PROGRAMME

MONDAY 23 OCTOBER 2017

Fundamental Processes
08:30  Registration and coffee
09:00  Physical concepts
       Dr Roth Phylaktou, University of Leeds
       Matter, density, specific gravity; gases & vapours; convective (or buoyant) flows; vapour pressures of liquids; heat and temperature; heat capacity; specific heat capacity; latent heat; the transmission of heat. Example calculations: densities of gases at various temperatures and pressures, density of fire gases; vapour pressures of liquids – relevance to flammability limits.
10:10  Coffee
10:30  Fuel and combustion processes and fundamentals
       Dr Roth Phylaktou, University of Leeds
       Polymers; synthetic polymers; thermal decomposition and stability of polymers; modes of fuel vapour generation from a solid; mechanisms of decomposition; thermal stability; importance of volatiles; the physical chemistry of combustion in fires; regimes of burning (flame types); rate of burning; energy release in a fire; the heat of combustion, DHc; the mechanism of gas phase combustion. Example calculations: calculation of heat combustion of material from knowledge of chemical formula.
12:00  Limits of flammability
       Dr Roth Phylaktou, University of Leeds
       Determination; quenching diameter; upward v’s downward flame propagation; minimum ignition energy (MIE); limitations/alternatives; influence of pressure on FL; influence of temperature; critical adiabatic temperature at the lower limit; predicting LFLs of mixtures of flammable gases (Le Chateliers rule); flammability diagrams; addition of suppressants. Example calculations: calculation of flammability limits of mixtures, use of flammability diagrams.
13:15  Lunch
14:00  Heat transfer: conduction and convection
       Dr John Staggs, University of Leeds
       Background; Conduction: Fouriers law; thermal conductivity; thermal diffusivity; steady state conduction; thermally thin; thermally thick; thermal resistance; composite slab.
15:10  Tea
15:30  Heat transfer: conduction and convection (continued)
       Dr John Staggs, University of Leeds
       Convection: convective heat transfer coefficient; thermal boundary layer; Navier Stokes equations; Prandtl number; Reynolds number; Stanton number; friction coefficient; Reynolds analogy; empirical method. Approximate integral method for transient conduction
Example calculations: heat transfer through an over door, temperature difference across a fire door (steady), estimation of critical heat flux, temperature difference across a fire door (unsteady).
16:30  End of day one
19:00  Course dinner

TUESDAY 24 OCTOBER 2017

Radiation, Ignition and Flame Spread
08:45  Registration and coffee
09:00  Radiation from fires
       Dr Roth Phylaktou, University of Leeds
       Nature of Radiation: Absorptivity, reflectivity and transmissivity; black body; emissive power (black body); emissive power (grey body); the inverse square law; effects of radiation. Radiative heat exchange: Simplified situations; view factors and exchange areas.
10:20  Coffee
10:40  Radiation from fires (continued)
       Dr Roth Phylaktou, University of Leeds
       Representation of flames in fire calculations. Thermal radiation in participating media: Mean beam length; emissivity of hot gases (no-soot i.e. non luminous flames); emissivity of gas-soot mixtures; applications. Representation of flames in fire calculations
Example calculations: true thermocouple temperature; view factors in an enclosure; minimum separation distance between school building and mobile classrooms.
TUESDAY 24 OCTOBER 2017 continued ...

12:30 Lunch
13:15 **Ignition**
   **Dr Roth Phylaktou, University of Leeds**
   **General**: The elements of ignition; ignition sources and fire causes; physical and chemical characteristics of fuels. **Ignition of gaseous fuels**: Minimum ignition energy (MIE). **Ignition of liquid fuels**: Experimental ignitability data; relationship between flash point and lower flammability limit (LFL). **Ignition of solids**: Critical heat fluxes, self heating and spontaneous combustion.
   Example calculations: liquid vapour concentration at flash point. Time to ignition for thin and thick solids.

14:45 Tea
15:00 **Spread of flame**
   **Dr Roth Phylaktou, University of Leeds**
   Factors influencing rate of spread; relative flame spread rates; liquid fuels; solid fuels: orientation and direction of propagation; density, thermal capacity and thermal conductivity; sample geometry; environmental effects.

16:15 **Fire Behaviour and Modern Buildings**
   **Dr Danny Hopkin, Olsson Fire and Risk**

17:00 End of day two

WEDNESDAY 25 OCTOBER 2017

**Pool Fires, Jet Fires and Cloud Fires**

08:45 Registration and coffee
09:00 **Steady burning diffusion fires**
   **Dr Roth Phylaktou, University of Leeds**
   Diffusion flames: Buoyant fire; jet fire; knowledge required for determination of hazard consequences: Jet fires; buoyant fires; fire plume regions: The buoyant plume; plume from a point source; air entrainment; virtual source; scaling laws; the "flame" plume; intermittency; flame length; velocities and temperatures (Centreline); effects of wind. Example calculations: length of turbulent diffusion flame.

10:00 Coffee
10:15 **Pool fires in the open**
   **Dr Roth Phylaktou, University of Leeds**
   Ignition and flame spread, mass burning rate, flame extent and geometry, flame length, flame tilt, flame drag. Case studies. Example calculations; rate of heat release from a pool fire, flame length.

11:15 **Jet fires**
   **Professor Derek Bradley, University of Leeds**

12:00 **Radiation from flames**
   **Dr Roth Phylaktou, University of Leeds**
   Radiation from flames (calculations): Representation of flames in fire calculations; point source models; surface emitter models.
   Case study: Milford Haven fire

12:40 Lunch
13:30 **Example calculations: radiation flux from flare on escape route**
   **Dr Roth Phylaktou, University of Leeds**

14:05 **Pool and jet fires, large scale tests**
   **Rob Crewe, DNV GL**
   This talk summarises the large-scale experimental work that has been carried out by DNV GL to study jet and pool fires. The type and range of fires of interest are noted, by reference to the different situations of industrial relevance. It is noted that many of the features of these fires are scale dependent. The type of data that can be collected in such experiments is discussed and the uses for this data are mentioned. Videos and pictures are used to illustrate the different fires and, in passing, to mention some of the key points that have been learnt as a result of carrying out this work.

15:00 Tea
15:15 **Cloud fires**
   **Peter Rew, ATKINS**
   Definitions, key modelling issues, prediction of burn area, flame speed, fatalities, heat fluxes.

16:10 **Pool and jet fires in compartments**
   **Professor Geoff Chamberlain, Consultant, Waverton Consultancy Ltd, previously Shell Global Solutions (UK)**
   Heat fluxes, mass burning rates, heat release rates, fire product compositions

17:20 End of day three
THURSDAY 26 OCTOBER 2017

Compartment Fires
08:15 Registration and coffee
08:30 The growth period
Dr Roth Phylaktou, University of Leeds
   Comparison to open fires. The Growth period: Fire plumes in compartments (during the early stages), effects of walls and ceiling. Applications: Response of ceiling mounted detectors; interaction between sprinkler sprays and fire plume; experimental modeling; Froude modelling; Grashof modelling; design fire growth rates. Example calculations: Gas temperatures in plume and near ceiling; minimum size fire for detector activation; response time of heat detectors; rate of heat release at time x after ignition.

10:00 Coffee
10:20 Flashover
Dr Roth Phylaktou, University of Leeds
   Definitions; conditions necessary for flashover; sources of radiative flux; flashover as a thermal instability; burning regimes; fuel and ventilation conditions necessary for flashover; critical heat releases; effects of lining material; Thomas’ flashover correlation; compartment temperatures prior to flashover. Example calculations: Maximum burning rate in a room of certain dimensions; size of fire necessary for flashover for different lining and construction materials; time to flashover.

12:00 Lunch
12:45 The post-flashover period and backdraughts
Dr Roth Phylaktou, University of Leeds
   The post-flashover period: Air entrainment and burning rate; fire resistance (introductory comments), correlation between fire resistance and fire severity; A note on flame temperatures; glass breakage in fires. Backdraught: Definition; circumstances leading to backdraught; scenarios; warning signs.

14:15 Fire performance of structures
Naomi Pimblett, BuroHappold Engineering
   Prediction of the performance of steel and concrete structures. An integrated fire safety design approach considering evacuation, structural performance, fire fighting and fire safety management. Project example.

15:05 Tea
15:20 Smoke movement
Dr Roth Phylaktou, University of Leeds
   Definition of smoke; optical density of smoke visibility through smoke; Smoke movement: Forces responsible; stack effect; fire buoyancy; External wind; air handling systems; smoke control systems: Smoke vents; smoke curtains; protected escape routes; toxicity: Definitions; tenability limits; carbon monoxide; hydrogen cyanide; carbon dioxide; low oxygen hypoxia; irritants.

16:05 Fire combustion products and toxicity as a function of ventilation conditions
Professor Gordon Andrews, University of Leeds
   Current research findings.

17:15 End of day four

FRIDAY 27 OCTOBER 2017

Compartment Fire Modelling
08:45 Registration and coffee
09:00 Overview of fire models
Dr Roth Phylaktou, University of Leeds
   What is a model? What do we need fire models for? What do fire models do? Computer fire modelling; zone models in some detail; field models.

09:40 A zone model in detail – CFAST
Dr Roth Phylaktou, University of Leeds

10:30 Coffee
10:45 Using CFD models
Jeremy Ockenden, BRE Global

12:00 Buffet Lunch
12:45 Transport to the University of Leeds

Cont …
The afternoon ‘hands on’ session will be held in the computer cluster 13:00

Hands on experience with a zone model

Peter Riley, University of Leeds
Dr Roth Phylaktou, University of Leeds

CFAST/CFASTlite model for multi-compartment fire simulations. Tutorial 1: Workshop fire: single compartment simulation. Tutorial 2: Workshop and office fire: multi-compartment simulation with one of the compartments fitted with sprinklers. Tutorial 3: Backdraught simulation (real incident): Multi-compartment fire in which fire burned under severely vitiated conditions, until door opened by fire fighters, resulting in backdraught.

15:30 Return transport to Weetwood Hall Hotel 15:45 Tea and issue of attendance certificates 16:00 End of day five and course