Hazards forum

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March 2013

Risk Communication – The Future

Neil Carhart

On **Wednesday 28th November 2012** the Hazards Forum hosted an **evening event.** The event was co-sponsored by The Royal Academy of Engineering, the Engineering Council, EDF Energy and the Institution of Chemical Engineers. The event was **held at the Institution of Chemical Engineers** at One Portland Place, London.

This was the third and concluding event in a series on risk perception and risk communication. These events set out to examine the barriers to the effective communication of risk and the strategies for breaking them down. The Löfstedt Report made the point that the public, stakeholders and regulators all perceive risks differently. The first event in this series examined public perceptions and how they had been formed, current good practice and ideas on risk communication, all with a strong research perspective. This second event looked at how industry perceptions can differ from those of the public. It also looked at internal and inter-industry differences as significant barriers to effective strategies. This final event looked at **strategies for the future**.

The event began with a few brief words from **Hazards Forum Chairman** Rear Admiral (retd) **Paul Thomas CB**, who welcomed the audience and thanked the sponsors and hosts for the event. He then introduced the **chair for the evening, Professor Ragnar E. Löfstedt, Professor of Risk Management** and **Director of King's Centre of Risk Management at King's College, London.**

Prof. Löfstedt was also the events first speaker. In March 2011 he was asked to Chair a Government wide review of UK occupational health and safety regulations by Chris Grayling MP, UK Department of Work and Pensions. On the 28th November 2011 his report **"*Reclaiming health and safety for all"*** was launched and the UK Government has now accepted all of his 26 recommendations. In his talk, *"After the Löfstedt Review"*, he discussed **the way ahead** and **what the government needs to do** post his review, focusing in part on the forthcoming Government work on risk.

The event's second speaker was **Jeremy Western, Special Projects Director** for **EDF Energy**. His talk, "*Risk perception and future nuclear development - the importance of reaching a more balanced perspective",* explored the current perceptions around **nuclear radiation risk** and the impact these have on the industry and society. He looked at whether these perceptions drive a sensible allocation of resources, whether they cause unnecessary public stress following accidents like Fukushima, and what should be done to address them. The talk drew on experience with **nuclear new build** and **nuclear waste management.** It also reflected on the learning from studies of health impacts following past nuclear accidents.

The final talk of the evening was given by **Mike Considine**, **Director** of **ChemRisk Ltd.**, which provides consultancy services on major hazard management to the oil and gas industry. In his presentation, "*Development and use of risk criteria in the chemical, oil and gas industries*", he **reviewed** the development and use of **risk criteria** in common usage within the **chemical, oil** and **gas sectors**. He described the formulation of semi quantitative approaches using, for example, risk matrices as well as more fully quantified approaches such as the evaluation of individual and societal risk.

Prof. Löfstedt began his talk by discussing the feedback he has received

since launching his review. This has generally been very positive, and there is a sense that stakeholders on both sides of the political spectrum appreciate the contents of the review. There were, however, a small number of concerns raised. Some politicians felt that the recommendations were not radical enough. They wanted particular elements of the existing regulation to be abolished. Prof. Löfstedt noted that this position would seem to be somewhat reflected in comments from the Prime Minister, writing in the Evening Standard that "we will kill off the health and safety culture for good"[1] and suggesting it is holding back British business. Prof. Löfstedt countered this by reporting that the evidence in his review shows quite the opposite, that health and safety is not a burden for industry. Better and smarter regulation, which David Cameron alluded to, is a good thing, as long as the measures are based on evidence and risk. Nothing else will do. He has also received some correspondence about the reviews stance on the exemption of some self-employed people from particular aspects of health and safety regulation. He clarified that this was not radical, and only applies to those who do not employ anyone, and whose work does not pose a risk to others, for example a novelist. In other words, if JK Rowling were to trip over her own printer cable, she wouldn't have to worry about the HSE coming to investigate her home office. This is not something the HSE ever has done, or would ever be likely to do. The law will still apply to small businesses in areas such as agriculture and 'bogus' self-employed people in areas such as construction. The important thing is that the scope of the law, and its limits, are clear and understood.

The third issue concerns the review's recommendations on consolidation. Some articles have falsely reported that the review suggests cuts of around 50% or even 80%. This is not true, and is an amalgamation of the reviews recommended consolidations, its small number of recommended cuts, and a number of cuts made by the HSE following the review. Questions have also been raised over whether the HSE has sufficient resources to implement the consolidations. Prof. Löfstedt reported that the HSE has indicated to him that they do.

He then moved on to discuss what is being done to implement the review's 26 recommendations. There are both big picture recommendations and more specific recommendations. With regards to the specific recommendations (such as the consolidation of regulations in the mining and petroleum areas, and the repeal of the Celluloid and Cinematography Film Act 1922), these are generally on schedule.

With regards to the broader recommendations, there are three main areas. The first is to set up a working group on risk in the European Parliament. There is a need for a discussion to ensure that the directives they issue are based on risk. This is very important. One of the findings of the review was that an increasing amount of UK legislation was formed in Brussels and not Westminster. One study found that 41 of the 65 new health and safety regulations issued between 1997 and 2009 originated from the EU. Between 1998 and 2009 EU directives accounted for 94% of the cumulative cost of UK Health and Safety Regulation. Elsewhere, it has been noted that approximately half of all new regulations that affect business in the UK originate in the EU. We should not ignore Europe, we should be acting from within. The working group was launched in September 2012 in the European Parliament. This is currently being chaired by Julie Girling MEP (UK Con). The group is composed of 10 members of the European Parliament. In 2013 they intend to focus on topic such as: 'Risk versus hazard – how to best regulate' in January, 'The Substitution Principle' in May and 'The definition of the Precautionary Principle' in November. Prof. Löfstedt expressed his hope that the Hazards Forum would play a role in providing evidence for these sessions.

The second area concerns the establishment of a committee on risk in

the House of Lords, or a sub-committee under the Science and Technology Committee. A proposal for such an ad hoc committee has recently been submitted, supported by Lord Lindsay, Lord Curry of Kirkhale and Lord McKenzie of Luton.

The third area is to initiate and facilitate a wider discussion of risk at the school and university level. In the process of conducting the review Prof. Löfstedt was surprised to find that there weren't many resources available for the teaching of health and safety at the university level. When asked why it wasn't more widely taught, academics suggested, rather bluntly, that it was not currently seen as an attractive topic of study compared to others. There are a small number of centres active in this area at various universities across the UK, but it is not seen as an area of study in the same way that even 'media studies' is. We should also be attempting to introduce risk into the school curriculum. Prof. Löfstedt reported that teachers have advised him that they would welcome this wider discussion of risk and decision science within the classroom. He referenced Daniel Kahneman's best-selling book *Thinking Fast and Slow*, which contains a chapter on introducing decision science into schools. Kahneman discusses how difficult it was to set up a text book on these issues, but the book has now been produced. It would be interesting, at least at a pilot level, to get something like this into schools.

Prof. Löfstedt concluded his talk by describing how he is now conducting a review of the actions that have been taken one year on from the publication of the original report. The aim of this review is to look at whether he is happy with the way the government has implemented his 26 recommendations. The conclusions of this were reported back to the government in January 2013 and are in the public domain[2].

The second talk of the evening was given by **Jeremy Western** who began by explaining how he intended to focus on some of the specific areas relating to nuclear safety, and would pose some challenging questions for the audience to think about and respond to. The emphasis of the talk was risk perception. The problems were illustrated through two examples.

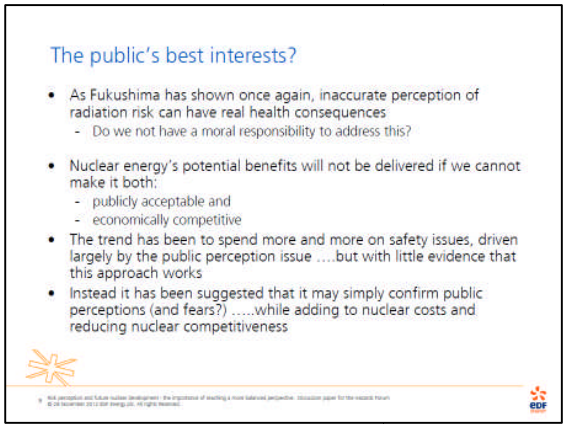
The first example looks at the response to serious nuclear accidents, the most recent of these being the accident at Fukushima in Japan. He emphasised that this was a serious event, and that the wider discussion of risk perception and the actions taken should not be interpreted to imply otherwise. EDF Energy, overseen by the Office for Nuclear Regulation, is doing a great deal to ensure that the lessons of that event are being learnt in the UK.

Sometime after the event people have stood back from it and looked at its impacts on human health. There have been numerous newspaper articles about the consequences following the event. There was a rushed evacuation response to the accident, and an initial perception of a serious threat from radioactivity. What we now know is that this evacuation actually led to more premature deaths, by a factor of at least ten, than it gave protection from radiation. In other words, the number of people saved from radiation exposure by the evacuation was actually very small, while over 400 people (mostly elderly) died as a result of the evacuation. The reaction was driven to a large extent by the public's sense of the scale of the hazard, which was not close to the reality of the risk. This is not a new situation. The studies of many previous accidents have come to a similar conclusion. Even for an accident as significant as Chernobyl it can be shown that the vast majority of the public health impacts are caused by mental stress relating to the fear of the event, rather than the effects caused by the amount of ionising radiation released (which was significant). These can manifest themselves in physical ways, but even if they do not, they are very serious health issues. They are in no way trivial. Thus it can be seen that risk perception has a real impact on harm.

The second example concerns radioactive waste. This is the single biggest issues which people raise questions about when consulted about the construction of new nuclear power stations. These are legitimate concerns which likely arise from the fact that the nuclear industry, globally and particularly in the UK, has made slow progress in demonstrating that it has an acceptable solution to this challenge. Over the years the industry has emphasised increasingly sophisticated measures to try and gain the confidence of sceptical members of the public, yet there is no real evidence that the concern has lessened.

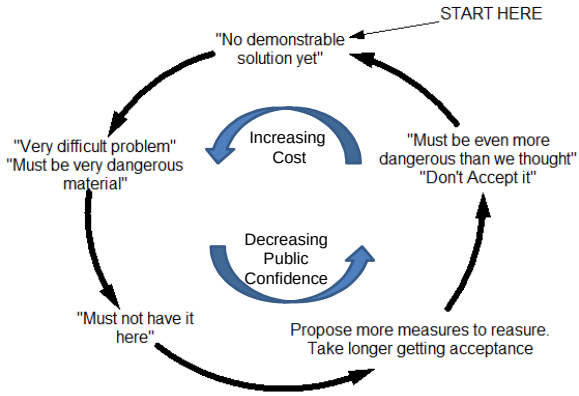
Taking these examples, Jeremy posed two questions:

- Are we really acting in the public's best interest by continuing the current approach towards reassuring the public about the issue of 'radiation risk'?
- If not, how do we move from our current paradigm without undermining public confidence?



There are a lot of challenges in the energy business, and if nuclear is going to make a contribution then it has to prove it can be delivered competitively. The trend has been to make it more complex, and therefore more expensive and less competitive. There is no evidence that taking increasingly disproportionate measures to win public confidence is actually alleviating concern. Getting this balance right is important for realising the potential for nuclear power to get us through the energy challenges we face. If you talk to people one-to-one about radioactive waste, generally their concerns will revolve around it being unique in various ways; that it is long lived, that it is more dangerous than other things we have to deal with and that no one has been able to demonstrate an acceptable solution. Often, if you speak to people to understand these concerns, then it is possible to unpack them, and understand how they are not reflected by the current evidence. For example longer half-life elements emit lower levels of radiation, and there are non-radioactive materials which last even longer, and can be much more dangerous to human health. However, it is not possible to do this for everyone.

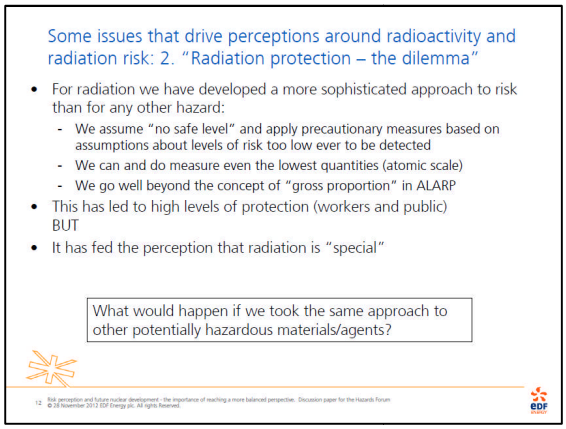
There is a sort of vicious spiral in the way in which we approach the challenges of radioactive waste as shown below:



People perceive there to be no demonstrable solution to the problem of nuclear waste. They conclude from this that it must be a difficult and dangerous problem, and as a result they become reluctant to the idea in general. The industry reacts to this public concern by proposing new, tougher safety measures which causes the public to think it must be even more dangerous than they had initially perceived.

The science on how radiation affects people has possibly developed more than our knowledge about any other material. There is a great international consensus and the processes the industry adopts ensure a very high level of safety. The industry takes the position that there is not a predetermined safe level, and it will instead always go as far as is reasonably

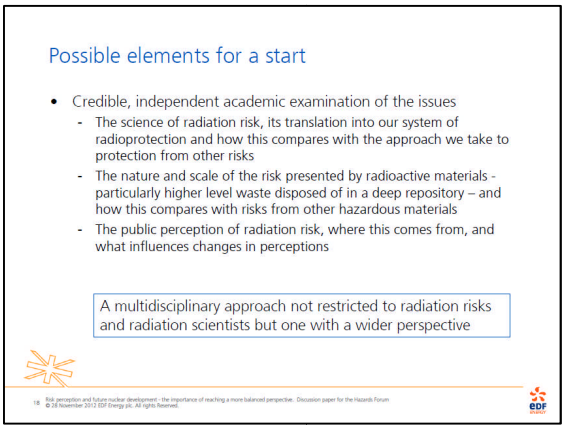
practicable. Sometime the industry even goes way beyond the concept of "gross disproportion" in terms of getting the risk to an ALARP (As Low As Reasonably Practicable) level. The measurements really do go down to the atomic scale. The unit of radioactivity, one Becquerel is one nucleus disintegrating.



The question was then posed: what would happen if we took that approach to other potentially hazardous materials/agents?

Jeremy went on to look in further detail at what might be driving public perception. The UK was one of the few countries to show a recovery in positive public opinion towards nuclear power following an initial dip caused by the events at Fukushima. In fact there are currently more people supporting the need for nuclear generation than there were before the accident. This certainly wasn't a reaction that occurred everywhere, so what led to this reaction in the UK? Unusually, there was a lot of coverage about the potential harm that the nuclear accident could cause, but after a while the message came through quite clearly in the reporting that it was the earthquake and tsunami that had caused most of the destruction. He postulated that the common sense reaction seemed to be that even when you throw this huge natural disaster at a nuclear power station, the consequences were not as bad as people might have previously imagined. The inference from this is that it is important to get messages across clearly and thoroughly.

He concluded by stating that while it could be interpreted as such, these issues were not raised to argue the case for the nuclear industry spending any less on safety precautions. The need is for a change in paradigm from doing more and more just to convince the public of the industry's safety. There is a very solid consensus over the science behind radioactive fuel, and we must be careful in discussing this paradigm shift not to undermine this or suggest that this is not the case. This development of public understanding needs to be led by a credible, independent, academic, multi-disciplined examination of the issues.



The final talk of the evening was given by **Mike Considine** on the development and use of risk criteria in the chemical, oil and gas industries. He began by talking about why risk management is important by looking at some recent events. We don't have to go back very far before we uncover some serious incidents such as fires, explosions and toxic releases. Many of the incidents are characterised by 10s or 100s of fatalities, some by very large pollution events, and in a lot of cases, huge reputational damage. The immediate impact of the event at Deepwater Horizon on the share prices of the whole oil industry was apparent, but BP in particular is still trading around one third less, relative to the other oil majors, than before the event.

The process for assessing and managing risk is relatively standard. A hazard is identified, the frequency and consequences are assessed and this is

represented as an expression of risk. Risk criteria assess whether the risk needs to be further reduced or it is low enough. If there is a need to reduce risk, how should this be done? What risk reduction measures should we adopt? This is a cyclic process. Frequency prediction makes use of historical data, for example looking at the record of fires or blowouts, and the population of components over which this has occurred. It is possible to get a ballpark figure for the frequency of many of these types of events. The records collected by the Oil and Gas Producers Association (OGP) are one example of a good source of such data. This suggests values of frequency that might be useful in all kinds of scenarios within the oil industry. If there is a need to be more specific, if for example there are more or less protective systems than on a typical facility, then frequencies can be synthesised using methods such as fault and event trees. These synthesis techniques are more common in the nuclear industry; the oil industry tends to rely more on historical data.

Computer models are used to predict the consequences of an event. These can be used to predict levels of thermal radiation, pressure or concentration of toxic substances. They have to be combined with the impact on particular targets. There needs to be an understanding of effects, such as thermal radiation, on people or other items of plant. Again the OGP provides good guidance on the vulnerability of people and structures to different impacts associated with fires and explosions. It may be necessary to differentiate between the impact on workers, the public and surrounding industries. It may be important to differentiate between acute and chronic impacts, and between fatalities and injuries. Impact to the environment is also of great interest. This could be measured in terms of pollution to waterways or damage to a population of rare species. Finally, the consequences of the risk may also need to be assessed in terms of business disruption and reputation damage.

Risk matrices are widely used across the industry. These will have a range of frequency categories along one axis and a range of severity categories along the other. Typically these categories are quite broad. The frequency categories may be based around groups separated by a factor of ten, while the consequences may also span broad categories from very minor injuries to a large number of fatalities. They are normally used for assessing specific scenarios rather than the totality of risk. Often the boxes in the risk matrix will be colour coded, and the colour will indicate the action to be taken should a scenario fall into a particular box. There are two main approaches. One approach relies on ‘tolerability’ whereby the colour of the box might suggest a timescale upon which action must be taken. A second common approach is to interpret the colour of the box as an indication of who needs to be made aware of the risk and who must sign off the risk management plan. As it is used for particular scenarios, the risk matrix approach is often associated with tools such as Hazard and Operability Studies, LOPAs etc.

As well as the risk from individual scenarios, we may also be interested in the totality of risk. One of the ways to express totality of risk is to use an F-N Curve which shows frequency against number (of a particular consequence, such as fatalities). Another approach is to select a particular individual and express the total risk to that individual from all causes. Often this is expressed as a series of ‘risk contours’ on a graph. These may be used, for example, to decide where to place the administration block on a site plan so that it is outside a particular level of risk, where to place the site boundary and where the nearest public habitation or facility is sited.

The risk criteria required depend on the type of study being undertaken. Sometimes this may require qualitative criteria, sometimes it may be quantitative. The philosophy on qualitative versus quantitative may vary from one company to the next. The level at which risk criteria

are required will also need to be taken into account. For example criteria could be applied across the whole organisation, for one business unit, at one site or one scenario. It is not appropriate to apply the same criteria to a single scenario and the totality of risk emerging from the whole company – there needs to be some scaling and apportionment factors. Assessing the risks associated with transportation can be very different from those associated with static sites, so this must also be taken into account.

Individual risk criteria can be used to establish a maximum level of risk above which any individual should not be exposed. Individual Risk criteria can be derived by drawing comparisons with levels of everyday risk from events such as traffic accidents and lightening. Societal risk criteria focus on the frequency and scale of events. It can be much more difficult to establish societal risk criteria since there are no readily available comparison benchmarks.

Mike then moved on to discuss the Centre for Chemical Process Safety (CCPS) project on risk criteria. The CCPS was established by AIChE in 1985 following the Bhopal accident to develop and disseminate technical information for use in the prevention of major chemical accidents. They provide a great deal of useful information for the oil and gas industry. This organisation is seen as defining best practice in the US. The project set out to cover the following types of risk assessment:

- Safety risk from episodic events
- Qualitative and quantitative risk assessments
- Total and individual event risks

It sets out to give guidance on how a company might develop its own risk criteria. It does not cover non-safety impacts (such as environmental, business and reputation impacts), impacts associated with long term and repeated exposures or transportation risks. It draws heavily on the experience and regulatory precedents set within the frameworks of the UK and Netherlands.

When developing criteria it is important to consider whether they should be experience based or whether they should drive the safety technology forward. The appropriateness of rigid limits or advisory goals also needs to be taken into account along with the application of the ALARP principle. The way in which risks are calculated is important, as is the treatment of new versus existing facilities and the scale and apportioning of the risk.

In terms of scaling of risk, it is necessary to ask whether the criteria apply to the total risk of all operators across the company, total risk at a particular site or total risk within a unit at a site? Similarly, in terms of apportionment, one must consider how much of the total risk threshold should be permitted to come from a particular process unit at a site, a specific operation within that unit or a single event scenario?

The societal risk criteria of the UK and Netherland are more than an order of magnitude apart, and this has brought into question the credibility of trying to define consistent risk criteria. However, when looking at the way in which these criteria were established these concerns can be somewhat allayed. For example the UK framework is based on rigid limits and a clear expectation for the application of the ALARP principle, there is oversight by a regulatory body such that the criteria become almost legislative. The lower Dutch criteria are aggressively technology driven, advisory without significant emphasis on ALARP and critically developed for smaller facilities. The Dutch criteria are more aspirational while the UK criteria are more of an enforced limit.

There are many challenges to establishing risk criteria. They must have technical rigour and practical applicability. The criteria must be sensible and highlight the higher risks. They must be credible and equitable. The public and employees may be sceptical of the levels of risk they perceive being imposed on them. Finally, the criteria should be benchmarked and validated.

Mike summarised his talk by stating that we must manage risk, and quantitative methods are often an important element in doing this. He re-emphasised the fact that risk criteria need to be credible and equitable, and that the CCPS Project provides good guidance on developing these criteria.

Prof. Löfstedt then introduced the discussion period. The first comment from the audience added support to Prof. Löfstedt's call for a new national focus on risk intelligence. As a country, we have "dabbled" in risk literacy, but there is a strong need for a full audit into the current position and what we need to do to improve the situation. In particular, a lot of work does go on in schools to teach risk (in PHSE and science), but there is a threat to its position in the curriculum. He then went on to suggest that while the nuclear industry has provided a significant contribution in the way we think about and manage risk, it may now be inhibiting the way forward by being too inward looking. The high hazards sector should ensure the public are aware of the risks they actually face, as well as educating them about the risks they only perceive to be important. For example, instead of providing the case for the safety of radioactive waste disposal, the nuclear industry should use its expertise to challenge other industries which deal with other toxic materials to improve their approaches. The public's attention needs to be directed to the things which really need to be improved, so we also need to amplify their risk perception of the real concerns. We must look outwards or we will have an inhibited view of the way forward.

Jeremy Weston responded to this by agreeing that it was very important to understand radioactive risks in perspective, and that this means looking at how it compares with under industries.

The second comment raised during the session supported the call for a multi-disciplinary approach to risk communication, and asked what EDF Energy's current approach was to communicating risk to the public? The third question related to public emotions. The technical analysis can be detailed and follow best practice, but what matters is the community response. The contributor posed the question: how can we elicit a proportionate emotional response when communicating risk? Another audience member argued that it wasn't necessarily to do with emotion, but there was something slightly different about nuclear power. He likened it more to the threat from BSE rather than a warning about a flood. With BSE, he suggested, there was no way for the public to know if they were safe, the threat being posed as coming from ones diet many years earlier. Radiation risk, albeit a misunderstanding of the risk, is in this different category. People don't know if they are safe after the event and it is difficult to get reassurance.

Again, Jeremy Weston responded to these points, this time by describing how the nuclear industry was trying to do much more than it had previously to communicate with the public. EDF Energy is currently engaged in two potential new build projects, and this has involved an enormous amount of communication with the public. The reaction has not been a huge concern about risk; it has been much more focused on roads and the influx of construction workers. Most of the members of the public involved have lived around nuclear power stations, and have built up a trust with the people who work there. The industry is trying to be more open and to communicate as much as possible, not just explaining risk. When explaining risk EDF Energy tries to put it into perspective and use analogies to make it easier to understand. They are also reopening their visitor centres. He agreed that radiation may be a very different situation to a flood, but it was not all that unique, and there were many examples of risks, especially with chemicals, that were similar. Part of the problem may be that radiation risks are *perceived* very differently.

The next audience member asked, with respect to risk criteria, whether the public

consensus on what is and isn't acceptable could jump following specific events. In other words, there may not be an absolute value, it may instead be dynamic. Mike Considine suggested that following a significant event there is a tendency to get an increase in regulatory focus and action in that area. Complying with any new regulations introduced as a result works to push the risk lower. This tends not to be driven by public perception. The techniques discussed in assessing the risk criteria are very much to do with managing the technical risk, managing public perceptions and outrage is a very different challenge. There was a period of time a few years ago when the industry was looking more at managing perceived risk and engaging with local communities. However, security concerns following 9/11 effectively stopped that dialogue.

Further questions were raised, asking for comment on the role of the media, and what could be done to engage with them more. The bounce back in support for nuclear power following Fukushima was cited as potential evidence that we might already be better than other countries at getting independent experts to cover these issues. It was postulated that the lobby groups may be much more proactive in this area in other European countries. The value of getting credible people in the media to communicate the science is very high. The industry needs to do establish the ground work so that those people explaining the science feel that the consensus of the community is behind them.

Another comment from the audience explored the need for a risk informed society, suggesting that to achieve this, three things are required:

- The message needs to get out to industry that simply getting the technical answers correct is only one side of the argument, they must also engage with the public debate and perceptions. They need to be provided with a set of tools with which to do this.
- It is necessary to promote these issues in wider society, and as pointed out earlier, this has to be done through university undergraduates and schools. It has to be done in an interesting and exciting way.
- The engineering profession has to take the lead. The institutions have to come together to proactively move forward in this area in an integrated way.

Sciencewise[3] an expert resource centre for public dialogue in science and innovation, funded by BIS was highlighted as being a potential route to address some of these challenges surrounding the communication of risk and the public understanding of risk.

The final question of the evening asked: what do we need to do differently to successfully communicate with generation Y? This led to a discussion about the impact of instant worldwide communication on BP following Deepwater Horizon. The industry has to think about capturing the attention span of the younger generation. Generation Y get a lot of their information from the digital world, and they develop a certain trust for particular channel within that domain. We have to know how to tap into these new trusted channels. The world is different, and we need to become more active in the social media world.

Rear Admiral (retd) **Paul Thomas CB** thanked the speakers once more for their contributions, and concluded by summarising the three sessions in this series of events. He acknowledged the success of the series, the excellent standard of speakers, and high level of engagement from those in attendance.

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[1] "PM: I will kill off safety culture" Evening Standard, 5th January 2012

[2] http://www.dwp.gov.uk/docs/lofstedt-report-one-year-on.pdf

[3] http://www.sciencewise-erc.org.uk/

Ergonomics and Engineers

Reg Sell
Past President, Ergonomics Society
(Now the Institute of Ergonomics and Human Factors)

Ergonomics is the fitting of situations, particularly jobs, to suit people. It aims to make good use of human capacities, take account of limitations and meet human needs. It aims to make things better for both the employer and the employee. It is the application of sciences such as psychology, physiology and functional anthropology to the work situation.

It is important for all types of job. There are those where comparatively small changes to jobs can bring improvements to a large number of people such as reducing the risk of muscular skeletal diseases by paying attention to manual handling and posture issues. Similarly it can reduce stress, the other major cause of lost time sickness absence by addressing issues such as role conflict and role ambiguity.

It can also look at those jobs where a few people can have a major influence on the effectiveness of a system. Particular attention here is to the reduction of the risk of design induced human errors in critical control situations where the consequence of such an error could affect many people as with the operation of a nuclear power station, for example.

It is thus of great importance to engineers because of its emphasis on design. It is important to look first at fitting the job to the person rather than trying to fit the person to the job, as all too often usually happens.

To get a better understanding it is probably best to look at some concrete examples. We tend to start from the consequences of not using ergonomics because this gives us a reason for studying the matter. However, what we are really interested in are the causes. We need to get beyond describing an incident as human error and putting more responsibility on to the engineer to apply ergonomics and design out the risk of these kinds of errors

It is important to look at life time issues. All too often the person responsible for the design is working to keep the production costs down and is judged by that criterion. They are less interested in the lifetime operational issues where the incidence of design induced human errors may well cause greatly increased financial costs and even the risk of death or injury.

Railway operation illustrates a range of issues. In the early days signals were operated manually with the signalman some distance from the signal and so there were manual handling problems and limitations on how far a signal could be from the box. There were also many places with trains going in both directions on the same track and signalmen could forget they had a train already on a piece of track under their control. This was tackled by providing a label which signalmen put over the signal saying “train on line”. Whilst this was a help it did not completely eliminate collisions because signal boxes were busy communication centres and the signalman could have to deal with a message before he put the train on line label in position. This problem was only completely solved when track circuiting came in and it was possible to see where every train was. Perception problems are still with us however, as with the Ladbroke Grove accident when the complex array of signals was complicated by the glare of the sun increasing the problem.

Aircraft controls have been a topic of interest since World War 2. It was found then that pilots were getting confused between the flaps and undercarriage

controls with many crashes resulting. This was overcome by standardising their positions and developing a set of knobs which were unlikely to be confused with each other. In another instance many planes, for some time after the war, were fitted with three pointer altimeters which were very prone to be misread leading to many crashes when pilots thought they were much higher than they were.

There are continuing problems when there are controls for electrical functions allied with those for flow. To increase electrical power you turn the control clockwise; to increase flow or pressure you traditionally turn the control (valve) anti clockwise. How this dilemma should be dealt with depends on how the operators of the system see the flow controls. With most modern control situations it is likely that the electrical model will work for all. However, the modern gas cooker controls which combine both principles in the same knob can only be a recipe for disaster, but we do not have data on any resulting errors. Did an engineer design them?

I was taken on to work for the CEGB in the early 60s because a grid control engineer failed to see from his diagrams that he had a live bus bar. Earthing to carry out maintenance caused all of SE England to be without electricity for some hours.

The car ferry, the Herald of Free Enterprise sank because vital information (the opening of the main doors) was not available to the Captain in spite of their requests for such information. The Andria Doria incident was caused by the captain getting confused by the type of radar then in use.

New technology raises a number of issues. The major innovation is the increased availability of information at a very low price. The choice is whether this information is kept for the use of just a few and thus used as a control mechanism by them of the many or spread about allowing the majority to have a better understanding of their own role and more immediate control over their work.

There does seem to be a problem in getting management to understand the continuing importance of these issues. Many large-scale IT projects, especially those for government departments seem to fail because of the failure to consider all the human factors aspects. Even when changes are made to improve the situation things can deteriorate. The DVLA in Swansea, when it was first set up, had many customer service problems because the jobs were broken down into such small tasks that the staff did not feel any control and did not see them as complete jobs. When this was changed to give each person whole jobs to do with the responsibility of seeing each one through from beginning to end the problems disappeared. However, some years later the customer service issues re-appeared because the new management went back and broke all the jobs back down into their constituent parts.

There is a need for engineers to understand ergonomic and human factor issues and to defend the need for them to be taken into account in the design of new products and systems and also to face up to those who would override these important aspects.

The Institute of Ergonomics and Human Factors (Formally the Ergonomics Society) is the professional body for those involved with the subject. It runs conferences and meetings both for members and those who are interested in the subject and is involved with a number of publications on the subject.

Reg Sell is a long standing member of the Institute/Society and has held many positions including that of President. He is currently a member of its Council and continues to represent the Institute on a number of outside organisations.

This paper was originally prepared for the Inter Institutional Group set up by the engineering institution to consider issues of health and safety.

For further information please visit:
www.ergonomics.org.uk

Extreme space weather: impacts on engineered systems and infrastructure

The UK should plan now to mitigate the effects of a rare but potentially serious solar superstorm, according to a report published recently by the Royal Academy of Engineering. Although the UK is better prepared than many countries, there are areas where we need to improve our resilience.

The Academy's report, *Extreme space weather: impacts on engineered systems and infrastructure*, was drawn up with the help of experts from many different disciplines. It is the UK's first in-depth assessment of the potential impacts of solar superstorms.

Explosive eruptions of energy from the Sun that cause minor solar storms on Earth are relatively common events. Superstorms, by contrast, occur very rarely - perhaps once every century or two. Most superstorms miss the Earth, travelling harmlessly into space. Of those that do travel towards the Earth, only half interact with our environment and cause damage. However, a solar superstorm is inevitable at some point and will degrade the performance of the electricity grid, satellites, GPS systems, aviation and possibly mobile communications.

The Academy recommends that a UK Space Weather Board be initiated within government to provide overall leadership of UK space weather activities. More research is also needed into the full effects of solar superstorms. The Academy further recommends that all terrestrial mobile communications networks with critical resiliency requirements should be able to operate without global navigational satellite systems (GNSS) timing for up to three days.

A Parliamentary and Scientific Committee Meeting was held on the topic in February at the House of Commons. Prof Paul Cannon FREng, Chair of the Academy's working group on extreme solar weather, who gave an address at the event, is quoted in a press release accompanying the reports launch as saying:

> "The UK is one of a small number of countries taking this risk seriously. The two challenges for government are the wide spectrum of technologies affected today and the emergence of unexpected vulnerabilities as technology evolves. The Academy recommends that government sets up a space weather board to oversee these issues across government departments.
>
> "Our message is: Don't panic, but do prepare - a solar superstorm will happen one day and we need to be ready for it. Many steps have already been taken to minimise the impact of solar superstorms on current technology and by following the recommendations in the report we anticipate that the UK can further minimise the impact."

For more information please go to www.raeng.org.uk/spaceweather

The full report can be downloaded from:
http://www.raeng.org.uk/news/publications/list/reports/space_weather_full_report_final.pdf

Most of the above is taken from the Royal Academy of Engineers press release dated 7th February 2013.

From the Secretary.....

We look forward to seeing as many members as possible at the **Annual General Meeting** on **Tuesday 19th March 2013** at the Institution of Civil Engineers, One Great George Street, London, SW1P 3AA at 16.30. The Agenda will be as per the Notice sent to members in January. For those unable to attend, however, an account of the meeting is planned for publication in the next Newsletter.

The **Calendar of Events** on Page 16 shows many forthcoming events including the Hf Evening Event that follows the AGM at 17.30 for 18.00, which will be at the same address. Further events are shown, including a number by member organisations of the Hazards Forum. The proposed date of the Hf June event is included also. Members are reminded of the benefits of attending events shown, including the offer of reduced rates for many of them.

Brian Neale

Parliamentary and Scientific Committee

The latest issues of "Science in Parliament", the journal of the Parliamentary and Scientific Committee of which the Hazards Forum is a member, has among its contents the following articles. Any member who would like any further information on any of the articles below should visit the PSC website www.ScienceInParliament.org.uk

ROYAL SOCIETY PAIRING SCHEME	Gisela Stuart MP and Dr Joanna Parish
FRONT OF PACK LABELLING	Professor Judy Buttriss
CHEMICAL ENGINEERING MATTERS	Andrew Furlong
INVESTORS IN INNOVATIONS	Dr Alison Todman and Professor Sa'ad Medhat
MATHEMATICAL SCIENCES RESEARCH	Professor David Delpy and Professor Frank Kelly
THE ENERGY BILL	Robert Freer
HELIUM	Dr Mark Stokes
ENERGY – THE NEXT GENERATION	Addresses to the P&SC by Frans van den Heuvel, Francis Egan and Dr Gordon Edge
WHAT NEXT FOR BIOSCIENCE BUSINESS INCUBATORS?	Dr Glenn Crocker
ASH TREES – EFFECT OF CHALARA FRAXINEA	Addresses to the P&SC by Professor Peter Freer-Smith, Martin Ward and Dr Monique Simmonds
ENERGY – HOW TO USE LESS	Addresses to the P&SC by Gill Kelleher, Ashley Pocock and Professor Roger Kemp
SUPPORTING GOOD PRACTICE IN UNIVERSITY MATHEMATICS DEPARTMENTS	Sean McWhinnie
METHANE: THE UNNATURAL GAS	Dr Grant Allen

HSE eNews – Some Examples

++ HSE launches safety clampdown on construction sites ++
Unsafe practices on construction sites are to be targeted as part of a national initiative aimed at reducing death, injury and ill health. Between 18 February and 15 March, inspectors will make unannounced visits to construction sites to ensure they are managing high-risk activity, such as working at height. During 2011/12, 49 workers were killed while working in construction and 2,884 major injuries were reported. The purpose of the initiative is to remind those working in the industry that poor standards are unacceptable and could result in enforcement action.
http://www.hse.gov.uk/press/2013/hse-construction.htm

++ Blueprint to set out health and safety issues and solutions for waste industry ++
A blueprint for addressing the terrible toll of death, injury and ill health in the waste and recycling industry is to be published following a landmark summit. Senior figures from across the sector met in Solihull to agree the key health and safety issues facing the industry and what needs to be done to tackle its poor health and safety record. Delegates at the event were urged to sign up to a statement of intent on HSE's website, making a public commitment to drive improvements – see http://www.hse.gov.uk/waste/statement-of-intent.htm

++ Draft guidance unveiled on workplace first aid changes ++
The Health and Safety Executive (HSE) has published new draft guidance to help employers get to grips with proposed changes to workplace first aid. Two pieces of guidance have been published on the HSE website following a consultation on proposals to amend the First Aid Regulations (1981) and remove the requirement for HSE to approve first aid training providers. The changes are expected to take effect on 1 October, subject to final approval by the HSE Board and Ministers. The guidance documents are available at: http://www.hse.gov.uk/firstaid/proposed-changes-first-aid-regulations.htm

++ Warning to offshore industry on blocking of data communications in dynamic positioning systems ++
A serious incident occurred where a diving support vessel's dynamic positioning (DP) system, designated as IMO class 2, failed resulting in the vessel drifting off position while divers were deployed subsea. Investigations have shown that a probable cause of the DP failure was a single fault which caused blocking of the DP system's internal data communications. Dynamically positioned (DP) vessels undertake a range of safety critical activities such as diving support, drilling for hydrocarbons and operations adjacent to offshore production installations. In many cases the safety of critical activities depends on the continued availability of DP functions. Many DP systems rely on bus-oriented communications networks. Investigation of the incident referenced above found that communications dependent on a dual bus network can be totally lost because of a single fault.

For more information please see: http://www.hse.gov.uk/safetybulletins/dynamic-positioning-systems.htm

Calendar of Events

Please check the Events section of the Hazards Forum website for more information at **www.hazardsforum.org.uk** and to see any updates in the calendar. These may include additional events or perhaps amendments to the Events shown below.
Please note that attendance at Hf Events is by invitation.

Date	Event	Venue	Contact/further information
March			
6	SaRS Event, Hf Supported: How Important is Reliability? An insight into reliability tools and their application to industry	Friends House,173 Euston Road, London	info@sars.org.uk
19	>> Hazards Forum Event: Annual General Meeting	Institution of Civil Engineers, One Great George Street, Westminster, London, SW1P 3AA	Tim at admin@hazardsforum.org.uk
19	>> Hf Evening Event: Education, social media and the internet - inspiring risk understanding in the Y generation	Institution of Civil Engineers, One Great George Street, Westminster, London, SW1P 3AA	Tim at admin@hazardsforum.org.uk
19	IMechE Event, Hf Supported: Ageing Offshore Installations & KP4	Aberdeen Exhibition and Conference Centre, Bridge of Don, Aberdeen, AB23 8BL	Taz Khatun at: t_khatun@imeche.org
April			
23	IMechE Event, Hf Supported: Offshore weight control: Managing design installations and cost	Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1H 9JJ	Taz Khatun at: t_khatun@imeche.org
24	SaRS Event, Hf Supported: Process Safety CPD Workshop	The Marcliffe Hotel, Aberdeen	info@sars.org.uk
June			
3	ICE Event: Biological and Chemical Mechanical Processes in Geotechnical Engineering	Institution of Civil Engineers, One Great George Street, Westminster, London, SW1P 3AA	events@ice.org.uk
19	IMechE Event, Hf Supported: Process Safety: A Global Challenge (1 day seminar)	Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1H 9JJ	Taz Khatun at: process@imeche.org
19	>> Hf Evening Event: An international approach to balancing risks and benefits: Life Quality Index applications (Provisional Title)	Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1H 9JJ	Tim at admin@hazardsforum.org.uk
20	IMechE Event, Hf Supported: Mechanical integrity of process plant: New guidance on inspection and testing (1 day seminar)	Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1H 9JJ	Taz Khatun at: process@imeche.org

The Hazards Forum's Mission is to contribute to government, industry, science, universities, NGOs and Individuals to find practical ways of approaching and resolving hazard and risk issues, in the interests of mutual understanding, public confidence and safety.

The forum was established in 1989 by four of the principal engineering institutions because of concern about the major disasters which had occurred about that time.

The Hazards Forum holds regular events on a wide range of subjects relating to hazards and safety, produces publications on such topics, and provides opportunities for interdisciplinary contacts and discussions.

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