

No.97 – Autumn 2017

## Welcome!

### *For all your news, views and events*

In HFN#97, we present notes from our September event, which considered new and emerging technologies, and the implications of change.

There's also our usual news round-up and a calendar of forthcoming events, an STS update and much more.

We hope you find HFN#96 interesting and useful. If you have an idea for a short article – or any other comment to make – please get in touch with [Greg Morse](#) at RSSB.

This is the first of our new-look newsletters, led by our new editor, Greg Morse. We're very excited about the new format and hope you find it as engaging as we do

Greg is RSSB's lead operational feedback specialist, and produces learning documents and presentations for the rail industry. He's also an author in his own right.

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## In the news

### *Road haulage company fined after worker killed*

On 20 October 2015, an employee of Essex-based road haulier YCT Ltd was crushed when his tractor unit rolled forward while he was coupling it to a trailer.

The HSE found that the company failed to implement safe systems of work or monitoring arrangements to ensure its drivers were consistently undertaking coupling and uncoupling operations safely. As a result, a culture had developed whereby its drivers were not always applying trailer parking brakes. YCT pleaded guilty to breaching Section 2 (1) of the [Health and Safety at Work etc Act 1974](#). It has been fined £170,000 and ordered to pay costs of £6,268.80.

### *Company and director sentenced after work left seriously injured*

A Swindon-based scaffolding company and its director have been sentenced after a worker was left with life-changing injuries.

Swindon Magistrates' Court heard how the man was erecting scaffolding on 19 December 2016 when the structure came into contact with 33kV overhead power lines. The father of five received an electric shock which led to the amputation of his left arm above the elbow, right arm below the elbow and both of his feet. He also suffered severe burns, damage to his vocal chords, and was in an induced coma for six weeks.

The HSE found the scaffolding should not have been built to a height so close to overhead power lines. The company and its director failed to ensure a safe system of work was in place for erecting a scaffold under them.

Boundary Scaffolding pleaded guilty to breaching Regulation 2(1) of the Health and Safety at Work etc. Act 1974. It was fined £80,000 and has been ordered to pay full costs of £1415.10.

## *Construction worker suffers fracture to back after fall from height*

Darlington-based Dufell Roofing has been sentenced after an employee suffered a fracture to his back.

Newcastle Crown Court heard how the injured person was in the process of fitting new plywood boards over the top of existing wood wool slabs on a roof in Morpeth on 15 April 2015.

Two employees were in the process of positioning the second plywood board when the injured person fell four metres through one of the slabs onto the floor of the plant room, colliding with internal pipework.

Prosecuting, the HSE told the court the firm should have identified that the slabs were potentially fragile and should have planned the work around this fact, with measures in place to prevent a fall.

Dufell Roofing pleaded guilty to breaching Regulation 15(2) of the [Construction \(Design and Management\) Regulations 2015](#) and was fined £25,000 with £24,572.84 costs, along with a victim surcharge of £120.

## *Make sure your employees Go Home Healthy*

The HSE has launched its Go Home Healthy campaign to ensure employers are aware of the risks of work-related ill health. For more information, click [here](#).

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## **New member focus**

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### *CRA signs up!*

The Hazards Forum is pleased to welcome Corporate Risk Associates – CRA – as its newest member.

CRA is one of the UK's largest integrated risk, safety and human factors consultancies and is renowned for delivering quality services to the Critical National Infrastructure, including Power, Nuclear, Process, Defence, Transportation and Finance.

The company is committed to developing the next generation of analytical experts through its ambitious training and development programme, and partnerships with UK universities.



For more information, check out <http://crarisk.com/>

## STS update

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### *Fourth special report published – Science in emergencies: chemical, biological, radiological or nuclear incidents*

The Science and Technology Committee has received a response from the Government to the 'Science in emergencies: chemical, biological, radiological or nuclear incidents' Report published by its predecessor committee during the 2016–17 session. Click [here](#) for more details.

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## An evening with...

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### *Reduction and control of hazards in emerging technologies, IMechE Westminster, 19 September 2017*

New technologies are developed and brought into highly competitive markets where time pressures are key. These same markets rightly expect very high levels of safety in such products, but tension can come if they're developed whilst the understanding of some associated hazards is not fully complete.



**Institution of  
MECHANICAL  
ENGINEERS**

This HF event examined the issues around the reduction and control of hazards in emerging technologies.

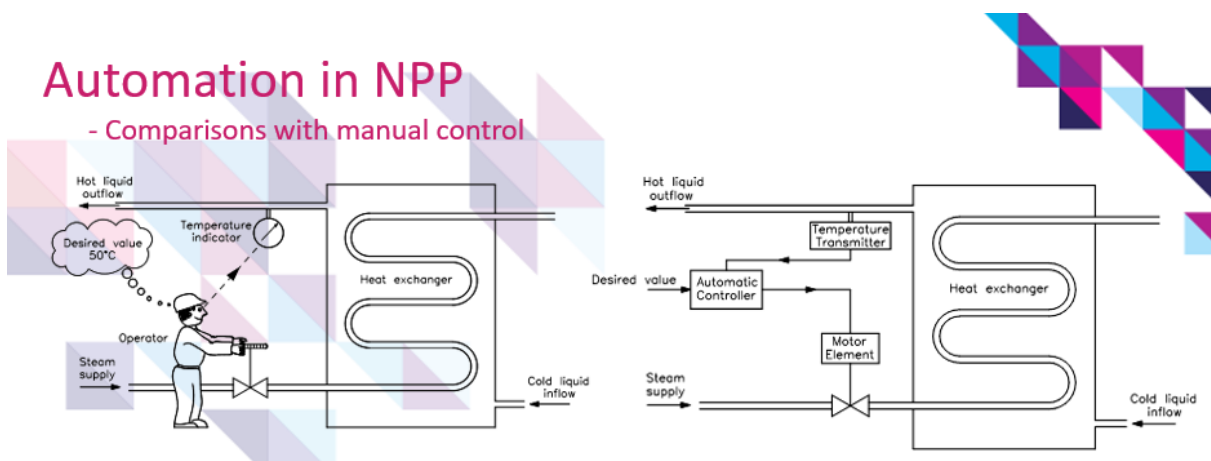
Chaired by Professor Andrew Curran of the [Health & Safety Laboratory](#), it covered much ground in its 90 minutes, Andrew rightly noting that the theme centred on 'a very enormous topic', but adding too that the event was timely, what with the current pace of change and the UK's burgeoning industry strategy.

A key point to remember was that we still need to learn lessons from the past, and need to understand problems of 'scale-up', so that we're implementing new technologies appropriately. We also need to recognise the introduction of people to these new systems.

The formalities observed, first up to the rostrum was Hugh Stephenson, Principal Consultant for new HF members, [CRA](#).

Hugh's presentation covered digital control and instrumentation reliability, including the problems associated with digital control instrumentation, current approaches – and possible future ones. He demonstrated the issues with an anecdote about the failure of his Mitsubishi FTO on a Gloucester roundabout in 2016. In a nutshell, infrequent fluid changes led to a build-up of gunk on the car's gearbox speed sensors. This meant the software no longer had inputs from those sensors...so they failed. Opening a bypass valve allowed the car to limp home – 150 miles – in third gear! The car was later converted to a manual gearbox...

Nuclear engineer Hugh went on to say how the nuclear industry is currently replacing a lot of aging analogue equipment with modern equipment. This is because ‘smart control’ on valves can give a better idea of the condition of plant, bring efficiencies, reduce maintenance...and ‘because we can’, thanks to the rise of a ‘tech-happy generation’ with access to cheap digital equipment. As such, these changes are somewhat inevitable.



When these changes do come, they bring changes in the way things fail too. In the ‘old’ world, explained Hugh, there could be dial failures, valve failures, human failures...in the ‘new’ one, there can be issues with temperature sensors...telemetry...Basically, there are more dependencies in the digital – ‘more automated’ – approach. For example, an air con failure can affect the environment in a way that makes software failures more likely. There’s also a greater need for low-voltage electrical supplies.

Hugh asked how much uncertainty is associated with the reliability of the analogue and digital modes, and pointed out that reliability can vary from industry to industry. It’s also all-too-easy to develop unnecessarily complex models.

Ukrainian government officials claimed the outages were caused by a **cyber attack**, and that Russian security services were responsible.

Should we be now considering cyber attacks in IEF derivation?

Random hardware failures often happen, but the main concern is with systematic failures (which are usually associated with the software element). These can come at the installation phase, or during maintenance, although there’s an increasing security element involved too.

Historically, safety and security have been considered separately. There are strong views that having a strong nuclear safety culture will not ensure you are ‘nuclear secure’. However, of more interest to the safety community is the consideration of how security shortfalls could affect nuclear safety, and how much risk is missing and should it be more visible?

Clearly, said Hugh, we need to improve the communication channels that flow between nuclear safety and security. With that in mind, the first Nuclear Cyber Security & Safety working group was chaired by CRA in July 2016. This was a useful forum, which clarified the need to consider carefully software updates /patches to improve security.

We also need guidance that looks at each facet and how it effects reliability of digital equipment. We collect operational experience elsewhere; should we do it in the digital world too?

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The next speaker, Richard Simcock of [Teva Pharmaceuticals](#), kicked off with an intriguing image to demonstrate the perils of not thinking fully about how something will be used (see right).



He also asked how we consider human factors in relation to ‘hazards for emerging technologies’? The answer is that it should be the same as we consider human factors for ‘other’ technologies – by considering the user at the heart of the design.

The key point, said Richard, is to think about what you’re really asking someone to do when you bring in new technology and be realistic about the limits of human performance.

By way of an example, Richard discussed crewless ships. To keep people ‘in the loop’, Rolls-Royce is creating a prototype virtual reality display system that gives a captain 360-degree views from a virtual bridge. The captain can hop from virtual bridge to virtual bridge, theoretically overseeing many different ships all at once through remotely supervised autonomy. This means that the captain has less control, but more to monitor, and is expected to ‘jump in’ within a greater span of control when required.

‘Humans cause trouble. Computers don’t. Or at least, when they cause trouble, they do so in ways that are often predictable, and if they do manage to screw up, other computers can stop them before anything really bad happens.’ In response to this quotation, Richard pointed out that computers are programmed by humans...

Returning to the motoring theme started by Hugh, he mentioned the self-parking Tesla, which utilises ‘an automated system which does not need you but you have to be watching all the time’. Thus, are we actively in control of something, where perceptual, cognitive and physical actions are **CONTINUOUSLY CALLED UPON AND NECESSARY** for successful completion of a task, or are we watching something that’s being actively controlled by ‘something else’, which does not need our help until it cannot cope?

Richard continued by talking about the term ‘ERROR’ – a word that’s been there ‘pretty much forever’. But software errors are really human errors too – be it an error in the code, in testing it, or validating it.

People write the software and people fail at alarmingly predictable rates. We need to design systems that allow us to operate them safely.

Richard referred to an example from the medical industry, specifically the ‘autoinjectors’ used for self-administering medication. The point is that they are not really automatic at all – for a start the

#### **Ironies of automation**

[Lisanne Bainbridge \(1983\)](#): ‘The designer who tries to eliminate the operator still leaves the operator to do the tasks which the designer cannot think how to automate.’

‘The more reliable the automation, the less the human operator may be able to contribute to that success. Consequently, operators are increasingly left out of the loop, at least until something unexpected happens. Then the operators need to get involved quickly and flawlessly.’

Raja Parasuraman: ‘There will always be a set of circumstances that was not expected, that the automation either was not designed to handle or other things that just cannot be predicted’. So as system reliability approaches – but doesn’t quite reach – 100% ‘the more difficult it is to detect the error and recover from it’.

cap needs to be removed by the user – and applying PCA analysis reveals a number of potential failure modes:

- Perception:** I didn't even see it
- Cognition:** I saw it but didn't know I had to remove it
- Cognition:** I knew to remove it but didn't know how
- Action:** I knew how, but didn't have enough strength



Each of these elements must be considered for any critical task in the medical industry. It's about identifying the errors and validating them all. What would this mean for the 'Tesla situation'? Well, it means that if you expect a user to 'maintain control and responsibility', you'd have to show that they could. So, your test conditions would be:

- 1) **Driver** – reasonably representative, say at the end of the day having worked a full shift and driving home
- 2) **Journey** – assume it's 2 hours because the traffic is bad
- 3) **Simulated use** – simulation must let the car control itself successfully for just under 2 hours without requiring intervention from the driver
- 4) Driver is expected to sit with 'hands on wheel' watching the successful journey, without taking their eyes off the road (otherwise how can they know to 'take over at any time' if they are not looking all the time) for the whole of the 2 hours
- 5) Driver is presented with an obstacle that the system fails to react to and the simulation must recreate how much time that person would have to respond and see if they can respond in that time

How likely do you think this test would be to 'pass'?

When new technology comes to our sectors, said Richard, we still have to make sure the end user is considered. We tend to do things because we can, not necessarily because we're actually making things safer. We need to think about the user and what we're really asking them to do.

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The final speaker was Matt Birtles, Principal Ergonomist at the [HSE](#), who continued the 'human' theme with a presentation on 'ergonomics enabling production'.

Matt challenged the audience to think about how 'we break people'. Much of it – as far as the HSE is concerned – is physical. And it was ever thus. Health and safety priorities in April 1943 included lung disease, lifting weights, dermatitis and machinery.

This was quite apart from rather more specific 1940s matters like how to camouflage your factory, tackling venereal disease and the employment of police-women in factories to 'ensure girls did not do things they should not do'.

Nowadays, the emphasis is more on musculoskeletal disorders (MSDs), workplace stress and occupational lung disease. Matt noted that these three topics are behind most lost-time incidents in this country, adding that it is financially sound to 'not break people'. Top of the list are the MSDs, which are responsible for some 41% of absences, with an average cost per incident of around £8,000. Furthermore, in 2014/15, 3 million working days were lost due to back pain in 2014/15.

Matt then presented a case study on MSDs relating to 'improving health, happiness and efficiency in supermarket distribution'. The idea had been to enable a well-known supermarket chain to increase its warehouse picking rates by around 15%.

Upping efficiency like this would cut the need to build new distribution centres and increase competitiveness, but the project also had to make sure the union was satisfied that the upping of productivity was 'safe' for its members. Relations between supermarket and union had been poor, and the workforce was aging. HSE had its work cut out and Matt described their role as akin to acting like the impartial 'adult' between two opposing factions.



The HSE found that the team were not working too hard, but were suffering from too many aches and pains. Part of the problem was that shelves had been designed poorly for the picking task, leading to more bending and reaching than necessary. It was thus realised that there was a chance to increase productivity by making some improvements to posture and working practices at the so-called 'picking face'.

The project was successful, and that success came from engaging with the 'end users' (or 'front line'). Everyone was given a chance to have their say, and it was telling that the management had never done this. Matt noted that the 'engagement factor' is 'huge': just talking with the workforce, addressing concerns and issues, made a big difference to how they felt about their work. Coupled with a wage increase, they started working more, and were happier about doing it. Productivity went up; millions were saved.

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The main presentations done, the Chair reiterated that models can be used to provide H&S assurance, end user reps can help design the new systems, and knowledge (in a detailed sense) can design out issues before new technologies are launched.

Other points raised include:

- Regarding automatic cars, we are still at the point where control systems may be more reliable, but when an operator has to intervene, the intervention can be major. We don't seem to have come far in 25 years. Richard said that 'the person' has in fact 'become an alarm management system'. Alas, it is more difficult to design the person in than it is to design the person out. Again, 'we need to work out if what we are asking people to do is achievable or not'.
- The need to assure the code of any new system: there can be unforeseen problems when they start to interact together (eg in an automatic car). Alas, we cannot apply same sort of checking processes to software as we can hardware.

#### Management of change – railways

Organisations with responsibilities for safety on the GB mainline railway system are required to consider and control the risk to passengers, the public and the workforce from any changes being introduced.

Change to the risk can arise from technical (engineering), operational, or organisational changes.

To find out more, check out RSSB's website:

<https://www.rssb.co.uk/improving-industry-performance/management-of-change>

- Designs should not be based on only theoretical models; the experience of the end user/worker is very important for assurance and for getting it right.
- Models are not reality.

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## Coming up

The [Events](#) section of the Hazards Forum website has more information and details of any updates, which may include additional events or amendments to those shown below. Please note that attendance is by invitation.

Date	Event	Venue	Contact/further information
November 2017			
21-22	<b>Heat Recovery Steam Generator User Group</b>	Nottingham Belfry Hotel	<a href="http://www.imeche.org/hrsg">www.imeche.org/hrsg</a>
December 2017			
5	<b>Human Factors in Transport Automation</b>	IMechE, One Birdcage Walk, London	<a href="https://events.imeche.org/ViewEvent?code=WOR6580">https://events.imeche.org/ViewEvent?code=WOR6580</a>
5	<b>Pressure Testing 2017</b>	IMechE, One Birdcage Walk, London	<a href="http://events.imeche.org/ViewEvent?code=SEM6575">http://events.imeche.org/ViewEvent?code=SEM6575</a>
6	<b>Residual Stress 2017</b>	IMechE, One Birdcage Walk, London	<a href="http://events.imeche.org/ViewEvent?code=SEM6578">http://events.imeche.org/ViewEvent?code=SEM6578</a>
6-7	<b>Pumps, Valves and Actuators 2017</b>	Mercure Sheffield St Pauls Hotel, Sheffield	<a href="http://events.imeche.org/ViewEvent?code=CMP6577">http://events.imeche.org/ViewEvent?code=CMP6577</a>
7	<b>Natural Hazards and the High Hazard Industries</b>	ICChemE, 1 Portland Place, Marylebone, London	<a href="https://tockify.com/the.hazards.forum/detail/343/1512667800000">https://tockify.com/the.hazards.forum/detail/343/1512667800000</a>
March 2018			
21	<b>Hazards and Procurement</b>	ICE, One Great George Street, London	TBC
June 2018			
19	<b>Grenfell a year on: what have we learned?</b>	ICE, One Great George Street, London	TBC

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