Institute of Physics - L&SE Branch Retired Members Section

Safety-critical Systems

THURSDAY 03 Feb & 17 Feb 2022

REMS (The Retired Members Section of the L&SE Branch) organise two **At Homes** each year which provide an opportunity for old friends to keep in touch. The next At Home will be online and spread over two days to minimise Zoom fatigue.

The theme is Safety-critical systems.

The individual talks are listed below. The speakers will explore the perception and appetite for risk in various aspects of human activities. The subjects include railway systems, air traffic control, nuclear safety and terrorism – all of which are amenable to objective analysis.

Programme

03 February
Railway signalling
Prof. Roderick Muttram, Fourth Insight Ltd.

Nuclear safety
Giles Hartill, Atomic Weapons Establishement (AWE)
Dr Steven Holley, Atomic Weapons Establishment (AWE)

17 February
Air Traffic Control
Chris Taylor, National Air Traffic Services (NATS)

Decision making under *a priori* risk
Prof. Sir David Omand GCB, Department of War Studies, Kings College, London

Summary
Prof. Paul Hardaker, Chief Executive, Institute of Physics

Please register on the IOP website (Events page).
For those unable to attend in person, the presentations will be streamed online.

Location The meeting will be streamed online.

Timing Talks will start at 4.00 p.m. (Zoom open from 3.45).

Contacts Bill Metcalf (bill.metcalf@physics.org) for the programme.
Dr. Hugh Deighton (hugh.deighton@physics.org for administrative matters.

Abstracts and CVs are available for those who register.

Abstracts

Safety Critical Systems 03 Feb 2022

Prof Rod Muttram *Fourth Insight Ltd*

Railway signalling

Railway signalling and control is much misunderstood by those outside the industry. Whenever an accident occurs that involves a train passing a red signal there are many ill-informed comments often drawing on what people are more familiar with – road signalling. The significant safety problem of 'leaves on the line' has become an oft-used and semi-humorous criticism of 'incompetent rail operators'. In fact, railway control and operations are complex and involving multiple interconnected technical and procedural safety systems. The constraints of a 'one degree of freedom' system present some fairly unique safety hazards including the ability to inform trains of things happening 'beyond visual range'. For many years rail has been at the forefront of automation and pioneered the use of software in safety critical applications. Metros, in particular, have achieved high levels of automation, up to full driverless operation, reducing staffing levels, improving consistency and capacity, reducing operational cost and significantly improving operational flexibility. The same technologies are spreading into mainline rail but the up-front costs are high and there are significant issues still to resolve. The presentation will cover the underlying issues and current developments drawing on the presenter's extensive experience.

Chris Taylor *National Air Traffic Services (NATS)*

Air Traffic Control

This lecture will provide an overview of how NATS provides ATC operations in the UK; which prior to the pandemic disruption, was handling around 8,000 flights a day, equivalent to 2.6M a year with direct connections to 370 world destinations. This includes about 80% of all transatlantic traffic.
This lecture will take the audience on a journey through the 'eye of an air traffic controller', from pre-departure flight planning through to take-off and the cruise through the UK airspace, to finally landing at the destination. The speaker will explain how NATS is applying new technologies and thinking to safely address significant changes in aviation. He will describe how safety is intrinsic in the development of ATC technology, people and process change. The lecture will also detail how adopting a customer-centric approach to innovation is essential in the air traffic management business and the NATS's response to the impact of COVID on air travel.

Giles Hartill & Dr Steven Holley *Atomic Weapons Establishment (AWE)*

The talk will focus on the unclassified principles and methods applied to the safety assessment of nuclear warheads. Regulations & requirements will be briefly introduced, with an emphasis on how they are derived, and their risk equivalence compared to other activities. An overview of the assessment methods employed will be provided such as failure modes and effects analysis (FMEA), fault tree analysis, and deterministic & probabilistic assessment principles. Historical examples of when things haven't always gone to plan will be covered, as well as why what we do today makes the probability of a nuclear emergency very unlikely.

Prof. Sir David Omand *Dept. of War Studies, Kings College, London*

This talk will focus on mechanism to avoid cognitive bias when analysing risk in those domains susceptible to *a priori* assumptions: these include e.g. internal risks such as terrorism and external risks of which cyber-warfare is a current example. Sir David will cover mechanisms and processes such as reverse inference pioneered by the Rev Thomas Bayes in c. 1730.

This talk will culminate the series on Risk and Impact and leave us with a rational basis for objective analysis of subjects which can, otherwise, be emotive. If anybody wishes to do so, Sir David's book ('How Spies Think') will provide some interesting pre-reading.

Speaker Biogs for REMS At Home, February 2022

Professor Roderick Muttram FREng FIET FIRSE CMILT SMIEE

Rod Muttram is an expert on safety critical systems particularly in defence/aerospace and railways. He worked at Ferranti Instrumentation (Group Engineering Director) and at Thorn EMI Electronics Limited (led the Defence Systems Division). In 1993 he moved to rail joining Railtrack PLC during the railway privatisation process as Director, Electrical Engineering and then Group Director of Safety and Standards. In 2003 he joined Bombardier Transportation (UK) Ltd as a Vice President with a wide range of Engineering, Safety and Quality Management responsibilities. He also chaired the European Rail Research Institute and was vice-chair of the European Rail Research Advisory Committee. He was deeply involved in the specification and development of the European Standard Rail Control System (ERTMS/ETCS). Since 2012 he has run his own consultancy and writes extensively on rail control matters.

Chris Taylor BEng (Hons) CEng FRAeS CMgr FCMI

Chris Taylor has worked for the Air Navigation Service Provider, NATS, for 22 years in a variety of roles. He has been involved in operations at the Swanwick and Prestwick, Scotland Centres and UK airports. His work has included engineering, international airspace and air traffic control procedure design. He is an experienced change manger with a background in Lean Six Sigma and business improvement. Chris has led innovation teams, running research projects, exploring new ideas and developing new concepts for product development within the aviation industry. He currently heads teams responsible for the safety & assurance of new technologies being deployed into ATC operations at ATC centers and airports for both civil and military customers.

Chris is a Chartered Engineer with a degree in Aerospace Engineering from the University of Liverpool, a certified Project Manager and a Black Belt in Lean Six Sigma. He is a Fellow of the Royal Aeronautical Society and is a Committee Member for the Solent Branch and the Air Transport Specialist Group. He is also a Chartered Manager and a Fellow of the Chartered Management Institute. He is passionate about aviation and with his Private Pilot's Licence he was part of a team that ran a simulated flight around the globe setting a new Guinness World Record.

Giles Hartill CEng FIMechE, Vice President ImechE

Giles is the Chief Warhead Engineer at AWE Plc, leading the design organisation responsible for the safety and performance of warhead systems throughout their entire product lifecycle, nuclear threat reduction and associated research activities. He is also responsible for safety management arrangements in compliance with the Defence Nuclear Safety Regulator's authorisation conditions and is the AWE technical lead for the U.S./UK Joint Re-Entry System Working Group under the Polaris Sales Agreement. Previously he was the delegated Design Authority for the Trident Re-Entry System. He is a Chartered Engineer and Fellow of the Institution of Mechanical Engineers and is currently serving his second term as Vice President, chairing the charity's Strategy Committee.

Dr Steven Holley PhD, CMgr, MCMI, CEng, FIET, VR

Steven is the Warhead Engineering Group Leader of Nuclear Safety at AWE Plc, and the Project Safety Manager for design programmes. He co-chairs a Warhead Safety Committee Technical Panel, and a joint MOD/AWE Design Authority Authorisee Safety Working Group. He has authored many nuclear safety guidance papers that have been adopted by MOD and implemented across the Trident Programme within the

nuclear safety cases and is developing the future safety programme with MOD and U.S. national nuclear laboratories.

Professor Sir David Omand GCB

David Omand is Visiting Professor in War Studies, King's College London. Previously his posts in British government service included UK Security and Intelligence Coordinator in the Cabinet Office, Permanent Secretary of the Home Office, Director GCHQ, and Deputy Under-Secretary of State for Policy in MOD. He is a member of the Senior Advisory Board of Paladin Capital investing in digital and cybersecurity technology. He served for 7 years on the Joint Intelligence Committee (the JIC). He is the author of *Securing the State* (Hurst, 2010) and co-author with Professor Mark Phythian of *Principled Spying: the Ethics of Secret Intelligence* (OUP, 2018). His latest book is *How Spies Think: 10 Lessons from Intelligence is* available as a Penguin paperback.