire resistance;
- the award to HSE's David Painter and HSL colleagues of the Hutchinson medal by the Institution of Chemical Engineers for a paper on deflagrations and detonations and;
- an award by East Sussex Police of a 'Serving Sussex Award' to the Festival Fireworks incident team comprising members from HSE's Specialised Industries Division and HSL's Explosion Safety Unit.

4 Progress on the Science Plan for 2011–2014

4.1 As agreed by the Board, the plan will continue to be structured to follow the themes and goals of the Strategy. This will include a brief Strategic Statement on Science (Annex 1.8).

4.2 The 2011/14 plan will provide information about on-going programmes of work, including HSE's support and forensic requirements, and an outline of emerging new areas of work. The plan will help manage continuity of funding and planning at HSL and enable HSE to specify scientific support commitments year on year and to build a more coherent research strategy over a 3 year time frame. The work agreed for the HSL long term Strategic Research Programme will also be incorporated into the 3 year plan although delivery will extend beyond the timelines of the plan.

4.3 In July 2010 the CSA issued a call for proposals to be considered within the 3 year rolling plan. A preliminary sift of over 150 proposals has taken place and a number of proposals in key areas have been identified, subject to further consultation on scope and methodology as appropriate. These include:

- Corporate statistics, social research and economic analysis to meet Board requirements;
- Long latency diseases, including health surveillance.
- Construction surveys;
- Sector-based requirements.

4.4 We have held a number of small internal workshops to explore further and prioritise some of the proposals in the following categories in greater detail: long latency diseases, musculoskeletal disease, noise and vibration and behavioural economics.

4.5 The CSA has asked HSL to develop long range thinking around five futures issues: waste and recycling, demographics, emerging energy technologies, ICT issues and biotechnologies. These will be commissioned through the Corporate science programme during 2011/12.

4.6 To ensure that the plan incorporates new emerging ideas in support of the Strategy and depending on future funding, we will issue a further call for proposals in 2011/2012.

5 Managing business risk and other governance issues

Business risk

5.1 At the beginning of 2010 HSE's corporate risk management arrangements identified the risk of inappropriate or ineffective provision and use of Science to deliver HSE's business objectives as leading to:

- lack of identification, provision and use of specialist advice to the front line to support sound regulatory decisions;
- lack of agreed benchmarks and standards in emerging technologies to support dutyholders in health and safety management, and HSE in regulatory decisions;
- lack and use of evidence to support HSE's policies, strategy, plans and interventions; and
- lack of forward look to position HSE to regulate new hazards in the longer term.

5.2 The CSA has systems and procedures in place to ensure that:

- advice is sought and effectively used where appropriate;
- research is targeted correctly in agreeing a Science Plan;
- research is effectively managed and used through research procurement and project management systems and procedures;
- sufficient capacity of specialists to support science delivery – the workforce strategy underpins related activity to secure specialist capacity and capability in line with business need and
- HSE staff can identify and access in-house specialist resource easily using the newly updated Science Portal on HSE's Intranet.

5.3 The CSA is also responsible for developing a range of ongoing activities to equip scientific and engineering (S&E) staff with clear continuing professional development (CPD) requirements and access to associated development materials

and training. This activity will establish corporate expectations and a framework for CPD across the S&E community.

5.4 The framework will provide a visual model to show staff how to achieve CPD that meets the expectations of relevant professional bodies, and is clearly aligned with HSE business needs. It will include a high level statement of corporate expectations and a guide to managing CPD - drawing on existing good practice including a mix of self learning, on-the-job experience plus formal training, contributing papers to conferences etc.

5.5 The merger of CSAG and the Corporate Specialist Division on 5th July 2010 has allowed the CSA to develop the synergies between the disciplines between the two groups. The merger provides a visible, flexible corporate science and engineering resource accessible to all parts of HSE and focussed on delivering HSE business priorities. For example, Social Science Advisers now work more closely with human factors, ergonomists and psychologists specialists.

Emerging risks and future challenges

5.6 There are a number of trends emerging which unless they are addressed will become significant business risks for research and technical support, these include:

- difficulties prioritising HSE's work and external contracts at HSL in areas of high demand and specialised resources e.g. major hazards;
- ensuring HSE retains its in-house expertise including the ability to identify important trends for HSE to acknowledge and research;
- whether staff will have the capacity to commission research as a science customer along side pressing operational and other work.

5.7 While some of these risks can be mitigated by proposed new commissioning arrangements (see paras 5.12-14), current constraints on recruitment and procurement and reductions in the science budget will limit our ability to manage these risks in the short term.

Governance

CSA science review of HSL

5.8 The CSA has a plan to review the quality of HSL's scientific activities over a four-year period.

5.9 The second of these reviews was conducted in October 2010. This covered fire, process and explosion safety. It also reviewed HSL's incident investigation work, focussing on the work of the ICL and Buncefield incident investigation teams. The review team, headed by the CSA, included Dr Jay Keller, Sandia (USA), Professor Vincent Tam, Kingston University and BP Exploration and Professor Jacqueline Akhavan, Cranfield University. The CSA asked the independent reviewers to focus on the following issues: quality of research and other outputs, quality of staff, national and international standing, adequacy of facilities and equipment, adequacy of collaborative engagement, and how research work was commissioned, solicited, planned, prioritised and disseminated.

5.10 After working through an information pack before the visit, the review group made a 2-day visit to HSL Buxton on 6-7 October 2010, and met with HSL management and staff and toured some of the laboratory facilities.

5.11 The reviewers concluded that:

- excellent work, both research and technical support, is being delivered by HSL;
- staff are good, well qualified and using good facilities available in Buxton;
- there is good work being done on career structures and staff development;
- HSL demonstrated real-world, applied work, not blue-sky work. These are areas that HSE is rightly interested in;
- staff are well-respected outside HSL and overseas and;
- there is good evidence of high profile international work and collaboration by some individuals and teams.

5.12 Many of the recommendations from the review concerned the development of people and arrangements for succession planning, particularly in those areas where customer demand is greater than HSL's immediate ability to supply. An action plan is being developed with HSL.

5.13 The 2011 CSA Science review at HSL will cover human factors and risk science. Whilst focussing on these disciplines, the review will also cover knowledge transfer by HSL including: development of guidance and practical tools, training courses; developing risk education for undergraduates in safety critical professions, and engagement with health and safety professionals through peer-reviewed journals and conferences.

Procurement of HSE science

5.14 The direct administration (planning and management) cost to HSE of the four science programmes is ~£1m. The Chief Executive, CSA and Director of Planning and Finance have informally identified that current arrangements appear to be complex, and that value for money and the application of results are unclear.

5.15 A review of the current arrangements requested by the Board in February 2010 started in mid 2010 which built on the workforce planning review undertaken in 2009. The latter review identified that a high turnover in staff will take place over the next 18 months as staff retire, providing the opportunity to re-shape the roles, responsibilities and functions of science business partners, project officers and their support staff; develop a succession plan; manage the transfer of knowledge and experience and establish career progression arrangements.

5.16 The review is concentrating on improving managers' accountability for planning and commissioning research and technical support (including the use of the outputs), and on improving working relationships between HSE and HSL. The review is due to report before the end of March 2011.

Annex 1.1

Glossary

Scientific and technical support

Scientific and technical support for operational activities accounts for ~ 2/3 of HSE's spend This work generally involves the utilisation of existing information and/or provision of such information in a usable form. Most support work is characterised as meeting relatively short term, immediate operational demands. It is categorised as reactive or planned support.

Reactive support
Support is classified as 'reactive' if it used to:

- investigate a specific incident, or accident, and any subsequent enforcement activity;
- investigate local issues and matters of evident concern identified at inspections of particular factories/premises; or
- answer specific questions about HSE's policies e.g. Parliamentary Questions on sheep dips, Freedom Of Information requests etc.

Planned support
This includes a range of activities to deliver HSE's requirements, principally operational and policy projects and developing capability. Most is supplied by HSL. Planned support includes:

- Work to assimilate information and knowledge (through research, statistical analysis, attendance at professional events etc.) and make it available to HSE to develop early thinking on policy formulation, work planning, focusing customer contacts etc.;
- Technical, social and economic advice for any topic area that falls under HSE's remit e.g. during negotiations and delivery of legislation;
- Test method development;
- Representational role at technical meetings;
- Production of draft Approved Codes of Practice, sector guidance, guidance on the interpretation or application of legislation; and
- Advice to the general public on scientific issues relating to health and safety

Research
HSE commissions little basic research. Our requirement is for applied research, which, in contrast to support work, is generally original investigation in order to acquire new knowledge, but directed to a practical aim or objective.

HSE commissions applied research:

- to provide independent advice for regulatory purposes;
- where industries lack the relevant scientific and technological expertise;
- where industries require new ideas to stimulate and encourage improvement; or
- where availability of results could be restricted if research can be conducted by only one company

Annex 1.2

Criteria for commissioning science.

These are the criteria for using science to deliver the Strategy.

HSE will:

- Use science to meet its role as a modern regulator to understand the most effective and efficient ways of securing improved health and safety outcomes.
- Use science with a strong focus on health and human and organisational behaviour, having regard for equality issues, and ensuring that money and resources are targeted at the delivery of the strategic priorities.
- Improve the linkages between science, policy and delivery and promote a better collaboration between scientists, policy makers and deliverers.
- Contribute to the development of Government science policy and apply it to all its work.
- Use its in-house resource, supported by external expertise where appropriate, to deliver its regulatory functions and contribute to the evidence base for the development of policy. This will be achieved through:
  - Front line work (e.g. incident investigation; inspection; safety case and report assessment; standards & guidance)
  - Cross-cutting activity (e.g. horizon scanning; generic guidance)
- Continue to apply research:
  - Where independent advice is required by HSE on the extent and nature of the hazards and risks involved
  - Where there is a need for informed HSE participation in national and international standards making
  - Where information is needed in the light of incident experience or to support specific enforcement activities or policy initiatives
  - Where projects are too risky for firms to go ahead with themselves, though there are clear health and safety benefits; for example, when timescales are long and/or the technical risks are high
  - When the particular part of industry lacks the relevant scientific and technological expertise
  - When entry costs are high for manufacturers of safety-related equipment and the industry is small and fragmented
  - Where industry is complacent or not innovative and requires the stimulus and competition of new ideas to encourage improvement
  - When the potential beneficiaries are too diffuse for any one company to undertake the research on its own or the availability of results will be restricted
- Provide support for HSE's regulatory activities through the commissioning of scientific support, with HSL as primary supplier to:
  - Understand the causes of incidents and ill-health;
  - Propose remedial measures;
  - Contribute to the evidence base to develop and deliver its priorities and programmes;
  - Make the knowledge gained widely available
  - Have regard to, and use, relevant science activities in Britain and internationally. Where appropriate, HSE will seek opportunities to collaborate with others.
  - Make publicly available information on our science programmes, subject to over-riding considerations for national security and/or HSE's intellectual property policy

Annex 1.3

The work of the Futures Group

In 2005, following a review of science within HSE, the Futures Team, based in the Health and Safety Laboratory, was established as a key component of HSE's futures system. The Team initially focussed on horizon scanning and identifying emerging issues of interest/impact to HSE. Since then it has produced short reports on a range of emerging issues, several more detailed reports and a set of scenarios for the future of health and safety in 2017.

In 2008 the Futures system was augmented by the creation within HSE of the Futures Group, representing specialisms from across HSE and promoting the contribution that futures work can make to HSE's longer term strategy and business objectives. The Futures Group also has a role in helping to identify new issues for exploration. Recent suggestions include:

- Ageing Infrastructure
- Increasing use of hypoxic atmospheres
- Intelligent sensor networks and pervasive computing

These efforts to encourage the use of futures capability within HSE are paying off, and the Futures Team is being increasingly used by groups within HSE to help in their planning. The number of commissioned studies is increasing with recent examples including horizon scanning reports on Medical Imaging and on the Textile Industry.

A larger price of work for the Emerging Energy Technologies Programme involved the production of a report covering contextual drivers of change, energy scenarios to 2020 and 20250 and a summary of the main technical developments. This report informed the preparation of a status report on the programme to SMT.

The Futures team, working with CSU has had input into the Sector Based Strategy development, via participation in workshops and direct advice to Construction, HID, Quarries and Manufacturing. CSU represents Futures on the Strategy Steering Group.

HSE's reputation in the field of Futures thinking has resulted in a growing list of invitations to speak to various organisations, for example at a DSTL Horizon Scanning Good Practice Seminar, at the 2010 Health and Safety Expo for RoSPA and at the BOHRF Research Committee. HSE was also represented, either by a member of the Futures Team or of CSAG, at a series of Technology Innovation Futures workshops run by the Foresight Directorate within BIS which built on a commission by HMT. This was looking at what the important technologies for the UK in the next 5-15 years would be, particularly with regard to the economic benefits they could generate. This external facing work, alongside the publication on the HSE Web site of key reports, means that HSE's Futures activities also benefit the wider health and safety system.

HSE's international reputation in Futures has been enhanced by the award to the HSL team of a two year contract, won by competitive tender, from the European Agency for Health and Safety at Work's European Risk Observatory to carry out the study 'Foresight of New and Emerging Risks to Occupational Safety and Health Associated with new Technologies in Green Jobs by 2020'.

Examples of work commissioned and completed in 2010.

Case Study 1 – Risk Communication in the 21st Century

This report develops an in-depth analysis of HSE's communication practices that answer these questions: What constitutes state-of-the-art risk communication? Which practices may be considered anachronistic? Does the Health and Safety Executive (HSE) use the most effective means to communicate risks? Which theories and tools are most apposite for the appraisal of HSE's risk communication? What policy recommendations would help the Executive to improve its performance in this area?

The researchers explore HSE's risk communication in two specific cases: that of the Buncefield oil storage incident of 2005 and that of the proposed development at the Oval cricket ground in London. The researchers conducted face-to-face interviews of the critical actors involved in each case. These interviews support a robust qualitative analysis of current risk communication practices. The analysis employs the latest theoretical and empirical knowledge from the academic discipline of risk communication.

The authors conclude that the HSE has engaged third parties successfully to develop a proactive risk communication when faced with a major incident. For most decisions, however, HSE still relies on communication practices derived from the consensual, expert-led model with which the Executive operates. The authors formulate five critical recommendations to adapt HSE's risk communication towards a more proactive model.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr785.pdf

Case Study 2 – **The Burden of Occupational Cancer in Great Britain**

The aim of this project was to produce an updated estimate of the current burden of occupational cancer specifically for Great Britain. The primary measure of the burden of cancer used in this project was the attributable fraction (AF) i.e. the proportion of cases that would not have occurred in the absence of exposure; this was then used to estimate the attributable numbers. This involved obtaining data on the risk of the disease due to the exposure of interest, taking into account confounding factors and overlapping exposures, and the proportion of the target population exposed over the period in which relevant exposure occurred. Estimation was carried out for occupational exposures classified by the International Agency for Research on Cancer (IARC) as group 1 (established) and 2A carcinogens (probable).

5.3% (8023) cancer deaths were attributable to occupation in 2005 (men: 8.2% (6366); women 2.3% (1657)). Attributable estimates for total cancer registrations are 13694 (4.0%); and for men: 10074 (5.7%) and women 3620 (2.1%).

Occupational attributable fractions are over 2% for mesothelioma, sinonasal, lung, nasopharynx, breast, non-melanoma skin cancer, bladder, oesophagus, soft tissue sarcoma and stomach cancers. Asbestos, shift work, mineral oils, solar radiation, silica, diesel engine exhaust, coal tars and pitches, occupation as a painter or welder, dioxins, environmental tobacco smoke, radon, tetrachloroethylene, arsenic and strong inorganic mists each contribute 100+ registrations.

Industries/occupations with high cancer registrations include construction, mining, metalworking, personal/household services, land transport, printing/publishing, retail/hotels/restaurants, public administration/defence, farming and several manufacturing sectors.

56% of cancer registrations in men are attributable to work in the construction industry (mainly mesotheliomas, lung, bladder and non-melanoma skin cancers) and 54% of cancer registrations in women are attributable to shift work (breast cancer).

This project is the first to quantify in detail the burden of cancer due to occupation specifically for GB.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr800.pdf

Case study 3 – Offshore Working Time in Relation to Performance, Health and Safety

This report from Oxford University details the offshore working time arrangements in operation in the UK North Sea sector and reviews evidence of their effects on the performance and health and safety of offshore personnel. The report also includes information obtained in interviews with occupational health and safety specialists in the oil and gas industry when asked about offshore work/leave schedules, shift rotation, issues of cumulative fatigue and rest offshore and other aspects of working time arrangements. The final chapter presents an overview and conclusions; it identifies optimum work patterns where possible, noting the gaps that exist in the research literature and includes recommendations for work/leave schedules, shift rotation and overtime, day/night shift rotation and data collection and analysis.

View the full report:
http://www.hse.gov.uk/research/rrpdf/rr772.pdf

Case study 4 - Learning Lessons for the London 2012 Olympic and Paralympic Games

This work was commissioned to provide an understanding of the potential hazards and risks associated with hosting the Olympic Games in Great Britain in 2012, as well as potential control measures that could be applied to these.

In order to contribute to this, the Health and Safety Laboratory conducted a literature review drawing on the experience of previous Olympic and major sporting events. Emergent topics from the review included: construction, public health and safety risks, road accidents, injuries, musculoskeletal disorders (MSDs), crowd safety, emergency planning and response, volunteers, workplace violence, fire safety, electrical hazards and carbon monoxide/gas safety.

Each of the topics was summarised by the risks identified from previous Olympic events and major sporting events, followed by controls that were applied or identified as potentially useful. The controls often provided practical ways to reduce risks, or to mitigate negative outcomes. A number of sources covered in the review identified the importance of communication between different bodies as well as gathering information from the public. These articles identified the use of technology such as mobile telephones and the internet. For example, mobile internet or texting systems to enable easy reporting of ill health or accidents by members of the public. The wide spread availability of camera phones may also provide opportunities to gather fast and useful intelligence. The opportunity to use novel technology could therefore contribute to a safe Olympic Games in 2012.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr811.pdf

Case study 5 - Communicating Health and Safety Messages to Young Learners in Vocational Education and Training

A number of industries are known to be at high risk from occupational Long Latency Diseases (LLD), including construction, engineering, plumbing, stonemasonry, quarry and foundry work. Recognising that the learners of today are the workers of tomorrow, the Health and Safety Executive has identified young learners in Vocational Education and Training (VET) as a key target group for reducing the incidence of LLD in some of these industries. The purpose of this research was to help the HSE improve its communications with relevant young learners to help raise awareness of risks, change attitudes and behaviours and to embed good practice about appropriate control measures.

While young learners recognise the importance of Health and Safety (H&S) information, there are a number of challenges around successfully communicating the risks of LLD. These include the complexity of LLD and a wide lack of clarity about what constitutes LLD and how they can be prevented. There are also challenges with translating what young learners learn in the classroom into practice on site because of the influence of more experienced colleagues and the pressures of resources and time. Communicating H&S messages more effectively will require greater clarity among wider stakeholders about the nature and risks of LLD. Communications could also be aided by clear, concise, visually engaging communication tools. The delivery of H&S messages by trusted messengers with experience in a young learner's chosen vocation is beneficial as is focusing information towards more junior or 'new' learners not yet overwhelmed by detail on Health and Safety.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr803.pdf

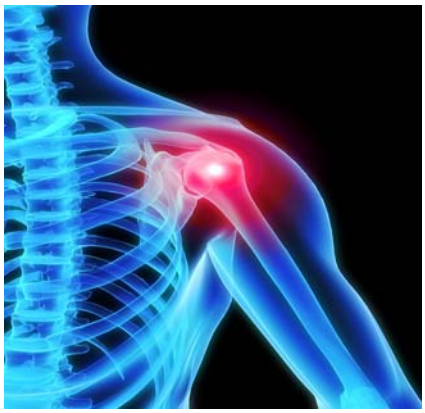
Case study 6 – Tower crane incidents worldwide

Since 2000 there have been five major incidents on UK construction sites that involved the collapse of a tower crane. These five being Canary Wharf in 2000, Worthing in 2005, Battersea in 2006, Liverpool in 2007, Croydon in 2007 and Liverpool in 2009. Subsequent investigation into these incidents by the Health and Safety Executive, assisted by the Health and Safety Laboratory (HSL), showed that these collapses were due to different causes.

HSL were requested to identify tower crane incidents that had taken place around the world between 1989 and 2009 and obtain, where possible, the causes of each incident and the tower crane involved. Where the cause or circumstances surrounding the incident have been identified the dominant categories were erection/dismantling/climbing followed by extreme weather. No particular crane manufacturer has been positively identified as being more prone to incidents than any other. The intention underlying the research was to use the information obtained to assist in advising and guiding the UK tower crane industry to help improve safety.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr820.pdf

Case Study 7 - Ageing and work-related musculoskeletal disorders (MSD)



This work was commissioned to provide a review of the recent literature concerning ageing and occupational MSD, and to carry out scoping activities to inform the formulation of future policy or guidance and provision of advice.

Attitudes towards ageing and work are changing; more employers regard older workers as a valuable asset and are willing to keep current employees on for longer periods past the usual retirement age. Older workers are more susceptible to work-related MSD than younger workers because of decreased functional capacity; the propensity for injury is related more to the difference between the demands of work and the worker's physical work capacity (or work ability) rather than their age. An older workforce has implications for the health and safety responsibilities of employers. These include providing additional support for worker requirements, changing the workplace attitudes towards ageing, providing a positive knowledge base, adjusting the workplace design and accommodations and improving worker/employer relationships (co-operation).

It is recommended that awareness campaigns are implemented to disseminate the benefits of ageing workers in the workplace and raise awareness of those elements of the workplace that are not suited to their needs. The expectation is that this will change the attitudes of employers and employees towards ageing and aged workers.

View the full report: http://www.hse.gov.uk/research/rrpdf/rr799.pdf

Annex 1.5

Peer-Reviewed Papers in Journals, Conference Proceedings and Book Chapters associated with contracts placed with HSL.

January to November 2010

A) Journal Papers

A.1) Journal Papers Published

1. ASHLEY, K., BRISSON, M.J., HOWE, A.M. (2010) Interlaboratory Evaluation of a Standardized Inductively Coupled Plasma Mass Spectrometry Method for the Determination of Trace Elements in Air Filter Samples: preliminary results. *Analytical Methods,* Aug 2010*,* 2, 1823-1826.
2. BARBER, C. ET AL. Knowledge and utilisation of occupational asthma guidelines in primary care, *Primary Care Respiratory Journal*, 2010, 19(3):274-280.
3. BELL, D.R., CLODE, S., FAN, M., FERNANDES, A., FOSTER, P., JIANG, T., LOIZOU, G., MACNICOLL, A., MILLER, B., ROSE, M., TRAN, L., WHITE, S. Interpretation of studies on the developmental reproductive toxicology of 2,3,7,8-tetrachlorodibenzo-p-dioxin in male offspring. *Food and Chemical Toxicology,* 2010, 48(6), 1439-1447
4. BUTLER O.T., COOK J.M., DAVIDSON C.M., HARRINGTON C.F., DOUGLAS L.M. Atomic spectrometry update. Environmental analysis. *Journal of Analytical Atomic Spectrometry,* 2010, 25(2), 103-141.
5. CHAPMAN, D., DENNIS, S., JOYCE, B., DONALDS, A.C., SIME, M.J.C. UK Fireworks surveillance for compliance with ADR and the UN default classification of fireworks. *Journal of Pyrotechnics,* Jun. 2010, 29, 40-46.
6. COGGON, D., HARRIS, E.C., BROWN, T., RICE, S., PALMER, K.T. Occupation and mortality related to alcohol, drugs and sexual habits. *Occupational Medicine,* 2010, 60(5), 348-353.
7. GANT, S. Reliability Issues of LES-Related Approaches in an Industrial Context. *Flow, Turbulence and Combustion*, March 2010 84(2), 325-335.
8. HARDING A-H, DARTON, A. Asbestosis and mesothelioma among British asbestos workers (1971-2005). *American Journal of Industrial Medicine.* Nov 2010, 53(11), 1070-1080.
9. HARTLEY W, DICKINSON N M, RIBY P, LEESE E, MORTON **J,** LEPP NW (2010), Arsenic Mobility and Speciation in a Contaminated Urban Soil is Affected by Different Methods of Green Waste Compost Application. Environmental Pollution 158, 3560-3570
10. HAWKSWORTH, S.J., PRITCHARD, D., HODGES, J., PARROT, R., WHITE, G., MELLOR, T. 2010. ICL Plastics investigation, Glasgow, May 2004. Loss Prevention Bulletin, Jun. 2010, 213, 15-19.
11. HODGSON, R., THYER, A., CONNOLLY, S. Investigation of the flammability hazard posed by aqueous glycol fluids. *Loss Prevention Bulletin,* June 2010, 213, 8-11.
12. HOLMES, T., CONNOLLY, S., WILDAY, J., HARE, J., WALSH, P. Managing fire and explosion hazards on offshore ageing installations. *Loss Prevention Bulletin*, Aug 2010, 214, 10-17
13. HOWARD, K. CHAPMAN, D. Defining Flash Compositions: Modifications to UN Time Pressure Test. *Journal of Pyrotechnics*, May 2010, 29, 32–39.
14. HOWE, A. Interlaboratory evaluation of standardized inductively coupled plasma-mass spectrometry method for the determination of trace elements in air filter samples: preliminary results. *Analytical Methods,* 2010, 2, 1823-1826.
15. IVINGS, M.J., GANT, S.E., SAUNDERS, C.J., POCOCK, D.J. Flammable gas cloud build up in a ventilated enclosure. Journal of Hazardous Materials, 2010, 184, 170-176.
16. JONES, K., PATEL, K., COCKER, J., BEVAN, R., LEVY, L. (2010) Determination of ethylenethiourea in urine by liquid chromatography-atmosphere pressure chemical

17. MANNO, M., VIAU, C., in collaboration with, COCKER, J., COLOSIO, C., LOWRY, L., MUTTI, A., NORDBERG, M., WANG, S., 2010 Biomonitoring for occupational health risk assessment (BOHRA), *Toxicology Letters*, 15 Jan 2010, 192(1), 3-16.
18. MOONIS, M., WILDAY, A.J., WARDMAN, M.J. Semi-quantitative risk assessment of commercial scale supply chain of hydrogen fuel and implications for industry and society. *Process Safety and Environmental Protection.* March 2010, 88(2), 97-108.
19. MORTON, J., COTTON, R., COCKER, J., WARREN N.D. (2010) Trends in blood lead levels in UK workers, 1995-2007. *Occup Environ Med,* Sept 2010*,* 67, 590-595.
20. PENSIS, I., MAREELS, J. DAHMANN, D., MARK, D. Comparative evaluation of the dustiness of industrial minerals according to European Standard EN15051, 2006. *Annals of Occupational Hygiene*. March 2010, 54(2), 204-16.
21. ROBERTS, T.A., SHIRVILL, L.C., WATERTON, K., BUCKLAND, I. 2010 Fire resistance of passive fire protection coatings after long-term weathering, *Process Safety and Environmental Protection*, 88(1) January 2010, 1-19.
22. RUSHTON, L., BAGGA, S., BEVAN, R., BROWN, T.P., CHERRIE, J.W., HOLMES, P., FORTUNATO, L., SLACK, R., VAN TONGEREN, M., YOUNG, C., HUTCHINGS, S.J. Occupation and cancer in Britain. *British Journal of Cancer,* 27 April 2010, 102(9), 1428-1437.
23. SAMS, C., PATEL K., JONES, K. Biological monitoring for exposure to pirimicarb: method development and a human oral dosing study. *Toxicology Letters*, 15 Jan 2010, 192(1), 56-60.
24. SAUNDERS, C.J., POCOCK, D., CARTER, G. Controlling gas shielded arc welding fumes using an on-gun extraction system. *International Journal of Ventilation*, 2010, 9(1), 77-82. (Originally published as a conference paper – 9th International Conference on Industrial Ventilation, Oct 18-21, 2009).
25. SAVOLAINEN, K; PYLKKANEN, L; NORPPA, H; FALCK, G; LINDBERG, H; TUOMI, T; VIPPOLA, M; ALENIUS, H; HAMERI, K; KOIVISTO, J; BROUWER, D; MARK, D; BARD, D; BERGES, M; JANKOWSKA, E; POSNIAK, M; FARMER, P; SINGH, R; KROMBACH, F; BIHARI, P; KASPER, G; SEIPENBUSCH, M. Nanotechnologies, engineered nanomaterials and occupational health and safety - A review. *Safety Science,* 2010, 48 (8):957-963. 4th International Conference on Working on Safety, Crete, 30 Sep – 3 Oct, 2008.
26. SAW, J-L, WILDAY, J., HARTE, H. Learning organisations for major hazards and the role of the regulator. *Process Safety and Environmental Protection,* Jul. 2010, 88(4), 236-242.
27. TAN, E., WARREN, N., DARNTON, A.J., HODGSON, J.T. Projection of mesothelioma mortality in Britain using Bayesian methods. *British Journal of Cancer*, 2010, 103(9), 430-436.
28. TURNER, S., MCNAMEE, R., ROBERTS, C., BRADSHAW, L., CURRAN, A. FRANCIS, S., FISHWICK, D., AGIUS , R. Agreement in diagnosing occupational asthma by occupational and respiratory physicians who report to surveillance schemes for work-related ill-health. *Occupational & Environmental Medicine,* Jul. 2010, 67(7), 471-478.
29. WEBBER, D.M., IVINGS M.J. Modelling bund overtopping Shallow Water Theory. Journal of Loss Prevention in the Process Industries. 2010, 23, 662-667.
30. ZANARDI, F., HARRIS, C.E., BROWN, T., RICE, S., PALMER, K.T., COGGON, D. (2010) Work-related mortality in England and Wales, 1979-2000. *Occupational and Environmental Medicine.* Dec 2010, 67(12), 816-22.

A.2) Journal Papers in Press

1. BUTLER, O.T, EVANS, H. FISHER, A., HILL, S., HARRINGTON, C.F., WEST, M., ELLIS, A. Atomic spectrometry updates: a twenty five year retrospective. *Journal of Analytical Atomic Spectrometry,* Advanced publication online Aug 2010.

2. COGGON, D., HARRIS, E.C., BROWN, T., RICE, S., PALMER, K.T. Work-related mortality in England and Wales, 1979–2000. *Occupational and Environmental Medicine.* Published online June 2010.
3. KEELEY, D.M. TURNER S., HARPER, P., Management of the UK HSE failure rate and event data. Journal of Loss Prevention in the Process Industries. 8 Oct 2010 (Advanced publication online).
4. MORTON, J., LEESE, E. (2010) Arsenic speciation in clinical samples - urine analysis using fast micro-liquid chromatography ICP-MS. *Analytical and Bioanalytical Chemistry,* Advanced publication online 24 Sept 2010 DOI 10.1007/s00216-010-4180-z.
5. MORTON, J., LEESE, E., COTTON, R., WARREN, N., COCKER, J. (2010) Beryllium in urine by ICP-MS - a comparison of low level exposed workers and unexposed persons. *Int. Archives of Occup. & Environ. Health* Advanced publication online Oct 2010 DOI 10.1007/s00420-010-0587-2.
6. FISHWICK, D. Well-being and work: a perspective from 8 European countries on common areas of understanding, national drivers for progress and research needs. *Journal of Occupational and Environmental Medicine.*

A.3) Journal Papers Submitted

1. ADISESH, A., LEE, C., PORTER, K. Harness suspension and first aid management: development of an evidence based guideline. *Emergency Medicine Journal*
2. BELL N., VAUGHAN N., MORRIS L., GRIFFIN P. An assessment of workplace programmes designed to control inhalation risks using respiratory protective equipment. *Annals of Occupational Hygiene*
3. FISHWICK, D., HARRIS-ROBERTS, J., ROBINSON, E., RAWBONE, R., EVANS, G., CURRAN, A., SEN, D., BARRACLOUGH, R. Respiratory symptoms sensitisation and the impact of worker education on health in large plant bakeries. *Occupational and Environmental Medicine*
4. HARRIS-ROBERTS, J., BOWEN, J., SUMMER, J., FISHWICK, D. Health and safety inspection of hairdressing and nail salons by local authority environmental health practitioners. *Annals of Occupational Hygiene*
5. HARRIS-ROBERTS, J., ROBINSON, E., FOURIE, A., REES, D., SPIES, A., CURRAN, A.D., FISHWICK, D., SEN, D., BARBER, C.M. Sensitisation and symptoms associated with soybean exposure in processing plants in South Africa. *Occupational and Environmental Medicine*
6. HARRIS-ROBERTS, J., POOLE, K., MASON, H. The influence of questionnaire, and simple and complex quantitative tests on the diagnosis and the staging of HAVS in the context of health surveillance. *Occupational Medicine*
7. HARRIS-ROBERTS, J., BARBER, C., RAWBONE, R., STAGG, S., ROBERTSON, W., ROBERTSON, A., MOORE, V.C., ROBINSON, E., NAYLOR, S., GARDNER, I., EVANS, G.S., BURD, M., CROOK, B., KINOULTY, M., BURGE, P.S., FISHWICK, D. Environmental and immunological investigation of an outbreak of alveolitis and occupational asthma at a car engine manufacturing plant. *Clinical Experimental Allergy*
8. HARRIS-ROBERTS. J., TATE, P., RAWBONE, R., STAGG, S., BARBER, C., FISHWICK, D., ADISESH, A. Respiratory symptoms in insect breeders. *Occupational Medicine*
9. HOWE, A., MUSGROVE, D., TAYLOR, C. Evaluation of sampling methods for measuring exposure to volatile inorganic acids in workplace air. Part 1: Sampling hydrochloric acid (HCI) and nitric acid (HNO3) from a test gas atmosphere*. Jnl of Environ. Modelling*
10. MELLOR, N. Management standards and work-related stress in the UK: progress on their implementation. *Safety Science*
11. ROWBOTHAM, A., GIBSON, R. Exposure driven risk assessment: applying exposure based waiving of inhalation toxicity tests under REACH. *Food & Chemical Toxicology*
12. SANTON, R. Mist fires and explosions – an incident survey. *Loss Prevention Bulletin*
13. WEBBER, D. Generalising two-phase homogeneous equilibrium pipeline and the models to the case of carbon dioxide. *J. Loss Prev Proc Ind or J. Proc Safety Env. Project*

14. WEBBER, D.M., IVINGS M.J., SANTON, R.C. Ventilation theory and dispersion modelling applied to hazardous area classification. *Jnl of Loss Prevention in the Process Industries*

B) Conference Papers

B.1) Conference Papers Published

1. ATKINSON, G., CUSCO, L. Unsteady deflagration of large low-lying vapour clouds. *6th International Seminar on Fires & Explosions,* University of Leeds, UK, 11-16 April 2010.
2. BUTLER, C., LEKKA, C., SUGDEN, C. Development of a process safety climate tool. *Mary Kay O'Connor Process Safety Centre International Symposium*, Beyond Compliance, Making Safety Second Nature, 26-28 October 2010, Texas, USA.
3. JONES, A., MONNINGTON, S. Review of guidelines on entrapment and falls from the use of bedrails. *Contemporary Ergonomics and Human Factors* 2010, 243-252.
4. OKUNRIBIDO, O An ergonomics assessment of post manufacture guarding for production machinery. *Safety of Industrial Automated Systems* – 6th International Conference (SIAS) 2010, 14-15 June, 2010, Tampere Hall, Finland.
5. OKUNRIBIDO, O., LEWIS, D., Work-related lower limb musculoskeletal disorders – a review of literature. *Contemporary Ergonomics and Human Factors* 2010, 333-241.
6. OKUNRIBIDO, O, WYNN, T., LEWIS, D. Is age/ageing a risk factor for work-related musculoskeletal disorders? A review of literature. *Contemporary Ergonomics and Human Factors* 2010, 27-35.
7. HEWITT, S. Triaxial measurement of the performance of anti- vibration gloves. 45th UK Conference on Human Response to Vibration. Institute of Naval Medicine, Gosport, UK, 6-8 Sept. 2010.
8. HUNWIN, G., THORPE, S., HALLAS, K. Improvements to the EN method of mechanical slip resistance test for footwear. Contemporary Ergonomics and Human Factors 2010, 471-479.
9. PITTS, P. Evaluation of candidates for additional frequency weightings for hand-arm vibration measurement. 45th UK Conference on Human Response to Vibration. Institute of Naval Medicine, Gosport, UK, 6-8 Sept. 2010.
10. PITTS, P. Evaluation of candidates for additional frequency weightings for hand-arm vibration measurement. 4th Conference Human Vibration Effects on Health-Performance- Comfort, VDI, Wurzburg, Germany, 3-4 May.
11. ROYLE, M., WILLOUGHBY,D., HOOKER,P., GUMMER, J. UDENSI,J. Self ignition of hydrogen by various mechanisms, World Hydrogen Energy Conference, Essen, Germany, 16 –21 May 2010.
12. SAW, J-L, WARDMAN, M., HOLMES, A., RESTON, S. Societal risk representation for effective risk communication. *13th International Symposium on Loss Prevention,* 6th-9th June 2010, Brugge, Belgium, 177-184.
13. SCHLEYER, G., UNDERWOOD, N., DALZELL, G., STACEY, N. Major hazards management – a finishing module for undergraduate engineers on how to manage risk. *Proceedings of EE2010: Inspiring the next generation of engineers.* 6-8 July 2010, Aston University, Birmingham, UK.
14. SNEE, T.J., MONTSERRAT, J.R. Assessment of the critical conditions for slow oxidation and autoignition in large process vessels. *13th International Symposium on Loss Prevention,* 6th-9th June 2010, Brugge, Belgium.

C) Book Chapters published

Morton J and Nelms S, Chapter 1 Plasma Ionization | ICP, Other Atmospheric Pressure Plasmas - Applications: Biomedical." *In* Beauchemin D and Matthews DE, editors. Elemental and Isotope Ratio Mass Spectrometry. Elsevier; 2010. 1088p. (Gross ML and Caprioli RM, editors. The Encyclopedia of Mass Spectrometry; vol. 5).

D. Other Peer-Reviewed publications

1. CUTHBERT, J. (2010) Aldehydes in air. *Methods for the Determination of Hazardous Substances, MDHS 102.* HSE Books.
2. GANT, S. E. (2010) Axisymmetric buoyant fair-field plumes Underlying Flow Regime 1-06. *ERCOFTAC QNET-CFD Online Knowledge Base.*

Annex 1.6

Journal/Conference Papers published under the 'Added value' project

1. ATKINSON, G and CUSCO, L. [2010]. Unsteady deflagration of large low lying vapour clouds 6th International Seminar on Fires and Explosions, Leeds.
2. BARBER, C. ET AL. [2010] Knowledge and utilisation of occupational asthma guidelines in primary care, *Primary Care Respiratory Journal* 19(3):274-280.
3. CHAPMAN, D., DENNIS, S., JOYCE, B., DONALDS, A.C., SIME, M.J.C. UK Fireworks surveillance for compliance with ADR and the UN default classification of fireworks. *Journal of Pyrotechnics,* Jun. 2010, 29, 40-46.
4. GANT, S. [2010] Reliability Issues of LES-Related Approaches in an Industrial Context. *Flow, Turbulence and Combustion* 84(2), 325-335.
5. HUNWIN, G., THORPE, S., HALLAS, K. Improvements to the EN method of mechanical slip resistance test for footwear. Contemporary Ergonomics and Human Factors 2010, 471-479.
6. OKUNRIBIDO, O. [2010] An ergonomics assessment of post-manufacture guarding for production machinery. *Proceedings of 6th International Conference on Safety of Automated Industrial Systems, SIAS,* 14-15 June, Tampere Hall, Finland.
7. OKUNRIBIDO, O., LEWIS, D., Work-related lower limb musculoskeletal disorders – a review of literature. *Contemporary Ergonomics and Human Factors* 2010, 333-241.
8. OKUNRIBIDO, O, WYNN, T., LEWIS, D. Is age/ageing a risk factor for work-related musculoskeletal disorders? A review of literature. *Contemporary Ergonomics and Human Factors* 2010, 27-35.
9. ROYLE, M., WILLOUGHBY,D., HOOKER,P., GUMMER, J. UDENSI,J. Self ignition of hydrogen by various mechanisms, World Hydrogen Energy Conference, Essen, Germany, 16 –21 May 2010.
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Representative publications associated with extramural research contracts– 2009 - 2010

HSE does not maintain a record of all publications associated with extramural research contracts. Some of the following references were identified by HSE's Information Management Unit (in September 2010) by searching Databases for references to research that acknowledged funding, co-funding or sponsorship from HSE. It provides an indication of the diversity of subjects and quality of publications associated with these contracts.

1. Effect of the Internal Promoter on Insertional Gene Activation by Lentiviral Vectors with an Intact HIV Long Terminal Repeat. Sean Knight, Marieke Bokhoven, Mary Collins, and Yasuhiro Takeuchi. Journal of Virology, May 2010, p. 4856–4859.
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5. Occupation and cancer in Britain. L Rushton, S Bagga, R Bevan, T P Brown, J W Cherrie, P Holmes, L Fortunato, R Slack, M Van Tongeren, C Young and S J Hutchings. British Journal of Cancer 102, 1428-1437 (27 April 2010).

6. Common mental disorder, unemployment and welfare benefits in England. E. Ford, C. Clark, S. McManus, J. Harris, R. Jenkins, P. Bebbington, T. Brugha, H. Meltzer, S.A. Stansfeld. Public Health 124, 675-681 (1 November 2010)/

7. CIPD, (2009). Line manager behaviour and stress at work. http://www.cipd.co.uk/subjects/health/stress/_lnstrswrk.htm
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5. Stocks J, McNamee, R, Turner, S, Carder, M & Agius, R. The incidence of medically reported work-related ill-health in the construction industry. Short report to

Occupational and Environmental Medicine, 2010*,* 67, 574-576.
6. Turner S, McNamee R, Roberts C, Bradshaw L, Curran A, Francis M, Fishwick D, Agius R. Agreement in diagnosing occupational asthma by occupational and respiratory physicians who report to surveillance schemes for work-related ill-health. *Occupational and Environmental Medicine,* 67, 471-478, (published online first 12 November 2010).
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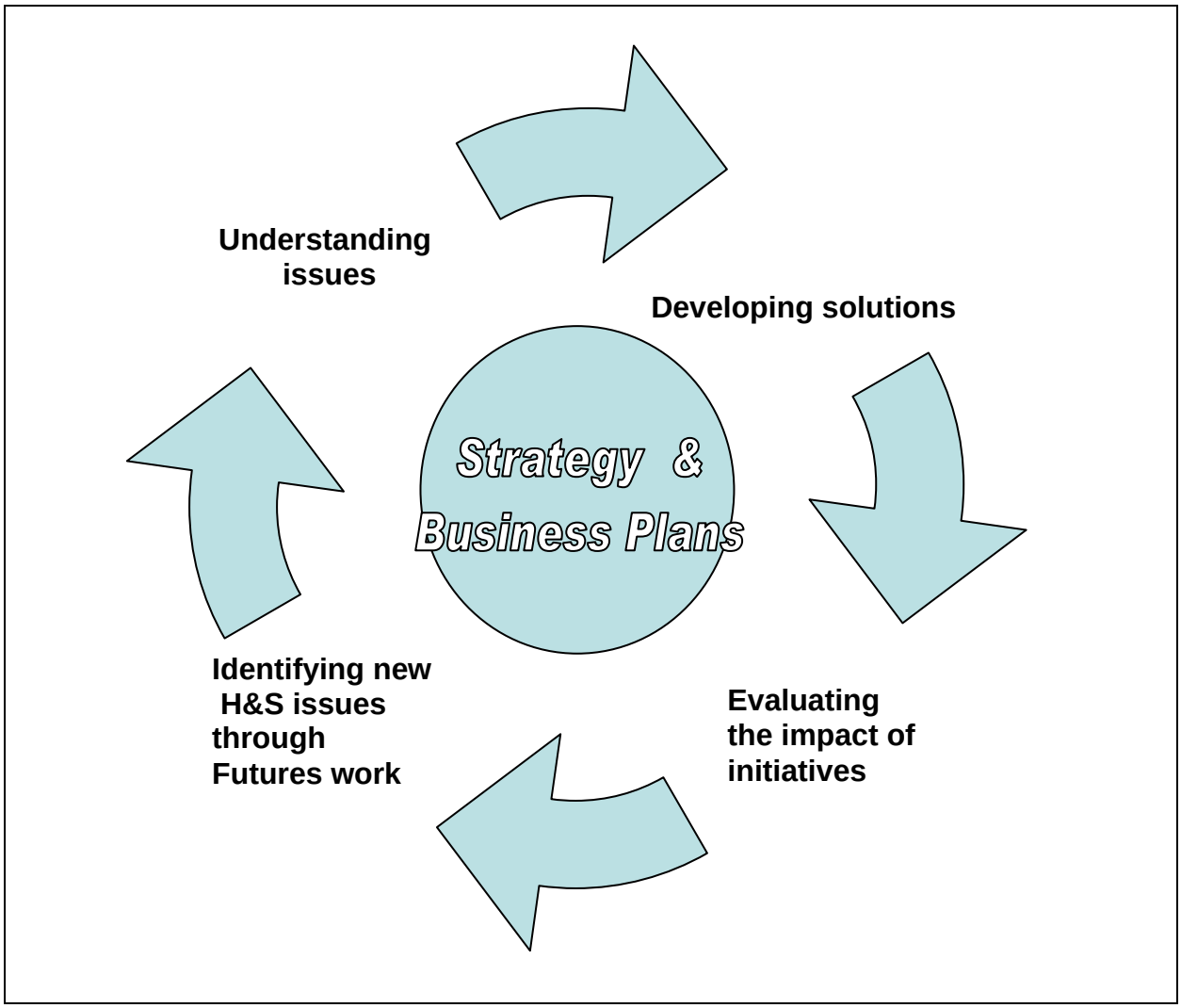
Strategic Statement on Science.

This Strategic Statement sets out how HSE uses it scientific and engineering resources in support of our mission to prevent death, injury and ill-health to those at work and those affected by work activities.

HSE is a strongly scientific and evidence based organisation with about a quarter of our staff being qualified scientists or engineers. Approximately 15% of HSE's budget is devoted to commissioning scientific research and support. Although we use a wide range of institutions and contractors, our principle supplier is the Health and Safety Laboratory, which is an agency of HSE and a world class facility. It provides vital technical and research level experience and problem solving skills.

Our scientific activities enable us to gather evidence, identify and develop practical solutions, and monitor and evaluate their success. At all stages the ability to anticipate and evaluate the importance of future challenges is critical to maintaining HSE's position as a forward thinking regulator.

The diagram illustrates the central role played by science.



What do we do?

HSE's Science:-

- supports delivery of the Strategy (*The Health and Safety of Great Britain: Be part of the solution*) and associated delivery targets
- supports front line regulatory functions (e.g. incident investigation)
- looks ahead to identify future challenges

In more detail:-

The 3yr rolling Science Plan identifies and prioritises science to:-

- acquire evidence for policy development
- support delivery of operational objectives
- develop practical solutions
- understand new and emerging issues and
- evaluate impact

in support of the following key themes of the Board strategy:-

  - Creating healthier, safer workplaces
  - Avoiding catastrophe
  - Investigation and securing justice
  - The need for strong leadership
  - Building competence
  - Involving the workforce
  - Customising support for SMEs
  - Taking a wider perspective

Forensic support for incident investigation is essential to enable HSE to carry out its enforcement activity with a high degree of confidence and success. HSE invests in the skills of its laboratory staff to document evidence, keep up to date with analytical and technological innovations, and research and develop new techniques and models as appropriate.

HSE is alert to the implications for health and safety of new technologies and changes in the workplace. We seek to advise and inform so that the UK is well placed to capitalise on innovation without detriment to our mission to prevent death, injury and ill health to those at work and those affected by work activities.

Our principles - Why do we do it

- We have a strong tradition for scientific method, use of experts, advisers and committees in the development of HSE's policies and regulations. This is drawn from our duty to commission and publish appropriate research and to provide training and information in connection with this, duties enshrined in the Health and Safety at Work (etc) Act 1974.
- We procure individual projects in accordance with best practice and continually strive to improve the management of commissioned science to improve efficiency and effectiveness by:-
  - working in partnership with industry, research councils and professional bodies to share funding,

    - by working with academics, other experts, industry groups and international regulators to improve the quality of research proposals and research outputs,
    - applying best practice with regard to procurement.
- HSE will continue its policies to attract and retain high quality professional scientists and engineers and develop appropriate scientific career structures – in line with the guidance of the Government's Chief Scientific Adviser.
- We aim to improve the understanding, communication and utilisation of the results of our scientific research– through
    - closer working between scientists and policy makers
    - greater emphasis on peer review, research evaluation and publication in the scientific literature
    - better knowledge management to enable easier identification of existing research