Gas, Vapour and Dust EXPLOSION HAZARDS, Protection, Mitigation and Prediction
Monday 25 – Friday 29 March 2019

Provisional Programme

Professor Gordon Andrews, University of Leeds
will deliver all presentations on Monday and Tuesday unless stated otherwise.

Monday 25 March 2019
FIRE, FLAMMABILITY AND EXPLOSIONS
Course Director: Professor Gordon Andrews
08.30 Registration
09.00 Fundamentals and stoichiometry
Some explosion incidents. Comparison of burner and explosion combustion. Flame
temperature dependence on equivalence ratio. Explosion induced wind. The fire and
explosions triangles - the basis of explosion protection. Combustion stoichiometry
calculations on a mass basis for gases, mists and dusts and applications of combustion
stoichiometry.
10.15 Coffee
10.30 Flammability limits
Flammability limits and theories for gases, mists and dusts, influence of T&P. Flash point
and vapour pressure. Fuel tank explosions – the TWA flight 800 1996.
12.15 Lunch
13.00 Controlling explosion risks in enclosures
Ventilation as an explosion risk control action. Auto-ignition temperatures. Inerting and
limiting oxygen for explosion protection. Minimum ignition energy and quenching distance.
14.45 Tea
15.00 Flame arrestors and explosion isolation barriers
Dr Ing. Jef Snoeys, Fike Corporation
16.15 Laminar and turbulent combustion
Laminar burning velocities and flame speeds including hydrogen. Spherical vessel
explosions in closed vessels, the \( K_G \) and \( K_{st} \) reactivity parameters. Spherical explosion flame
propagation theory. Self-acceleration of laminar propagating flames into cellular flames and
then turbulent flames. The implications for \( K_G \) as a function of vessel volume.
17.30 End of day one
19.00 Course dinner

Tuesday 26 March 2019
CHARACTERISATION OF GAS AND DUST EXPLOSIONS VENT AND SUPPRESSION
PROTECTION DESIGN
Course Director: Professor Gordon Andrews
08.45 Registration
09.00 Dust explosion characteristics and the influence of dust size distribution
10.30 Coffee
10.45 Industrial explosion suppressions systems
Dr Ing. Jef Snoeys, Fike Corporation
12.15 Lunch
13.00 Gas explosion venting theory and design standards, including hydrogen explosion
venting
14.45 Tea
15.00 Flameless explosion venting – product, performance, vent system design examples
and case studies
Dr Ing. Jef Snoeys, Fike Corporation
15.45 Vent Ducts, Large L/D venting and Interconnected Vessel Explosions
17.15 End of day two
Wednesday 27 March 2019

VAPOUR CLOUD EXPLOSIONS

Course Director: Dr Roth Phylaktou

08.45  Registration

09.00  Managing explosion risks
       Mike Johnson, DNV GL
       Overview of the approaches to explosion risk assessment and management including
       decision making in an environment where there are uncertainties in both data and methods.
       The potential influence of the regulatory framework will also be discussed.

10.00  Important parameters in turbulent explosions
       Dr Roth Phylaktou, University of Leeds
       Identification of important variables in terms of both fundamental properties and of the
       system physical and chemical properties (overall geometry, blockage ratio, flow velocity,
       mixture reactivity, pressure loss, ignition position etc.) Turbulent combustion regime
       diagrams.

11.00  Coffee

11.15  Important parameters in turbulent explosions (Cont.)
       Dr Roth Phylaktou, University of Leeds
       Calculations of maximum flame speeds and overpressures after accelerations through an
       obstacle field

12.15  Lunch

13.15  The role of large scale experiments in explaining vapour cloud explosions
       Dr Stephen Burley, The University of Manchester
       Mechanisms of pressure generation in vapour cloud explosions and how they have allowed
       major incidents to be explained.

14.35  Explosion mitigation by general area water deluge
       Mike Johnson, DNV GL
       Droplet size, spray water content and distribution, nozzle supply pressure, foaming agent,
       mitigation mechanisms, effectiveness criteria, uncertainties.

15.45  Tea

16.00  Flame acceleration and transition to detonation (hydrogen and other reactive gases)
       Dr Roth Phylaktou, University of Leeds
       Phenomenological model of turbulent flame acceleration process; shock wave formation,
       auto ignition and explosive transition to detonation; steady state and overdriven detonations.

17.00  End of day three

Thursday 28 March 2018

BLAST PREDICTION AND BLAST RESPONSE

Course Director: Dr Roth Phylaktou

08.45  Registration

09.00  Blast loading identification and blast effects on structures
       Dr Stephen Burley, The University of Manchester

10.15  Coffee

10.35  Review of explosion simulation methods
       Dr Roth Phylaktou, University of Leeds
       Methods, available models, validation requirements. (TNT equivalence and Multi-Energy
       methods in some detail)

12.00  Lunch
Thursday 28 March 2018 continued

13.00  The Congestion Assessment Method (CAM)  
Dr Jonathan Puttock, Cranford Hazards Research Ltd, formerly Shell Research Ltd

13.40  A phenomenological model (SCOPE) - details and use in exceedence calculations  
Dr Jonathan Puttock, Cranford Hazards Research Ltd, formerly Shell Research Ltd

Description, capabilities, validation, limitations; its use, with several thousand runs, to derive reliable statistical assessment of explosion overpressure risk.

14.20  Tea

14.35  EXSIM and PDRFoam  
Dr Jonathan Puttock, Cranford Hazards Research Ltd, formerly Shell Research Ltd

15.15  LNG Explosion Hazards  
Dr Ian Cowan, Atkins

16.15  Experimental scaling  
Dr Roth Phylaktou, University of Leeds

Extrapolating small scale tests to full scale hazard assessment, comparative assessment of scaling of explosions on the basis of different turbulent combustion models, MERGE project.

17.00  Example problems - some simple calculations illustrating the significance of parameter

17.30  End of day four

Friday 29 March 2019

EXPLOSION ASSESSMENT: CAPABILITY, VALIDATION, LIMITATIONS AND APPLICATION OF CFD

Course Director: Dr Roth Phylaktou

08.45  Registration

09.00  Barrier methods for explosion control  
Professor Vincent Tam, University of Warwick

Review of current control methods and exploration of barrier methods in detail.

09.45  Explosion model evaluation  
Professor Vincent Tam, University of Warwick

Covers, among others, the de facto standard method for evaluation of models.

10.15  Coffee

10.30  Simplified flammable gas volume methods for gas explosion modelling from pressurized gas release  
Professor Vincent Tam, University of Warwick

Examine assumptions and validity of a range of source term modelling.

11.00  Buncefield Incidence 2005 - Explosion mechanism  
Professor Vincent Tam, University of Warwick

11.45  FLACS  
Pablo Giacopinelli, GexCon

12.30  An overall review and concluding remarks  
Professor Derek Bradley, University of Leeds

A summary of current knowledge, major areas of uncertainty and future research.

13.15  Lunch

14.00  Example problems – demonstration of CFD modelling exercises  
Pablo Giacopinelli, GexCon

15.30  End of day five and course