Health and Safety Executive Board			HSE/14/06
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Science Report 2014

Purpose of the paper

1. This is the sixth annual Science Report. The Board is asked to note and comment on the report and oral briefing from the Director of Science.

Background

2. HSE's budget for commissioned research and technical support in 2013/14 is ~ £28m[1]. HSE is a strongly evidence-based organisation with about 850 of our staff being qualified scientists, engineers or analysts who use their expertise to contribute to the management of risks in workplaces and the development of evidence-based policy.

3. This Report 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;
- results of an internal audit of research commissioning;
- progress towards the rolling three year science plan; and
- progress on the current and new Strategic Research Programmes.

Communications

4. HSE's press office will provide communications activity on publication of the science report. We will issue a press notice to trade and national media confirming publication and highlighting the achievements of the report. We will promote the report via the HSE website and this will include the publication of the press notice. E-bulletins will be used where appropriate and social media activity on HSE's press office Twitter account will direct people to the report on the website and will highlight achievements from its content.

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

Devolved administrations

5. There are no implications for the devolved administrations.

Action

6. To note and comment on the Science Report.

Paper clearance

7. This paper was cleared by SMT at its meeting on 8th January 2014.

Health and Safety Executive

Science Report 2014

1. Executive summary

1.1 In the 2013/14 financial year the Health and Safety Executive (HSE) will spend around £28m[2] on commissioned research and technical support. During this year, HSE has commissioned 173 new research and technical support projects, in addition to the 335 that were underway at the start of the year. It is expected that 218 will be completed within the year. This year HSE has commissioned work on a variety of topics including an overview of diesel engine exhaust exposures, falls through fragile materials and heat stress impairment of temporary refuges on offshore platforms.

1.2 The Corporate Science Unit manages the planning, commissioning and evaluation of HSE's science. An internal audit of science commissioning was conducted in summer 2013 and provided substantial assurance that risks to the achievement of business objectives were being managed appropriately.

1.3 An evaluation was conducted of the progress implementing recommendations arising from the four recent reviews of the quality of science at the Health and Safety Laboratory (HSL). Overall, those reviews found the quality of HSL's science to be high. Good progress has been made implementing the majority of actions with only a small number yet to be completed. The scope of future reviews of the quality of HSL's science will be agreed by March 2014.

1.4 The quality and value of HSE's science continues to be recognised externally and a number of staff have been presented with awards. Internally, the contribution of science to the achievement of business objectives is regularly assessed and this year the majority was considered to be of either good or excellent value for money. Reactive support to inspectors from HSL, or external suppliers, was considered to be essential or supportive in all cases.

1.5 During 2013, the three Specialist Resource Groups (SRGs) - covering disciplines in Health, Safety and Human Sciences - have reviewed specialist work plans and priorities from across HSE to ensure specialists are deployed where they are most needed. The Director of Science and senior managers who make up the SRGs have provided corporate oversight of professional issues for specialists.

1.6 The recently established knowledge management capability in HSL/HSE is proving useful, for example a knowledge management toolkit is now available and is being used, by HSE staff. Knowledge capture from key staff leaving HSE have also been conducted this year.

[2] Excluding funding for science managed by the Office for Nuclear Regulation (ONR) and a Defra funded pesticides research programme that is managed by the Chemicals Regulation Directorate (CRD). ONR and nuclear licencees work together to manage a programme of support and research which is funded by licencees.

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 imporve knowledge about occupational safety and health;
- apply new ideas and knowledge to 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 for scientific, technological, engineering and medical support is for its operational and regulatory work. As in previous years, this requirement accounts for around two thirds of our expenditure on commissioned science. It includes support for investigations and major incidents conducted by both HSE and Local Authorities.[3]

2.3 HSL is HSE's principal provider of forensic scientific support. In 2013/2014 HSE commissioned ~ £3.5m reactive support for investigations and major incidents from HSL. HSE also commissioned ~ £0.6m reactive support for investigations from other providers where HSL has limited or no expertise.

2. 4 HSE also commissions ~ £16m planned support (mainly from HSL) which covers a range of activities, principally running operational and policy projects and developing and maintaining HSL's capability. This is to make knowledge and information available to HSE to discharge its functions such as developing early thinking on policy formulation.

Research

2.5 HSE commissioned ~£8m of applied research in 2013/2014[4]. HSE does not normally commission academic or blue-skies research. Wherever possible, HSE commissions research in partnership with relevant industries and stakeholders, and collaborates with national, international and EU programmes. HSL are beginning to set up a PhD programme to encourage links with academia.

Futures work

2.6 The HSE Futures work, underpinned by the Futures Team in HSL's Foresight Centre, continues to work to identify new and emerging issues with potential to impact on the UK health and safety system and to track progress. Its work feeds into many areas of HSE/HSL's work, including strategy development and science planning. As well as undertaking futures work for HSE, the HSL team is involved with central government and international foresight activities (see Annex 1.3).

[3] Annex 1.1 includes a glossary of definitions of reactive support, planned support and research.
[4] Annex 1.2 includes criteria for commissioning science.

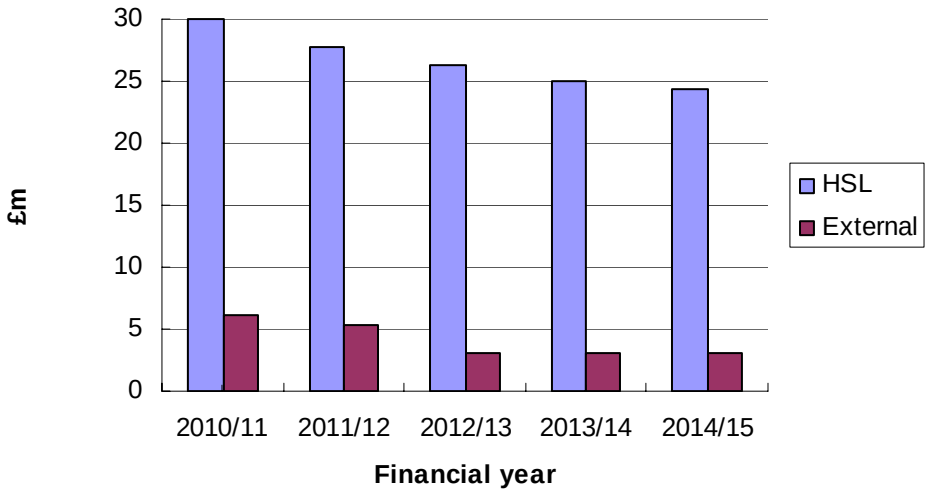
3. Use of science in 2013/14

Research

3.1 The Science Plan 2012-15 supports the HSE Business Plan. Directorate management of research budgets ensures that the commissioning of research and support is aligned with HSE's business objectives.

Finance and cost recovery

3.2 In 2013/14 HSE plans to spend £25.1m with HSL and ~£3m with external contractors. This represents ~ 17% of the HSE budget. The chart below illustrates the budget for HSL and external providers over the SR10 period.



3.3 The science budget for each Directorate in 2013/14 is:

- Cross-Cutting Interventions Directorate (CCID) - £2.52m
- Chemicals Regulation Directorate (CRD) - £0.5m
- Corporate Science, Engineering and Analysis Directorate (CSEAD) - £7.52m
- Field Operations Directorate (FOD) – £8.45m
- Hazardous Installations Directorate (HID) – £8.1m
- Operational Strategy Division (OPSTD) – £1.05m

3.4 There are a number of on-going science projects that are jointly funded with industry or other organisations. For example, in the CSEAD portfolio, there are three projects that require a HSE contribution of £323k, representing ~ 3% of the total project cost. However, the number of jointly funded projects is reducing year on year.

3.5 There is a range of work undertaken in support of the major hazards regime, predominantly by HSL. This includes reactive on incident support (~£700k for 2013/4)), assessment of Offshore Safety Cases and COMAH Safety Reports (~£500k) and research work of wider interest to the industry (~£1.3m).

3.6 HSE uses research visits to workplaces to understand work processes and maintain its understanding of current industry practices. Following the introduction of Fee for Intervention, a research protocol for HSL staff visiting workplaces has been published on HSE's website. The introduction of Fee For Intervention has led to a small number of organisations not volunteering for research visits but it is too early to assess whether the number of volunteers will be significantly affected overall - HSE will keep this under review.

Examples of work published or completed in 2013

3.7 The work includes a diverse range of topics and requirements[5], some commissioned from HSL and external contractors and some carried out internally by HSE analysts, including:

- A survey of pesticide usage
- Mobile elevated work platform incident analysis
- The use of infra-red (tympanic) temperature as a guide to signs of heat stress in industry
- Assessment of self reports of work-related illness in the Labour Force Survey
- Customer segmentation analysis
- Impact assessment performance
- Estates excellence evaluation
- Exposure to bioaerosols and dust at Materials Recycling Facilities
- Guidance on the use of air-fed suits in the nuclear industry
- Improving fire plume modelling for liquefied natural gas (LNG) accidents
- Corrosion Under Insulation: lessons learned from incident investigations
- Chronic Obstructive Pulmonary Disease (COPD): causation, exposure and impact on workers
- Experimental research to understand the hazards associated with a 'Hydrogen Economy'
- Use by large organisations of the 'Management Standards for Work-Related Stress'

Demonstrating the use and value of work commissioned or completed in 2013

Reactive support

3.8 A review of the value of HSL's scientific contributions to prosecutions during 2011/12 was presented in the Science Report 2013. This year the contribution of support provided by HSL to investigations that do not lead to prosecutions was examined, together with all cases using external support including those following the prosecution route. This review included a sample of jobs commissioned from HSL and external contractors over a six month period from 1 April 2012 to 30 September 2012.

[5] Case studies for some of this recently completed work are at Annex 1.4.

Cases where HSL provided reactive support

3.9 There were 1548 FOD-investigated cases within the six-month review period and HSL provided reactive support for 95 (6%) of these. 55 of the 95 cases, selected at random, were evaluated.

3.10 HSL's occupational hygiene discipline was used in 59% of these cases, followed by engineering and personal safety in 27% of cases. For the remainder of cases, ergonomics and gas safety expertise were used.

3.11 HSL's Visual Presentation Services were not used for any of the sampled cases that did not go for prosecution, but they were involved in 13% of the cases being considered for prosecution. This may be because the inspector considered a prosecution likely and obtained specialist photographic evidence.

3.12 Inspectors considered that HSL's input was essential in three quarters of the cases evaluated, and supportive in the rest. Their initial requirements were fully satisfied in 90% of the cases. Similarly, most of the cases were delivered to time and within agreed costs. A selection of case studies is at Annex 1.5.

3.13 Previous reports concluded that whilst the proportion of cases that required HSL support was small, access to high quality forensic services, on demand, was essential to a successful outcome. This review reached the same conclusion for investigations that do not result in prosecution.

Cases where external contractors provided reactive support

3.14 There were 10 external contracts for incidents occurring in the selected six-month period (0.6% of the 1548 investigated cases) and 8 were evaluated. The input of the external contractors was considered essential or valuable by inspectors in all cases. All work fully met the requirements of the inspector and was delivered to time and cost. For these cases, a wide range of expertise was called upon including vehicle examination, electrical installation, scaffolding, explosives and leisure industry expertise. An example is described in Annex 1.5, case study 5.

Research and planned support projects

3.15 HSE regularly collects internal customer feedback about timeliness, quality and delivery of research and planned support project outputs. Analysis for 55 recently completed projects showed that a high proportion (~90%) considered the objectives of the work to be fully or mostly met and this is consistent with the results from previous surveys. 80% of respondents felt that the business needs/knowledge gap had been fully or mostly addressed.

3.16 Around 80% of customers judged the scientific quality and delivery of the project products to be good or excellent (rather than fair or poor) which is a comparable response to the previous year's sample. 87% of customers considered that the time scale of the work enabled them to use the results as originally planned. 70% stated that the project did not exceed its original anticipated cost; this is an improvement compared to last year.

3.17 Approximately two thirds of commissioned projects result in an openly published report or peer-reviewed paper; other deliverables included items such as conference papers, electronic tools, guidance, contribution to policy development and workshops.

Recently completed evaluations

3.18 HSE evaluates interventions to understand their value in contributing to the objectives of preventing people being killed, injured or made ill by work. Two evaluation studies were published in 2013. The *Evaluation of the HSE Worker Involvement Training Courses* found evidence of substantial and lasting impacts of HSE's 'Do Your Bit' training for health and safety representatives and their managers, aimed at increasing the effectiveness of worker involvement in health and safety in organisations. The *Evaluation of health surveillance for hand-arm vibration (HAV) following Faculty of Occupational Medicine (FOM) accredited training courses* found evidence that attending a FOM course led to immediate and short-term improvements in the confidence of health care staff performing health surveillance for HAVS.

HSL Strategic Research Programmes

3.19 Three Strategic Research Programmes (SRPs) started in spring 2011 and have proved to be a successful model for longer-term ambitious multi disciplinary collaborative research, preparing HSE for future changes in the workplace and supporting development of HSL capabilities and knowledge. Two further SRPs were approved in 2013 – '*Demographics'* and '*Advanced Manufacturing and New Emerging Materials'.*

3.20 The Strategic Research Committee (SRC) invited outline research proposals from HSL for these two new SRPs. Following wide peer review, detailed proposals will be evaluated in early January 2014 at Governance Board meetings, which will include external peer-reviewers. Projects should commence in April 2014.

3.21 Over the year the profile of the 3 mature SRPs ('*Exposome*', '*Health surveillance*' and '*Mathematical modelling*') has been raised across HSE with each having a refreshed Community of Practice available to external parties and each being delivered as a Director of Science seminar. Beyond HSE, each SRP is generating peer-reviewed publications, poster presentations and conference papers.

3.22 The '*Exposome'* SRP gathers information on workplace health hazards from new substances. The year's achievements include significant workplace sampling and analysis for exposure to isocyanates and amines with a peer review publication in preparation. In terms of new technologies, over 200 urine samples were analysed for 61 elements possibly used in new generation semiconductors. An in-mask silica sampler was developed in collaboration with the National Institute Occupational Safety and Health, (NIOSH), USA. Work on biological monitoring was presented at the 9th International Biological Monitoring Conference (Manchester) and a Canadian research group are keen to collaborate in aero-allergen exposure assessment.

3.23 Under the '*Health surveillance and health consequences*' SRP, the baseline surveys in the brick, stone and foundry sectors are almost complete having collected exposure and health information for over 600 individuals. Data relating to workers' health were collected including work history and respiratory symptoms, lung function, chest

radiographs and a number of early biomarkers of health effects. Analysis of these data alongside measurements of both current and historical exposures will commence in late 2013.

3.24 A computer simulation model for chronic obstructive pulmonary disease (COPD) incorporating population dynamics, trends in smoking and occupational exposure to respirable dust, fumes and gases has been successfully developed. The model allows the long-term health impact of workplace interventions to be evaluated and provides policy makers with a tool to explore different options and their likely impact. This year the model was presented at the EPICOH (Scientific Committee on Epidemiology in Occupational Health) conference and to the Advisory Committee on Toxic Substances to illustrate the potential increased risk of COPD posed by low toxicity dusts.

3.25 Progress has been made this year in the '*Mathematical Modelling'* SRP on dense gas dispersion particularly modelling dispersion over varied topography at low wind speeds. A literature review of dense gas dispersion modelling was completed and a novel design for a shallow-layer dense gas dispersion model was produced and peer-reviewed by Professor E. Toro at Trento University, Italy.

3.26 The Geographical Information Systems (GIS) team have investigated how to represent populations on maps to generate more realistic population estimates. For example, where children may be outside school buildings part of the day and so outside the relevant zone of interest.

3.27 The SRP approach has had multiple benefits including:

- enabling partnership with external stakeholders in steering the work programmes through their membership of the governance boards;
- facilitating the development of joint research work in collaboration with other national and international scientific experts to ensure that HSE's work is underpinned by leading-edge scientific and technological developments in health and safety;
- better preparing HSE for future changes in technology and working practices that impact on health and safety by commissioning strategically rather than piecemeal through small projects that have not always been optimally aligned with delivering HSE's business;
- leveraging funding by co-funding joint research work;
- providing less experienced researchers with the opportunity to be involved in chairing conference sessions, networking with international colleagues and drafting manuscripts for peer review publications.

Communicating results

3.28 The communication of results from scientific work uses many approaches including engagement with industry bodies and health and safety professionals, the HSE website, articles for trade and professional magazines, research reports, and scientific papers. 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. The

Director of Science is continuing to encourage publication of findings in peer-reviewed journals.

3.29 A significant development during 2013/14, is the move towards 'open access' publishing. The Finch report[6] considered funding mechanisms for open-access publishing, where the cost of publication is moved from readers to authors. The purpose of the shift being increase returns made on investments from public funds and support the Government's move to greater transparency. The Government announced in July 2012 that it accepted the 'Finch Group' recommendations; HSE funded research is in scope.

3.30 For HSE, the move to open access will further strengthen our committment to making research findings freely available to stakeholders and should enhance the uptake and use of research findings. It will will bring access to journal and conference papers in line with the current position for the research reports on the HSE website which are already freely available to readers. HSL has already made changes to its website to facilitate stakeholder access to open access journal and conference papers[7].

3.31 The Minister for Universities and Science, David Willetts, at the inaugural event of the Campaign for Social Science's 2013 lecture series, highlighted and praised HSE Gas Safe research: *" ... I think this is a really interesting granular example - social scientists at the Health and Safety Executive worked with the Gas Safe Register to identify the groups most at risk from unsafe gas appliances and encouraging them to register for annual gas safety checks. In just five months, the pilot resulted in a 300% increase in the number of high risk households having checks. Of those, one fifth was found to have potentially dangerous problems'.* For further details, see case study 5, Annex 1.4.

3.32 This year a number of HSE and HSL staff have been presented with awards:

- Jill Wilday (HSL) won the 2012 IChemE Frank Lees medal for the best safety-related paper in a 2011 IChemE publication. Her paper[8] on emerging risks using carbon capture and storage was as lead author with co-authors from the iNTeg-Risk European project.
- The Centre for Workplace Health (CWH) was used by the Government Office for Science in their January 2013 report *'Engaging with Academics: How to Further Strengthen Open Policy Making'*[9] as a case study showing how a centre of excellence brings substantial benefits. It highlights that CWH: *'has ensured that doctors and nurses are exposed to policy work early in their careers, allowing them to interact with policy officials more efficiently.'*

[6] For details of the report by the 'Finch Group' (The Working Group on Expanding Access to Published Research Findings) and the response by the Government and others, see http://www.researchinfonet.org/publish/finch/

[7] The new HSL website information on publications from 2013 is at: http://www.hsl.gov.uk/publications/bibliography-reports-papers-and-articles/publications-2013.aspx

[8] Wilday J, Paltrinieri N, Farret R, Hebrard J, Breedveld L, (2011), Addressing emerging risks using carbon capture and storage as an example, Process Safety and Environmental Protection, 89, 463–471.

[9] http://www.bis.gov.uk/assets/goscience/docs/e/13-581-engaging-with-academics-open-policy-making.pdf

- Steve Critchlow (HSL) has received a Divisional Commander's Award from Great Manchester Police as a member of the forensic and search teams for the investigation of the 2012 fatal domestic gas explosion at Buckley Street, Oldham. Detective Chief Inspector Peter Marsh nominated the teams because of the exceptional level of detail and commitment shown on the forensic recovery. This was fundamental to the success of the police prosecution.
- Chris Barber (HSL Deputy Chief Medical Officer) received the British Thoractic Society's 'Highly Commended Award for Excellence in Delivery of Respiratory Education' on behalf of the CWH for the work he led to develop an interactive case-based e-learning module hosted by the British Medical Journal. Over 5,700 healthcare workers from 96 countries have completed the module.
- Research led by Dr Anthony Darby[10] at HSL was included in the *Thorax* journal awards for papers published in 2012. This research assessed the contribution of workplace exposures to COPD risk in a community with a heavy burden of past industrial employment supplement.
- Gillian Frost, HSL statistician, received the 150th Anniversary prize from the London School of Hygiene and Tropical Medicine on completion of her 3-year MSc in Epidemiology for achieving the highest set of marks across her degree.
- The British Occupational Hygiene Society (BOHS) Award for the best poster at the *Occupational Hygiene* international conference, April 2013 was jointly awarded to Susan Fraser, Howard Mason, Andrew Thorpe, Paul Roberts, Ian Smith and Gareth Evans (HSL). Their research showed that simple, practical changes to bakery 'improver' formulations can reduce exposures to dust and allergens in bakeries.
- Dr Andrew Curran, HSL's Director of Science and Delivery, was awarded an Honorary Professorship by the University of Sheffield. The title was awarded based on evidence of excellence in a professional/academic field and ongoing collaboration with an academic department within the University of Sheffield.

3.33 The quality of HSL reports has improved this year. Activities to further improve report writing and editorial review have included; piloting a bespoke one day course on report writing which will be rolled out, issuing 'top tips' for staff on writing and editing reports and formalising which staff are best placed to undertake editorial review.

3.34 Annex 1.6 lists HSL's 2013 scientific publications from January to the beginning of November 2013 and papers in press. These papers describe work undertaken for both HSE and external customers.

3.35 Publications prepared by external researchers following research commissioned by HSE with them, and those where HSE has contributed as co-author/sole author, are listed in Annex 1.7.

Knowledge Management

3.36 The programme to develop a Knowledge Management capability in HSL has concluded and the development of a manager's toolkit and knowledge management activities have moved towards sharing and promoting activities.

[10] Darby, A., et al. (2012) Chronic Obstructive Pulmonary Disease among residents of an historically industrialised area. Thorax. 67 (10) 901-907

3.37 The knowledge management toolkit was launched this year, and is available to all HSE staff through an online community. The launch included a Director of Science seminar and workshops. The workshops gave HSE managers the opportunity to explore and practice the techniques in more detail; this has included Knowledge Cafés in CCID, lessons learnt exercises in Legal Adviser's Office and a number of knowledge captures of staff leaving HSE. The feedback has been that the toolkit and help from HSE and HSL practitioners, has been welcome and the outcomes have been enhanced through application of the techniques.

3.38 The Knowledge Council (chaired by the Director of Science) has continued to provide a focus for this work, providing a useful forum for cross-HSE sharing of experiences and issues.

3.39 HSL hosted a joint Knowledge and Innovation Network and Interlab Forum knowledge management event in June 2013, to share approaches with other government departments.

HSL's Investment Research Programme (IRP)

3.40 HSE continues to contribute to HSL's Investment Research Programme (IRP). The IRP enables HSL to undertake innovative research and develop links with other institutes in order to develop new capabilities and experimental approaches. This allows HSL to develop and strengthen its ability to deliver practical solutions to health and safety challenges for both HSE and external customers. This year the focus has been on developing scientists to enable them to apply their skills to new applications. This is to proactively reshape capabilities in line with HSE's evolving needs, as well as growth areas for external work that will offset the planned reduction in scientific work placed by HSE over future years.

3.41 IRP funding is allocated to: strategic research programmes (~ 40%); product development (~ 15%); and individual tactical projects (~ 45%) including research, scientific publications and scientific activities to underpin development of training courses delivered by HSL. HSE's funding contribution in 2013/14 is £0.75m (50% of the £1.5m total).

Newly commissioned research in 2013/14 includes projects to:

- develop an experimental method to test the sampling efficiency of large-particle samplers ('thoracic samplers') such as those used to measure personal exposure of workers to sulphuric acid mists;
- review and further develop assessment tests for hand arm vibration.

Recent IRP work has allowed HSL to:

- enhance capability in composite materials science and engineering including failure analysis, non-destructive testing and electrostatics.
- launch the 'Quadvent' software product to model flammable gas jets either in a ventilated enclosure or outdoors, for use as part of hazardous area classification under the Dangerous Substances and Explosives Atmospheres Regulations and;
- strengthen experimental capability in the measurement of potential worker pesticide exposures.

4. Science Plan for 2014 and beyond

4.1 The Science Plan for 2012-15 was first prepared in 2012 and an updated version was published on HSE's website in August 2013. It sets out how HSE will apply science and engineering resources to the delivery and realisation of its business plan. HSE's Business Plan 2012-2015, demonstrates how HSE will deliver its part of the strategy *'The Health and Safety of Great Britain: Be part of the solution'*.

4.2 At the end of June 2013, the Director of Science issued a call for proposals from HSE Directorates, science customers and HSL, to be considered within the 3 year rolling science plan from 1st April 2014. Proposals must articulate the links to delivery plans and the benefit of the work. The Science Plan draws on ideas from policy makers and specialists from HSE and HSL. The Director of Science provides overall scientific assurance for the plan.

4.3 The Corporate Science Unit (CSU) and the Director of Science have reviewed ~ 60 proposals the majority of which will be commissioned subject to consultation on scope and methodology and Corporate Efficiency Board/ministerial approval in some cases. Proposals in key areas have been identified including: corporate statistics, offshore oil and gas and long latency disease. The numbers of proposals have been steadily falling over the last 3 years, which reflects a reduction in science budget but also the capacity of staff as customers to commission research alongside operational, including cost recovery work.

4.4 HSE's Science Business Partners have continued to work closely with their counterparts at HSL to allow them to address capability/capacity issues early in the commissioning process.

4.5 The reductions in reactive support requirements from HSL over the last year or so, and the reduction in proposals from HSE customers, means that the science plan will require some rebalancing. As spend on reactive work at HSL in 2014 and beyond is reduced compared to historical levels, the plan will need to ensure that HSL's capability to respond to major incidents is still available through funding of specified planned support programmes of work. These will be developed with advice from the Specialist Resources Groups over the coming year.

4.6 This year the CCID Science Strategy Group was formed and has provided management oversight to ensure that: the science CCID commissions is coordinated across its Divisions and within HSE's wider research landscape; addresses CCID's business and longer-term research needs and that emergent knowledge is shared with others. The CCID science business partner and CCID staff have worked closely with HSL to improve scientists' appreciation of policy work at the laboratory.

5. Governance

Management of HSE science and internal audit

5.1 During Summer 2013, an audit of HSE's science commissioning was carried out by HSE's Internal Audit (IA) team. The audit team examined the process for commissioning

research and technical support projects (excluding reactive support) from HSL and the management of these projects by staff in CSU. The purpose of the audit was to make practical recommendations for improvement in the management of business risk, control and governance where appropriate. The specific areas examined by the auditor included:

- links to HSE business needs
- appropriate approval of work
- project management
- dissemination of research findings

5.2 The lead auditor gave substantial assurance that that the risks to the achievement of the business objectives were being properly managed by staff. There were no recommendations arising from the report. The audit did identify some current work underway in CSU to better track and disseminate research reports and other project deliverables.

5.3 In April 2013, IA also examined key areas for implementing HSE's SR10 financial strategy – this included cost reduction for non-frontline spending on external research. CSU provided information on the management of HSE's external science budget, which contributed to IA being able to offer substantial assurance that there are robust controls in place to adequately manage the risk of not implementing HSE's SR10 financial strategy.

5.4 The size and cost of the team responsible for commissioning science has reduced this year, and by April 2014, following a number of staff retirements, there will be a single team of 14.5 people, a net reduction of 10.3 FTE posts since January 2011. Knowledge management exercises have been conducted to ensure HSE captures the key knowledge of those planning to retire.

Science Review at HSL

5.5 As reported in previous science reports, between October 2009 and October 2012, HSE's Director of Science commissioned a review of the quality of HSL's scientific and technical outputs. This 'Science Review' was conducted in four stages, and sought assurance that HSL's scientific activity and outputs compare favourably with the work of similar organisations in the UK and overseas.

5.6 The general conclusions of the four reviews were that:

- excellent work is being delivered for HSE by HSL.
- staff are good, well qualified and using good facilities available in Buxton.
- HSL scientists demonstrated real world and applied work, not blue-sky work. These are areas HSE are rightly interested in.
- staff are well respected outside HSL and overseas.
- there is good evidence of high profile international work and collaboration by some individuals and teams.
- HSE and HSL to continue to work to maintain and extend the HSL's key strengths including their in-depth knowledge and influence in the UK and internationally.

5.7 For 2013, the Director of Science requested an internal review of how far the recommendations and the actions plans had been implemented. This review was conducted in September 2013 by Dr Andrew Curran (HSL), Dr Mary Trainor (HSL), Dr Jo Harris-Roberts (HSL) and Richard Lewis (HSE CSU). The review team collated the recommendations and proposed actions focused on: commissioning research; science planning; knowledge dissemination; exploiting knowledge; staff development, recruitment and succession planning; specific business areas and activities in HSL and quality assurance.

5.8 The review team noted that during the three-year period of the science reviews, the context in which HSL operates was changing, so that it was not always appropriate or possible to implement some of the recommendations. HSL was subjected to a civil service wide recruitment freeze and to reduced demand from HSE. Its response was a business case, which was approved by the Minister responsible for health and safety in the DWP in 2012. The business plan gives greater emphasis to developing an external customer base and marketing products and services globally. Revenues from this work enable HSL both to meet its costs at a time when income from HSE is reduced, and to recruit scientists to specialisms needed to meet demands from external customers.

5.9 Recommendations from the reviews relating to staff development and to particular scientific activities are being addressed in line with HSL's business plan, where it is sustainable to do so. The view of this review team is that the recommendations of the science reviews have been implemented so far as these constraints and new opportunities have allowed.

5.10 Future reviews of the science of HSL are being considered. These will take account of approaches to assessing and demonstrating the impact of public sector research establishments' work that are being developed by the Interlab Forum. HSL is an active member of this forum, and at its workshops, introduced approaches to assessment that had been developed to evaluate HSL's Investment Research Programme, with HSE's support and encouragement.

Strengthening commissioning of HSL science and technology support

5.11 The past 12 months have seen significant improvements in aligning the commissioning and delivery of scientific and technological support with HSE's needs. This is as a result of the changes successfully implemented during the last two years.

5.12 Additional changes to make further improvements through strategic commissioning are under discussion. These include strengthening links with universities and increased work through the HSL Foresight Centre. It is intended that an increase in strategic commissioning will further reduce the proportion of work commissioned through smaller tactical projects, including through the annual science planning round, introducing efficiency savings.

5.13 In parallel, changes are continuing in the commissioning of incident investigation work. A review of the requirement for investigation and inspection support has been commissioned by the HSL Partnership Board.

5.14 As in previous years, a review of HSL's overall capability against HSE's evolving requirements is underway. HSL is performing a gap analysis to inform HSE of any disciplines where greater resource is needed to meet increasing demand, or where HSE's requirements are or will fall.

Implementation of Specialist Review

5.15 The three Specialist Resource Groups (SRGs) set up by the review have been active through 2013, bringing together senior managers to provide corporate oversight of specialist deployment and professional issues. SRGs currently cover defined disciplines in three groupings: *Health*, *Safety* and *Human Sciences*.

5.16 Whilst developing the new ways of working needed to operate effectively, SRGs have focussed initially on specialist resource and deployment issues. This has included reviewing specialist work plans and priorities from across HSE to ensure specialists are deployed where they are most needed. SRGs have also built on existing arrangements to help improve the processes for assessing business needs in order to produce robust bids for recruitment into SRG disciplines, informed by a wider corporate view.

5.17 SRGs will be continuing their work through 2014, expanding into new areas of their remit to begin considering the professional issues that sustain HSE's specialist workforce, e.g. competency development. The Director of Science is also planning to commission an evaluation of the SRGs in due course to inform how these arrangements may develop in future.

Annex 1.1

Glossary

Scientific and technical support

Scientific and technical support for operational activities 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 is 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, 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, blue skies 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.

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

Futures and horizon scanning

HSE/HSL are active in central government and international foresight activities as well as futures work within HSE. Some examples are given below:

UK and Internal Activities

During 2013, HSE commissioned new Strategic Research Programmes at HSL on *Demographics* and *Advanced Manufacturing and New Emerging Materials*. These topics have been identified by the horizon scanning system as being of interest.

The Futures Team contributed to the HSE 'strategy refresh', which involved a review of HSE's sector strategies. The Futures Team was one of the subjects of HSE's rolling programme of Science Reviews. These are undertaken by a team comprising the HSE Director of Science and three external experts. The review team noted that: *'Futures work is a fascinating and worthwhile area but one which is difficult to focus and manage'.*

In October 2013, HSL announced the formation of a new Foresight Centre, which would initially comprise members of the Futures Team and Knowledge Management experts. The Foresight Centre will work with HSL's business development and consultancy specialists to provide customers within HSE, the UK Health and Safety System and worldwide, with access to HSL's knowledge of health and safety issues. An internal governance board will oversee the work of the Centre.

Central Government Links

The new structures proposed following the 2012 Cabinet Office review on Horizon Scanning (the Day Review), have been established in the Cabinet Office and are now operating alongside the Horizon Scanning Centre (HSC) in BIS. In January 2013 the Cabinet Secretary's Advisory Group selected five topics for study during 2013. Responsibility for these was shared amongst various lead departments. The topics were: emerging technologies; emerging economies; changing supply and demand of resources; changing social attitudes of young people and the future of demographic change in the UK.

Lead departments worked in different ways to fulfil their briefs, with the demographic change project, led by Professor Sir Mark Walport, the government's Chief Scientific Adviser, operating in the most inclusive way. HSE participated in two workshops, one at the start and one towards the end of the project.

Our link to futures in government and with other departments continues to be via the Heads of Horizon Scanning forum, run by the HSC. During 2013 the HSC commissioned twelve horizon scans, intended to be the first steps in the replacement of the Sigma Scan. Many of these topics are of interest to HSE, and HSE/HSL staff reviewed and commented on four of these: demography; transport; automation and robotics and young people. Our cross-government links led to our participation in the planning group for a horizon scanning seminar held in January 2013 by DSTL and involving government and private sector participants.

International Activities

The final report of the EU-OSHA project 'Foresight of New and Emerging Risks Associated with New Technologies in Green Jobs by 2020', carried out by the HSL Futures Team and partners SAMI Consulting and Technopolis Group, was published in April 2013. The main and summary reports are available on the EU-OSHA websites. The HSL team and SAMI Consulting returned to Bilbao in November 2013 to give a follow-up workshop to the EU-OSHA Focal Points. The Futures Team's input to the EU iNTeg-Risk project input came to an end with the completion of the project. The iNTeg-Risk project was a large scale collaboration involving nearly 80 partners. The Futures Team's role was to lead a work package involving international partners to provide geographical information on emerging technologies for incorporation into a web-based Risk Atlas. Futures Team members represented HSE at the EU-OSHA Research Priorities Meeting in Brussels in October 2013. This meeting was to launch the report 'Priorities for occupational safety and health research in Europe: 2013-2020', which followed from a 2012 meeting in Paris, at which the Futures Team presented a paper on the Green Jobs project. Also in October 2013, the Futures Team attended the PEROSH[11] Futures Group in Berlin.

[11] PEROSH Partnership for European Research in Occupational Safety and Health – a network of 12 research institutes whose aim is to coordinate and cooperate in R&D efforts in occupational health and safety.

Annex 1.4

Examples of work published or completed in 2013.

Case study 1. The Pesticide Users' Health Study - Survey of pesticide usage

The Pesticide Users Health Study is a cohort of nearly 66,000 commercial pesticide users, certified under the 1986 Control of Pesticide Regulations, who had agreed to participate in HSE's programme of research into their health. A survey to assess the history of pesticide usage among members of this cohort, and to assess the level of self-reported ill health associated with pesticide exposure, was undertaken during 2004 and 2006.

The response rate (14%) to the questionnaire was very low; this may have been partly attributable to a general decrease in survey response rates and to the fact that the main wave of the survey was undertaken at a particularly busy time of year. Respondents listed nearly 2,500 unique trade names and 677 active ingredients. The most common areas of pesticide usage were amenity weed control and the treatment of cereals. Individuals who were often exposed to pesticide concentrate were four times more likely to report 'ill health' associated with pesticide use than those exposed to diluted products. Additionally individuals who had used pesticides in jobs lasting more than 15 years were more likely to report 'ill health' than those working in jobs lasting less than 5 years.

HSE's programme to monitor the long-term health of people who work with pesticides is continuing with the Prospective Investigation of Pesticide Applicators'' Health Study (PIPAH).

View the full report: RR957 - The Pesticide Users' Health Study - Survey of pesticide usage

For other related research see:
RR958 - The Pesticide Users' Health Study - An analysis of mortality (1987-2005)
RR956 - The Pesticide Users Health Study - An analysis of cancer incidence (1987-2004)

Case study 2. Mobile Elevated Work Platform Incident Analysis

Mobile Elevated Work Platforms (MEWPs) are commonly used across all industrial sectors by a whole variety of trades, including mechanical and electrical contractors, and painters and decorators, as a safe, temporary method of working at height. There is a large range of MEWPs on the market and their controls and functionality varies depending on the category, manufacturer, model and size of machine. As their popularity and range of applications has grown, concerns have emerged about trapping and crushing accidents involving MEWPs.

This report identified accidents in the UK and abroad involving MEWPs and attempted to identify the key factors that contributed to them. The research analysed person-machine interface/human factors events rather than engineering issues. The work focused on MEWP occupants being trapped against overhead or adjacent objects whilst in the platform of the MEWP, particularly when the operator becomes trapped over the controls leading to sustained involuntary operation of the controls. Typically, this type of accident occurred when the operator was moving the MEWP within confined areas.

View the full report: RR961 Mobile Elevated Work Platform (MEWP) Incident Analysis

This incident analysis is complemented by further research considering particular types of MEWPs and activities; for this see: RR960 Mobile elevated work platforms

Case study 3. The use of infra-red (tympanic) temperature as a guide to signs of heat stress in industry

Previous research by the Institute of Medicine, showed that the use of a simple infra-red (IR) ear thermometer did not provide a reliable prediction of core body temperature for use in industrial situations. The aim of the current research was to explore the use of an IR ear thermometer further, and to determine whether the consistency and accuracy of the measurements obtained could be improved sufficiently to provide a reliable indication of the risk of an individual suffering from heat strain.

Published studies where IR temperature has been compared with core temperature benchmarks such as rectal temperature to provide further detail on likely sources of variation in measured tympanic temperature were re-examined. Based upon the factors identified, a number of experimental studies were carried out to explore the influence of these factors, together with revised measurement methods aimed at reducing their influence.

The results showed that the new technique devised did give more reliable results than those found previously although the predictive relationship determined showed that IR tympanic temperature could still not be used to predict actual core body temperature with a sufficient degree of accuracy for it to be used in industry.

However it is suggested that this provides a possible basis for the use of IR thermometry as a screening tool in monitoring hot workplaces for possible risks of thermal strain

View the full report: RR989 The use of infra-red (tympanic) temperature as a guide to signs of heat stress in industry

Case study 4. Follow-up and assessment of self reports of work-related illness in the Labour Force Survey

The Labour Force Survey (LFS) is HSE's primary source of data on work-related illness. It relies on respondents' perceptions of medical matters and their own assessment of whether their illness was caused or made worse by work. The aims of this research were to assess the nature/degree of work relatedness of illnesses reported in the LFS and to measure the impact of these conditions on the daily lives of those affected through a Work-Related Illness Survey (WRIS).

In the WRIS, a sample of respondents reporting a work-related illness in the 2010 LFS were re-interviewed and asked to provide more details about their illness and its connection with work. With their permission, their doctor was also contacted and asked to provide information on the reported illness and give their view of its link to work. Finally, a panel of experts reviewed the information and assessed the link between work and the illness. In 77% of cases, it was accepted by the case review panel that work was the main or contributory cause of the illness**.** In a further 10% of cases it may have exacerbated symptoms. For 13% of cases, the case review panel judged that a link between work and the illness was unlikely.

There is no standard measure of work-related illness without problems; all available sources are subject to some kind of error. Self reports are broadly reliable and the level of mistaken reports will to some extent be counter-balanced by opposite biases. When sensibly interpreted, the LFS provides valid information not available from other sources.

View the full report: RR970 Follow-up and assessment of self reports of work-related illness in the Labour Force Survey

Case study 5. The Use of Risk Based Customer Segmentation

Audience segmentation is the cornerstone of marketing. By dividing the population into subgroups based on defined criteria, e.g. attitudes and behaviours, product or service usage, communication behaviours, media usage, and demographics, different segments of the population can be targeted and marketers can communicate with them more effectively.

In order to improve the efficacy of health and safety interventions HSE analysts worked with Gas Safe Register (GSR) to commission research from an external consultancy, which would divide people based on their attitudes to gas safety. The segmentation used existing data sources such as the quarterly gas users' survey supplemented with additional questions and RIDDOR. The segmentation was verified by the use of focus groups and overseen by an advisory board which included HSE.

The segmentation identified six distinct, self explanatory, risk groups:

- Ostriches,
- Dismissive Sceptics
- Apprehensive Preventers
- Insecure Worriers
- Bargain Hunters
- Over Confident DIYers

The result of the segmentation was used in conjunction with knowledge drawn from the behavioural economics literature to design an intervention campaign targeted at the two highest risk groups: **ostriches** and **dismissive sceptics**. The aim of the campaign is to encourage gas users from these specific groups to register for an annual gas safety check.

Case study 6. Impact Assessment (IA) performance

The Regulatory Policy Committee (RPC), an independent body which scrutinises the quality of Impact Assessments (IAs) and judges whether they are fit for purpose, releases regular 'league tables', comparing the performance of the departments and bodies which participate in the system.

HSE economists, together with our social scientists and statisticians, provide expert advice during the development of IAs. HSE have done extremely well since the introduction of the system and were top of the table during 2011, with 91% of our IAs being fit for purpose. During 2012 (see table), HSE again came very near the top, with 93% of IAs rated as fit for purpose (compared to the overall average of 81%). In fact, the only departments above HSE had only one IA scrutinised each.

So far in 2013, HSE have submitted IAs for 6 proposals, of which only one was rated as not fit for purpose (that IA was resubmitted and received a Red rating again; these ratings are the subject of ongoing discussion with the RPC and BRE). Additionally, the RPC now also scrutinises other documents for small or deregulatory proposals, which can go on a 'fast track'. During 2013, HSE have submitted 4 proposals for the RPC to either allow onto the 'fast track' or validate their costs and benefits to business. All of them were accepted.

RPC's 2012 "league table"

Department	IAs	Red	Amber	Green	Fit for purpose	2011
Cabinet Office	1	0	1	0	100%	80%
Foreign & Commonwealth Office	1	0	0	1	100%	N/A
Ministry of Defence	1	0	0	1	100%	0%
Health and Safety Executive	15	1	5	9	93%	91%
Department for Transport	50	6	19	25	88%	77%
Department of Energy and Climate Change	25	3	10	12	88%	82%
HM Treasury	15	2	8	5	87%	89%
Department for Business, Innovation and Skills	92	15	49	28	84%	77%
Department for Environment, Food and Rural Affairs	61	10	26	25	84%	70%
Department for Education	37	6	20	11	84%	86%
Department for Work and Pensions	18	3	8	7	83%	42%
Department for Culture, Media and Sport	17	3	9	5	82%	76%
Department for Communities and Local Government	29	7	15	7	76%	69%
Ministry of Justice	14	3	11	0	76%	69%
Department of Health	31	10	16	5	68%	47%
Home Office	31	10	17	4	68%	50%
Food Standards Agency	2	1	1	0	50%	50%
Scotland Office	3	2	1	0	33%	N/A
TOTALS	443	82	216	145	81%	72%

Case study 7. Estates Excellence evaluation

Over the course of 2012/13 HSE rolled out a national programme of engagement with local businesses across a number of trading estates in Great Britain (GB) with the aim of helping them develop their understanding of sensible health and safety and related risk management. Visits to the businesses were conducted by HSE visiting officers together with external partners such as large private businesses and local fire authorities.

The national roll-out followed a pilot project in the South East, which had been successful in engaging businesses in that area. An evaluation of the nationwide intervention was planned in order to identify the benefits it has brought and help make a decision over whether the programme would continue to run across further trading estates. The evaluation would also help identify issues and aspects of the programme that could be improved.

HSE statisticians were initially involved in the project - helping to identify suitable locations for intervention, based on local injury and employment data. Following the interventions across GB, they were then asked to lead an evaluation of the completed programme. The evaluation comprised qualitative and quantitative surveys and the purpose was to evaluate the response of businesses to the project and the outcomes achieved. Questions were designed to understand key participation drivers, business benefits, and the specific actions taken (if any) by businesses as a result of engagement. The quantitative survey was completed using an online survey tool and the qualitative evaluation, allowing a more in-depth investigation of issues, comprised a series of telephone interviews with businesses, completed by HSE staff following interview training by an HSE social researcher.

Responses from businesses were generally very positive although it was noted that there was an element of self-selection in terms of who was willing to be part of the evaluation. Businesses were particularly positive about the opportunity to get advice from health and safety professionals outside of the usual enforcement visit scenario and felt that the visiting officers were knowledgeable and helpful. A large number of businesses had made specific practical changes as a result of the intervention and reported that they were now more confident in managing health and safety.

Furthermore, the project team were able to take away several useful findings in terms of improving the quality of the programme and the evaluation confirmed that this approach is working well and should continue to be taken forward. Monitoring of the initiative will continue using online surveys of participating businesses as the programme proceeds.

Case study 8. **Occupational hygiene implications of processing waste at Materials Recycling Facilities: exposure to bioaerosol and dust**

Materials Recycling Facilities (MRFs) are specialised plant that separate, process, grade and store solid waste fractions, prior to onward dispatch to re-processors. MRFs play an important role in meeting the demand on UK government to substantially reduce the amount of waste sent to landfill. Provision of MRF sites will be necessary to meet demands for recycling and this industry is likely to expand in the long term.

Although recycling and sorting of waste is increasingly mechanised, reliance on manual operations remains. The processes involved during recycling can generate organic dust, which may lead to exposure to airborne microorganisms and their toxic by-products. This may cause health problems in workers involved in handling waste. This research investigated exposures to dust and its microbiological components amongst workers employed at MRFs. The findings showed the potential for workers to be exposed to general airborne dust above the level considered a substance hazardous to health. Also, there was the potential for exposure to fungi and bacteria, as well as endotoxins, which are agents known to have harmful effects on human health. Endotoxin exposures may be at levels greater than the health-based limit identified by the Dutch Expert Committee on Occupational Safety.

The report concludes that the health implications of employee exposure to dust and bioaerosols was not fully considered at the sites visited. This was associated with a lack of corporate occupational health strategies and a failure to adequately manage health and hygiene provision. The project identified a number of areas for improvement, including undertaking suitable and sufficient risk assessments; adoption of well-implemented, risk-based health surveillance programmes; and the provision of adequate hygiene facilities.

View the full report: RR977 Occupational Hygiene implications of processing waste at Materials Recycling Facilities: exposure to bioaerosol and dust

Case study 9. Developing guidance on the safe use of air-fed suits in the nuclear industry

Air-fed suits are worn for radiological protection during nuclear decommissioning to protect a worker's skin and the respiratory system from radioactive particulate contamination. Air-fed suits fully encapsulate the wearer, have a trailing airline supply, and are used with other equipment and Personal Protective Equipment (PPE). The total ensemble can have a significant effect on workers' physiology and performance.

Although guidance on radiological protection issues is available, both the Office for Nuclear Regulation (ONR) and the nuclear industry, identified that guidance on non-radiological issues, such as managing ergonomic and physiological effects, was limited. Therefore ONR commissioned HSL to to undertake a programme of work from 2008, in close collaboration with an industry stakeholder group, to develop this guidance. The industry stakeholder group included nuclear industry licensees and PPE manufacturers. The aim is to reduce risks to workers – reducing the likelihood of both accidents and ill-health. The guidance '*Airfed suits in nuclear decommissioning – safe working practices*' was published by ONR in 2012 and the scientific paper on the research underpinning the guidance was published in 2013[12].

Managing air-fed suit operations safely and effectively involves complex interactions between people, PPE and work systems. The programme of work by HSL was to ensure that the new guidance: introduces new information, particularly recommendations for safe working times; reinforces and shares good practice for air-fed suit work from across the industry; and provides simple summaries of key physiological and ergonomic principles.

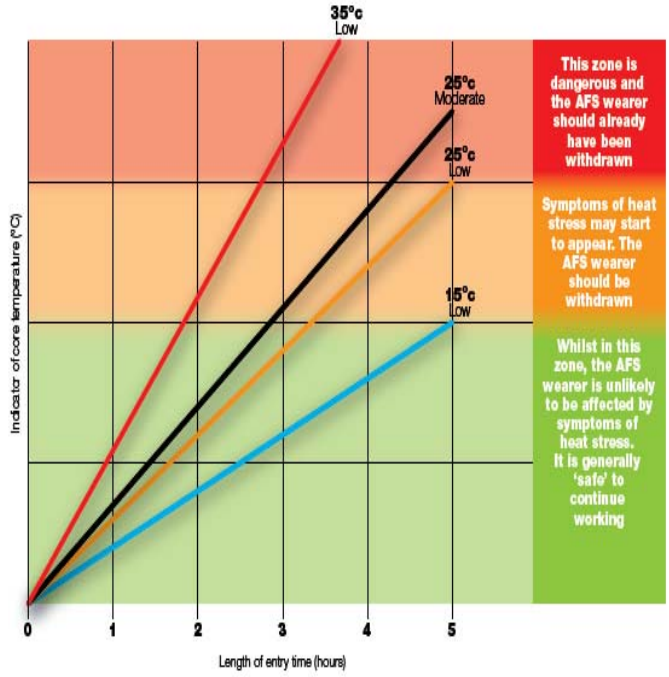
HSL's programme of work included:

- a literature review on the use and physiological aspects of air-fed suits;
- assessment of air-fed suit use by industry including observations at decommissioning sites and analysis of site records, site-staff questionnaires and focus groups;
- physiological trials under different environmental conditions at HSL's state-of-the-art thermal chamber, using volunteers who wore typical AFS ensembles for tasks based on real decommissioning work; and
- development of the guidance.

The guidance uses the 'PLAN-DO-CHECK-ACT' cycle agreed as the most suitable approach for the primary audience, who are both regulators and the nuclear industry including managers, safety and health professionals, supervisors and workers.

'PLAN' covers activities before a shift to safeguard general worker wellbeing. These include selecting workers who are medically fit; ensuring that workers' competences and training match their tasks; and preparing for the team working and 'Buddy' systems used in decommissioning.

[12] Millard, C., Vaughan N. and Webb, D. (2013) Developing guidance on the use of air-fed suits in the nuclear industry. Cognition, Technology and Work 15, 67-77.



'DO' covers activities and briefings before and during a shift which increase workers' physiological wellbeing. These include safe entry duration recommendations (Figure) and advice on rehydration and fluid replacement regimes (all based on data from the HSL physiological trials). Safe entry durations and fluid requirements are estimated using the containment area temperature combined with the physical activity level and any extra PPE and equipment worn. Recommended maximum safe entry durations (one entry per day) for moderate and low physical activity levels.

'CHECK' explains the debriefing and checking at the end of and after a shift which improve worker wellbeing. This includes good practices for rest and rehydration between shifts, checks for heat related illnesses and more general health surveillance.

'ACT' uses outcomes from 'CHECK' for change and improvement. For example, if heat illness symptoms are observed, then containment area temperature and/or physical activity level may be too high for the entry duration, and changes may be needed.

The ONR guidance has been well received. HSL are now working with ONR and the nuclear industry on the physiological effects on workers of suits which are not airfed.

Conference Presentations

Millard C and Webb D (2011) Air fed suits – beyond radiological protection. The Society for Radiological Protection, Buxton 26th January 2011.

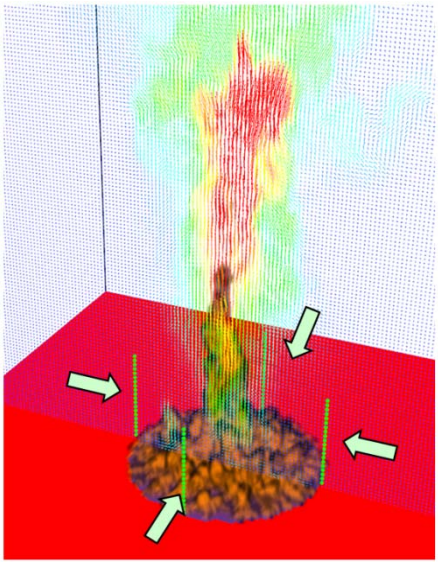
Simister D, Webb D, Millard C and Vaughan N (2012) Airfed Suit Work – ONR Guidance. International Radiation Protection Association 13 Glasgow 13 -18th May 2012.

Webb D, Millard C and Vaughan N (2012) Nuclear Airfed Suits – A case study. 2nd International Wellbeing and Work Conference Manchester 2012.

Case study 10. Improving fire plume modelling for Liquefied Natural Gas (LNG) accidents

Demand for natural gas has led to an increase in the use of liquefied natural gas (LNG) in Great Britain and elsewhere. Associated with this is an increase in import terminals and more frequent ship deliveries. This has led to concern about the potential consequences of accidents in terminals. Ignition of LNG releases can form fire plumes with major accident potential. Assessments of the risks of such major accidents requires scientifically-based consequence modelling developed using experimental data. Improvements in computational approaches are needed to allow uncertainties in major hazards consequence modelling, more broadly, to be reduced.

Significantly improved experimental data is now available from large-scale experiments on LNG fire plumes from spills on water, performed at the US Sandia National Laboratoryand funded by the US government. Use of this data has the potential to improve consequence modelling for risk assessments, reducing the uncertainty in the modelling and hence allowing improved targeting of risk control and mitigation measures. In particular, the experimental data revealed unexpected behaviour of fire plumes in the trial with the highest LNG release rate. The flames did not cover the entire area of the LNG spill, but were instead confined to a smaller region and the height of the flames was greater than expected.



Using this new experimental data to improve consequence modelling and hence reduce uncertainty in assessing risks, requires complex and computationally intense mathematical analyses to understand the physical phenomena. Therefore, HSE commissioned HSL specialists to analyse the experimental data using a global sensitivity analysis employing novel and computationally efficient emulator approaches. Emulator approaches have only recently been adopted in the field of process safety and have the potential to produce a step-change improvement in sensitivity and uncertainty analysis of consequence models. This research has the additional aim for HSE of demonstrating whether these emulator approaches are practicable for major hazard applications. The HSL research was undertaken in liaison with Shell Research Ltd. It will be presented at the May 2014 IChemE 'Hazards 24' Conference[13] together with complementary HSL research into flow behaviour in large scale LNG pool fires funded by Shell Research Ltd.

To analyse the experimental phenomena seen at Sandia, the HSL team performed pool fire simulations using a Computational Fluid Dynamics model called the Fire Dynamics Simulator (FDS) to predict the flame height and the air entrainment rate into the fire. The objective of these simulations is to understand how the flame height and entrainment rate

[13] Kelsey A., Gant S., McNally K., Betteridge S., *Application of gloabal sensitivity analysis to FDS simulations of large LNG pool fires.* Abstract accepted for presentation at IChemE 2014 'Hazards 24' Conference, Edinburgh.

vary as a function of various physical inputs (burn rate, fire diameter and radiative fraction) and model inputs (the computational cell size and turbulence model). Conducting a global sensitivity analysis requires a large number of simulations and using a standard approach with Monte Carlo sampling would would have required months of computing time. To avoid this, the HSL team successfully tested a novel alternative emulator approach. An emulator reproduces the response of predictions (flame height and entrainment rate) to variation in input quantities. It is created from a small number of simulations and is essentially a sophisticated curve-fit to the underlying model, returning both the value of the prediction and a measure of the uncertainty in the emulator fit to the underlying model. The total computing time, including both the FDS simulations and sensitivity analysis, was less than 2 weeks.

The results of the HSL's global sensitivity analysis were used to examine the effects of scale and uncertainty, and identify the key model inputs that have the greatest effect on the flame height and entrainment rate. These findings help to advance our understanding of the Sandia experiments, which will have important implications for hazard estimation for major LNG spills. In particular, one hypothesis being considered to explain the observed experimental behaviour is, that in the test with the largest LNG release rate, the speed at which air and fuel vapour was drawn into the fire exceeded the flame speed. The flames could therefore not propagate upwind, against the entrained flow, and ignite the whole surface of the LNG pool. HSL's research has helped explore this hypothesis and improve understanding of how the behaviour of LNG fire plumes changes as the scale of the release is increased. The HSL research also shows that using an emulator enables a global sensitivity analysis to be performed in a major hazards application, where it otherwise would not be practicable because of the computing time entailed.

These findings have the potential to significantly enhance the consequence modelling programme of work by HSL for HSE in support of land-use planning, quantified risks assessments, and incident investigations.

Case study 11. Corrosion Under Insulation: Lessons Learned from Incident Investigations

Much process plant both onshore and offshore is operated at higher than ambient temperatures in order to maintain process conditions and prevent the condensation of volatile products blocking pipe work and vessels. Lagging or insulating of critical plant is frequently carried out to maintain process temperatures. The primary disadvantage of insulation is that it prevents easy access to surfaces to carry out inspection and maintenance activities. This has led to numbers of failures referred to as '*corrosion under insulation*' or '*under lagging corrosion'*. These failures can lead to accidents injuring or killing workers and could lead to major accidents. For onshore plants, such major accidents also have the potential to harm the public.

Corrosion under insulation has been known to plant operators and HSE for many years, however, it has remained an intransigent, pervasive problem and failures still occur with some regularity. In addition to safety concerns, for industry, handling corrosion under insulation issues, also presents significant business costs. For instance one petrochemical company has estimated that these issues account for 40% of piping maintenance costs.

Over the last decade, HSE has commissioned HSE specialists in engineering materials to investigate three corrosion under insulation incidents. These investigations have identified common features of corrosion under insulation including: the breach of insulation covering process pipe work; the penetration by water, often containing chloride ions; and, in many cases, corrosion over a considerable period of time. Details of the findings of the three investigations are below. A paper has been published by Geary (2013) and a further paper is in preparation by this author to raise awareness with engineering safety specialists.

These findings have informed HSE's information for specialist inspectors on the causes and detection of corrosion under insulation as well as the actions to be taken during inspections as part of the aim of increasing industrial awareness of the issues in all high hazard plant. This also links to HSE's overall stakeholder work in connection with the COMAH Strategic Priority on Ageing Plant. It is noteworthy that industry is actively developing solutions to corrosion under insulation. These include: consideration of the use of non-absorbent insulation materials; the ease of removal of insulation to facilitate maintenance and inspection; management systems to ensure early reporting and repair of damaged insulation; and the use of advanced inspection systems to detect corrosion under insulation.

Incident Investigation 1

Failure of an insulated hydrocarbon line occurred on a refinery site and led to a major explosion and fire. The insulation had been adequately specified and installed, however, it had subsequently been breached in order to accommodate a walkway bracket. The penetration into the lagging had not been adequately sealed and rain water had penetrated the lagging material, pooling at the lowest point of the pipe. Corrosion had occurred over a period of approximately 13 years and catastrophic failure occurred when the remaining sound material could no longer withstand the internal pressure.

Incident Investigation 2

A 100mm diameter, carbon–manganese steel hydrocarbon line burst, leading to a major gas release on an offshore platform. The insulation on the pipe work had deteriorated allowing water, containing salts to penetrate the lagging and pool at the interface between the pipe and the lagging material. Corrosion of the external surface of the pipe had progressed over a period of between 2 and 10 years until the remaining, sound material could no longer support the internal gas pressure. The corrosion rate was aggravated by a badly applied paint coating on the exterior of the pipe which led to failure in a much shorter period than would otherwise been expected. Inspection by ultrasonic thickness measurements had been made on the pipe prior to failure, but in positions remote from where failure occurred.

Incident Investigation 3

Failure of an insulated section of steel pipe work on a chemical plant led to a significant release of chlorine gas. Water had gained access to the annular space between the pipe and the insulation through an ineffective seal at one end of an insulation segment. The water had pooled at a position in the pipe where the insulation had formed a bridge over two circumferential pipe welds, resulting in a volume of water sufficiently large to support a corrosion mechanism. Corrosion had progressed unnoticed for a period of between 11 and 18 years before failure occurred.

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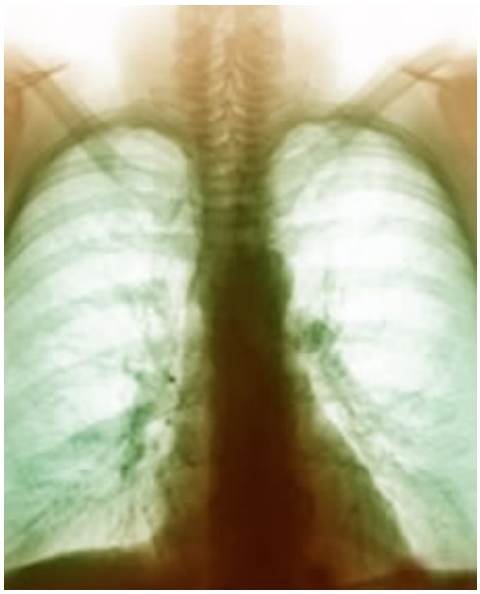
Case study 12. Chronic Obstructive Pulmonary Disease (COPD): causation, exposure and impact on workers

One of single biggest contributors to the burden of occupational disease in Great Britain is Chronic Obstructive Pulmonary Disease (COPD). There are an estimated 4,000 COPD-related deaths per year, ~ 30% of the total estimated deaths per year from work-related diseases. The major causal agents for occupational COPD are vapours, gases, dusts and fumes (VGDF).



Research of international significance on COPD causation, exposure and worker impact has been undertaken at HSL in collaboration with other international experts including Professor Paul Blanc (University of California) under the Investment Research Programme. The first research papers were published in 2012 (Darby et al., 2012) and 2013 (Fishwick et al., 2013). Research into exposure and causation is considered essential if occupational causes of COPD are to be tackled and the burden of disease reduced. Research led by HSL's Dr Anthony Darby assessed the contribution of workplace exposures to COPD risk in a community with a heavy burden of past industrial employment. A random population sample of 4000 Sheffield residents aged over 55 years, enriched with a hospital-based supplemental sample of 200 individuals, was approached for study. A comprehensive self-completed questionnaire elicited physician-made diagnoses, current symptoms, and past workplace exposures. The latter were defined in three ways: self-reported exposure to VGDF; response to a specific exposure checklist; and through a job exposure matrix (JEM) assigning exposure risk likelihood based on job history independent of respondent-reported exposure. A subset of the study group underwent lung function testing. Population attributable risk fractions (PAR%), adjusted for age, sex and smoking, were calculated for association between workplace exposure and COPD. Fifty percent of questionnaires were returned from the general population sample and sixty percent by the hospital supplement. The findings confirmed significant associations between reported COPD and both generic vapour, gas, VGDF and JEM-defined exposures.

This study supports the predominantly international evidence-based idea that workplace conditions are important when considering the current and future respiratory health of the workforce. The journal *Thorax* highlighted the importance of this novel study and the need for further research; the paper describing the research received the *Thorax* award for one of the best papers in 2012, the editor noting:

'we were pleased to publish th[is] first UK study of occupational exposures and COPD.[an] area fraught with potential confounding….and we look forward to studies aimed at discovering how far the reported associations are genuinely causal.' [Cullinan, 2013].

It is difficult to identify specific occupational contributors to COPD at the individual level to guide prevention. Research led by HSL's Professor David Fishwick aimed to understand

how different expert clinicians attribute likely causation in COPD. In the study, ten COPD experts and nine occupational lung disease experts assigned occupational contribution to fifteen hypothetical cases of COPD. The overall findings supported the view that respiratory physicians are able to assign attribution to different causation factors. COPD experts were more likely to recommend a change of work rather than change of work practice.

The research outlined above has allowed HSL researchers to be recognized as international experts on this important issue.

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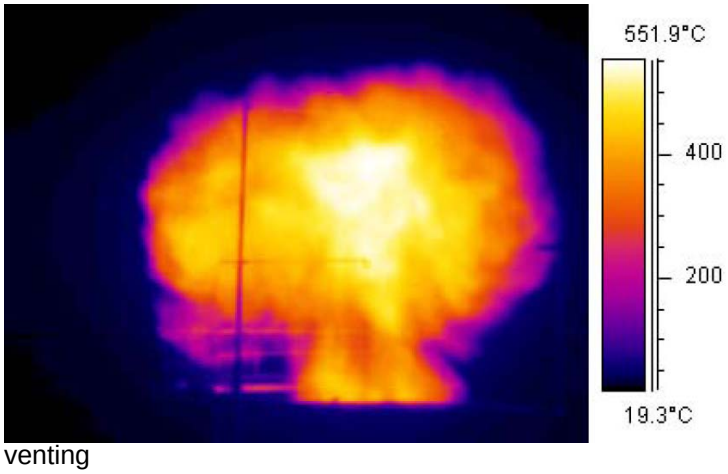
Fishwick, D., et al., (2013) Chronic Obstructive Pulmonary Disease Among Residents of an Historically Industrialised Area. Thorax. 67 (10) 901-907

Case study 13. Experimental research to understand the hazards associated with a 'Hydrogen Economy'

The need for energy security, reduced greenhouse gas emissions and affordability are changing the energy landscape in Great Britain. Where energy sources are renewable, their use with hydrogen-based systems can provide a clean energy source as well as a means of storing the fluctuating outputs associated with sources such as wind and solar systems. This makes hydrogen-based systems potentially attractive as an 'energy carrier'. However, the flammable and explosive properties of hydrogen have significant safety implications.

Understanding the potential implications for health and safety of emerging energy technologies and its regulation is important for HSE to ensure that the regulator acts as an enabler to safe uptake by duty holders. HSE's work may include supporting early adopters, developing partnerships with other governmental departments, industry and researchers, challenging duty holders where needed, and identifying whether more is needed in terms of technology, standards or regulation. The potential health and safety implications of the hydrogen economy is part of the broader foresight work carried out by HSL for HSE. See for instance [HSL, 2011].

HSL has a major programme of research into hydrogen safety. This was initiated under the HSL Investment Research Programme and thereafter funded by HSE, duty holders, other government departments and the EU. Under this programme, HSL has published 34 journal and conference papers since 2007 and the findings from HSL's large-scale experimental research into potential releases from hydrogen refueling stations for vehicles underpins the UK (and European) Installation Permitting Guidance for hydrogen and fuel cell stationary applications.



HSL Infrared image: experimental venting of hydrogen deflagration from a roof vent

The most recent HSE co-funded research by HSL is into the safety implications of hydrogen fuel cell systems in indoor environments including enclosures. Hydrogen fuel cells are electrochemical devices that oxidise hydrogen to release electricity. New commercial applications with fuel cells acting as an energy carrier can require indoor use, either for security reasons, or because their design necessitates protection from adverse weather. This research is part of the EU 'Hyindoor' Project (http://www.hyindoor.eu/) which is co-funded through the European 'Fuel Cells and Hydrogen Joint Undertaking', a public-private partnership between the European Commission, and fuel cell and hydrogen industries. The project collaboration gathers key players in the field, including HSL and other scientific institutes (KIT-G, JRC, NCSRD), academia (UU), industry (Air Liquide, HFCS), and CCS Global Group).

HSL is a key player in the HyIndoor experimental and modelling research into: the potential for hydrogen accumulation; explosion venting of lean homogeneous and localised hydrogen mixtures; and indoor fire regimes such as well-ventilated and under-ventilated fire, self-extinction of flame, and external flames. HSL's experimental work is carried out at large scale using a 31m^3 enclosure. The research has demonstrated the influence of real wind conditions on hydrogen dispersion and accumulation. For instance wind into an open vent can reduce hydrogen concentrations compared to buoyancy-driven ventilation alone and in such circumstances a wind-dominated model, such as HSL's Quadvent, gave better predictions. The concentration differences resulting from sub-sonic versus choked-flow releases have also been demonstrated. HSL's experimental work also investigated, at large-scale, the explosion venting of hydrogen deflagrations from weak enclosures using a range of vent sizes, vent numbers and positions, hydrogen concentration and hydrogen homogeneity.

The overall aim of HyIndoor is to provide scientific and engineering knowledge for the specification of cost-effective means to control hazards, and to develop state-of-the-art safety guidelines to inform the development of EU and international regulations, codes and standards frameworks. This is in order to support the safe introduction of hydrogen fuel cells in early markets. HSL's findings within the project team have been presented in 2013 (Hooker et al., 2013; Hostis et al., 2013) and further research is being presented in 2014 (Hooker et al., 2014). Overall, HSL's research is making a significant contribution to this important work to facilitate safe uptake of this new energy-carrier technology in Great Britain and Europe wherever hydrogen may be handled indoors. For instance, hydrogen vehicles, re-fuelling stations, and combined heat and power applications.

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Case study 14. Use by large organisations of the 'Management Standards for Work-Related Stress', and the use of emotional intelligence, resilience and mindfulness to reduce stress in the workplace

Work-related stress is a major cause of occupational ill health and can affect productivity and human error. In 2011/12, the estimated incidence of new work-related cases of self-reported stress, depression or anxiety in Great Britain stood at 207,000 and there were 10.4 million self-reported working days lost[14]. Over the last decade, the need to tackle work-related stress and related conditions has been increasingly recognised and a significant body of international research has shown a direct link between work characteristics and employee stress and well-being.

HSL researchers worked with HSE to develop the 'Management Standards for Work Related Stress' (HSG218) which are aimed particularly at managers in medium and large enterprises. The Management Standards: describe conditions that are more likely to lead to higher levels of health, well-being and organisational performance; give advice to help identify the gap between what is happening in an organisation and these ideal conditions; and help managers to develop solutions to close this gap. Subsequent research led by HSL working closely with HSE analysed progress by enterprises in implementing the Management Standards (Mellor et al., 2011). The findings, based on data collected from over 100 public sector organisations, show that, under supportive contexts, organisations were able to follow the Management Standards approach for assessing psychosocial risks, and implementing interventions.

The most recent research in this programme of work for HSE was published in 2013 (Mellor et al., 2013) and examines the use by large organisations of the Management Standards. Five large organisations drawn from the public and private sector were interviewed about what they had put in place to prevent stress. The research found that some organisations have gone some way to implementing actions that have contributed to alleviating taboos about stress and recognising that stress can affect everyone and is not a sign of individual weakness. The findings showed a wide range of activities. One organisation reported that self-reported stress had decreased from 35% to 28% and then 24% two years after. Positive feedback from assessments by the National Health Service Litigation Authority was provided to this organisation which also won an excellence award in Human Resource Management for managing stress.

Overall, the research showed that senior management commitment and worker participation are key to managing work-related stress and are commonly reported across organizations, although to variable form and depth. The solution chosen to identify stress issues is a short assessment of all staff via annual staff surveys, coupled with in-depth assessments of groups at risk. Common practice also includes combining individual and organizational interventions. One significant challenge for larger organisations is the translation from identified stress issues to focused interventions and their evaluation. The findings from this most recent research suggest that the HSE Management Standards approach for dealing with stress issues is practicable.

[14] HSE, *Annual Statistic Report for Great Britain 2012/13.* http://www.hse.gov.uk/statistics/overall/hssh1213.pdf

The on-going programme of research for HSE includes joint research by HSL and Loughborough University into common health problems, particularly stress, anxiety, depression and musculoskeletal disorders. These are characterised by subjective symptoms and are collectively the leading cause of sickness absence for workers in Great Britain. Due to report in 2014, this research looks into understanding how to move beyond the 'hazard-risk-control' model developed for understanding accidents and occupational ill-health due to exposure to hazardous agents such as chemicals, noise and vibration. The aim is to develop effective intervention strategies for common health problems.

HSL's programme of work for HSE is also supporting duty holders by transfer of the research outcomes through the training courses and consultancy HSL undertakes for larger companies on managing psychosocial risks and implementing effective interventions. It is noteworthy that HSL's offering is based on start-of-the-art best practice for reducing stress, including positive well-being and emotions. This puts a focus on positive assets and resources within the person and the work enviroment rather than solely a deficit model on 'what is not working'. For instance, HSL training courses include: emotional intelligence, mindfulness, and organisational and individual resilience.

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Annex 1.5

Case studies highlighting reactive support assistance in investigations

During our work on assessing the utilisation and value of reactive support we have approached investigating inspectors who have provided feedback on the contribution that HSL and external specialists have made to specific investigations prior to the introduction of Fee for Intervention. The cases summarised here give examples of how this type of support contributes to regulatory inspection:

Case study 1: Dust exposure

HSE visited a recycling company following a complaint about poor and unsafe working conditions, particularly the lack of control of a very dusty atmosphere. Verbal advice was given, and several weeks later a joint visit with HSL staff was made to take dust samples, when it was noted that conditions were already much improved. HSL's analyses revealed that dust exposure in some workers was above the Workplace Exposure Limit. Further discussions took place with the duty holder regarding provision of appropriate respiratory protection.

In evaluating the scientific support from HSL, the inspector commented on the positive impact this piece of work had had on the duty holder, noting that this case was the epitome of "Good health and safety - Good for business". This was because the company was prompted to reassess its management of dust contamination from the whole process and, as a result of HSE's recommendations, re-engineering their process increasing the output of finished product by 15%. Without HSL's expertise HSE could not have demonstrated employee exposure and therefore the wastage from the process.

Case study 2: Hydraulic pipe repair

An engineer was called to repair a damaged hydraulic pipe on a research vessel moored at a UK university site. The damaged pipework was removed and replaced with a temporary section of hose without incident. When the engineer returned to the site with new pipework, and as he was attempting to disconnect the hydraulic hose, the fitting came away under force from the deck pipe and struck him in the face causing serious injury.

Following a visit to the vessel by an HSE inspector and a specialist mechanical inspector, it was established that (a) the system of work being used at the time of the incident was not appropriate for releasing pressure within a hydraulic system and (b) there was no pressure release system on the boat, provision of which would have been the responsibility of the owner of the boat (the university). The pipe and fittings were examined by specialists at HSL, who reported that the olive on the pipe that became detached was not one supplied by the company that employed the engineer. However, there was no indication that the joint had failed. It was possible that the joint had not been tightened adequately on a previous occasion so had not created a suitable ridge to hold the olive in place, but as the university did not keep any records of contractors working on the hydraulics, it was not possible to obtain a list of all the contractors who had worked on the boat, therefore effectively closing this line of enquiry. The inspector concluded that HSL's input was supportive to the investigation, underpinning the improvement notices that were issued on the university and the hydraulic company to improve their procedures, training and documentation.

Case study 3: Asbestos removal

HSE visited a site where unsafe removal of asbestos insulation board (AIB) panels from the ceiling of a garage was taking place. The floor directly under the ceiling was covered with debris comprising AIB mixed up with some form of white insulation, the exact nature of which was unknown but thought to contain asbestos. The debris was collected and later analysed by HSL specialists. Analysis confirmed that the board was AIB, and that the white loose insulation material did not contain asbestos. Based on the evidence seen on site, the HSE inspector considered that the asbestos removal fell way below the expected standards for a licensed removal contractor, and prosecution was proposed. However, the company went into liquidation before the action could come to court. In the evaluation, the inspector commented that HSL's scientific support was essential to how decisions were taken in relation to this investigation.

Case study 4: Scaffolding incident

Scaffolding erected to allow repair of a church spire was deemed dangerous by HSE, who served prohibition notices on the principal contractor and the company to whom it had sub-contracted the scaffolding work. HSE advised that an additional scaffold had to be erected to allow removal of the existing structure without further danger. The subcontractor used a scaffold design company to produce plans, however, HSE considered these inadequate and sought the opinion of an independent scaffolding specialist. The independent specialist confirmed that the design was insufficient and did not meet acceptable industry standards. The design company agreed to make most of the changes recommended by HSE, so no further action was taken in this investigation. The independent scaffolding specialist provided support that was valuable to the progress of this case.

Annex 1.6

HSL Papers and Editorials in Peer-Reviewed Journals, Papers in Conference Proceedings and Other Publications

January to end October 2013

A) Papers and Editorials published in peer-reviewed scientific journals

A.1) Papers and editorials in peer-reviewed scientific journals - Published

1. ADISESH, A., ROBINSON, E., NICHOLSON, P., SEN, D., WILKINSON, M., and STANDARDS OF CARE WORKING GROUP. UK Standards of care for occupational contact dermatitis and occupational contact urticaria. *British Journal of Dermatology* 168[6], 1167-75. 2013.

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Annex 1.7

Representative publications associated with extramural research contracts – 2013 and/or including HSE authors

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 (end October 2013) by searching Databases for references to research that acknowledged funding, co-funding or sponsorship from HSE. Included here are publications arising from The Health and Occupational Reporting (THOR) scheme. Publications prefixed with # indicate papers including HSE staff.

1. Beyrau F, Hadjipanayis MA and Lindstedt RP. Particle thermometry in radiatively ignited explosive mixtures. *Proceedings of the International Colloquium on the Dynamics of Explosions and Reactive Systems (ICDERS),* 29 July – 8 August 2013.

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4. Carder M, McNamee R, Turner S, Hodgson J, Holland F and Agius RM. Time trends in the incidence of work-related mental ill-health and musculoskeletal disorders in the UK. Occupational and Environmental Medicine. Occupational and Environmental Medicine. Published Online First: 23 January 2013 doi:10.1136/oemed-2012-10090. 70:317-324.

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Annex 1.8

Strategic Statement on Science

The following paragraphs state 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 17% of HSE's budget is devoted to commissioning scientific research and support. Although we use a wide range of institutions and contractors, our principal 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. HSE is both owner and major customer of HSL, and will continue to maintain a strict separation between these roles.

Our scientific activities enable us to gather evidence, identify and develop practical solutions, and monitor and evaluate their success in supporting our Strategy and business delivery plans. 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.

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 business plan
- supports front line regulatory functions (e.g. incident investigation)
- looks ahead to identify future challenges

The Summary Science Plan sets out how HSE will apply science and engineering resources to the delivery and realisation of its business plan. HSE's Business Plan 2012-2015, demonstrates how we will deliver our part of the strategy *'The Health and Safety of Great Britain: Be part of the solution'*.

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 will maintain the capability and readiness to future incidents in critical areas.

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 GB 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.

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,
- 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.