



Hazards forum



The Hazards Forum Newsletter

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Edited by Dr. Neil Carhart

Views expressed are those of the authors, not necessarily of the Hazards Forum

Further information regarding the articles in this issue is available from
Tim Fuller on 020 7665 2230, in the Hazards Forum Secretariat Office

E-mail: admin@hazardsforum.org.uk

Hazards Forum website: www.hazardsforum.org.uk

Hazards Forum Executive Secretary: *Brian Neale*

June 2015

Hazards Forum AGM 2015

Brian Neale and Neil Carhart

The Hazards Forum Annual General Meeting was held on Tuesday 24th of March 2015 at the Institution of Civil Engineers, One Great George Street, Westminster, London, SW1P 3AA. The meeting began at 16:30 and was chaired by the Hazards Forum Chairman, Rear Admiral (retd.) Paul Thomas CB FREng.

The Chairman welcomed all those in attendance and reported the apologies for absence received from those members who could not attend.

R/Adm Thomas directed those present to the Annual Report of the Trustees 2014 which had been made available to them along with the Notes of the previous year's AGM. Having been approved by the Hazards Forum Executive Committee, the Chairman sought and received acceptance for the Annual Report from the AGM.

The Chairman discussed the Hazards Forum's financial accounts which were made available as part of the Annual Report. He thanked the Independent Examiner of the accounts, and confirmed they had also been approved by the Executive Committee, including the Trustees. The Forum continues its policy of maintaining a reserve roughly equivalent to one year's working budget. A very small deficit was incurred this year, but significantly less than that for the previous year. This has occurred as a result of a rise in membership subscriptions being somewhat offset by a decrease in corporate sponsorship. Initiatives have been put into place to reduce some expenses, though the end of year financial statement remains consistent with the reserve policy.

Sponsoring organisations have been offered a means to link their sponsorship with membership as a way of maintaining both. Attracting new companies is an area of focus.

The Charities Commission was pleased to receive the 2013 Annual Report with the 2014 Annual Return. The Hazards Forum's charitable objectives are of utmost importance and the Executive Committee is pursuing new ideas about how these can continue to be met successfully.

The Chairman then turned to discuss the success of the year's evening events. He highlighted the high quality of the speakers and thanked those who had contributed to them and to their organisation, including those groups and organisations that had provided sponsorship, that is: the Institution of Civil Engineers, the Safety and Reliability Society, the Institution of Mechanical Engineers, UK Petroleum Industry Association and the Institution of Chemical Engineers. This year's events included: *'Returning to normal service – challenges of resuming normal operations following disaster'* in March; *'Reducing risk through sharing experience- why wouldn't you?'* in June; *'Managing risk in a connected world – time for the next generation'* in September, and; *'Health care risk management and issues for the future'* in November.

The Forum continues to employ multiple communication and publicity channels in order to help it achieve its charitable aims. The new website, inaugurated a year previously, in particular has been good at promulgating information. The Executive Committee is looking at how best to communicate to a wide audience, and the website is an important component of that. The website has attracted traffic from scores of countries worldwide and further work will be undertaken to try and understand why people are visiting the site and how their needs can be better addressed.

The Secretariat has been running Survey Monkey, taking views on those who have attended the events. There has been good

engagement with this and helpful feedback received. The forum also has a Twitter presence now where almost 600 tweets had been posted during 2014.

Those in attendance suggested there may be benefits in additional measures of engagement, such as articulating and emphasising the value of membership.

Luise Vassie was elected to continue as a Trustee for her second term. Andy Buchan, president of SaRS was welcomed to the Executive Committee. The Hazards Forum is now operating in much closer communion with SaRS and looking at how this can be developed moving forward.

On behalf of the Hazards Forum, the Chairman thanked Alexander Bierrum, the independent examiner for reviewing the

accounts, Brian Neale in his role as Executive Secretary, Tim Fuller as Secretariat Office Administrator, Jane Homer as Accounting Technician, and Neil Carhart as Editor of the Hazards Forum Newsletter for their support through the year.

The Chairman also thanked the Executive Committee for their tireless efforts, the members of the Hazards Forum, the Institutions who established the Forum and the companies for their support without which the Forum could not continue.

As no other business was raised, the Chairman once again thanked those in attendance, and highlighted that the next Annual General Meeting has been proposed for 26th March 2016 at the same location.

Maintaining a Robust Nuclear Safety Culture – from New Build to Decommissioning

Neil Carhart

On **Tuesday 24th March 2015** the Hazards Forum hosted an **evening event** at the Institution of Civil Engineers, One Great George Street, Westminster, London.

The UK Nuclear industry has been in existence for over sixty years and has progressed through pioneering innovation and “white heat of technology” to commercial power operation, fuel cycle operations and associated waste management. In this period, the industry has not only successfully adapted the technologies upon which it depends, but the vital role of humans in high technology systems and organisations has also become fully recognised. This evening seminar aims to bring together regulatory and industry perspectives of nuclear safety culture development across the nuclear plant lifecycle.

The event began with a welcome from **Paul Thomas**, Chairman of the Hazards Forum, who thanked the event’s co-

sponsors, the Institution of Civil Engineers. He encouraged members to contribute any thoughts or feedback following the event as well as suggestions for future events and activities which the Forum could undertake for the benefit of its members. He then handed over to **Dave Fergie**, a member of the Hazards Forum Executive Committee who chaired the event.

Dave introduced the event, expressing his interest in hearing more about the experiences of the nuclear sector. He then introduced the first speaker, **Clare Pollard**, Human Factors Section Lead & Technical Authority for Areva Risk Management Consultants. Her talk was entitled ‘*Managing Decommissioning: the Human Perspective*’. Nuclear decommissioning is a complex activity requiring support from operators, regulators and specialist contractors. The systematic removal of engineered safety systems and the move to a reliance on

administrative controls along with training, staffing, procedural and equipment modification presents nuclear site licensees with significant safety challenges. It is vital that these challenges are identified, understood and managed carefully to ensure nuclear safety is maintained throughout the process. In her presentation, Clare discussed the transition from an operating facility to a demolished site from a Human Factors perspective, suggesting some areas of research and development which should be undertaken to minimise risk.

The second presentation, '*Safety culture - a regulator's perspective*', was given by **Marc McBride**. Marc is a Nuclear Safety Inspector in Human and Organisational Capability at the Office for Nuclear Regulation (ONR) and is the ONR's lead for safety culture. In his talk Marc described ONR's approach to assessing nuclear safety culture, its experience of applying the approach to date and how it is being adapted for the future. He also described how ONR looks at the underlying organisational culture and its impact on safety and to what extent it is possible, from a regulator's perspective, to distinguish a separate nuclear safety culture (or indeed break it down further into a new build, decommissioning or operations nuclear safety culture).

The third speaker was **Bob Duarte**, Policy, Standards and Culture Manager for EDF Energy. His presentation explored achieving the right culture in Nuclear New Build. A nuclear project on the scale of Hinkley Point C sees the coming together of thousands of experienced people bringing with them their unique skills and perspectives. These people also bring with them behaviours and practices from their past; some of which might be just what we want, others less desirable. Initial cultural alignment strategies focussed on well-rehearsed and established operational nuclear power station approaches but it quickly became apparent that the standard nuclear operations model wasn't an easy fit in the nuclear construction project. A new approach was needed and it had to be an approach that encompassed the needs of the whole project and still kept its

focus on 'Safety and Quality Today – Nuclear Safety for a Lifetime'

Clare Pollard began the first talk by highlighting the tragedy in the French Alps which occurred on the day of the event. Given that the Hazards Forum is a community interested in safety it was felt appropriate to stop for a moment and think about all of those caught up in the tragedy.

Following a moment of collective silent reflection, Clare began discussing her experiences with nuclear decommissioning, huge amounts of which are being currently undertaken across the UK. She described the importance of culture in the decommissioning process. The literature on the subject suggests that changing culture is difficult. There has to be an understanding of why change is needed, and there has to be a desire to change the culture. In general, individuals do not like change. This can be problematic as the move towards decommissioning brings with it many changes. As such, a change in culture can be forced upon individuals and organisations as they engage in the decommissioning process.

What is decommissioning? For a nuclear plant this is post-operational clean-out of all the material that may have been stored on site. It is the initial dismantling and removal of contaminated parts as well as the demolition of structures and the return of the land to an agreed end state for future use.

For operators this means, among other things, bringing in large pieces of equipment and moving huge structures, taking apart facilities people have worked in for years, and building the structures that allow that to happen. It can also involve carrying out remote operations, working in cramped and less than desirable working conditions.

Decommissioning is a complex technical problem. Our existing nuclear plants are ageing, and we have to take some responsibility to move these decommissioning programmes forward. They present both nuclear hazards and conventional safety challenges such as

working at height and the manual handling of difficult equipment. It is necessary to consider innovative ways of dealing with these hazards. This includes how the waste streams will be managed and controlled. This all needs to be done in a way that is mindful of organisational and management considerations.

If you go from operations to decommissioning, there can be meaningful differences. For example, the organisation and its employees must adapt from safety management systems based on an operating nuclear facility which they will most likely have worked with for some time, and be comfortable with, to new safety management systems based on decommissioning tasks. These could potentially be written in part by external contractors. The organisation must adapt from routine training and refresher training during operations that it has established and implemented for many years, to retraining staff in new hazards, new activities and skills. The operators will go from being the most knowledgeable to a part in a system where they may no longer have full awareness of how to carry out the tasks they are involved with. This also means specialist decommissioning contractors may need to be brought in; a change which can be uncomfortable for the operators.

Decommissioning brings with it a change from activities which can be routine and repetitive to a much higher proportion of one-off activities. This increase in unique activities is an area of concern from a human factors perspective. It is true that people undertaking repetitive activities can get complacent or bored and invent novel ways to perform the tasks but one-off activities can also be very hazardous. People need to be given the opportunities to undertake sufficient training, rehearsing the processes as many times as they need until they feel comfortable. There needs to be an environment where people feel able to say *"I don't feel comfortable, can we go through the process again?"* The nature of these activities also changes dramatically. For example, decommissioning brings with it a

significant increase in the amount of material being moved off-site.

Communication processes also change from lines and methods that are routine and well understood to those which are novel. This too can introduce new hazards during the decommissioning process.

In terms of Safety Culture, Clare described her focus on the behavioural aspects of culture, how things are performed, what sorts of behaviours are accepted, where the boundaries are drawn and what assumptions underlie them.

There are different questions which need to be considered such as:

- What is the culture of decommissioning?
- Is the culture stable throughout the process?
- Is there one single culture in a decommissioning project or multiple cultures?
- What key aspects might affect culture?

Decommissioning involves lots of companies coming together, each bringing their own culture. This affects the culture that is already in the facility being decommissioned. Clare then considered four issues:

- Ownership
- Knowledge Management
- Resilience
- Workforce Morale

There are many different cultural aspects associated with decommissioning. One interesting one concerns the question of who is actually in charge. The parent body organisation can change *during* some decommissioning projects. This has a drastic effect on how the project is approached and what is seen as the most appropriate way to proceed.

Clare explained how, from her own experience, people tend involved in the operation of a facility tend to think as if it will not be decommissioned at all. Even when the process has begun it can still be

hard for people to consider the fact that the equipment will eventually be dismantled, particularly those considered to be safety critical during operation. There is a need to be mindful of this, as it can result in a culture where people think they are only 'playing along' with a process, and it won't actually progress beyond defueling for example.

Issue: Knowledge Management

- ❖ > 50-60 years later...
- ❖ **Facility design information**
 - ❖ Handover and retention? Accurate? As-built? Verified?
- ❖ **Operational information**
 - ❖ What waste? Stored where exactly?
 - ❖ What incidents?
- ❖ **Experience from other/similar plants**
 - ❖ How?
 - ❖ Learning lessons for new build?

AREVA
Innovation Energy

AREVA RMO – 27 April 2015 – p.2

One aspect of culture that is very important is the level of uncertainty that people have to deal with. In general, people do not like having to deal with uncertainty. How we hold data on the plant is an interesting problem. In one recent decommissioning project involving the transfer of a lot of data raised problems. A lot of old data may be held on outdated storage media such as floppy discs. Understanding that things like this happen should be taken into account in the way we work today. This means thinking carefully about recording the decision making process, and trying to eliminate any potential for future uncertainty about why a particular decision was made. Information has to be captured and communicated in a very clear and concise way so that in 50 years' time, when it comes to demolishing a facility under construction today, there is no uncertainty about what is there and why. It is not unheard of for a piece of plant to be in a different location from the plans. The kind of information given to people at the hand over between operation and decommissioning is particularly interesting given the time-spans that are involved.

One of the things about decommissioning is that we have to get from our starting

point to our end point in a responsive manner. In some situations there is limited knowledge about what will be found until the inspection takes place. There is limited knowledge about what will be required until that stage in the process is reached. Undocumented changes or events may have occurred in the past which affect the process. To deal with this both the organisation and the individuals from which it is comprised must be responsive, flexible and dynamic.

All of this has to be performed at a point where the organisation is probably not at its most resilient. When considering closing the plant for good, and people are thinking about the changes in their employment, they are unlikely to be at their most resilient. We need to make sure that people comply with instructions, but we also need to be able to react to new discoveries. People need to be dynamic as the safety boundaries of the plant change throughout the transition.

Issue: Resilience Planning

- ❖ Can we promote resilience during decommissioning?
- ❖ Pressures and programmes?
- ❖ Compliance?
- ❖ Predictability and replicability?
- ❖ Where are the safe boundaries of the plant?

Getting from A to B – Responsive and Flexible

AREVA
Innovation Energy

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Some people have said that there is no need to overly focus on workforce morale in transitioning to the decommissioning process, as it brings the positive opportunity to build and develop a whole new set of competencies. This may be true of someone who is interested in the process, particularly contractors who can become specialists in the process, moving between decommissioning sites. However the same may not be true of someone who has been on the site for 30 years, dedicated to the operational phase. For them decommissioning represents something very different. They will have a very different attitude, perhaps with

concerns about their future. Some bigger sites have plans to help people through this progression, but some of the smaller sites don't. This presents an interesting culture clash when highly motivated contractors are brought in to work with operations staff who may not be as enthusiastic, and may even put up active resistance. The motivation of the staff needs to be taken into consideration. The single most important thing is that the operators have to have a level of engagement.

There is some research still needed. The IAEA are looking into organisational and management factors of decommissioning more than they were; their previous focus being on technologies. It can almost become an exercise in 'hearts and minds'. People have to want to be involved, and they must have a succession plan for their future.

Issue: Workforce Morale

Management Principle: Always be cheerful and positive; hold great dreams and hopes in the pureness of your heart

Management Principle: Business is based on partnerships and must bring happiness to all parties

- ❖ How do you maintain safety when the workforce is facing unemployment?
 - ❖ Building up your reputation and competency on a decom project is a positive – for some
 - ❖ Ensuring engagement
 - ❖ Prolonging the programme vs 'demob happy'?
 - ❖ Promoting critical thinking?
 - ❖ Priorities and motivators of Staff vs Contractors?
 - ❖ Ensuring a positive culture

AREVA RMC – 27 April 2015 – p.4

Clare summarised her talk by reiterating the complexity of decommissioning. There are significant differences between operational and decommissioning plant. In terms of human factors, this raises issues in knowledge management, resilience and workforce morale. More research is needed and we need to better consider the human element of decommissioning. The operator is the most important aspect.

The second speaker of the evening was **Marc McBride** who gave a regulator's perspective on safety culture. He began by describing the small specialist team within the Office for Nuclear Regulation which looks at leadership and management for safety. One of its key

focuses is on safety culture within licensee organisations in the nuclear industry. He discussed the approach of the regulator to this idea of safety culture, the expectations they set for licensees in the nuclear industry and the sorts of assessment techniques they encourage and apply.

The International Atomic Energy Authority (IAEA) defines safety culture as:

“That assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance.”

From the regulator's point of view, the key item here is the “characteristics” of the organisation. The regulator is not trying to discern a separate safety culture, they are looking at the underlying characteristics of the organisation, and their impact on safety. It would be possible to define many different cultures (e.g. a security culture, a decommissioning culture, a new build culture) but for the ONR the core aspect is in understanding the underlying assumptions of the organisation that pervade everything it does, and may have a positive or detrimental impact on safety.

The IAEA's thinking has developed in this area from nuclear safety culture as a topic in its own right, to something which pervades all of an organisation's activities.

It is important to recognise that an organisation is not necessarily defined by a single culture. Marc referred to the work of Edgar Schein on organisation culture which identified different types of culture that could exist within an organisation, including the subcultures of organisational groups, and the micro-cultures of operational units. The culture within an organisation could also be influenced by external factors, such as the national culture. This is particularly important for companies or organisations that are operating across different countries, or have supply chains that extend across geographic boundaries. Different cultures can exist on different sites of the same organisation, or at different strata of the organisation. This is something that the regulator has to take into account.

The 'Review of US Department of Defense Nuclear Enterprise 2014' defines nuclear enterprise as the infrastructure that delivers the US's nuclear deterrent capability (i.e. submarines, missiles and long-range aircraft) that the US military maintains. From 2007 there were a number of incidents, relatively minor in their outcome, involving such things as the unauthorised transfer of nuclear warheads, unauthorised export of nuclear materials, and incidents of cheating in training and assessment of competence. A number of reviews were subsequently carried out following these incidents, but they failed to get to the route of the problem. Last year the defence secretary commissioned two additional reviews. An internal review, and an external review which was published, to look more deeply at the leadership, culture and practices within the nuclear enterprise.

This review said a lot of very interesting things about the culture within the organisation. Marc extracted elements of this review and aligned them with Schien's model of organisational culture levels in terms of: artefacts (i.e. the characteristics an inspector might observe within an organisation), the espoused values and beliefs, and the basic underlying assumptions. One issue covered by the review concerns one specialist wrench, for performing a very important job of attaching warheads to missiles. This single item of equipment covered 450 missiles across three bases. Crews on these airbases, as you find in many organisations, were dedicated to their mission no matter what. So they had developed a means to get around this limitation: they used FedEx to ship the wrench between bases.

While posting the wrench was the observable event, the regulator is interested in the underlying drivers of the resulting behaviour. The US Department of Defense report did very good job of exploring this. For example, it identified a leadership 'Say-Do' gap. They would say that the nuclear deterrent was the US military's number one priority, but their actions communicated a different message. Those working lower down the

organisational hierarchy saw a shortage of equipment, key skills and experienced personnel. The report looks further at the types of culture which drove this. They witnessed a culture that was risk adverse and inspection focussed. It was quite apparent that individuals, particularly senior managers, were on a mission to drive risk down to zero, picking on things that were almost incidental to the basic mission. They were adding inspection on top of inspection; audit on top of audit; more processes and more procedures. This ends up driving the opposite behaviours from the ones you want. It can result in a detrimental impact on nuclear safety.

Marc then turned to look at the ONR's approach. They have set a number of expectations for safety culture, embodied in safety assessment principles. These quite deliberately simplify the concepts around four key themes:

- Leadership
- Capable Organisation
- Decision Making
- Learning from experience.

ONR's expectations for safety culture

- **Safety assessment principles:**
 - MS.1: Leadership
 - MS.2: Capable organisation
 - MS.3: Decision-making
 - MS.4: Learning from experience
- **Technical inspection / assessment guides**
 - Management of organisational change
 - Intelligent customer
 - Nuclear baseline
 - Safety management prospectus
 - Management systems
 - Design authority
 - Internal challenge
 - Training and competence
 - Supply chain*
 - Governance*

* In development

ONR Office for Nuclear Regulation

Leadership is of course one of the key influencing factors in culture. The ONR look at the capability of leadership to foster a positive nuclear safety culture. They look at how leaders monitor safety performance and what that tells them about the culture of their organisation. The regulator looks at decision making and how it is informed by opinions, particularly those of independent experts. They look at how the minority voice is heard and taken into account in decision making within nuclear organisations.

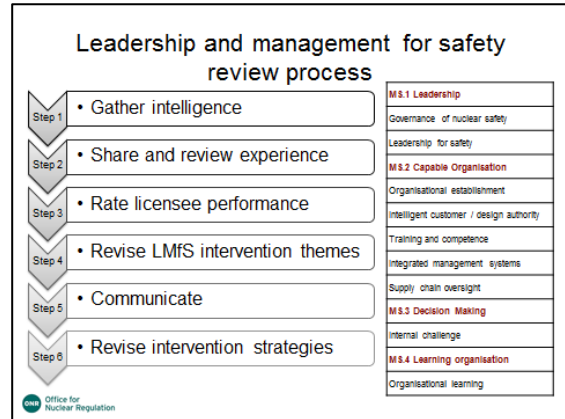
The ONR also assess learning from experience, not so much in terms of the processes as this is quite well established, but in terms of the resulting behaviours. What does the leadership do to promote a learning culture within its organisation? What examples do leaders set for learning within organisations? These are the things that matter.

These four assessment principles are supported in practice by a suite of technical inspection/assessment guides. These are used by the ONR for their own purposes but in effect they set the expectation for the industry. These look at areas such as the management of organisational change, the role of the intelligent customer, governance, training and competence, etc.

The ONR encourages licensee safety culture self-assessment, including survey tools, but also follow up activities that really get to the bottom of the issue. This should be a regular and continuous activity in order to draw patterns and ensure that the desired effects are occurring. They also carry out interventions at Board and Executive level. This is perhaps where the nuclear industry is different from other industries. The Board and Executives of licensee organisations are very much in focus to the ONR. They observe Board meetings and those of other senior committees, they interview Board and Executive members around their oversight of nuclear safety culture, and the sorts of examples that they set personally within their organisations. They carry out interventions around governance structures, looking at how the senior committees are constituted and how the continued competence of the people who sit on them is assured. The ONR investigates how the Board ensures it has access to independent advice on matters of nuclear safety. In total this can be quite intrusive at a senior level.

This goes alongside all of the activity you would expect from a regulator in terms of compliance inspections, technical assessments, safety case reviews etc.

The ONR undertakes annual leadership and management for safety reviews. This is drawn from all of the interactions with the licensee to pick out key themes within the organisation. If necessary, ‘deep slice’ interventions are carried out. This may typically involve four to six inspectors, over a three day period, interviewing around 100 people in the organisation at different levels and in different contexts in order to get a good understanding of the culture.



The leadership and management for safety review process has been running for a couple of years. It begins with intelligence gathering from site inspectors, safety performance indicators, events that have happened and other sources. This is reviewed and shared. The licensee performance is then rated. This is not the most important element by any means, but it does allow for benchmarking. Most importantly is an identification of where ONR’s focus for activity should be moving forward. The response to this process has been very good. A number of licensees conduct their own similar assessments in parallel to the ONR which allows for benchmarking as to whether the two agree, and insight into what the licensees’ priorities for improvement are. Detailed information is provided confidentially to licensees, while good practice and areas for improvement are also shared anonymously within the Nuclear Safety Directors Forum.

The ONR then review and revise intervention strategies, based on whether similar issues are identified across licensees, and whether a different approach is needed.

Marc concluded his talk by giving an overview of the sorts of outcomes identified during the 2013/14 cycle of the leadership and management for safety review process. Most elements were rated 'adequate' or better. Of particular note was the area of training and competence. This has been quite a strong feature of the nuclear industry. Strong ownership, a systematic approach to training, good internal and supply chain coverage, and good scrutiny and challenge of the process within the licensees were all observed.

There were a couple of areas for improvement identified. The first area concerns organisational capability. The industry has produced a code of practice (the second edition was published in February 2014) which has resulted in improvements, but there is scope for better demonstration of organisational capability and resilience. That is whether those organisations really understand where their vulnerabilities are and whether they have the ability to deal with them. The second area for improvement is organisational learning. Some mature processes have been observed, but there is not as much evidence of the good identification of root causes that would get to real learning on nuclear safety matters. In other words, have the licensees challenged themselves sufficiently, particularly the management teams, into what their role was during the incident and what they could have done differently. This would really get to better learning.

A safety culture network has been established between the nuclear industry and the ONR. This network is used both to share good practice and the ONR's strategy for how they will go about addressing the priority issues moving forward. There is a lot of good assessment of safety culture, but the challenge of interest to the ONR is how this information is followed up to deliver improvement. There is a challenge in the nuclear industry around new entrants and new people coming into the industry. What was a relatively stable operating environment with quite a mature, well established workforce is going to change.

The industry needs to maintain a good culture in that context. Lastly there is a challenge in terms of changing ownership structures. These challenges arise out of concerns over value for money and funding structures, and these can create management changes unfamiliar to the industry.

The final speaker of the evening was **Bob Duarte**, Policy, Standards and Culture Manager, at EDF Energy's New Nuclear Build Gen Co. Engineers like knowing how things work, but sometimes it can be difficult for the softer skills to penetrate into engineers' psychology. Bob described the first-hand experience he had of this through EDF Energy's construction activities. He began his career as an engineer but moved into the role of managing personnel and training. The years spent working as an engineer on nuclear reactors greatly influenced the way he now thinks and works. It give a focus on why nuclear safety is important. When you work on a nuclear reactor you get an understanding an appreciation for the fact that all nuclear safety management is about managing the safety of the fuel.

At its initiation the new nuclear construction programme conducted some research into nuclear events. One piece of work by the International Atomic Energy Authority (IAEA) revealed that from a sample of 247 nuclear related events, 13% of them were founded in decisions and actions made during the commissioning phase, 39% during manufacturing and 48% during construction. This influenced the organisation's strategy for how it was going to approach nuclear safety during the new build programme.

World Association of Nuclear Operators (WANO) plan evaluation experience emphasises that 'different does not mean wrong'. The way in which work is conducted from one country to another may vary, but that does not necessarily mean that the processes in either country are wrong. The same thinking can be applied to a construction project involving different organisations. EDF Energy had

to acknowledge that its model of the world is not necessarily correct or incorrect, and neither is that of the construction workers coming onto the site. It is simply a matter of perspective.

Bob then considered the different perspectives of nuclear safety culture that may exist and how these relate to experience working in the nuclear industry. A Nuclear Operator may have a particular perspective based on their proximity to working with the reactor. Their focus may be born out of knowledge of the reactor and how it works. This will give them a close insight into the impact it could have on them, their family, the local area or even the world. This position shapes their views and actions. While developing this model of perspectives on nuclear safety culture Bob spoke to an ex-submariner who had moved into the civil nuclear industry. It quickly became apparent that he had a different focus to a civil nuclear operator because of the immediacy the impact of making an error on a nuclear powered submarine. His actions were metaphorically and physically closer to the reactor core. If the submarine reactor stops working, those on board may quickly die, this influences a different focus on nuclear safety which is perhaps less concerned with the wider factors.

Those involved in the construction project of a nuclear power station provide a third perspective, further removed from the functioning core than that of the submariner or even the nuclear operator. At this level of disconnect it is still possible for design and latent errors to occur which have an impact on the management of safety of the operational plant. This notion of future operational failure is not necessarily very tangible for someone working from that perspective. This has to be factored into the construction strategy.

Even further removed again are those involved in the manufacturing and supply chain during construction. As seen in the statistics from the IAEA they play a big part in the potential failure of the operating power station. Somehow those working from this perspective have to be brought

into line with the others who have a much closer appreciation for the impact on safety they can have. In many cases, those from different perspectives are not even really speaking the same language as each other. The manufacturers and the construction suppliers may not understand what the construction project managers are talking about in terms of the future operations of the plant and the power of the reactor core they are building. They are removed from the impacts to the extent that they don't really resonate with them at all.

The members of the EDF Energy New Nuclear Build can be broadly split into three groups: some have a nuclear background, some have a construction background and other have more general industrial experience. Those with a background in the nuclear sector tend to have a focus on 'trying to achieve future nuclear safety and build as the designer intended'. Those with a construction perspective are 'trying to achieve safety and quality through best construction practices'. They bring with them a lot of experience from mega-construction projects such as the London Olympic park. Very broadly speaking the third group just want to do the best they can in their role.

What the new build construction project is trying to achieve with each of these three groups is 'nuclear construction excellence'. Part of the strategy going forward is trying to articulate and communicate the message about what this is. The language used does not necessarily talk about culture, but rather what it means to deliver nuclear construction excellence.

All of this takes place in the context of many other interacting cultures: security culture, continuous improvement culture, learning culture etc. Everybody brings with them a part of their story.

Bob then played an extract from a training film which provides an insight into how an example of a construction culture could have an impact on future nuclear safety. In the video a worker on a construction site is raising a concern as the quality plan

says that two out of three concrete pumps must be available before work begins. Pump three has been dismantled, leaving only pumps one and two operational. He is concerned as a previous incident has meant that pump one has only been able to be run for an hour at most. It keeps overheating and a modification has had to be put in place. His supervisor dismisses the concern as it is still technically available as a back-up. The concerned worker argues that in its current state pump one might not be of a suitable standard to be considered “available”. His supervisor questions the meaning of “available”, as while the concerned worker interprets this as “available to perform the whole job” his supervisor points out that this isn’t what the quality plan actually says. He says “You are right to question it, but we aren’t talking nuclear physics here are we? It is a pump for putting concrete in a hole.” A third colleague had signed off that two pumps were available during the start-up checks; therefore the paper work that they must comply with has been accurately completed. With this pressure from his supervisor, the concerned worker gives in and continues with the job despite his apprehensions.

Video such as this facilitate discussions with the teams working on the nuclear construction sites about what cultures and behaviours are driving that kind of decision making. Decision making takes a very local role, everyone makes decisions on a daily basis and so does the organisation as a whole. These decisions can all impact nuclear safety. Somehow the supervisor in the video had been influenced to make a decision based on an imperative to complete the job as quickly as possible rather than as safely as possible. It is important to understand how that attitude is generated and how it can be stopped.

EDF Energy place nuclear safety as their “overriding priority” and at the forefront of everything they do. This is stated in the Nuclear Safety Policy. The organisation has adopted the IAEA’s definition as discussed by Marc McBride in his talk, which essentially says EDF Energy’s culture will be a summation of their

behaviours and attitudes. However, it is appropriate to ask whether this is suitable for a new build construction project. Having done this, they concluded that it was ok, providing it was interpreted in the correct way. Bob explained that the way an individual does things is something to do with their individual knowledge, behaviour and values. These are deep routed, learned over a long time and based on mental-models that the individual is comfortable are correct. The way an organisation or project collectively does things are also a product of knowledge, behaviour and values, but are based on specification and procedures, things taught in classrooms, project needs and potentially without any evidence that they are correct. Aligning the way individuals do things to the way the organisation does things is a challenge.

The Hinkley Point C programme introduced its own values: positivity, respect, humility, solidarity and clarity. Behind these are lots of behaviours

The real objective of the programme is to develop an understanding of the consequences of getting something wrong. There is a need to learn and share what ‘good’ performance looks like and then let that knowledge influence our decision making. This is in service of the objective of nuclear safety, as per the IAEA definition, which is “to protect individuals, society and the environment by establishing and maintaining in a nuclear power plant an effective defence against radiological hazard.”

The models of culture based on nuclear operations did not strike a chord with the construction teams. Things developed in operations do not work in construction. The jargon and language used got in way. A vital key stakeholder engagement step had been missed. The construction teams had not been brought along on the journey from the beginning, instead policies had been imposed on them. The strategy was seen as a “wagging finger” ordering people to work in a particular way. This did not work which meant painful discussions were required.

In response the jargon was dropped and all stakeholders were engaged through interviews and meeting in order to develop understanding and demonstrate humility by learning from each other. The initial Nuclear Safety Culture Strategy was re-written as 'Develop behaviours which support nuclear construction excellence'. This became the new objective. The actual term 'nuclear safety culture' was removed from the definition. The process looked to develop behaviours based on what is required to meet this end objective and to start to combine the Hinkley Point C values and behaviours with Nuclear Safety Culture traits.

Bob concluded by outlining the route map for the programme which starts with agreeing a common objective. This is followed by the development of an understanding of the impacts on future nuclear safety and an understanding of how things are done today. From here the right behaviours to support the objective can be identified, and the values applied to continuous learning. These all work towards achieving nuclear construction excellence.

Dave Fargie thanked the speakers for sharing their insights before opening the session up to questions from the audience.

The first question asked the speakers of their experience of managing quality control with sub-contractors. Clare responded first, acknowledging that with sub-contractors, on some occasions, there may not be a great deal of control over who will be on site until they arrive. They have to comply with the site-licensees quality requirements, but the site-licensee may not fully understand what they are dealing with, hence bringing in a specialist sub-contractor. This can potentially creep outside of their knowledge base and comfort. They have to fulfil the intelligent comfort role so they still have to understand what the specialists are coming in to do, particularly in terms of what good looks like for that particular job. Some organisations are not necessarily set up to do this, and need help. Bob drew on his experience of working with

their suppliers to manage third-party suppliers, particularly in the competencies of the manufacturing of specific pieces of equipment. These manufacturers are quite a long way from the lead organisation's concepts of nuclear safety. The discussions have been eye-opening, but rewarding and positive. The manufacturers tend to be very good in terms of standard quality and safety systems, but have a more limited understanding of nuclear safety. Common weaknesses across these organisations have been identified on which the lead company tends to intervene. They assist in developing and ensuring the knowledge in these areas.

The second question, directed at Clare, related to the storage of nuclear waste, specifically the timescales and locations of storage. Clare responded that there is often a timescale for getting waste off site as there will be an operating window in which to get it to its destination. Sometimes the necessary equipment will only be available for a specific period. The timescale therefore is often defined by someone else.

The next question asked about the underlying assumptions of workers, how you can access them, and how you know when you have understood them. Marc began answering this question by acknowledging that the culture of an organisation is defined by these underlying assumptions. They can build up over many years from seemingly insignificant things. The difficulty is really central to how do you change culture through these assumptions if the ones that exist are not the ones you desire. These can change in response to what the leadership is doing. They can have a significant impact on the culture and assumptions. The leadership needs to understand the model of culture and get to the underlying assumptions to change the rational and basis for them. There is an opportunity to do this in response to events and when new leaders enter the organisation. After that, they can quite often get carried away. The connections with the board, and their influence on the

underlying assumptions, are also important.

Bob drew on the Davis-Besse event, a North American nuclear power station where the reactor head was almost eroded despite having a nuclear safety culture that was widely considered to be one of the best in the industry. This encourages reflection on whether even the assumptions on the quality of the nuclear-safety culture are correct. These issues come to light after significant events, but the challenge is in understanding them proactively.

The fourth question from the audience referenced Bob's earlier comment that different is not necessarily wrong. How do you influence the behaviours of those coming onto site, and if it is different, how do you ensure they work to an acceptable standard? Bob agreed that there has to be a minimum acceptable standard from those working with the organisation. The values and behaviours of others have to be brought up to these standards if they are not there already. At the Hinkley Point C construction project, the experience of the construction teams has to be recognised. They bring with them experiences that the lead organisation does not have. There has to be a shared learning period and a re-articulation of what is believed to be true in a way that is understandable and acceptable to others.

A follow-up question asked whether the lead organisation attempts to explain the traits of nuclear safety culture to the contractors when they are talking a language which doesn't necessarily align. Bob explained that they have stopped using nuclear specific language, and even terminology such as 'traits' as it can seem less practical and immediate to the work. Instead they try and use videos and scenarios and self-evaluation.

Another member of the audience asked how to go about understanding the performance shaping factors that affect the safety of the organisation. There is a tendency to be good at this for delivering high-reliability equipment, plant or processes but not so good for delivering high-reliability organisations.

Marc responded first by describing the ONR's use of the term 'Organisational Safety Case'. This manifests itself in the nuclear industry in documents such as Nuclear Baselines. These describe the organisation, its structure, resourcing, competencies etc. It provides a justification that it is competent against the activities that it intends to carry out. This includes a vulnerability analysis. This is a period of examination or vulnerabilities within the organisation, such as impending retirements, and what they are doing about them in the short, medium and long term. This helps to keep the Nuclear Baseline alive. It helps to keep a live view in qualitative and quantitative view of vulnerability. The established processes of controlling organisational change also help manage this as any change will trigger a process to ensure that the organisation is still capable to fulfil its requirements.

Bob added how key indicators related to the nuclear safety traits are tracked on a monthly basis. This can help the organisation react to any adverse trends. Coupled with these lagging indicators are proactive efforts surrounding leadership.

The final question asked about the financial considerations of safety culture change and how these are viewed by the regulator. Bob stated that in terms of construction, there is a whole national infrastructure that helps construction workers acquire new skills for the nuclear industry. This is funded from multiple sources. There is a lot of nationwide investment therefore in this from those involved in new nuclear build. Marc added that safety culture change can be simple and doesn't necessarily involve large amounts of money. How the senior managers engage with their workforce and the sort of information they ask for can have a big impact. There isn't a pre-requisite for a particular level of investment to achieve an improvement in safety culture. An audience member agreed that this can have an impact, but also highlighted that sustaining the change over a long period of time can also be a challenge. The safety culture has to be sustainable.

Dave Fargie closed the event by reiterating the thanks on behalf of the Hazards Forum to each of the speakers for a stimulating and fascinating evening. He also thanked the Institution of Civil

Engineers for sponsoring the event, and the audience for their participation. He then invited all those in attendance to continue their discussions over refreshments.

From the Secretary...

In March 2016, Rear Admiral (retd) Paul Thomas, CB FREng FCGI CEng will have completed his second three year term as our Chairman. As per the Constitution, the Executive Committee is thus in the process of considering potential candidates for the role as from the AGM in March 2016.

The next Annual General Meeting has been proposed for 26th March 2016 at the usual location of One Great George Street, Westminster, London, SW1P 3AA.

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
June			
2 nd	IMechE Event: Fit for Purpose Safety Cases in the Nuclear Industry	The Studio Birmingham, 7 Cannon Street, Birmingham, West Midlands	http://events.imeche.org/ViewEvent?code=S6205
5 th	ICE Event: ICE Bridges 2015 – Maintaining Commitment to Infrastructure	Institution of Civil Engineers, 1 Great George Street, Westminster, London SW1P 3AA, UK	http://www.ice-conferences.com/ice-bridges-2015/about/
16 th	Hf Event: Risks Affecting Management Systems (Provisional Title)	Institution of Civil Engineers, 1 Great George Street, Westminster, London SW1P 3AA, UK	admin@hazardsforum.org.uk
23 rd	SaRS Event: 21 st AR2TS	Burleigh Court Conference Centre, Loughborough University (West Park), , Loughborough, Leicestershire LE11 3TD, UK	http://www.sars.org.uk/events/21st-ar2ts-2015/
30 th	ICE Event, Hf Supported: ICE Health and Safety 2015	Institution of Civil Engineers, 1 Great George Street, Westminster, London SW1P 3AA, UK	http://www.ice-conferences.com/ice-health-and-safety-2015/about/
July			
17 th	ICE Event: ICE Nuclear 2015	Institution of Civil Engineers, 1 Great George Street, Westminster, London SW1P 3AA, UK	www.ice-conferences.com/ice-nuclear-2015/
September			
7 th	ICE Event: Coastal Management 2015	Hilton Amsterdam Hotel, Apollolaan 138, 1077 BG Amsterdam, Netherlands	http://www.ice-conferences.com/coastal-management/
15 th	IChemE Event: Layer of Protection Analysis (LOPA)	Manchester, UK	www.icheme.org/lopa
22 nd	Hf Event: Risks managing quality and the environment in the global arena (provisional title)	Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1A, UK	admin@hazardsforum.org.uk
October			
7 th	IChemE Event: Human Factors in Health and Safety – Human Factors and Design	Norton House Hotel, Ingliston, Edinburgh, UK	www.icheme.org/humanfactors

HSE eNews – Some Examples

++ Total fined over worker's burns in molten sulphur ++

The Total Lindsey Oil Refinery in North Lincolnshire has been fined after a worker suffered serious burns when he stepped into an open manway lid and hit molten sulphur below. HSE told the court that Total had no effective safe system of work in place in relation to the attaching and detaching of the loading lance. The hazard of working on top of the tanker had not been adequately identified or assessed

<http://press.hse.gov.uk/2015/total-fined-over-workers-burns-in-molten-sulphur/>

++ Quarrying company fined for ignoring advice ++

A Mold-based quarry firm has been fined for putting employees, contractors and delivery drivers at risk. The company pleaded guilty to continued non-compliance with relevant legislation, despite being warned previously by the health and safety watchdog.

<http://press.hse.gov.uk/2015/quarrying-company-fined-for-ignoring-advice/>

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.SciencelnParliament.org.uk

NATIONAL SPACE CENTRE	Chris Bishop
THE WORLD NEEDS SCIENCE AND SCIENCE NEEDS WOMEN	Professor Dame Carol Robinson
THE UNIVERSITY OF NOTTINGHAM ENTERPRISE ZONE	Professor Chris Rudd
WHY SCIENCE IS IN THE DIPLOMATIC TOOL KIT	Professor Robin Grimes and Dr Emma Hennessey
KEW LAUNCHES NEW SCIENCE STRATEGY	Professor Katherine Wills
DEVELOPING A CIRCULAR ECONOMY	Jacob Hayler
THE FUTURE OF LIFE SCIENCES IN THE UK	Address to the P&SC by Doris-Ann Williams and Dr Malcolm Skingle
DEVELOPING LOW-FIELD NMR SPECTROSCOPY FOR TACKLING FOOD FRAUD	Dr Kate Kemsley and D David Williamson
SUPPORTING TECHNOLOGICAL INNOVATION IN BRITISH INDUSTRY	Nigel Williams
THE ACOUSTIC DESIGN OF SCHOOLS	Professor Bridget Shield
A SCIENCE LEGACY FOR THE NEXT PARLIAMENT	Address to the P&SC by Baroness Finlay and Andrew Miller MP
LIGHT	Address to the P&SC by Dr Rob Massey, Susie Wheeldon, Liz Benson and John Allen
THE INTERNATIONAL YEAR OF LIGHT SHEDS LIGHT ON THE 'DARK AGES'	Dr Anne-Maria Brennan
ELI IN THE CZECH REPUBLIC	Otakar Fojt

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.

The Hazards Forum
One Great George Street
Westminster
London SW1P 3AA

E-mail: admin@hazardsforum.org.uk
Telephone: 020 7665 2230
Fax: 020 7799 1325

Website: www.hazardsforum.org.uk

Registered charity number 1047047