Safety & Loss Prevention

Subject Group Newsletter

Issue 39, May 2009

IChemE
Safety & Loss Prevention
Subject Group

Safety & Loss Prevention

Subject Group Newsletter

Issue 39, May 2009
Editor: Dr John Bond, email: john.bond007@ntlworld.com

Contents

EDITORIAL

EPSC and OPERA arranged a very interesting meeting "An Audience with Andrew Hopkins" on the 23 March 2009. This meeting was about the lessons to be learnt from the Texas City Refinery fire. Andrew gave his own, sometimes controversial, views about the causes which went to the top of the company. In particular he expressed the view that there had to be more emphasis on rule compliance and less on risk management. A contrary view was given by Peter Webb. Andrew Hopkins has written a book "Failure to Learn" which is not yet available on the internet but I have borrowed a copy and will write a review in due course. I suspect that the debate on rule compliance versus risk management will go on for awhile.

ENERGY SAFETY: NEW CHALLENGES MEETING: UCL 9TH JAN 09

This highly successful one day meeting organised by IChemE Safety & Loss Prevention Subject Group focused on the safety challenges associated with the quest for new forms of energy. Speakers covered a diverse range of topic spanning carbon capture and sequestration, nano-technology, fuel cells to biofuels. Dr Steffi Friedrichs of Nanotechnology Industries Association provided a SWOT analysis of the nano-materials in the energy sector, the perceived risks highlighting the lack of established testing protocols for assessing such risks. State of the art CFD modelling work on hydrogen combustion and explosion with particular reference to fuel cells was presented by Professor Jennifer Wen, Kingston University. The meeting organiser, Professor Mahgerefteh of UCL Chemical Engineering discussed some of the urgent challenges associated with the safe transportation of CO2. Addressing such issues is considered as key to the success of CCS. Professor Bahaman Tohidi, Director of Centre for Gas Hydrate Research at Heriot-Watt University presented the results of his research on the role of naturally occurring hydrates as an effective barrier against the escape of CO2 from subsea storage sites. The production of biofuels has undergone a seven fold increase in the past 4 years. Janet Etchells of HSE reviewed some of the main hazards and HSE guidelines regarding their safe production and use.

DESIGN AND SITING OF PROCESS PLANT BUILDINGS

This conference was held as a joint meeting of the S&LPSG of the IChemE with FABIG and EPSC on the on "Design and Siting of Process Plant Buildings", held on the 4th of December 2008.

The first speaker was Wilbert Lee of Chevron (USA). The API RP-753: "Management of Hazards Associated with Location of Process Plant Portable Buildings" is concerned with the management of risks associated with the location of portable buildings on process plant and the reduction of risks to the occupants. The guidance covers the hazards of explosion, fire and toxic materials. The standard supersedes API RP-752.

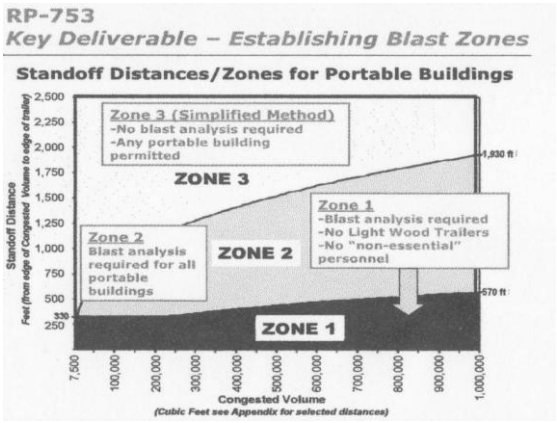
The USA OSHA and CSB concerns and issues covers better guidance for use of portable buildings, occupancy numbers, location of non-essential personnel, the minimum safe distances and simplified method

The API RP-753: Guiding Principles covers location of personnel away from hazards, minimizing the use of portable buildings near process areas and managing occupancy during high risk operations. The design, construction, and installation of buildings to protect occupants and management system for portable buildings

The key items of API RP 753 covered occupied portable buildings only for offices, change houses and maintenance shops. Other examples in RP covers building not intended for occupancy. There was no occupancy screening and the blast capacity for light wood trailers was

- ..0.6 psi max. for 2A Damage, (localized damage)
- ..0.9 psi max for 2B Damage, (widespread damage, but no structural collapse)

The API RP-753: key items were more simplified method developed with 3 blast zones based on plant layout and size and can be used for siting of light wood trailers. There were exclusion zone and safe distance for wood trailers and limitations of non-essential personnel locations. Detail explosion analysis could be consequence or risk based.



The second speaker was Andrew Crerand of Shell Global Solutions (UK) who spoke on "Risk-Based Approach to Siting of Portable Buildings". He started by outlining the background to explosion modelling, the development of risk based tool and the application of the risk based tool. The system was based Shell Explosion modelling giving the overpressure generated and the impulse prediction. The Congestion assessment method found that one correlation (plus another for the roofed case) has correlated all the relevant experimental data for source overpressure. The formulation for source radius and pressure decay was still valid but it was important to take account "obstacle complexity". Many of the non-ideal aspects of real plant can be allowed for. The run times were less than 1 second and the results were a reliable screening tool.

Method for determining the probability of exceeding a certain overpressure at a given location was important. If used for "Critical" areas where a worse-case explosion was used it would otherwise be unrealistic and intolerable.

The sustainable pressure for the building was dictated by structural strength. For a full exceedence method extensive information would be required. A Generic Exceedence methodology was found in Shepherd software and comparison with API RP752 generic frequencies of major explosions (350 mbar assumed) were satisfactory

He concluded that scientific understanding of gas explosions has greatly improved in the last 20 years with risk based methods now existed for occupied buildings, facility siting and safety management. Validated software tools are becoming available

The third speaker was Kieran Glynn of BP "Developing Guidance for Siting and Design of Process Plant Buildings on BP Sites". He started with a historical background to the problem from 1950s to 2008 and covered building siting, occupancy, drivers, and plant operations. Examples were given of accidents with fatalities in buildings from Flixborough to a 1987 refinery incident. From 1990s and 2000s there was explosion modelling, better understanding of physics of vapour cloud explosion, dynamic structural analysis/ design with PC based programs being available. By 1998 /2003 there was CIA Guidance with location specific blast design criteria replaced by prescriptive blast loading. It described Risk based and Hazard based methodologies and covered all permanent buildings not just Control Rooms. I covered explosions, fires and toxic releases. API 752 was first issued in 1995 and the 2nd edition in 2003. The scope is similar to CIA document "Process Plant Hazard and Control Building design"

After the Texas Refinery incident there was an urgent recommendations to API 752 task Force to revise the recommended practice or issue a new practice to ensure safe placement of occupied trailers and similar temporary structures away from hazardous areas of process plants. We issued a safety alert to your membership to take prompt action to ensure the safe placement of occupied trailers away from hazardous areas of process plants.

In BP there was different approach with the same Goal. There was to be "No harm to people". Portable buildings were sited in zoned and restricted places. New permanent buildings had no restrictions on location but design is specified to protect occupants from hazards which could arise at location of building. With existing buildings the goal is to protect occupants of all existing buildings from Hazards. There was a risk based prioritisation towards achieving the goal.

The forth speaker was Dirk Roosendans of Total Petrochemicals "Siting Design and Protection of Occupied Buildings at Total Petrochemicals". He described the building siting principles with layers of protection analysis, risk assessment criteria, QRA Tool in Total Petrochemicals the output of QRA tool and the validation of the tool. The essential features were prevention, mitigation and protection.

Details were given of the Assessment Criteria for individual Scenarios and Criteria for QRA giving rise to the risk

contours for individual loads and the societal risk. The input data was described for the QRA Tool including ignition source and scenario models. Modelling of the physical effects of confinement and congestion, the vulnerability of blast overpressure and heat radiation, the resistance of materials, contours with the accidental loadings were used in the validation of the QRA. This resulted in the principles and inherent safe design obtained. The system was also applied to design of all equipment.

The fifth speaker was Max Kolbe of Baker Risk (USA) "Master Planning for Companies Performing Siting Studies & QRA's" He described the work of the company in developing Master Planning for Companies with Facility Siting Studies (FSS) and QRA with the methodologies and test data used. They had carried out unique testing programs in the area of large scale VCEs on structural impact analyses. They had a global approach to FSS and QRA to identify individual scenarios to establish the dominant causes, consequences or risks across the company's assets. The lessons learned were:-

- take a global approach
- define study methodologies and criteria of interest
- test the methodology on a pilot scale
- refine study results if initial conservative assumptions result in high levels of expenditure (e.g., building upgrades)
- after applying consequence analysis, consider risk analysis
- add all buildings to a database
- identify all release cases that dominate risk
- sort database globally, country or site specific to identify where best to spend funds to drive down risks.
- link the management of change process to master planning
- directionally, drive sites to lower risks (can be 5-10 years)

The sixth speaker was Jeff Daycock of, DNV Energy "Risk Based Design Methodologies: Limitations and Future Developments". He thought that there were exciting times with the recent trend in the process risk analysis world particularly with off site and on site risk. Risk analysis had to be used to optimise design and hence save money. Offshore QRA linked risks to people with risks to assets. Building risk assessment was integral to explosion and fire analysis and had to be fed into QRA. On-shore risk analysis was more variable being less conservative with on-site risks. The software approaches were now geared to design input and more focused on explosion than fire. They were much more variable than offshore risk analysis with no consensus. The BLAST and PHAST risk software were similar and used generic failure cases and leak frequency with similar other details. They were brought together in the risk model for people, assets and buildings.

The seventh speaker was Paul Summers of MMI Engineering (USA) "Design of Modular Blast-Resistant Buildings for Petrochemical Facilities". The ASCE Task Committee on blast design was now used through industry in the USA for the design of buildings to resist vapour cloud explosions at refineries and petrochemical plants. Control rooms and operator shelters were covered with modular buildings covered in the 2008 edition. The motivation for their use is clear but most can be removed from the site. The design approach included the blast load prediction based on cloud characteristics (fuel, size, concentration), ignition (location, strength), confinement (degree and size), and congestion, selection of appropriate performance criteria, loading analysis giving rise to the design of the members and foundations. Three levels, low, medium and high damage levels of response are thus obtained. Probable projectile impact analysis is considered from different types of projectiles.

The final speaker was Ken Patterson of Yule Catto "CIA Guidance Protection of People on Chemical Manufacturing Sites". A detailed account of the explosion at Hickson and Welch was given and its effect on a building. The Chemical Industry Association had been central in devising a standard and guidance for the design of buildings on chemical plants in the UK and he gave a detailed account of the method adopted. Finally he reminded people that the real risks had to be assessed but it was best to get as many of the staff off the site, concentrate on the areas of greatest risk but remember the buildings are secondary and the primary aim is safe operation

EPSC CONFERENCE, LEARNING FROM ACCIDENTS, ANTWERP, 9/10 OCTOBER 2008.

This event which was jointly organised by EPSC and its partners was found on the premise that learning from accident is a push – pull activity. In other words so called learning organisations extract and push out the lessons from internal incidents to the outside world as well as pull in lessons from the mishaps of others. To a large extent this conventional wisdom was challenged throughout the conference by several speakers who asserted that a focus on internal learning from high consequence – low probability events provides sufficient opportunities to allow the organization to improve its own safety performance. This then begs the questions why in the past have high hazards companies neglected their own internal learning? The conference offered many reasons such as lack of senior management commitment but the most popular reason was absence of process safety measurement. Until relatively recently there has been little guidance on outcome and activity indicators for process safety. Without this fundamental building block in place companies tend to have both feet firmly planted in mid air as far as process safety performance. It was contended that well chosen indicators offer to kick start a conversation with senior managers on resourcing issues as well as engagement with the wider workforce which in turn creates the right environment for learning. So it would seem that even a soft focus on learning from accidents cannot avoid reference to indicators and measurement in the current post Texas City and Buncefield climate. The next question regarding learning from accidents is what is the future of sharing across companies and industries if most are able to learn and improve from their own failure? The simple and yet never easy answer is that in future organizations will benefit from not only sharing technical details on incidents but also more completely offering and receiving insights on how they have learned from incidents.

DEPARTMENT OF WORK AND PENSIONS

New legislation, the Health and Safety Offences Act 2008, which will increase penalties and provide courts with greater sentencing powers for those who flout health and safety legislation has been welcomed by DWP Ministers.

The Act raises the maximum penalties that can be imposed for breaching health and safety regulations in the lower courts from £5,000 to £20,000 and the range of offences for which an individual can be imprisoned has also been broadened.

DWP Minister Lord McKenzie said:

"It is generally accepted that the level of fines for some health and safety offences is too low. These changes will ensure that sentences can now be more easily set at a level to deter businesses that do not take their health and safety management responsibilities seriously and further encourage employers and others to comply with the law.

"Furthermore, by extending the £20,000 maximum fine to the lower courts and making imprisonment an option, more cases will be resolved in the lower courts and justice will be faster, less costly and more efficient.

"Jail sentences for particularly blameworthy health and safety offences committed by individuals, can now be imposed reflecting the severity of such crimes, whereas there were more limited options in the past.

"I am delighted that this legislation is now on the statute book and very grateful to my colleagues Keith Hill MP and Lord Bruce Grocott for introducing the Bill and for the support received from all sides of both Houses of Parliament."

The Act amends Section 33 of the Health and Safety at Work etc Act 1974, and raises the maximum penalties available to the courts in respect of certain health and safety offences. It received Royal Assent on 16 October 2008 and will come into force in three months time, in January 2009

Web Site: www.dwp.gov.uk

DEVELOPMENTS ON HSE WEB SITE

CD220 - A consultative document on proposals for the Chemical (Hazard Information and Packaging for Supply) Regulations 2009 – CHIP 4 ends 13th February 2009. Further information can be found at the web site below.

http://www.hse.gov.uk/consult/condocs/cd220.htm

HSE has just reorganised its web site to feature a 'Chemicals Portal'. See:
http://www.hse.gov.uk/chemicals/index.htm

Some output from the Buncefield Process Safety Leadership Group can be seen on:

http://www.hse.gov.uk/comah/buncefield/recommendations.htm

Initial PSLG guidance on implementing the Buncefield MIIB Emergency Preparedness Response and Recovery report recommendations 1 and 3 to 8

- Initial PSLG guidance on implementing the Buncefield MIIB Emergency Preparedness Response and Recovery report recommendations 1 and 3 to 8 [PDF 81KB]
- Recommendation 3: Appendix 1 - Template for completion of the on-site plan for COMAH sites [Word 146KB]
- Recommendations 5 & 6: Appendix 1 - Assessment of Vulnerable Emergency Response Equipment and Resources [Word 102KB]
- Recommendation 7: Appendix 1 - COMAH Off-site plan exercising/auditing Record [Word 231KB]
- Recommendation 8: Appendices 1-5 - Communicating with the public [Word 61KB]

The following was published on 13th Nov and may be of interest to members:

"The Buncefield Investigation - Government and Competent Authority's Response" It will be interesting to note from page 15 that the Process Industries Leadership Group "will provide the means for collecting and sharing incident data and will act as a conduit for improvements to be promulgated to industry"

http://www.dwp.gov.uk/publications/dwp/2008/buncefield.pdf

The Health and Safety of Great Britain - Be part of the solution. The HSE are inviting safety people to visit the following site and to contribute:-

http://www.hse.gov.uk/strategy/index.htm

Thought is being given to whether the S&LP Subject Group and/or whether IChemE should respond.

Guidance on Developing Safety Performance Indicators – for Public Authorities and Communities/Public – for Industry.

These have now been published, 09 September 2008.

Report of the Workshop on Human Factors in Chemical Accidents and Incidents.

This has now been published, 28 May 2008.

An independent review of HSE methodology for accessing societal risk and HSE's response.

The review and response of the HSE are given on Societal risk website and
http://www.hse.gov.uk/research/rrhtm//rr703/htm

contains the report "Societal Risk – Initial Briefing to Societal Risk Technical Advisory Group".

OECD WEB SITE

http://www.oecd.org/department/0,3355,en_2649_34369_1_1_1_1_1,00.html

Chemical Accidents

The OECD Programme on Chemical Accidents addresses a subject that concerns everyone who uses or handles hazardous chemicals, works in a chemical plant, or lives near one. This programme helps public authorities, industry, labour and other interested parties prevent chemical accidents and respond appropriately if one occurs.

The Black Hole

Said the Safety Consultant "I learn
That unless you have money to burn
You'll never control
A single black hole
As they do in that tunnel at Cern.

"So you'll have to persuade Number Ten
To fund a collider for when
There's a lot of dark matter
That someone must scatter
To avoid a Big Bang at Big Ben

ARTICLES IN THE NEXT ISSUE OF THE *LOSS PREVENTION BULLETION*

The *Loss Prevention Bulletin* publishes safety articles and accident case studies in the process and chemical industry. Many of the articles are provided from anonymous publications and are therefore not avialble through other sources.

LPB Issue 207, June 2009
SPECIAL ISSUE: HYDROGEN

- Information for authors and readers
- An explosion on board a tanker that resulted in a fatality
- Hydrogen generation inside sealed components
- Hydrogen explosion from batteries
- Unexpected production of hydrogen
- Flash fire at hydrocracking unit
- Vent stack fire at an HCl plant
- Case studies in hazards during early process development
- Liquid dispersal and vapour production during overfilling incidents
- Bulletin briefing
- Events

For further information on the *Loss Prevention Bulletin*, or to purchase articles online, please visit www.icheme.org/lpb

ARTICLES IN THE NEXT ISSUE OF *PROCESS SAFETY AND ENVIRONMENTAL PROTECTION*

IChemE's bi-monthly journal *Process Safety and Environmental Protection* covers all aspects of safety of industrial processes and the protection of the environment. The articles published, which are all peer reviewed, report research from around the world. *Process Safety and Environmental Protection* is the official journal of the European Federation of Chemical Engineering: Part B. For further information, or to subscribe, visit www.icheme.org/journals

Below are the papers featured in Volume 87, Issue 3, Pages 147 – 216 (May 2009).

- Fire and explosion assessment on oil and gas floating production storage offloading (FPSO): An effective screening and comparison tool
  Pages 147-160
  Jaffee A. Suardin, A. Jeff McPhate Jr., Anthony Sipkema, Matt Childs, M. Sam Mannan

- Calculating the benefit to workers of averting a radiation exposure lasting longer than the working lifetime
  Pages 161-174
  P.J. Thomas, R.D. Jones

- Research on 3D dynamic visualization simulation system of toxic gas diffusion based on virtual reality technology
  Pages 175-183
  Songbai Cheng, Guohua Chen, Qingguang Chen, Xueying Xiao

- Professional ethics and corporate social responsibility
  Pages 184-190
  John Bond

- Pretreatment of municipal landfill leachate by a combined process
  Pages 191-196
  K.W. Pi, Z. Li, D.J. Wan, L.X. Gao

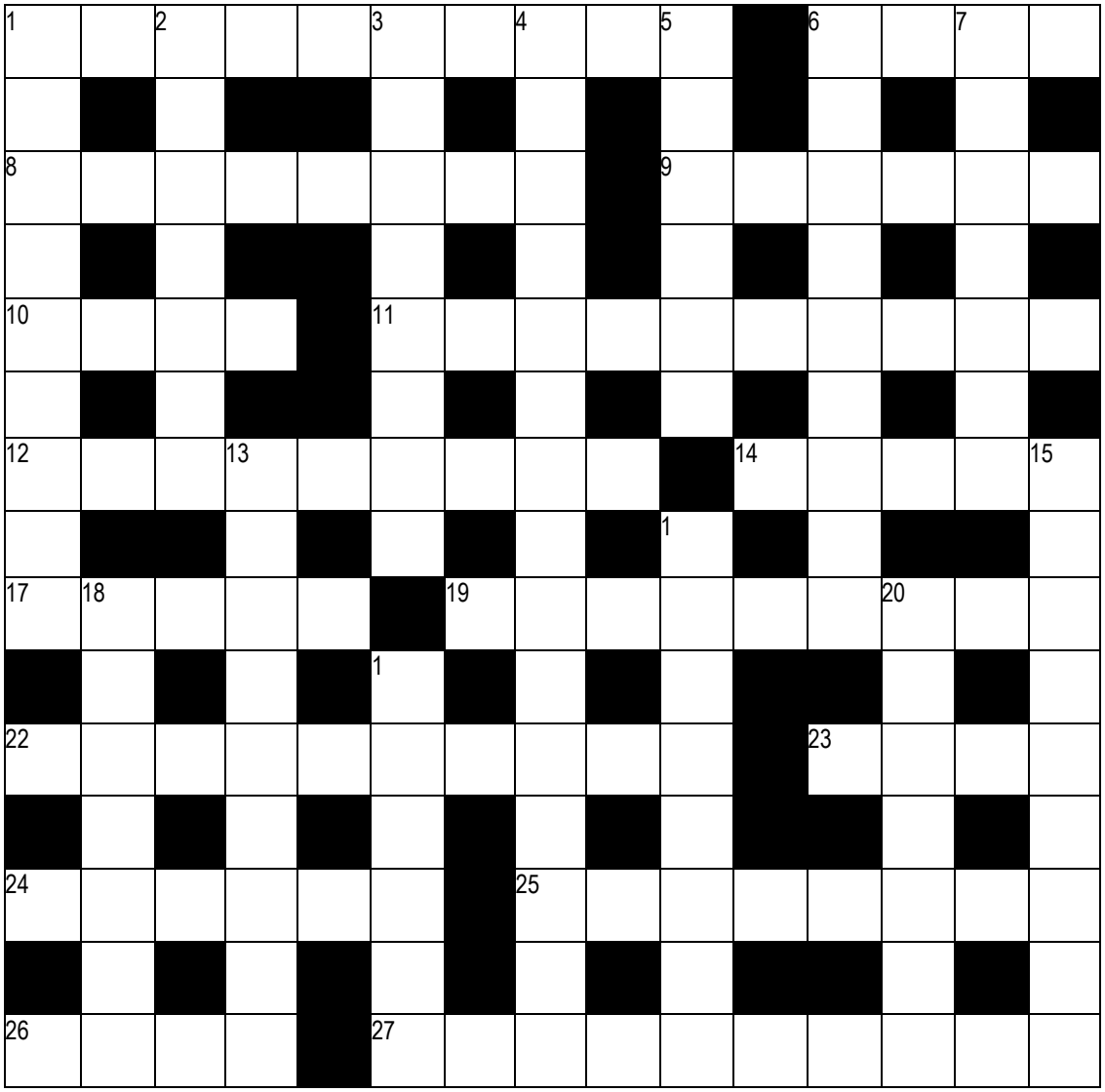
- A superstructure model for the synthesis of single-contaminant water networks with partitioning regenerators
  Pages 197-205
  Raymond R. Tan, Denny K.S. Ng, Dominic C.Y. Foo, Kathleen B. Aviso

- Influence of wheat straw addition on composting of poultry manure
  Pages 206-212
  Ivan Petric, Almir Šestan, Indira Šestan

- Letters to the Editor
  Pages 213-214

- Recent Safety and Environmental Protection
  Pages 215-216

CROSSWORD PUZZLE No. 28



ACROSS

1. Compose a musical to prove disastrous when reviewed. (10)
6. In careless hands their teeth can do damage. (4)
8. Pretty obvious clue here. (8)
9. A slip-up when drying the laundry. (6)
10. Homeric weight. (4)
11. Study the Queen's Home Information Pack - This journal has one. (10)
12. Morse wasn't a safety one. (9)
14. Creepy little units of mass. (5)
17. Loops back around the bobbin. (5)
19. Consequence of old methane explosion. (5 - 4)
22. Germ theory adapted to measure humidity. (10)
23. Some RAF are in a remote place ... (4)
24. ... while some get Iran as a base. (6)

25. On the way to being toxic, food could explode. (5, 3)
26. Man is one of them in the U.K. (4)
27. Electrically speaking, hero is confused before becoming motionless. (10)

DOWN

1. Nations produce true icons of their own. (9)
2. The French have offspring to learn them. (7)
3. Bury cat mangled by a bit of give and take. (8)
4. Weariness of plant hand would be dangerous in a surgeon. (8, 7)
5. Doggy compiler of this one. (6)
6. Not altogether hard, just somewhat dense. (9)
7. Metallic union is almost a marriage ceremony! (7)
13. Bring into existence but natter about broken heart. (9)
15. ICI proofs can be excessively tiresome. (9)
16. Close to a young lady an accident has just been avoided. (4, 4)
18. Science of matter has created more than on medicine. (7)
20. They say an insult is just a facade. (7)
21. One Parliamentarian on air could spoil the whole. (6)

Answers to Crossword Puzzle No. 27 in Issue 38

Across

1. Aerobic
5. Boracic
9. Ascorbate
10 Siren
11. Confined space
13. Creosote
15. Modems
17. Ampere
19 Bassinet
22 Expansion loop
25. Allyl
26. Inhibitor
27. Eardrum
28. Rat race

Down

1. Ajar
2. Recycle
3. Boron
4. Chariots
5. BLEVESIris
6. Resistors
7. Carnage
8. Condensate
12. Octadecane
14 Sprinkler
16. Launcher
18. Popular
20. Naphtha
21. Minium
23. Orbit
24 Brie

DIARY OF SAFETY EVENTS

GROUP	*TITLE OF MEETING*	*PLACE AND CONTACT*	*DATE*
Hazards Forum with Ergonomics Society	How ergonomics improves patient safety	The Institution of Civil Engineers, One George Street London SW1P 3AA admin@hazardsforum.org.uk	16 May 2009
S&LPSG with Surrey Branch	Oxygen Safety Systems		June 2009
S&LPSG	Follow up to Buncefield	Manchester Conference Centre gjones@icheme.org.uk	15 Sept 2009
Hazards Forum	Safety Risks of Alternative Energy	The Institution of Civil Engineers, One George Street London SW1P 3AA admin@hazardsforum.org.uk	22 Sept 2009
S&LPSG	Risk Criteria		2nd half 2009
Hazards Forum	New Nuclear Reactors	The Institution of Civil Engineers, One George Street London SW1P 3AA admin@hazardsforum.org.uk	24 Nov 2009
S&LPSG	Workshop on Safety for University Teachers		Nov 2009
Hazards Forum	Carbon Capture	The Institution of Civil Engineers, One George Street London SW1P 3AA admin@hazardsforum.org.uk	16 March 2010
S&LPSG with Energy Institute	Launch of IP 9 LPG Model Code of Practice.		
S&LPSG Future Programme	Management of Alarms and Trips Dust explosions		

Do we have your correct postal and email address?

To check and update your details with IChemE visit http://www.icheme.org and login to 'My Account'

Safety compliance roadshow for the process industries

10 June 2009

Wynyard Rooms, Wynyard Park, Billingham TS22 5TB, UK

This half-day event will provide an overview of the newly amended or updated safety legislation and guidance that impacts the UK's process industries. The morning's presentations will conclude with a networking session over lunch, sponsored by ABB.

Sarah Shore of the Health & Safety Executive (HSE) will deliver the keynote paper discussing HSE's strategy and approach for the UK's process industries. Regional process operators will discuss their experiences of managing the requirements of the regulations on site, and consultants will provide an objective view, sharing their learning points from working with regional process operators.

The event is organised in association with IChemE's Teesside Members Group, and Safety & Loss Prevention Subject Group.

Who should attend? Process safety specialists, operations managers, HSE advisors and all engineers with responsibility for, or an involvement in:

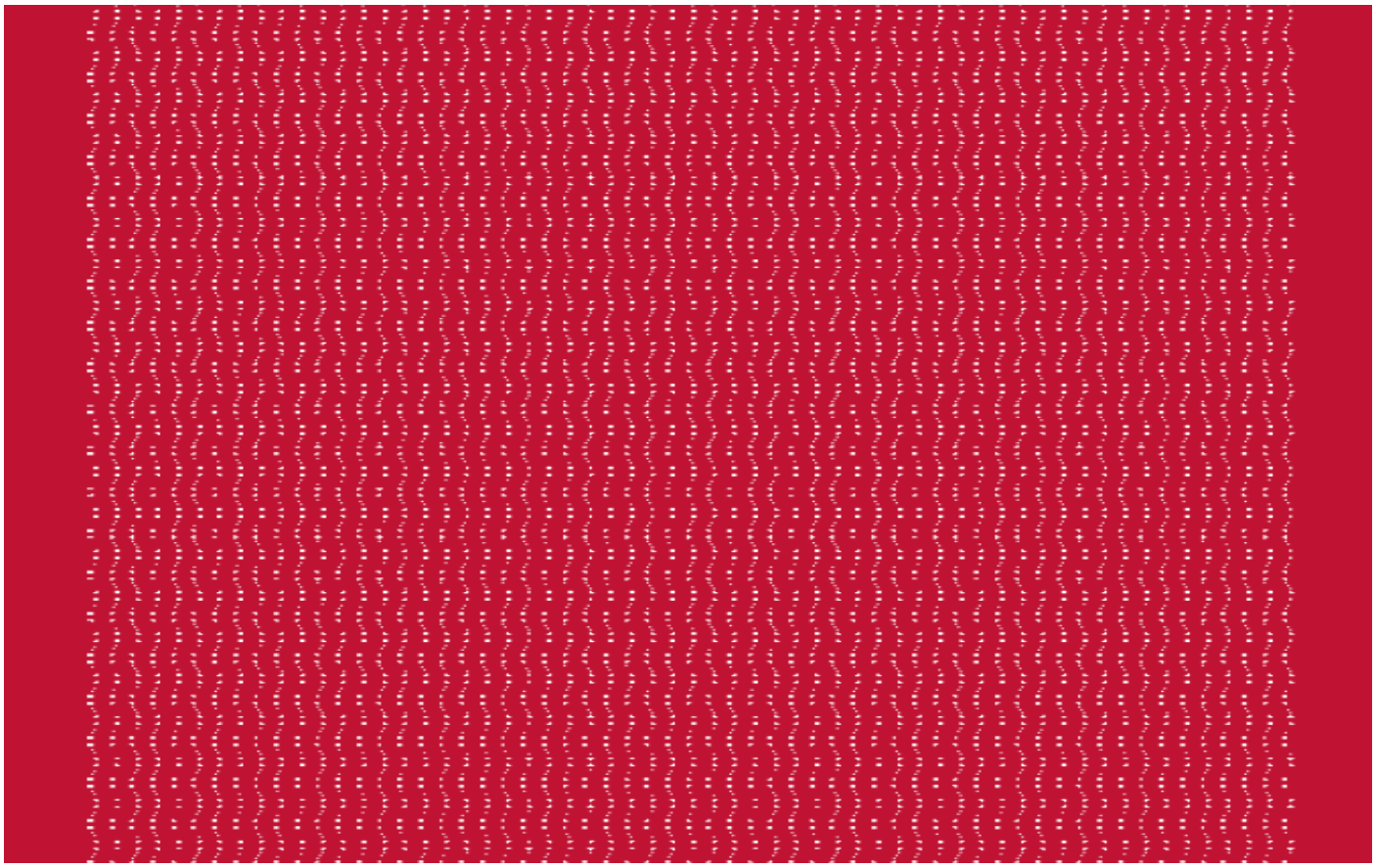
- COMAH
- Process Safety Performance Indicators (PSPIs)
- Offsite Emergency Plans
- Dangerous Substances & Explosive Atmospheres Regulations (DSEAR)
- Location and Design of Occupied Buildings

Provisional programme

8:30	Registration, tea and coffee
9:00	Chairman's introduction, ***Graham Ackroyd*** *(Syngenta)*
9:10	***Sarah Shore*** *(Lead on COMAH Remodelling – Health & Safety Executive)* HSE's revised approach for COMAH
10:00	**Rob Peeling** *(Operations Manager, VERTECT Business – Johnson Matthey)* A practical methodology for developing PSPIs
10:30	Tea and coffee break
10:45	**Jo Fearnley** *(Senior Consultant – Aker Solutions)* Learning points from conducting five year COMAH resubmissions
11:30	***Denis Hampson*** *(CEO – The Cleveland Emergency Planning Unit)* Working with the CEPU in forming an offsite emergency plan (COMAH)
12:00	**Steve Sherwen** *(ABB)* and **Malcolm Horne** *(Artenius)* Compliance with DSEAR throughout the lifecycle of mechanical equipment
12:30	***Ken Norrie*** *(Project Manager – BASF)* Location and design of occupied buildings
13:00	Concluding discussion and remarks
13:15	Lunch, sponsored by ABB
14:00	Close

Exhibition: Exhibition space is available. To discuss opportunities, please contact Clare Sanders.
Tel: 01788 534457, Email: csanders@icheme.org

Registration: Pre-registration is essential. To reserve your place, please contact Gemma Jones, Tel: 01788 534433, Email: gjones@icheme.org



"Hazards XXI" and workshops

Process safety and environmental protection

10 - 11 November 2009

The theme of this symposium is process safety and environmental protection in a changing world. New industries can generate unforeseen safety risks and environmental impacts, as new technology introduces unforeseen ways of causing failures.
Organisations also still fail to address foreseeable risks, as lessons from established industries are not learnt. It is important that we improve our understanding of all these risks in areas such as nanotechnology, clean coal power supply, oil sands, next generation biofuels, renewable energy, LNG, nuclear, decommissioning, etc.

Contact: Rosemary Cragg, Conference Officer, IChemE.
Tel: +44(0)1788 578214
Email@rcragg@icheme.org

EFCE
Event 680

IChemE
heart of the process