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
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
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 $K_s$ 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
Paul Cronin, 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**  
Paul Cronin, DNV GL  
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**  
Paul Cronin, 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**

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 exceedance 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  **2D vs 3D Consequence Modelling Software (FRED & FLACS)**  
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  **Demonstration exercises using 2D and 3D modelling software**  
GexCon
15.30  **End of day five and course**