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HSE'S CURRENT AND FUTURE SCIENCE PLANS			

Purpose of the paper

1. The Board has asked for an annual Science Report to cover the use, efficiency and effectiveness of our investments in science.

2. The Board is asked to note and comment on the Report and the oral briefing.

Background

3. The Mainstream Research budget in 2008/09 is ~ £36.3m. In addition, about 1000 staff use their skills in science, technology, engineering or analysis as a key input to their work for HSE.[1]

4. Until recently, the quarterly performance report included assessments of progress in science and research. This Science Report now addresses these matters on an annual basis, and is the first of these reports.

5. The Science Report examines and outlines:

- How HSE uses science and research in its work, what applied research has been done and how results are used;
- How HSE is conducting its science work following MBUS (Making Best Use of Science);
- How HSE gets better value and outputs from this science and research work; and
- The approach to the next Science Strategy and Science Plan.

Argument

6. The Science Plan for 2008/09 is based on ongoing needs stated in business cases approved by programme directors. Funding was allocated from the mainstream research budget to meet reactive support requirements in full, to complete the Local Authorities' S&T programme and to increase major hazards work.

7. During 2008, CSAG applied the MBUS recommendation that business need drives HSE's research. Work started on aligning priorities in science planning to meet HSE's DSO targets. Senior managers, scientists, specialists, policy staff and external specialists worked from early 2008 to establish a Science Plan - including research for the medium to longer term. However, the SMT Science Sub Group decided in October 2008 that work on the Science Plan should be reworked in line

[1] There are separate funding arrangements for research for Nuclear Directorate and Pesticides Safety Directorate. These data are not included in the report.

with the emerging HSE Strategy and should be issued after the HSE Strategy is completed in 2009.

8. A lesson learned when the previous HSE Strategy was implemented is that the time taken to realign HSE's activities caused a knock-on effect in delaying the development of science plans and commissioning and completing new research. To avoid any hiatus as HSE develops delivery arrangements for the new HSE Strategy, the Science Plan for 2009/10 focuses on stated business need – as in 2008/09.

9. There are a number of proposals for new strategic research and support which will put pressure on the mainstream extramural research budget. CSAG will seek additional funding when developing HSE's business plan for 2009/10.

10. The Science Report summarises how performance is being managed and demonstrated. This includes governance arrangements and controls on developing requirements within HSE.

11. The report also examines the effectiveness of investment in support and research including peer reviews of proposals and published outputs. While HSE can demonstrate the value of small-scale research projects, more work could be done to demonstrate the longer-term usefulness of support and research to delivering HSE's objectives.

12. The report examines how the quality of scientific work is demonstrated. For example, the CSA is proposing to conduct a rolling programme of science reviews at HSL with assistance from external specialists and academics.

Action

13. To note and comment on the contents of the science report and the oral presentation.

Annex 1

Science Report 2009

1. Introduction

1.1 This is the annual update on HSE's use of commissioned science in support of its business activities[2]. It describes progress made following the internal review Making Best Use of Science (MBUS).

1.2 There are four sections:
- Background information on HSE's scientific requirements;
- Overview of the value of science commissioned in 2008/09 (and earlier);
- Planning arrangements for 2009/10;
- Next steps to support the new HSE Board Strategy

1.3 Work covered in this report builds on significant progress in the last 2-3 years on planning and commissioning of science with HSL and external contractors.

1.4 Work for 2009 onwards includes:
- Deriving emerging plans for science from the Board Strategy
- Developing 3-year rolling plans and moving away from annuality
- Enhanced peer review of research
- Encourage publication of research in peer-reviewed journals and other publications.
- Improved measures to assess outcomes and demonstrate value and impact of commissioned science

2. Background

2.1 HSE commissions scientific support and applied research to:
- support HSE's operational work – especially forensic work for inspections, investigations and enforcement as well as technical support e.g. for land use planning advice;
- 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 etc; 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 scientific, technological and engineering support for regulatory and operational work - called reactive and planned support. This work accounts for about 2/3 of HSE's science expenditure, meets immediate needs and is generally relatively short term. Local Authorities can also call on this work.

[2] This report excludes consideration of science commissioned by the Nuclear Directorate, which has separate funding arrangements, and the Pesticides Safety Directorate, which has funding arrangements with DEFRA for its research.

2.3 'Reactive support' [3]. provides immediate support for investigations and major incidents. In 2008/09 HSE expects to commission ~ £6m of reactive support, principally from HSL.

2.4 A wide variety of scientific disciplines is essential to provide a responsive and expert reactive support service, although the capabilities and capacity can fluctuate from year to year, depending on the types and number of incidents and investigations.

2.5 HSL has expertise and capacity in a wide range of relevant disciplines: engineering, explosion, fire and process safety, occupational hygiene, risk science, ergonomics, work psychology, health exposures, personal safety, mathematical sciences, analytical work, evidence management, mapping. Support is commissioned from other providers where HSL has limited or no expertise, for example radiation protection, aspects of offshore work and nuclear specialisms.

2.6 Planned support 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 development 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

2.7 Research work progresses through a cycle - from understanding the issues, towards developing practical solutions, tools or interventions and finally to monitoring and evaluating their effectiveness.

2.8 HSE commissions and publishes research in compliance with the Health and Safety at Work etc. Act 1974. In 2008/09 the value was £12.5m.

2.9 Approximately half of this research is commissioned from HSL. This original work helps the Laboratory maintain and stimulate expertise for operational support work. It also enhances its scientific reputation through the continued publication of work in the peer reviewed scientific literature.

2.10 The remainder is commissioned with other organisations, generally in areas where HSL has limited or no capability and where open competition stimulates creative thinking and value for money. This annual amount has declined by ~ £8m following completion of the HSL PFI deal in 2004.

[3] 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, and
- answer specific questions about HSE's policies e.g. PQs on sheep dips/FOI etc.

2.11 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
- where availability of results could be restricted if research can be conducted by only one company

2.12 Wherever possible, HSE aims to commission research in partnership or collaboratively with relevant industries and stakeholders. HSE is increasing dialogue with the Research Councils to share knowledge and maximise benefits.

2.13 Apart from Futures Work (including Horizon Scanning), HSE commissions little basic research or blue-skies thinking. The Futures team in HSL identifies emerging trends and technologies that HSE may need to address over the next 10 years or so. Their recent contributions have included the development of scenarios for health and safety in 2017, as well as short reports on the political, scientific, technological and socio-economic implications of a range of emerging issues. Awareness of emerging technological developments enables HSE to work effectively with industrial sectors to identify occupational health and safety implications on topics like nanotechnologies and the hydrogen economy.

3. Overview of science in 2008/09 and earlier

3.1 Commissioned work is managed in four main science programmes. Since 2006, these have corresponded to the main business areas in the HSE Business Plan:

- Justice - covering technical support for HSE's inspection, investigation and enforcement work. It includes a small number of projects. It currently includes resource to develop and maintain capability at HSL;
- Conventional Health and Safety – mainly research that supports the development and delivery of policy initiatives and operational interventions;
- 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 perspective, and important work not managed in the other programmes.

3.2 In addition, HSE is spending smaller amounts in:

- Local Authorities' S&T initiative – which will cease in March 2009 when the LAs' requirements for support and research will be reallocated to other programmes; and
- Investment Research Programme – to enable HSL to research ideas of potential marketable value to future external customers and HSE.

3.3 Each programme produces an annual plan that identifies forward commitments and new projects to be commissioned in year. Currently, the plans are pragmatic, based on the Science Strategy 05/08 and on the science required to meet programme directors' ongoing needs. Proposals for new work are described in business cases that are subject to approval by programme directors. Proposals for 2009/10 that are being developed in the last quarter of 2008/09 increasingly support the goals of the HSE Strategy.

3.4 Since 2006 HSE has worked to improve its management of commissioned science, taking account of the recommendations of the MBUS and Office of Science and Innovation (OSI) reviews. A new subgroup of the Senior Management Team has been formed to advise on all aspects of science strategy and governance. Work to develop improved rolling 2 – 3 year science plans to support the new Strategy is in progress. The next phase will concentrate on improvements to performance monitoring, with more emphasis on tracking science utilisation.

3.5 In 2008/09, HSE plans to spend £29.79m from the science budget with HSL and £6.5m with other suppliers. HSE is currently planning to spend the same amounts in 09/10 and 10/11. There is upward pressure on extramural research, which will materialise in higher bids, particularly in 10/11.

3.6 So far, in 2008/09, the programmes have commissioned ~ 150 new main projects in addition to reactive and other small-scale support projects.

Financing science in 2008/09

3.7 The Making Best Use of Science (MBUS) project recommended that from April 2008 the budgets allocated to programmes should be delegated to main budget holders. Budgets are managed by the programmes rather than centrally by the Chief Scientific Adviser as before.

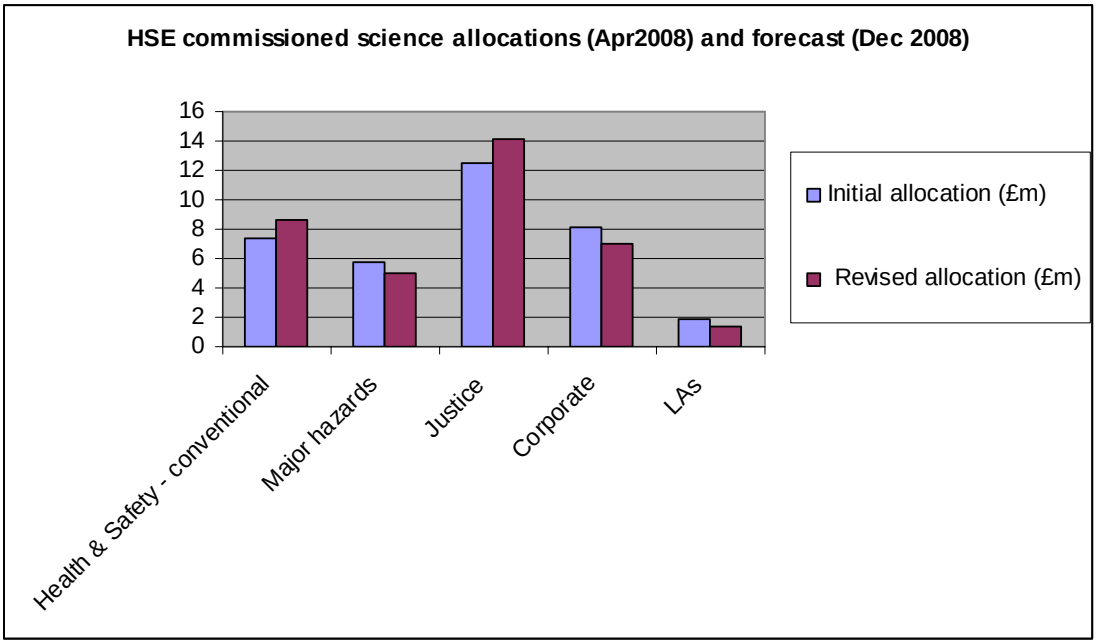
3.8 Programme Directors' bids for 2008/09 exceeded the budget by ~ 10% for extramural funding and ~30% for work with HSL. Funding was prioritised and allocated from the science and technology budget to preserve the forward commitment to continue research already in progress, meet reactive support requirements in full, to complete the Local Authorities' S&T initiative and to increase major hazards work.

3.9 There have been pressures, new and changed requirements and delays that required reallocation of resource between programmes. For example, the Major Hazards Programme was allocated additional extramural funding in year to meet new Board objectives.

3.10 Approximately £1.5m of the allocation to Major Hazards is cost recoverable, in accordance with our policy for recovery of costs incurred in operation of permissioning regimes, either as costs attributable to an individual company or as 'common good' work.

3.11 About 10% of the 150 main projects were funded jointly with industry or had some collaborative funding. In terms of financial 'gearing', this amounts to about £1m HSE spend contributing to research of value in excess of £10m. For major hazards industries, the value of live Joint Industry Projects in which HSE has an interest, amounts to ~ £4.5m: HSE's contribution is £381k – 8.6% of total sponsor contribution.

3.12 The initial allocations of the science budget between HSE's programmes in April 2008 and the revised forecasts at December 2008 are presented in the following chart.



3.13 HSE also funds a proportion of HSL's Investment Research Budget.

3.14 The science plans required HSL to respond at short notice to a markedly increased demand for Major Hazards work compared with 2007/08 (approximately double the 2007/08 figure) and to complete the requirements of the LA Science and Technology Initiative. The forecasts provided by HSL in December 2008 reflect HSL's capacity and capability. These show that, whilst real progress has been made to respond to HSE's requirements, there continue to be areas where demand exceeds delivery.

Examples of work commissioned in 2008/09

3.15 The following lists give an indication of the diversity of research commissioned in year.

Occupational health and safety programme:

- Assessment of exposure to carcinogens and asthmagens in the contract import, processing and repackaging industries (£135k)
- Contamination of water based metal working fluids – as it relates to respiratory ill health (£278k)
- Biological monitoring in surface engineering (£710k – over 3 yrs)
- Validation of the work related Stress Management Standards Indicator tool (£130k)
- Wind loading on luffing cranes (£250k)
- Applying behaviour change / worker engagement to small and medium construction companies (£135k)
- Accidents, ill-health and lost time among construction workers – follow-up survey (£150k)
- Evaluation of Moving Goods safely programme (£200k)
- Flooring slip resistance – developing solutions (£200k)
- Footwear slip resistance – developing solutions (£250k)
- Developing the evidence base of high risk noise and hand-arm vibration industries and identification of activities for interventions (£150k)
- Pneumatic and internal combustion tools vibration emission test codes (£498k to 2011)

- Suitability of supplier information on noise risks and noise emission values for workplace risk assessment (£100k)

Major hazards programme:

- Carbon sequestration processing risks (£100k)
- Support for government policy on societal risk (£450k)*
- Raising situational awareness of safety barriers for the prevention of accidents (£150k)*
- Human factors in containments level 4 facilities (£100k)
- Ageing Plant (£300k)*
- Formation of flammable mists offshore – Joint industry project – HSE contribution £50k)

Corporate programme:

- The relationship between shift work and disease (£520k – to 2011)
- Evaluation of the HSE – Local Authorities partnership (£95k)
- Hydrogen venting (£280k)
- The Health and Occupation reporting network (THOR) (£1.8m from 2008 – 2012)
- Questions on ill health and injuries in the 2009 Labour Force Survey (£220k)
- Electrostatic hazards associated with refuelling with fuel blends (a Joint industry project - HSE contribution (£100k)
- Investigation into the explosion mechanism following the Buncefield incident - a Joint industry project (HSE contribution £150k–£200k)
- iNTeg-Risk - Early recognition, monitoring and integrated management of emerging new technology related risks - a joint industry project (HSE contribution ~ £400k)
- Investigation of water spray barriers for smoke control in tunnelling (£163k)

The use and value of science commissioned or completed in 2008/09

3.16 The timescale to commission, report on research and evaluate its impact means that benefits accruing from research findings can take some time to realise. This section lists some examples of work completed in year and observations on science that has contributed to delivery of the Fit3 programme. There is also a short analysis of project utilisation information provided by science customers immediately following completion of projects.

3.17 Publications in peer-reviewed journals also provide an important indicator of the quality of research undertaken. Data provided by HSL show that from January 2008 to date, HSL has published or submitted for publication 74 papers in the scientific literature.[4]

Delivery of the Fit3 programme.

3.18 The science requirements of the Fit3 programme reflect the different levels of maturity of the component programmes. Some have required more work to understand the issues involved, whilst others have moved on to develop appropriate tools or towards evaluation of interventions. For example:

- The major surveys (questions in the Labour Force Survey and THOR) provide HSE with the evidence base on the number and nature of work related injuries and diseases.
- There is a continuing programme to develop the evidence base on long latency diseases including occupational cancers, chronic obstructive pulmonary disease, caused or made worse by occupation and noise induced hearing loss. In 2008, the

* Further details on these projects are provided at the end of this report.

[4] Details of the work published in 2008/2009 are provided at the end of this report. Similar information on publications arising from extramural projects is not readily accessible.

emphasis was on effective use of controls, developing leading indicators and collecting incidence and prevalence data in specific sectors such as the construction and the waste/recycling industries.
- HSE has continued research to develop tools to help prevent musculoskeletal disease and COPD for example the Assessment of Repetitive Tasks (ART) tool that supports the Backs Campaign.
- HSE has a sound understanding of the causes and controls for some hazards and types of occupational ill health such as slips and occupational asthma, and have developed tools to assist in the management of them. HSE is now looking to understand how to get industry to apply the solutions more effectively.
- HSE has evaluated a number of major interventions and continues to work to draw together lessons learned from these.

Examples of recently completed work

3.19 examples from other programmes include:

Major Hazards Programme
- Research into optimising hazard management by workforce engagement and supervision is being used by industry.
- Several projects that draw together issues about underground storage of natural gas and the implications for the development of risk assessment
- Evaluation of the effectiveness of Non Destructive Testing screening methods for in-service inspection.
- Opportunity Cost Methodology applied to Land Use Planning Restrictions - Peer Review

Local Authorities S&T Initiative
- The Web-based toolkit - managing work-related violence in licensed and retail premises has been widely publicised through HSE and the LACORS.

Corporate Programme
- The evaluation of directors' awareness of the Institute of Directors/HSE guidance is due to report and represents the first part of a two-stage evaluation – the second part being the assessment of the impact of measures taken on the leadership behaviour of directors.
- Work on high-pressure hydrogen releases is leading to a rethink of the safety of hydrogen dispensers.
- Research commissioned from University College London into the assessment of the mutagenic frequency of retroviral and lentiviral vector systems has been published in arguably the most prestigious peer reviewed virology journal. The results are being used to support amendments to HSE's guidance on the use of lentiviruses in research.
- A joint project between the Health Protection Agency and HSE to investigate factors affecting the likelihood of legionella pneumophilia causing disease
- The development of Trojan Horse health and safety messaging has been taken forward by industry, especially by the construction industry in Olympics work.

Project Utilisation

3.20 The main source of information on utilisation of results of projects comes from science customers. They are required to comment on how well a project met its objectives, how the results are being used and to make a judgement on the quality of the work and its delivery to time and budget.

3.21 For all programmes, about 90% of reports submitted by science customers describe the scientific quality and the contract management to be good or excellent.

3.22 Reports from science customers for projects contracted in 2007 -2008 show that they judged 77% of projects were completed to time and cost. In comparison, reports about projects contracted in earlier years show that they considered 46% of projects were completed to time and cost.

3.23 This science report reviews the value of projects that were contracted in 2007-08, the first full year in which science planning and commissioning took account of MBUS recommendations. The timescale for commissioning through to reporting and evaluation of science projects means that there is a delay in determining the impact of this work. The data in the table below confirm that only a proportion of the work commissioned in year also report in year.

3.24 The drawback with existing information sources on research utilisation is that they provide for interpretation at project-level rather than programme level. They do not take account of the higher-level view from the Programme Director or Major Budget Holder, and there would be merit in adopting a broader approach.

Programme	Number of new projects contracted	Value of new projects contracted	Number/cost of projects completed	Number of utilisation forms returned/value
Corporate	34	£5059k	19 /£1661k	13/£1185k
Fit3	59	£7297k	20/£2770k	8/£850K
Justice	25	£15,900k	2/£132k	1/£42k
Major Hazards	30	£2190k	6/£219k	4/£175k
TOTAL	148	£30,446k	47/£4780k	26/£2252k

3.25 The Justice programme comprises operational support work that has been drawn into larger 2 – 3year blocks to facilitate access. There are some examples and case studies at the end of this report that illustrate the outcomes and benefits of support associated with recent serious incidents**.** The programme has few one off projects. Utilisation information on one project showed this provided information to enable HSE to take operational decisions about the applicability of new air monitoring software.

3.26 In 2008 - 2009, the Justice Programme has evaluated all recent reactive support work and concluded that approximately 90% of work commissioned from HSL had provided direct support to regulatory activity.

3.27 After 1 April 2009 following changes in procurement systems, reactive support work will be evaluated on a 3-year sample basis to check that the current criteria are still correct.

3.28 The Major Hazards Programme contracted projects in 2007/08 that supported offshore operational activity, HSE's societal risk commitments or contributed to joint industry projects.

3.29 In 2007/08, the Corporate programme managed research projects that contributed to HSE, wider government and EU policy making and evaluation. This included work on electromagnetic fields (EMF) measurement uncertainty, the impact of regulatory uncertainty on productivity, the relationship between health and economic growth, the effect of regulation on compliance, the quality of working life, HSE's contribution to the DCLG evaluation of the National Process Improvement Project. The programme also managed support contracts with HSL, including those for project specification and horizon scanning.

3.30 In 2007/2008, a large proportion of the science completed for the Fit3 programme addressed work to inform delivery of the programme such as support to programme delivery

and tracking surveys. Other work covers the evidence base for musculoskeletal disorders, including work to inform decisions on appropriate interventions.

4. Planning for 2009 – 2010

4.1 Work to revise the 2005 – 2008 Science Strategy has been deferred until the HSE Strategy has been finalised. Nevertheless, the three themes of the existing Science Strategy continue to provide an indicative framework for the future. [5]

4.2 Until the new Science Strategy is ready, Programme Directors have been advised to plan their science requirements by concentrating on key business areas and taking account of the goals of the new Board Strategy.

4.3 It was originally intended that science planning for 2009 onwards would follow the MBUS recommendation for a 3-year rolling plan driven by corporate business need and subject to challenge and review in a more open debate. The move away from annual plans was intended to facilitate long term planning and avoid end of year 'cliff edges'. Three year plans were also seen as helping to redress the balance between the urgent support requirements that can dominate our use of the science budget at the expense of important longer term research questions.

4.4 A successful pilot for a new planning process was undertaken in 2007 and extended to science planning in 2008. The first phase, completed July 2008, brought together representatives from policy, programmes, HSL scientists, academia and stakeholders and used a backcasting technique to identify a wide range of ideas for research to deliver business objectives and fill gaps in scientific evidence.

4.5 The outputs of these workshops formed part of a draft discussion document on longer-term research requirements that was presented to the Science Subgroup in October 2008. The Subgroup advised that this document should be aligned with emerging Board strategy before further consultation. Consequently, the timetable for introducing a 3-year rolling science plan has been extended to ensure that the first year of the rolling programme fully supports the new HSE Strategy.

4.6 As a consequence, the 2009/2010 science plan is being developed along similar pragmatic lines to the previous year's plan, but taking account of Directorates' emerging work on development and implementation of the new Strategy's objectives. Detailed draft plans are expected in early 2009/2010.

5. Next steps

5.1 This section describes work in progress and ideas for further improvements to HSE's science.

Optimising the balance between support and research.

5.2 Most of the commissioned science budget is devoted to operational support and relatively short-term science initiatives.

[5] 3 key themes of the Science Strategy 2005 - 2008

- Supporting delivery of the Strategy and Public Service Agreement targets
- Supporting front line regulatory functions (e.g. incident investigation)
- Looking ahead to identify and meet future challenges.

5.3 Work to develop HSE's longer-term research agenda has been initiated by the Chief Scientific Advisor who is organising a number of workshops with invited academics and experts. Topics to be addressed are:

- demonstrating the impact of HSE
- developing and using appropriate data sources

5.4 The results of the first workshop are due to be reported soon: the second workshop will take place in February. The Chief Scientific Adviser will present the emerging findings of these workshops to SMT for consideration of how new work will enable delivery of the HSE Strategy and with a proposal for appropriate funding to support key projects and begin work in 2009.

5.5 Other research initiatives to support the strategy include

- A review of requirements for surveys
- New research into the economics of regulation.

Governance and efficiency

5.6 The Chief Scientific Adviser's Group (CSAG) and HSL are undertaking a number of projects to review the management of support and produce options for streamlining delivery in 2009/10. These include:

- a review of the Core Activity Programmes within the Justice Programme – recommendations to be available February 2009
- A review of HSE's core requirements from HSL - recommendations to be available February 2009 within the study of the governance of HSL.

5.7 The emerging findings indicate that a redistribution of responsibilities and budgets may be appropriate for 2009/10. This proposal would be subject to consultation with operational Directors. The value of work under consideration is ~ £2m.

Enhanced peer review

5.8 Proposals to improve and extend how HSE assesses the quality of work provided for include:

- increased use of invited experts to workshops to debate research programmes and projects
- proposals for annual science conference
- Introduction of a 4-year rolling science review programme for HSL, incorporating external input from leading academics and policy makers to ensure that the work is good quality and fit for purpose. The first review will be lead by Professor Sir Anthony Newman Taylor, and includes the Centre for Workplace Health, clinical measurement, epidemiology and related mathematical modelling.
- actions to increase the proportion of commissioned work that is published in peer reviewed journals.

Improved communication of research evidence

5.9 HSE has an open publication policy with regard to research reports and we are increasingly looking at appropriate publication options for support projects. This is to discharge a statutory duty to share lessons with the wider health and safety community. It also has the benefit of demonstrating HSL's research capability to the worldwide scientific community, and helps manage reputation.

5.10 The Canadian Health Services Research Foundation has developed a simplified practical format for making research findings digestible to policy/decision makers that has been adopted in the UK by the Government Social Researchers and others. It assists the dissemination and uptake of research that provides evidence for strategic thinking, policy makers and scientists. HSE is beginning to pilot and promote this approach.

Summary

5.11 While HSE will ensure that support for inspection, investigation and enforcement continues, pressure to get better value from research will grow. Attention will be given to

- Strengthening the link between science planning and delivering the HSE Strategy;
- Giving more attention to Futures Work and emerging trends that HSE would need to address;
- Demonstrating the quality, value and impact of our work, especially in managing and exploiting the knowledge HSE acquires.

Julia O'Hara & Richard Lewis
HSE Corporate Science Unit
13 February 2009

Annex 1
Examples of work commissioned in 2008/2009.

Raising Situational Awareness of Safety Barriers for the Prevention of Major Accidents

This project involves the publication of guidance on raising awareness of the control measures or 'safety barriers' which are put in place in order to prevent major accidents. Earlier research on the factors that contribute to safety in the major hazard sector revealed that both industry and regulators consider that lack of 'barrier awareness' is a key issue. The outputs from the project will provide a resource for the preparation of targeted training and awareness raising programmes by companies, training providers and other third parties such as trade associations.

The benefit of this approach is seen as being that it magnifies the effect as others take up and make use of the material produced. The guidance will advise inspectors and duty holders on the development of a strategy for raising barrier awareness and an understanding of risk communication within organisations and contributes to the leadership agenda. At the practical level it will include a toolkit for assessing the level of barrier awareness in organisations. The assessment can then be used as the basis for implementing a barrier awareness programme. The funding for this project during 2008/09 has been £150K.

Ageing Plant

This project takes forward the findings from previous research which showed that "ageing plant" can be a factor in the causation of major accidents. In this context "ageing" does not solely relate to chronological age but may encompass issues such as changes in conditions of service, poor construction or poor maintenance that mean that plant can start to "age" right from day one. The work has been based on the detailed analysis of accident data from the UK and Europe to assess the role ageing plant played in the circumstances of the incident.

A principle product of the project is a revised inspection guide for inspectors. This sets out the rationale for targeting intervention at ageing plant and identifies benchmarks for the appropriate management of plant and equipment in the "ageing" category. The project extends the previous research in that it also deals control and instrumentation issues. Question sets have been prepared to guide inspectors when assessing duty holders' control of ageing plant as part of their asset management system. The delivery guide is supported by technical guidance and links to the accident analysis work. The technical guidance and incident analysis work will also be available to industry to use in their assessment and management of ageing plant risks. The project is due to be completed by the end of June at a total cost of £300K.

Societal risk

HID's research in support of cross government implementation of societal risk in land use planning and COMAH enforcement has continued to demonstrate HSE's collaborative approach in taking forward sensitive and difficult policy changes. The implementation program includes significant scientific support. HSL and HID staff co-authored an 80 page report for the HSE's Technical Advisory Group on Societal Risk. This well received document which will soon to be published, will place the technical and policy challenges faced by HSE and its partners into the public domain. HSE has also initiated trials with industry and local authority stakeholders that make use of HSL's risk assessment and GIS expertise. The trials have enabled HSE to begin developing a pragmatic scheme for

considering societal risk in land use planning. Atkins Global and ERM between them have delivered a number of important projects that answer a number of the technical challenges. These include a review of the Dutch societal risk methodology, an assessment of the case for scale aversion in major hazard assessment, a framework for societal risk decision making and consideration of building damage in land use planning advice. The outcome of this work feeds into the Technical Advisory Group and through to the cross government working group on societal risk and ultimately for ministerial consideration. Work continues into 2009/10. The work has involved £450k of resource from HSL's Fire and Process Safety and the Risk Science Units. The total budget for the two external contractors has been £200k.

Risk based models for the prioritisation of pipeline replacement

HSE has a continuing interest in working with relevant industry stakeholders on the refinement of risk based models for the prioritisation of pipeline replacement. Two examples are:

1 The cast iron gas mains replacement programme. Different models have been developed for steel and ductile iron pipelines. The models influence the choice of mains to be replaced and enable HSE to work effectively with the industry to ensure that the selection of pipelines for decommissioning (replacement) are based on proper assessment of the risk of incidents. The industry has commissioned a number of projects in this area over the last 10 yrs, in the development of which, HSE has provided advice, comment and support as necessary. In doing so, HSE has where appropriately, commissioned research to assess and evaluate proposed modifications to the models

2 Variations to the Advantica Pipeline Replacement Prioritisation Model are required depending on the type of gas/fluid being carried. As a result of the incident at Maryhill, Glasgow in 2004 and responding to the public inquiry into the incident held in the second half of 2008, work is underway to amend the model to reflect properties of propane, which differ markedly from natural gas. The amended model will be used to prioritise the choice of buried metallic service pipe to be replaced and enable HSE to work effectively with the industry to ensure that their programme of pipeline replacement is based on a proper assessment of the risk of incidents. Data obtained through a research project recently completed by HSL, looking at the diffusion of propane through different types of soil, will inform the revision of the Advantica model.

Annex 2

Examples illustrating HSL's contribution to HSE's investigation and enforcement work.

Case Study – Buncefield oil storage depot

The Clients

HSE
Environment Agency
Health Protection Agency

The Problem

The Buncefield Oil Storage Depot was comprehensively damaged by a series of explosions and fires which started at approximately 6am on Sunday 11th December 2005. This was the largest event of its type in Europe since the 2nd World War. Several people were injured but none fatally. Many of the surrounding industrial premises were destroyed and windows were shattered at 1 km distance.

What We Did

HSL was called in immediately by the Health Protection Agency to collect air samples and perform analyses as soon as possible. A scientist was "blue lighted" to the scene within a few hours of the request being received.

Subsequently HSE asked HSL to carry out a wide-ranging investigation to establish the cause of the incident. The Environment Agency requested damage surveys and mapping of all the tank bunds
The investigation covered the following principal areas:

- Examination and photography of site damage
- Interrogation of site CCTV images

- Investigation of control and alarm systems
- Fire and explosion studies
- Human factors issues: control room layout and shift working

The primary cause of the incident was found to be the overfilling of a tank containing unleaded petrol, resulting in the escape of 250,000 litres of fuel. There was little or no wind at the time and a vapour cloud, consisting of air and hydrocarbon vapour, was formed. This cloud spread around the site, following the natural topography, until it encountered a source, or sources, of ignition. The malfunction of the tank control and alarms systems was key factor in explaining the release.

A series of experiments was carried out on the Buxton site using two full-scale models of sections of the storage tank in order to study the fuel release. The overpressure generated during the explosion was deduced from damage to buildings and cars; in the case of the latter, a number of vehicles were subjected to various explosive overpressures in a blast chamber at HSL in order to “calibrate” the damage observed in vehicles on the Buncefield site.

Outcome/Benefits

HSL’s findings were presented in a series of incidents reports to HSE. Our staff will be required as expert witnesses in any legal proceedings.

The magnitude of the overpressure generated during the explosion could not be explained by conventional wisdom relating to unconfined vapour cloud explosions. HSL is therefore collaborating with industry on a joint research project to study this phenomenon.

Case Study – Investigating tower crane failures

The Client

HSE

The Problem

Each year we are asked by HSE to provide forensic support to over 200 serious industrial accident investigations. Some of these investigations arise from the failure of the many different types of crane in use on industrial sites in the UK and, of these, the collapse of tower cranes is probably the most catastrophic.

What we did

The collapse of two tower cranes in less than four months at sites in south London and Liverpool, tragically took the lives of two workers and one member of the public. The same company supplied both cranes, and HSE took the precaution of prohibiting the use of cranes of this type until their safety could be independently demonstrated.

HSL was called to the scene at an early stage in both investigations. At one location, our mechanical engineers and specialist photographers spent seven days on site, carrying out a detailed examination of the collapsed structure and observing recovery operations. The jib slewing rig and sections of the mast were brought to HSL for further examination, a major logistical exercise involving a fleet of seven lorries. Although the mechanism of failure was quickly diagnosed, it became necessary to carry out full-scale loading tests in order to validate the proposed failure scenario. A crane test rig was therefore constructed on one of HSL's outdoor test pads.to replicate the upper part of the tower crane assembly and series of load tests were carried out. In addition, a series of cyclic load tests were carried out in the laboratory using a servo-hydraulic test machine.

At the other incident the HSL team was on site for nine days. Here the recovery operation was hampered by high winds and the need to free some of the evidence from concrete that

had set after the collapse. In this case the laboratory examination was less protracted and, by eliminating a number of potential scenarios, the failure was attributed to wind loading.

Outcomes/Benefits

Understanding the cause of accidents is key to preventing their recurrence. Both investigations led to a better understanding of the behaviour of tower cranes under load and indicated the need for additional research. In addition, the construction industry has been reminded of the requirement for regular inspection of tower cranes by a competent authority.

Case Study – Explosion at ICL Plastics Ltd., Glasgow

The Client

HSE
Strathclyde Police (joint investigators)

The Problem

At approximately 12 noon on 11 May 2004 an explosion occurred at ICL Plastics Ltd., Maryhill, Glasgow and the factory building subsequently collapsed. Nine people died and 40 others were seriously injured. HSL was immediately requested to provide assistance to the joint HSE/Strathclyde Police investigation and a team consisting of gas explosion specialists, photographers and metallurgists were dispatched to the scene.

What we did

At the scene HSL and HSE staff assisted the Police in sifting though thousands of tons of debris in order to establish the source the explosion. After many days on site, clear evidence was found of a gas or dust explosion having occurred in the basement of the premises. The substantial steel beams supporting the ceiling of the basement had been deformed upwards and, from the extent of this deformation, the explosion overpressure was calculated using finite element stress analysis. This approach was validated in a series of mechanical tests carried out at HSL.

At the outset a number of potential sources for the production of an explosive atmosphere in the basement were considered, including natural gas, LPG, various dusts and solvents used on the premises. However, subsequent evidence from excavations established that the most credible scenario was leakage of LPG from an underground pipe entering the premises from an external above-ground LPG tank. This pipe had corroded over a prolonged period of time and there was a corroded hole adjacent to the basement wall. Using a tracer gas, it was established that there was a route by which the escaping gas was able to migrate into the building. Once in the basement there were a number of potential ignition sources.

HSL metallurgists removed the pipe and transported it to the laboratory for detailed examination by x-radiography, metallography and microscopy. Deterioration by corrosion was confirmed and several other areas of through-wall corrosion penetration were discovered. In addition, chemical analysis of volatile vapours and gases; examination of control equipment from gas- heated ovens; examination and testing of LPG oven burners

and gas train; tests on dust samples; explosion tests and modelling of the health effects of propane and methane, were all carried out at HSL.

HSL Engineering Services manufactured a scale model of the premises and surrounding area for use in court.

Outcome/Benefits

HSL staff assisted in diagnosing the cause of the incident and in eliminating other scenarios in a methodical and scientific manner. We provided expert witness testimony in the subsequently successful prosecution and public inquiry.

Annex 3
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