

## Allan St John Holt Memorial Lecture – 26 October 2011

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It is a genuine honour to have been invited to deliver this lecture, but I'm not a little apprehensive. Previous speakers have been people noted for their development and communication of safety policy and practice. In me, you have an ancient submariner, an engineer and someone who is passionate about the need for continuous improvement in the management of safety, but certainly no expert in the field. So I can't offer any silver bullets or deep philosophical thoughts – rather a few observations based on my experience in nuclear and rail.

I would argue that it is difficult to conceive of a more complex mix of hazards than those represented by the modern nuclear powered and armed submarine. As a result, nuclear submarines are often held to be very dangerous. However, I suggest that this is an erroneous notion. A dictionary definition of 'Dangerous' is 'unsafe or full of risk'. Although nuclear submarines have more than their fair share of hazards they are not unsafe because we prevent those hazards resulting in serious consequences by identifying and mitigating the risks through good design, construction and operation.

Safety or failure to achieve it is, of course, one of the risks that we all face. But should we treat it as somehow different or more important than those other risks? Well it is about harm to health, but on the other hand if we fail to manage financial, commercial or reputational risk then our enterprise may founder and that can have harmful impacts on not only our employees, but much more widely on society at large. For these reasons, I am a convert to the idea that we should manage all our risks in a systematic or 'holistic' manner. That is by developing the right organisational structure, instilling correct behaviours and nurturing an appropriate culture. However, in recognition of the genesis of this lecture, let me direct my remarks today specifically at safety and when I say this, I recognise that my focus will be very much work related. Given that there are about 14,000 accidental deaths annually in the UK and some 3 million injuries, the effective management of risk is a priority in many other fields including, pharmaceuticals, food, energy, motoring and water.

I have seen safety divided into three categories, which I find quite helpful. They are:

- Occupational
- Technical
- Process

I am going to deal fairly swiftly with the first. Not because it isn't important – we still have significant numbers of injuries and deaths in the workplace and this is unacceptable. The target has to be zero although there are those who suggest this is an impractical notion. Well to them I would say look around in your organisation and I'll wager you'll find groups/divisions/teams that, year on year, manage to avoid serious injuries. So why shouldn't we all strive to emulate these successes? Perhaps there's a bit of a problem with nomenclature here when we use 'target' as a signpost on the journey towards zero. Would it not be better to use words such as 'milestone' or 'way point' to describe that journey?

Regrettably, occupational or industrial safety has earned the nickname of 'Elf & Safety'. This pejorative characterisation is unjustified, but its use is supported by the media and fuelled by a litigious compensation culture. Health & Safety is now frequently used as an excuse for not doing things and arguably this has an unintended effect on real safety. For example, it is suggested that there is a restriction in the opportunities for leisure and adventurous activities, particularly for young people, because of the perceived impact of this compensation culture. Not only does this deny the young practical opportunities to discover how to identify and manage risk, but also excludes the development of social and leadership skills which these activities are designed to promote. And in saying this, it is important not to lay the fault at the feet of the law, which has proportionality at its heart.

In addressing this undesirable outcome, let me make a shameless plea for greater support of those, such as the Engineering Development Trust, who provide young people with what is now termed STEM experience. These organisations run programmes which provide opportunities to experience the excitement and challenge of real engineering and science projects. As an important component of these activities, the participants learn how to recognise risk first hand and how to manage it. If you would like to learn more of EDT's programmes and success stories, please see me later!

Let me finish on the subject of occupational safety by suggesting that common sense and professional judgement have oft times been replaced by overly complex risk assessments and highly prescriptive procedures. Somehow, safety has become something that is done to us rather than being everyone's responsibility. The Safety Manager, much vilified and misunderstood as he or she is, becomes the owner of safety rather than a vital source of advice, encouragement and assurance.

In support of the use of proportionality and professional judgement in safety management, let me here plug a document (and it's free) that is produced by RSSB on behalf of the rail industry. It is entitled '*Taking Safe Decisions*' and It describes the industry consensus view of how decisions should be taken that properly protect the safety of rail industry staff, passengers and others, satisfy the law and respect the interests of stakeholders, whilst remaining commercially sound. (**Reference 1**)

Let's now have a look at my other two categories. Of course, all three are inter-related, but I find it useful to examine them initially in relative isolation and then identify interfaces and determine how they can be most effectively managed.

For me, technical safety is principally concerned with the design of plant and equipment in such a way that it can be constructed, operated and maintained safely. Sadly, there are many examples of where the importance of designing in safety from square one is neglected. Fortunately the adoption of processes such as HAZOPs, Hazard & Operability Studies, have facilitated the early engagement of all 'stakeholders'. In particular, this ensures that those who will subsequently operate and maintain the kit have an opportunity to ensure that their experience and needs are recognised through the design process. Increasingly, the tools that are deployed to avoid problems during operation are also being adopted in design to improve the robustness of this process. An example is the use of Human Performance Improvement tools to identify situations where the designer is prone to error.

The end result of all this work is the 'safety case' which defines the so called 'design intent'. The cost of production of the safety case for complex hazardous plant, such as a nuclear power station, can run into millions of pounds. If the case represents a sound basis for safe and effective operation through a long life, then it's been money well spent. At a recent 'Fit for purpose safety case' seminar, a member of the Office of Nuclear Regulation offered a simple 4-part test for fitness.

Firstly, are they for the **Organisation**? Too often safety cases are written in a way that is based on a perception of what the Regulator wants.

Next, are they **Usable** on a day-to-day basis? Frequently, safety cases are sets of vast tomes that, once produced and approved, are rarely looked at again. They are what Mr Charles Haddon-Cave QC, author of the report into the loss of Nimrod XV 230, refers to as 'Shelfware'.

Thirdly, are they **Concise**? The production of safety cases is often sub-contracted and you could be forgiven for thinking that the contractor is paid by the tonne. The principal arguments and parameters of the case need to be set out logically and succinctly. These requirements can then be translated into clear instructions and procedures that the operators want to follow because the actions and limits they include are properly understood. At the end of the day, it is the Licensee or Duty Holder who must demonstrate ownership and understanding of the totality of the arguments – it's what is frequently referred to as being an Intelligent Customer.

Lastly, are they **Honest**? Do they reflect the totality of the case including any parts that may be less robust than others. Much better to acknowledge weakness rather than pretend that everything is wonderful – as we know to our cost, life's not like that.

And once we have developed our lovely, slim, fit for purpose safety case it must be maintained in a live form. Modifications to design need to be reflected in revisions to the case and every now and again we need to give it a spring clean or in nuclear jargon, a 'Periodic Review'. This ensures that the case reflects the plant as it stands today and provides an opportunity to see how we measure up to current safety standards and practice – "are the risks still ALARP?" we have to ask ourselves.

Here, I want to introduce a practical example of where a late change to a design that wasn't properly assessed led to very serious consequences. The Thermal Oxide Reprocessing Plant (THORP) at Sellafield reprocesses spent nuclear fuel. A product of the plant is highly radioactive liquid which is the feed stock for the Vitrification Plant. On 28 April 2005 it was discovered that some 83,000 litres of dissolver liquid had leaked onto the floor of the feed clarification cell. It is possible that the leak had been developing for a period of up to 8 months without discovery.

As to the causes, let me quote from the HSE's Report of its investigation: **(Reference 2)**

*Video evidence indicated that the leak came from a pipe,....., which had completely severed at a point just above where it enters accountancy tank B ..... The most likely cause was fatigue failure from the swinging or swaying motion of the suspended tank, which occurred during agitation of the tank contents as part of normal operation. The motion occurred because of design inconsistencies in the later stages of the design process and during construction, together with a modification to the operational mode of the vessel around 1997, which inadequately considered the impact on pipework. The change process overlooked the effects of the tanks swinging on their suspension rods during agitation of liquor, leading to pipework fatigue.*

No-one was hurt nor was there any environmental impact outside the cell, but the plant was shut down for two years. The loss of operating revenue was very significant and the company's reputation suffered seriously.

Whilst I have referred to this incident in terms of design modification I can recommend both the HSE's and BNFL's reports as valuable sources of learning across a broad spectrum of topics. I'll return to the incident shortly to illustrate another point.

I am now left with my third component – Process Safety. I think of this as being predominantly about people and the 'softer issues'. Commodore Andrew McFarlane, one of my successors as the MoD's nuclear regulator is quoted in the Nimrod report as saying "Safety is delivered by people, not paper". Let me have a go at addressing some of the more important people issues as seen through my periscope.

Firstly, we say that we need a strong safety culture, but what do we mean by this? Once again, I turn to the nuclear industry. In the aftermath of Chernobyl, the International Atomic Energy Agency established a group to examine lessons learned and provide guidance. One of the first of these guides addressed safety culture and included this definition:

*"that assembly of characteristics and attitudes in organizations and individuals*

*which establishes that, as an overriding priority, nuclear plant safety issues*

*receive the attention warranted by their significance.”*

So it's about individuals and the organisations within which they operate. It talks about Attitudes and Behaviours and acknowledges that nuclear safety must be given overriding priority, but that we should take actions that are proportionate to the risk. This guide, INSAG 4 and its newer companion, INSAG 15, are recommended reading when seeking to deal with the practicalities of developing and measuring safety culture. **(Reference 3)**

May I now turn for some *bon mots* to another submarine engineer, Admiral Hyman Rickover USN. He earned, with real justification, the sobriquet of 'Father of the Nuclear Navy'. He was an exemplary leader who set himself and those who worked in his programmes unwavering standards of excellence. One of his most frequently used quotations is:

*“Responsibility is a unique concept... You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you... If responsibility is rightfully yours, no evasion, or ignorance or passing the blame can shift the burden to someone else”.*

And then there is a somewhat chilling codicil to this quote:

*“Unless you can point your finger at the man who is responsible when something goes wrong, then you have never had anyone really responsible”*

In all of this, he is unequivocal in his view of the need for absolute clarity about who is responsible for what throughout our organisations. At the very top of the shop this means that Board members and Executive Directors must have a genuine understanding of the risks for which they hold responsibility and of the consequences of failing to discharge that responsibility effectively. Sadly, an analysis of the root causes of many serious incidents, both safety and financial, indicate that the most senior people in the organisation didn't know, didn't understand or didn't want to acknowledge the risks they were supposed to manage.

In the UK nuclear industry it is now common for new Executive Directors and Board members to receive detailed briefing on how nuclear is different from other major hazard industries. This will include an understanding of radiation and radioactivity and how they affect people and the environment. The means of controlling these hazards is also explained and, in extremis, the actions which will be taken to mitigate effects if all the defensive barriers are breached. In this way, these key individuals are able better to question what they see and are told when they are conducting safety tours and plant visits. Visibility of the most senior folk at the coal face on a regular basis is, of course, genuinely appreciated by the workforce. If these busy folk take time to demonstrate their commitment to safety and listen to what the front line has to say, then they will not only influence culture and behaviour, but have an opportunity to check whether their carefully constructed messages are being successfully communicated to and understood by those who deliver safety.

I said I would return to the THORP incident and this time it is to illustrate the need for a questioning attitude. There were many signals that were missed or ignored which should have alerted the plant staff that there was something amiss months before the final failure and its dramatic results. However, THORP was still viewed as a 'new plant' with a very low likelihood of anything going wrong. It is vital that we maintain a sense of chronic unease and certainly reject any tendency towards a good news culture. This questioning attitude must be fostered at all levels of the organisation and we should encourage and, if appropriate, reward those who speak up when they see something that they feel isn't right.

One other point on leadership. The role played by our supervisors is fundamental to safety. All too frequently, however, they are expected to be great leaders without having been given any help or training in carrying out this challenging task. It is for very good reason that all men and women in the Royal Navy have to complete and pass a multi-week course in theoretical and practical leadership skills before they can be promoted from the Able to the Leading Rate.

A final quote and one that's often misattributed to Rickover:

*“You have to learn from the mistakes of others. You won't live long enough to make them all yourself”.*

So we need to reflect on not only the learning that comes from our failures and importantly our successes, but also that from the myriad of other relevant sources. Only in this way can we test how we are doing on that all important journey of continuous improvement towards world class performance. But how might we measure where we are on that journey? A method adopted by all the nuclear power plants around the world is termed 'Peer Review'. This is managed by WANO, the World Association of Nuclear Operators, whose Mission is:

*To maximise the safety and reliability of nuclear power plants worldwide by working together to assess, benchmark and improve performance through mutual support, exchange of information and emulation of best practices.*

These reviews are conducted regularly at all nuclear power plants and at certain of the Sellafield nuclear chemical plants by a team of acknowledged expert peers. They spend three weeks at the plant gathering evidence of performance against a set of Performance Objectives and Criteria. Given the credibility of the peers and the evidential basis of the feedback, the process is immensely powerful if somewhat painful when on the receiving end. The plant is expected to respond to the AFIs, or Areas for Improvement, and then progress in embedding improvement is checked by means of a return visit some 18 months later. Where a plant is having difficulty in determining how best to make progress in a specific area, WANO will offer a Technical Assist visit. This method of obtaining an independent and expert view of an organisation's strengths and weaknesses is now the subject of a limited scope trial in some other major hazard industries. I would commend its consideration more widely.

In finishing may I, as an engineer, repeat some words from my esteemed colleague and friend Roger Bibbings, RoSPA's Occupational Safety Advisor who reminds us of the debt which we owe to engineering in making our lives not just possible but safer. He goes on, *“Safety judgments are built into the engineered environment in so many ways of which we are barely conscious. This hidden hand of safety is working away quietly day in day out, saving lives and as a society we are barely conscious of it. If things work safely, do not just take it for granted, thank an engineer”.*

#### **References:**

1. RSSB – Taking Safe Decisions <http://www.rssb.co.uk/safety/Pages/safetydecisionmaking.aspx>
2. Report of the investigation into the leak of dissolver product liquor at the Thermal Oxide Reprocessing Plant (THORP), Sellafield, notified to HSE on 20 April 2005 <http://www.hse.gov.uk/nuclear/thorpreport.pdf>
3. Key Practical Issues in Strengthening Safety Culture - INSAG-15  
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