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INSTITUTE OF EXPLOSIVES ENGINEERS
SEPTEMBER 2015

Explosives Engineering

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Strengthening relations
with industry partners

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Cunard's three Queens
celebrate 175th
anniversary with
fireworks spectacular



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Explosives Engineers Educational and Research Trust

The Trust was formed in 1982 to advance the theoretical and practical education and training of persons engaged in the explosives engineering industry by the provision of training courses and the publication of technical, educational and informative material together with the financing of research and the provision of scholarships to assist with courses of study in the field of explosives engineering.

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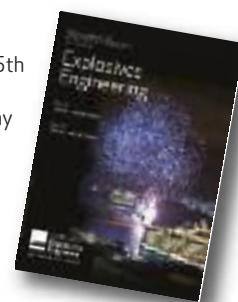
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Front cover picture:
Showtime, Cunard 175th
Anniversary Season –
Liverpool Barge Display
with Queen Mary 2 in
the foreground.
(Photo courtesy of
James Morgan).



Explosives Engineering

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The President speaks

*"If everybody is thinking alike,
then somebody isn't thinking."*
—Gen. George S. Patton Jr.

When I took over as President 18 months ago, I had clear aims of what improvements were needed to solve fundamental problems such as IT and website capability. I can now report that not only have those improvements been delivered but in the process a lot of other legacy issues have been addressed such as mapping the national occupational standards to our membership levels, delivering a new Constitution, enhancing professional recognition with stakeholders such as the Engineering Council by promoting EngTech and IEng status, revising the DOES PM contract to contain milestones and deliverables against the requirements of the SSSG members. We have also supported and been an enabler for promoting those in their early careers in the industry. Further, I have improved the previously established accountability and transparency within Council and introduced measures to keep our operating costs down.

The successes have been down to the hard work, initiative, commitment and focus on delivery from your volunteer Council members.

Referring to my aims above, the Institute owes considerable thanks to the team that designed the new website and I would particularly like to thank Dave Welch, Lucy and the team at Ramora for the considerable effort to improve and sustain the functionality and effectiveness of the website. The site is now meeting the majority of our requirements and is developing all the time. The site offers functional benefits to both our individual and company members as well as attracting others who are looking for the explosives industries' professional body. Consequently I would remind you to visit the website calendar, members' area, and professional accreditation for items of news, events, seminars and training opportunities coming up over the next year.

The IT system is fully functional and the members' database is giving additional capability to those originally envisaged and I should like to thank Vicki Hall for taking the initiative for developing this area. Dave and Vicki are also pursuing the video conferencing facility so that we can get a wider participation at Council meetings and consequently reduce travelling expenses.

Work to coordinate membership, education and professional registration continues with Andy Pettit, Ken Cross and Graham Brooks developing the interlinks to ensure that new applicants can clearly see the pathway from National Occupational Standards through to membership criteria and onwards to professional registration and the CPD requirements throughout.

Further, I attended the Engineering Council's President's reception where promoting the benefits of Engineering Technician accreditation were very much a joint priority. As a result, the Engineering Council has undertaken to support next year's conference and provide future journal articles on the benefits of professional registration.

For succession planning, I have asked Andrew Smith to understudy Ian McKay as Finance Director and have asked others to understudy a variety of roles to give some resilience within Council.



Poster Prize
Winners at the
Early Careers
Symposium with
President John
Wolstenholme.

An example of the Institute's support for those in the early years of their explosives careers came when I was asked to speak at the Early Careers Symposium where over 100 young professionals had assembled to learn about others' sectors, careers and network opportunities. It was really encouraging to see the level of enthusiasm shown by the attendees and hopefully many of them will now be looking to join the Institute.

The quote at the beginning of this article, from Gen George Patton Jr, highlights how we need to approach the next stage of development if we are going to effectively progress our strategy to further increase the Institute's standing as the explosives industries' professional body. Consequently, as I look forward to handing over to Dave Welch as the new President, I have recommended that the next steps are:

- To reorganise Council into working in teams, with their leads responsible for achieving the Institute's strategy, by increasing their responsibility for its delivery for example by bringing in other members of the Institute to support them. This will give an opportunity to all members of the Institute to become involved by contributing whatever time or skills they are able to.
- That in the elections for next year's Council all members consider standing for available Council positions to broaden the industry representation on Council.
- That the Institute should investigate the value of its branding and image, as well as how we support the recognition of training within the industry.
- To control our costs to keep the increases in subscriptions within appropriate limits. An increase is required after a period of no increases to provide the resources needed to undertake our increased workload. I do not foresee the requirement for salaried staff as I believe that you, the members, have the talent and experience that the Institute needs to achieve the majority of our requirements. However this will require new ways of working that are now possible thanks to the new office IT system and a multi-functional website.

Next, I would like to congratulate Dr Sidney Alford on recently being awarded the OBE but it is with regret that I have to inform you of the passing of Dominic Ogden after a long illness and may I extend our sympathies to his family. Dominic joined the Institute in 1984 and he will be missed by many who knew him.

As I look back, I have really enjoyed my presidential term and together we have achieved a great deal. For that I have to thank all of you who have supported me. I think the Institute has tremendous prospects as the professional body for the explosives industry. I look forward to seeing how you build on the current achievements.

As you read this, Vulcan XH588 will be near its final landing and I will be near mine.

All the best to you all,

John Wolstenholme CEng FISTrE MICE MIEpE
President

The Explosives Industry Forum

The Explosives Industry Forum (EIF) meeting due to be held on the 19th May 2015 was conducted by correspondence.

Members of the forum received updates from:

HSE on:

- the progress of its science plan;
- operational matters including the coming into force of the Control of Major Accidents Hazards Regulations 2015 (COMAH) and HSE's decision making process on closing licence and classification application files when applicants have not responded to requests for additional information; and
- Policy matters including the publication of sub-sector guidance in support of the Explosives Regulations 2014 and progress towards the UK Explosives Notified Body being accredited to BS EN 17065:2012;

CBI-EIG on:

- the development of standards supporting the EU's Pyrotechnics Directive; and
- the meetings of the EIF's Explosives Transport, Structural Justification and Electrical Guidance Working Groups.

EIF agendas, papers and minutes are available on HSE's Explosives Group Web Community at <http://webcommunities.hse.gov.uk/connect.ti/explosives/grouphome>

The next meeting will be held on the 22nd of September 2015 and if you want to have a topic raised please contact the Secretary on sec@iexpe.org.uk and provide the relevant details.

In its role as 'Voice of the Explosives Industries' the Institute of Explosives Engineers is inviting its members and partners to contribute to its knowledge base and help set the agenda that the Institute will seek to promote over the next 5 – 10 years.

This will enable the Institute to represent those views at the EIF with a view to stimulating debate, and establishing the issues that should be addressed in:

- HSE's Explosives Sector Strategy
- Sector led guidance
- Sector led research

The responses will also enable the Institute's work outside GB allowing it to speak from a position of knowledge to the wider explosives and regulatory communities.

The short questionnaire found below has been produced to help the Institute identify and prioritise those topics that its members and partners believe to be most important to the sector.

You can either provide a response by visiting the Institutes website or by answering the questions below and e-mailing your response to legislation@iexpe.org before the 30th of November 2015.

What part of the Explosives sector do you work-in or represent?

What are the biggest changes you believe that are likely to happen in the explosives sector over the next 5-10 years?

(These can be technical, organisational, demographic or legislative changes. Please identify whether those changes are likely to be relevant to the sector as a whole or to your part of the sector in particular. If you identify more than one change please can you identify which is the most important and/or highest priority.)

What are the greatest challenges that you believe the explosives sector is likely to face over the next 5-10 years?

(These can be technical, organisational, demographic or legislative challenges. Please identify whether those challenges are likely to be relevant to the sector as a whole or to your part of the sector in particular. If you identify more than one challenge please can you identify which is the most important and/or highest priority.)

Are there any areas or topics where you believe new or additional guidance will be required by the explosives sector over the next 5 – 10 years? Please tell us if you or your organisation would be willing to contribute to developing guidance in the areas and topics you have identified.

Are there any areas or topics where you believe new or additional research will be required by the explosives sector over the next 5 – 10 years? Please tell us if you or your organisation would be willing to contribute to this research.

Are there any occupational health and safety topics that you believe will present particular issues to you or to the explosives sector in general over the next 5 – 10 years?

(An occupational health and safety issue is one that does not relate to the major hazard properties of an explosive. It could for example relate to exposure to harmful, toxic or carcinogenic chemicals, manual handling issues and musculoskeletal disorders, or the potential challenges to health presented by irregular working patterns.)

What are the biggest changes, challenges and issues that you think are going to confront you over the next three years as individual operating in the explosives sector?

Would you be willing to discuss any of your responses further with a member of IExpE's Council?

Martyn Sime BSc(Hons) PGDip MRSC CChem MIEPE
Email: legislation@iexpe.org



The Explosives Engineering Education and Research Trust Award for the Best Final Year Explosive related study, BEng Mining, was presented to Joseph Coxson by Andy Wetherelt at the Camborne School of Mines in July. The title of the dissertation was "Optimising Burden at Cornish China Clay Operations".

Registrar report

Thank you to all applicants who replied to my request for confirmation of whether or not they wish to continue with their application. I will make greater efforts to send out 3-monthly progress requests.

Congratulations to Lex Greer CEng MExpE on becoming professionally registered after his interview on 30 July.

Registrations

Professional registration statistics as at 31st July 2015

	CEng	IEng	EngTech
QUALIFIED	24	4	3
IN PROGRESS	5	3	0

Application forms sent but not yet received back - 32

Request for mentors

Anyone reading who is professionally registered at any grade and who can spare some time to be a mentor for one or two applicants, please get in touch with me at registrar@iexpe.org. The role isn't onerous but it is important that we, a professional engineering institution, provide advice and support for those who aspire to demonstrate their professionalism throughout their application and beyond. The role of a mentor is to help the applicant or potential applicant to understand the process, the commitment to the precepts of professional registration, the detail of the UK-SPEC and, last but not least, the completion of the application form and preparation for interview.

Assessor training

SEE, supported by the Engineering Council, runs a "Training Day for Assessors of Professional Review Interviews", usually at Lockheed Martin, Ampthill on an irregular basis. The workshop includes a review of Engineering Council requirements and delegates are invited to carry out mock interviews of potential EngC registrants who have kindly agreed to take part in the exercise. Relevant documentation is made available to all those attending.

Places are strictly limited to eight delegates, drawn from the SEE and the half-dozen or so professional affiliate institutions that have a similar partnership to ours. These delegates are generally those who can subsequently be expected to assist with PRI interviews for the Society (SEE) and, where appropriate, be part of a "pool" of interviewers available to other institutions. All delegates must be registered with Engineering Council as CEng or IEng and SEE reserves the right to be selective in accepting delegates and observers to the workshop in order that there is a good mix of institutions and disciplines.

Anyone who is interested in becoming an assessor should make contact with the Registrar at registrar@iexpe.org.

CPD

Engineering Council policy on CPD will require the Institute's Registrar to sample all CPD records from 2016. CPD records can be kept in any form but I certainly find the easiest way is to use a purpose-built, cloud-based, database that I can access from PC and smartphone with equal ease. I encourage all members to sign up for MyCareerPath accounts at <http://mycareerpath.iexpe.org/Login.aspx?ReturnUrl=%2fpages%2fdefault.aspx>. The software can be used to capture previous experience as well as recent CPD.

What counts as CPD? The simple answer is that CPD is anything where you have learned something that increases your professional knowledge or skills. This can be formal training events, symposia, conferences, working meetings, reading trade and professional journals...the list is almost limitless.

Ken Cross MBE CEng MSc BSc(Hons) FIEpE

Development Office for Explosives Skills (DOES) Programme Manager Update

I wish to pass on my thanks to Holli Kimble (IExpE Council Member and Chair of the Early Careers Focus Group) and her team of volunteers who were very active in setting up and organising the ECFG Symposium 7th - 8th July 2015 at Heythorpe Park, Oxfordshire. This was a resounding success and this initiative is fully supported by the SSSG for a subsequent event and the DOES PM will be offering support. The ECFG committee can be contacted on the following email: earlycareerssymposium@gmail.com.

DOES PM has been set three main SSSG Priorities - Priority 1 - Training, Education and Work Experience, Priority 2 - Sharing Expertise and Priority 3 - Attract and Retain Talent with updates to these below:

Priority 1 - Training, Education & Work Experience (Up skilling)

- Expert Working Groups (EWGs) (1) Disposal, (2) Test, Trials and Evaluation (3) Storage and Transport (4) Explosives Safety Management (5) Manufacturing continue to meet on a regular basis (or being reinvigorated - Manufacturing) and sharing best practice, site visits and industry updates.
- SSSG Early Careers Focus Group held their inaugural ECFG Symposium 7th-8th July and had 99 attendees and 117 at the formal dinner/reception night. This was very well received and the SSSG supports that this should be built upon and delivered again next year.
- WOME and any OME training courses and activity to be shared and uploaded to the IExpE website and SSSG members made aware. SSSG website being updated to include range of WOME/OME training courses and hyperlink to company and training providers.
- SSSG OME Symposium update - this is scheduled for 29th -30th September 2015 at Shrivenham with this year's theme 'Change', timetable and schedule of presentation has been agreed and can be found at the following link: www.symposiaatshrivenham.com
- SSSG are looking to place a list of secondment opportunities to be hosted on the IExpE/SSSG web pages.

Priority 2 - Sharing Expertise

- Feedback on SSSG Defence Explosives Sector Training & Apprenticeship/Graduate Group Meeting, inaugural meeting took place 12th May 2015 and main updates - Explosives Apprenticeships and future changes, with discussions around the 'Explosives Apprenticeship Model' and what this looks like? Also discussing shared training

The Institute congratulates Sidney Alford OBE on his recent award

opportunities, secondment/ examples, career pathways and increasing industry participation – widening the net.

- CPD events (for SMEs) – DOES PM to arrange and co-ordinate, working with SSSG employers to provide suggested events and for SSSG members for endorsement and make arrangements for the top one or two selected, with employer support (to provide speakers/experts to deliver event(s)) but for DOES PM to arrange and co-ordinate.
- Sharing expertise looking at new and innovative solutions and links via the EWGs for sharing best practice. Being discussed at EWGs and feedback from the ECFG, with examples of the Past Accident Review (PAR) workshops and outputs updated on the IExpE/SSSG website.
- Establish a programme of presentations.....
.suggestions, Electrostatic, Hazard test protocols, Hazard testing, Legislations updates ER2015 etc. SSSG website to be updated with a timetable of events.

Priority 3 – Attract and Retain Talent

- Visibility of career opportunities/company career pathways, DOES PM to obtain and publish on the SSSG website individual and links to company pathways.
- Opportunities for own people to visit other employers to engage and create positive relationships, DOES PM to provide a timetable and agreed visit plan. Timetable of planned further visits being discussed to coincide with EWG meetings and after feedback from the ECFG symposium (MOD/QQ Shoeburyness, 7th September 2015 and Roxel, Summerfield 11th November 2015 – ECFG already planned) details will be updated on the IExpE/SSSG website page.
- DOES PM to map SSSG employer STEM provision and link to IExpE/SSSG website, including company points of contacts and early career contacts.

Finally, don't forget to book your place at the next Ordnance, Munitions and Explosives Symposium at Cranfield University, Shrivenham – this year's theme is 'Change' and will be held 29th - 30th September. Please see the following website for further information. www.symposiaatshrivenham.com/ome

If any IExpE member has any questions, please feel free to contact me for details.

Allan Hinton FinstLM MCMi CMILT AIEpE
DOES Programme Manager

Email: doespm@iexpe.org or secretariat@iexpe.org
Mobile: 07866 429559 Tel: 01785 240154

Whether everyone sees it as such, I am privileged to work with my father in the company he founded over quarter of a century ago. Even for people who have never met Sidney Alford, anyone who has ever read his columns in this publication over the years will have a strong sense of his character and opinions. Instinctively good at what he does, iconoclastic, unquestionably moral, the archetypal small man refusing to buckle under the weight of dogma and big business; he is not someone who will keep his opinions to himself.



Sidney Alford OBE on a recent trip to Vietnam.

Sidney was recently awarded an OBE for his services to the field of EOD. While this may not seem particularly surprising to those who have only read his articles or seen him appear on TV, those who know him better will recognise the significance of this. It is, in many ways, a vindication of his stand and a just reward for being true to himself and not bowing to pressure. As a lone voice against what he sees as an Establishment that is too big and slow to help the soldier on the ground, or the self-serving corporation that puts profits above morals, he has never done anything that could be seen as helping the cause of winning an OBE. Never say that this award was won using some Other Bastard's Efforts: he did this on his own.

A creative inventor and chemist at heart, Sidney is also a successful entrepreneur (albeit one who thinks business is a dirty word) having founded a couple of companies with partners before founding the self-named Sidney Alford Ltd in 1985. Later renamed Alford Technologies, the company now specialises in producing a range of user-filled explosives charges for EOD, breaching, demolitions and maritime salvage. A measure of the success of the company is that it has received two Queen's Awards for Innovation but until now it was ironic that the recognition had gone to the company rather than to Sidney to whom much of the success was owed.

On receiving news of the award, I know Sidney was surprised and delighted but I think the biggest pleasure came from reading the letters from his friends and the realisation that they all really understood him and appreciated what he has achieved and the style in which he has done it. For me, I can only say it is about bloody time!

Roland Alford

Managing Director

Alford Technologies

Awarded the Queen's Award for Enterprise 2004 & 2009 - Innovation

EuEximp Project

The project is maturing nicely, including the addition of a new industry partner for Germany following a gap after the initial partner had to drop out. This issue had been picked up by the Swedish authority acting for Erasmus+ in their comments on the project's interim report:

- **Strengths:** A project which despite a few challenges in terms of changes regarding evaluation activities and the withdrawal of a partner has managed to get a good start of implementing the project plan.
- **Weaknesses:** It is hoped that the challenge with replacing the German industry partner and finding a new partner will reach a solution soon.

The new industry partner is MAXAM Deutschland GmbH, a manufacturer of explosive products for the civil sector. The point of contact in MAXAM is Reimund Goeder, their Plant Manager/Industrial Manager Factories. Given that Germany has a long-standing legal code for explosives qualifications for all stages of use, manufacture, R&D... and all levels of individual, be they operator or CEO, it is intended that the German partners will act as a 'control group' to compare the implementation of occupational standards and outcome- and evidence-based qualifications against the more traditional didactic methods.

Work has begun on the structure and initial content of the two 'intellectual outputs' (EC terminology), namely:

- a step-by-step guide which will provide users with the mechanics of implementing the occupational standards
- a more detailed manual which will provide more insight into the standards, the mechanics of implementation and

case studies from the EUEximp project to provide examples of implementation in different parts of the explosives sector and in qualification attainment and management-tool modes.

Since the last report, the EUEximp partners have held a project meeting in Germany, at the premises of the project partner, Dresdner Sprengschule. The meeting provided the forum for all partners to update each other on their progress to date:

Sweden - BTC has replaced all its IT across the company and the EUEximp POC, who is president of the company, expects to create a copy of their existing competence management database so that they can overlay the NOS for a couple of grades on to it. The aim of the project for BTC is to have a more comprehensive management tool that allows them to see and utilise all skill sets across multi-disciplinary teams and projects.

UK - Event Horizon has received provisional agreement from the British Entertainment and Cinematographic Trade Union (BECTU) to develop a 3-tier qualifications system for explosives SFX, aligned to existing grades of Trainee (no qual), Technician (Level 2), Senior Technician (Level 3) and Supervisor (Level 4). Working from that premise, Event Horizon has nearly completed role profiling for these grades, using the full suite of NOS for ESA and also the NOS for SFX implemented by SkillSet, which covers other roles such as engineering workshop practice and production costing. Once this role profiling is complete, including examples from their specialist area, the draft framework will be presented to BECTU for comment and eventually the development of the qualifications themselves.

Estonia - Voglers Eesti OÜ has completed role profiles for its two explosives safety supervisors and is in the process of finding an assessor who will be able to work with them to qualify them over the coming months. The key to this assessment will be the ability to work remotely as much as possible, given the costs of travel etc.

Portugal - GJR Pyrotechnics and Explosives and Coimbra University have put a lot of effort into understanding the Standards and role profiling the GJR workforce. The intention is that ultimately all GJR's workers will be qualified, though the actual qualifications required have yet to be determined and the technical advisor on the project will visit the company in September to help with this element. There will then be a requirement for a suitable qualifications centre to assess and qualify these candidates.

Germany - as reported above. Dresdner Sprengschule and MAXAM Deutschland will work feverishly to catch up with the project and develop their way forward.

EUEximp International Workshop - 14th April 2016 (Provisional)

The EUEximp project will hold a workshop for interested parties from as many nations as possible in the same week as the IExpE Conference. It is hoped that the workshop will take place on 14th April 2016, the day after the IExpE Conference, in the same venue. Details will be published on the IExpE website once they are confirmed.

Membership of EUExcert UK

Membership remains static and all members of the SSB are de facto members but all are invited to join in their own right. Membership is still free of charge for this year and provides members with a network of like-minded organisations across Europe.

Ken Cross MBE CEng MSc BSc(Hons) FIEExpE

¹ <http://www.euexcert.org/>

Condolences

Condolences from the Institute are sent to the family of Tony Slate on the recent death of his wife Joan. Joan tirelessly supported Tony in all his work related to explosives by preparation of the documentation. She worked alongside Tony with great commitment and good humour.

Remembering

The Late Lt Col Mike Watkins MBE RLC

Members may be interested to know that the ashes of the late Lt Col Mike Watkins MBE RLC, who died in 1998 at Vimy Ridge while helping to make safe WWI explosives, have now been laid to rest at All Saints Church, Church Street, Mears Ashby, NN6 0DN.

Strengthening relationships with industry partners: an Inspector's perspective

By **Martyn Sime** BSc(Hons) PGDip MRSC CChem MIEpE

This paper was first presented as the Keynote Address at The Institute of Explosives Engineers 2015 Annual Conference.

Reflecting on my three year attachment to HSE's Explosives Policy team; the work we have done in delivering a consolidated set of Explosives Regulations; the work the policy team still have to do in delivering further changes to take account of the recast of European explosives legislation; as well as the projects HM Chief Inspector of Explosives, Dr Richard Daniels, has tasked me to undertake before my planned return to leading a field team of inspectors, I realised that the subject of the Institute's 2015 conference is not only timely but vital to us all as a sector if we are to display the resilient behaviours that should continue to ensure our sector is effective, efficient, and safe.

My experience working with the Explosives Policy team as part of the Explosives Legislative Review (ELR) has highlighted to me the importance of having a network of professional relationships and reinforced my view that those who want or need to improve their systems, but who stand waiting for the regulator (whoever that may be) to tell them what to do and how to do it, will often be waiting for a long time and may find that when they become subject to attention it is in circumstances they would prefer to be different.

This indicates that being proactive in strengthening those beneficial relationships that allow us to share both understanding and solutions is essential to future relevance and success. Having mechanisms to do this therefore become important and perhaps you could reflect on how you achieve this within your organisation and with your partners.

But what should we mean by "Strengthening Relationships with Industry Partners"?

One of the great benefits of the English language is that words can be used flexibly to mean different things and often, over time, this can mean that their common usage carries a different concept to that original meaning. This can present real challenges in a regulatory environment, highlighting the importance of ensuring that both speaker and audience have a common understanding of the topic under discussion.

The on-line version of the Cambridge dictionaryⁱ defines 'strengthen' as "to make something stronger or more effective, or to become stronger or more effective" and includes 'concentrate', 'reinforce' and 'reignite' as relevant terms in the associated thesaurus. It is obvious that there are plenty of positives around 'strengthen', some of which, such as 'reignite' are particularly relevant to our sector. But the thesaurus also injects a note of caution by including words such as 'aggrandise' which highlights the importance of 'strengthening' something for the right reasons.

The thesaurus' identification of the relevance of 'reinforcing' is very relevant to our sector too. There is often nothing new in the underlying cause of explosives incidents and the principles of good

practise are largely constant – reinforcing our links with existing stakeholders, making sure that we retain the knowledge, experiences and skills of diminishing sub-sectors means that that good practice can be communicated across and between different generations and work areas. As an explosives professional I see this as being an essential role for our professional bodies in general and the Institute in particular.

The dictionaryⁱⁱ provides further help when we consider what a 'relationship' can be. It includes as definitions "the way in which two things are connected" and "the way in which two or more people feel and behave towards each other".

The thesaurus identifies that there are many positives around the word 'relationship' but I would suggest that in, and of itself, it is a 'neutral' word. It requires some sort of behaviour or action to establish it, make it better or to strengthen it.

Interestingly simple inaction can often result in a relationship failing. It is a rare thing to be able to pick up relationships with both organisations and individuals where they were left off. This is another area where we have re-learned lessons as part of the ELR process. Even though over time organisations can remain the same, roles and people change. This means that failure to periodically review, maintain and alter relationships can often result in you needing to play catch-up when you can least afford to.

I found myself throwing the net wider when I considered a definition of 'industry'. The light blues' dictionaryⁱⁱⁱ suggested two helpful definitions:

- "the companies and activities involved in the process of producing goods for sale, especially in a factory or special area"
- "the people and activities involved in one type of business".

The reference to a 'special area' definitely covers the way the sector is regulated, not only in the UK but around the world.

But I found the dark blues' definition^{iv} of "an activity or domain in which a great deal of effort is expended" aligned better to my experiences.

Again reflecting on the thesaurus highlighted additional issues for example 'manufacture' and its definition is an issue that has captured the attention of the sector since at least 1875; 'trade' is without doubt necessary if our sector is going to continue to be able to generate the income to support standards and maintain safety; and 'quality assurance' is currently the focus for explosives legislation coming out of Europe as we increasingly move into a post industrial landscape where the manufacture of 'raw materials' increasingly takes place either offshore or at the point of use, and is also the basis behind the HSE's Hazardous Industries Directorates model for regulating major hazards.

As we were conducting the explosives legislative review it became apparent that for our sector that 'the industry' has not only changed and continues to change its structure, but has always been much more diverse than other sectors. 'Work' or 'business' are not always the central driver and I believe that that point is demonstrated by the range of speakers at the 2015 Conference – all are relevant, and all manage the same types of materials, but the range of activities and the different aspects of our lives that they touch is perhaps unparalleled when compared to the wider major hazards sector.

I will return to this topic in detail later on but I think that recognising that industry is about effort reinforces the importance of ensuring that that effort is directed and achieves a reasonable return.

Partner is a word that those of us working in the public sector increasingly use as we look to increase our efficiency and I again found the dictionary^v helpful in crystallising the concept as it suggested both:

- *"a person or organisation you are closely involved with in some way" and*
- *"one of a pair who are playing a sport or a game together, especially when the pair are playing as a team".*

Again partner is a very neutral word – it requires an adjective and therefore some sort of action to turn it into a beneficial partnership and like relationships a failure to maintain it will often result in your partners having different priorities when you really need them. But I think the thesaurus suggested the positive activities and behaviours that we would want to see from strengthened relationships with partners in its references to collaboration, enabling and helping although I would contend that being 'buddies' isn't necessary in a professional environment. As an example, Brian O'Driscoll, Ireland centre, Grand Slam winner and most capped rugby international in history identifies that it is a myth that great teams have to be made up of great mates – that he and fly-half Johnny Sexton would often have very forceful discussions and that what often builds a great team is a shared purpose.^{vi}

In my view one of the strengths of the ELR process was the 'creative tension' that HSE's partners brought into the process. It allowed issues to be identified and debated, reasoning to be documented and appropriate solutions implemented.

I would however introduce a note of caution to relying on partners in gathering opinions. It is important when representative organisations work in partnership that it is clear when any views expressed are the collective views of an organisation rather than those of the individual representative. This of course requires effort to be expended by organisations, and given that it is the members who often led a representative their weight, by individual members to ensure that their organisation understands their views and remains an effective partner.

By considering the key words making up the statement "Strengthening relationships with industry partners" we develop a clear concept, establish and build effective contacts and links, are inclusive and identify our common interests in order to deliver our shared goals and individual aims.

One of the key messages that the 2015 Conference will reinforce and that we can take into our day jobs is that by not being parochial and by recognising that we operate in a sector that is broadly based, we can learn from others and not only maintain but develop our professional and organisational competence.

I said I would return to the structure of our industry. It is worth considering our sector as an increasingly diverse and potentially disparate set of populations – in fact the Institute's rebranding and its reference to itself 'as the voice of the explosives industries' can be seen as recognising and acting on those changes.

Thirty to forty years ago those populations were largely contiguous. They were primarily found working in large government organisations such as MoD or major industrial concerns. These organisations were involved in a wide range of activities, not only in explosives and major hazards but also in the generality of logistics, quality control and quality assurance. At least in theory they understood the behaviour of their explosives from cradle-to-grave, were often able to roll out the individual who had originated concepts and techniques to solve problems. These organisations often worked on high volume tasks and had sufficient resource to ensure resilience and to individually carry the overheads associated with:

- developing standards
- exchanging knowledge and experience
- training new staff although I'm not sure I would use competence in the way we understand it today
- regulation
- developing policy

The environment has however altered radically. Geopolitical change, privatisation and fundamental changes to sources of energy in the UK have led to the fragmentation of those older larger organisations and reductions in the volume of work that they used to undertake – although the work itself has rarely disappeared completely and in some skill areas has seen massively increased demand. This means that the explosives hazards and risks still remain along with a requirement to be able to manage them.

Smaller, leaner organisations, have sprung up to exploit some of the niches that have been left by the big beasts – but they are often no longer able by themselves to undertake much of the 'non-productive' work that standard setting was based on. In many instances they now rely on imported explosive substances and articles for their work rather than 'home produced' products. This changes the focus of risk profiling from controlling manufacturing operations and ensuring the safe storage of materials that your organisation has produced, to developing approaches to ensuring the explosives you have been supplied with are the ones you specified and that they meet relevant and adequate, internationally recognised, standards of safety.

In addition there has been growth in new subsectors for example in the:

- development of less sensitive materials such as ANBI and Insensitive Munitions;
- use of explosives in safety systems;
- increasing role of contractors in EOD work;
- increasing role of Universities in undertaking fundamental explosives research supporting both civil uses and the security community;
- use of fireworks and other pyrotechnic articles in the entertainment sector; and
- black powder and ammunition in leisure activities such as shooting and re-enactment.

We have also seen significant growth in the provision of training and other professional services around the world. Interestingly the selection of the training or service provider often appears to be based on the individual's experience of the UK's historical approach to managing explosives hazards and risks.

One only has to read "*Explosives Engineering*" to see how broad the scope of the sector is, the activities its members find themselves involved in and the professional practices and explosives skills and competencies that remain relevant.

Other subsectors have also changed in structure. For example the retail fireworks sector is increasingly dominated by large retailers with mature management systems but who do not have a tradition of managing explosives hazards. Further change can be expected in this subsector as non-UK suppliers increasingly exploit the levelling playing field that EU trade rules have enabled.

We have also seen those companies supplying explosives into the blasting sector providing blasting services, and in effect increasingly following the old MoD model of being in direct control of the entire lifecycle of their explosives.

These issues present particular challenges that HSE has recognised in its strategy for the explosives sector^{vii}.

But it is obvious that isolation can lead to a reduction in breadth of organisational competence; and when people move on from a small organisation, in its depth. Isolation can also lead to 'not invented-here' syndrome, to a one size fits all approach, and potentially in failures to recognise hazards and risks that are new to, or have been forgotten by, an organisation. In an explosives setting these types of failure can, and have, led to catastrophic incidents in both the UK and around the world.

But in a sector that went from gunpowder to the atom bomb in little more than a century, and from touching a lit spill to a powder trail and running, to high reliability, high integrity programmable initiating

systems in less than two, change is something that we have all lived with and have, in general, managed.

The illustration^{viii} below shows how changes to the environment have caused populations of one animal at the top of its food chain, the South American jaguar, to be cut off from each other. This presents risks of inbreeding and localised extinction when pressures on habitat become too severe and individuals cannot interact with other populations.

In parallel with approaches that are being taken elsewhere environmentalists have recognised that the world cannot be returned to the way it was and that if the different populations are to remain viable and survive, links need to be made so that individuals and their genetic material can move between territories, maintaining and reinvigorating populations. In our explosives context this exchange of individuals and genetic material can be seen as an exchange of understanding, knowledge, learning and competence that is facilitated by strong relationships with partners across our sector rather than physical corridors.

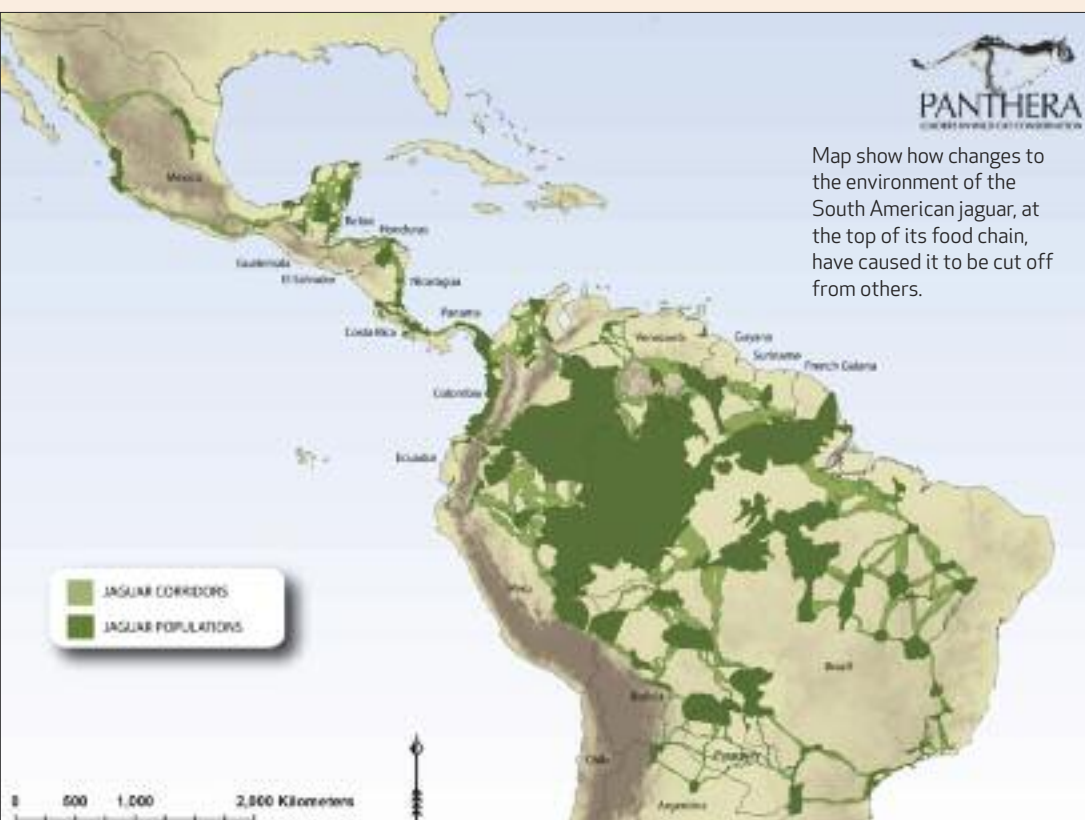
This is why events like The Institute of Explosives Engineers' Conference, and the overarching roles that professional bodies and trade organisations have, are increasingly relevant to the survival of our sector as one that is safe, relevant and respected. In addition their role in supporting the work of more tightly focussed groups such as the Sector Skills Strategy Group can be seen as holding open old corridors and building new ones to ensure our viability.

But like everything worth doing, strengthening relationships requires effort, has the potential to eat resource and if not properly managed can result in either mutual backslapping but no progress or alternatively expending excessive effort with those who do not have the potential to be an effective partner.

My experience with the ELR suggests there are no absolutes, no hard and fast rules on when to strengthen relationships but you do

have to remain focussed on what your organisational objectives are. There has to be value added, whether that is at the level of the individual worker, member or company, or more widely for a sub-sector or for the sector as a whole; and it is clear from the 2015 Conference programme that we and our employers and clients are all likely to benefit directly or indirectly from both the presentations themselves and the opportunity to discuss them with colleagues in an open environment.

Finally partnership working has to deliver your aims and objectives. I certainly consider Conference as an opportunity to find out what is going on in the wider sector, what I can learn from others that will help me to do my job better, and to ensure that I maintain my relevance to others in the sector by my continuing professional development.



Map reproduced with kind permission of Natural Sciences 205, University of Montana.

HSE sees partnership working as one of its primary vehicles for promoting and persuading stakeholders of the benefits of sensible health and safety.^{ix} This approach goes back to the Robens Report in 1972 and the Health and Safety at Work etc. Act 1974 which effectively calls for those who create risk to manage it, rather than setting prescriptive rules which people have to follow.^x

The improvements in work-related safety in the United Kingdom since 1974 show how effective partnership working as exemplified by the Health and Safety Commission, now the board of HSE, can be. HSE's board, comprising representatives of employers, workers and regulators has been able to work to effectively establish and deliver HSE's strategic aims and objectives consistent with its overall strategic direction.^{xi} By undertaking its work flexibly, collaboratively and openly in a public space the HSE Board also allows the wider interested community to take part in and comment on its activities.

We followed a similar approach when we were consolidating the GB explosives legislation – our objectives for partnership working were to:

- ensure that as many stakeholders as possible who had an interest were identified;
- that wherever practicable our interactions with stakeholders would be via representative bodies or other opinion leaders or formers;
- that those we believed needed to be actively involved were proactively approached;
- that others were able to monitor progress and could ask to become directly involved at an appropriate time for appropriate tasks or to address appropriate issues.

There have already been plenty of successes for partnership working in our sector and it is worth highlighting just a few of them. By actively strengthening relationships we have seen significant improvements in the tools we use. For example in the workability of regulations and the relevance of guidance, including both that produced directly in support of ER2014 by both HSE-led working groups and the sub-sectors themselves, in EIF driven technical guidance, and in industry guidance on Ordnance arisings in aggregates. We have seen that when representative groups, professional bodies, company representatives and involved individuals come together to work on an issue, significant benefits for the wider community can be realised.

I have also picked out the EU Q&As on the implementation of the Civil Uses Directive^{xii} as a particular example of collaborative success because I believe it highlights the role of bodies such as those representing both manufacturers and users of explosives in working with their member state representatives to ensure that there is a common understanding of the intent and implication of EU directives. Often by working with their partners they can lead or drive a topic where single regulators could not!

The applicability of technical standards is becoming increasingly important in a globalised world as it often sets the fundamentals of what safe is considered to be. What I have learned here is that it is often important to work with partners to identify why a national requirement came about and whether or not it remains relevant or appropriate to delivering safe outcomes.

At last year's Conference we heard of the utility of national occupational standards in ensuring and assuring competence, which if you have been involved in the investigation of an incident or near

miss you will know is always a topic that attracts real scrutiny. It is good to see that the EUExImp project continues to enable their implementation across the EU and as I look forward I hope to see positive outcomes from that collaborative project.

Another relatively new collaborative group is the Sector Skills Strategy Group (SSSG) and I believe that it is a real benefit that it is not led or driven by the regulator. SSSG efforts and outputs increasingly identify that where people can come together with a common objective not only they, but the wider community, can benefit. SSSG's work to promote headline events such as the Ordnance Munitions and Explosives Symposium (to be held at the Defence Academy of the UK, Shrivenham, 29th to 30th September 2015) should provide obvious benefits but I also believe the practitioner working groups such as those looking at Explosives Safety Management, storage and disposal as well as reviewing past accidents should start to bring useful tools and techniques not only to the members of SSSG but to individual workers as well as the wider sector.

In conclusion, the importance of strengthening relationships with industry partnerships can be seen in what those links and corridors deliver, in how effective partnering arrangements can act as a force multiplier, enable your voice to be better heard, and in how they allow your objectives to be better delivered. The breadth of interests of the Institute's membership give it the potential to be a central player in this work both in the UK and in our increasingly globalised sector.

Partnerships built on strengthened relationships between individuals or organisations provide practical ways to manage change or learn from others' experience. There is little that when you get down to it is completely new and being willing to learn from others' experiences and, in our broadly-based sector, often painful mistakes should not be seen as either a sign of weakness or a lack of competence but as a model for effective future working.

ⁱ <http://dictionary.cambridge.org/dictionary/british/strengthen>

ⁱⁱ <http://dictionary.cambridge.org/dictionary/british/relationship>

ⁱⁱⁱ <http://dictionary.cambridge.org/dictionary/british/industry>

^{iv} <http://www.oxforddictionaries.com/definition/english/industry>

^v <http://dictionary.cambridge.org/dictionary/british/partner>

^{vi} <http://www.bbc.co.uk/sport/0/rugby-union/29837289>

^{vii} <http://www.hse.gov.uk/aboutus/strategiesandplans/sector-strategies/explosives.htm>

^{viii} http://www.panthera.org/sites/default/themes/panthera/images/rangemaps/Jaguar_Units_Corr.jpg

^{ix} <http://www.hse.gov.uk/press/2005/c05005.htm>

^x <http://www.hse.gov.uk/aboutus/40/ministers-letter.htm>

^{xi} <http://www.hse.gov.uk/aboutus/howwework/management/dwphse.pdf>

^{xii} http://ec.europa.eu/enterprise/sectors/chemicals/files/explosives/qa_for_website_en.pdf

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What's in a name?: bomb disposal in the British Army

By **Bruce Cochrane** MPhil MExpE



Royal Engineers Bomb Disposal badge.



Royal Logistic Corps, Ammunition Technical Officer badge.

Explosive Ordnance Disposal (EOD) is an activity that predates its given name and even its former name, Bomb Disposal (BD). It is a widely held, but erroneous, belief that EOD was born in 1939 with the formation of BD Parties, Royal Engineers (RE). Much of the available literature on the subject begins with a brief discussion of the introduction of air dropped bombs in the years preceding the First World War, before going on to describe the establishment of the RE BD organisation nearly 30 years later.ⁱ This concentration on air dropped munitions ignores the EOD work devoted to naval munitions, land service ammunition and terrorist devices, all of which predate the use of air dropped bombs and continue to form the vast bulk of EOD activity to this day.ⁱⁱ It also pays scant attention to the disposal of air dropped bombs in the early years of their use. A comment made in several histories of the subject is that there was no bomb disposal organisation before 1939 and that none was needed.ⁱ While it is true that no units were solely dedicated to EOD, or were named as such, an EOD capability certainly existed. However, that capability was embedded in units with other roles and less glamorous titles.

This article traces the development of EOD in the British army, the units involved with it and how the responsibility for EOD came to fall where it now lies.

In the army, responsibility for EOD is shared between the Royal Logistic Corps (RLC)¹ and the RE. The Royal Navy (RN) and Royal Air Force (RAF) also have their own EOD capabilities, but these are outside the scope of this article. However, lest the author be accused of single service parochialism, let it be noted that the RN founded the first British EOD establishment, the Mine Warfare School at HMS Vernon, in 1875. The RAF, for their part, dealt with the first unexploded aircraft bombs to fall on the UK during the Second World War in October 1939. Both continue to do valuable work to this day.

1896 – 1913

1896 provides a convenient starting point both in terms of organisation and technology. The preceding two decades had seen a revolution in military technology, with the introduction into service of smokeless powders, high explosives, armour plate, breech loading and quick firing artillery and repeating small arms. This year was also when one of the forming corps of the RLC began to emerge in a form recognisable today. The Ordnance Store Department, made up of officers, and the Ordnance Store Corps, made up of soldiers, were renamed the Army Ordnance Department (AOD) and Army Ordnance Corps (AOC), respectively.ⁱⁱⁱ

At this time Ordnance Officers were trained at the Royal Military Academy at Woolwich – the Shop – alongside Royal Artillery (RA) and RE officers. The Ordnance Officer's Course was known as the 'o' course. As well as subjects such as store keeping and accounting, students studied mathematics, physics, electricity, chemistry, metallurgy, weapons, ammunition and explosives. Any modern Ammunition Technical Officer (ATO) would recognise the broad principles of these latter elements. Once qualified, an Ordnance Officer could be employed in general ordnance supply duties or might be appointed as an Inspecting Ordnance Officer (IOO), whose role was to advise on the storage of ammunition and to inspect, repair and dispose of the army's ammunition and explosives. The term "ammunition" was, and still is, taken to include all land service munitions, whether inert or explosive filled, as well as bulk demolition explosives and accessories. AOC soldiers employed on ammunition technical duties were called Laboratory Foremen. They were also trained on a long course at the Shop and were employed on similar duties as IOOs.^{iv}

¹The RLC was formed in 1993 from The Royal Army Ordnance Corps (RAOC), The Royal Corps of Transport, The Royal Pioneer Corps, the Army Catering Corps and the Postal and Courier element of the RE. The EOD function came from the RAOC.



Hand dropped bomb - WW1.



RN BD party WW2.



WW2 BD party.

In both cases, their long training and wide experience of the principles and details of ammunition and explosives made them the obvious choice whenever the need arose to dispose of an item of Unexploded Explosive Ordnance (UXO). This task was termed the disposal of 'stray ammunition'. This quaint term encompassed all munitions found away from military establishments and frequently included UXO in a 'misfired' or 'blind'² state.^v

a network of IOOs posted to garrisons up and down the country who were able to respond quickly to requests for assistance whenever 'stray ammunition' or other UXO were encountered.

Even before the start point of this article, the RE had been responsible for laying mines and booby traps and were called upon to clear the enemy's mines when they were encountered. Land mines as we now understand them - explosive filled and command or pressure initiated - first appeared during the American Civil War. Electrically initiated mines and 'fougasses'³ were deployed by RE in the Zulu War of 1879, the Sudanese campaigns of 1884 - 88 and the South African War.^{vii}

1914 - 1918

IOOs and Laboratory Foremen accompanied the British Expeditionary Force (BEF) to France in 1914 and their role was initially similar to that in the South African War - safety and maintenance of British ammunition and disposing of unexploded ordnance. As the campaign settled down into trench warfare the expenditure of ammunition on both sides, particularly artillery and grenade natures, dramatically increased and this created its own problems. One aspect of this was the large number of blinds. It is assessed that up to 30% of British shells failed to function at the target.^{viii} Another was the large number of accidents that occurred - especially with the many new types of grenade. Both of these drew on the technical skills of the IOOs and Laboratory Foremen and led to a greater recognition of the need for proper ammunition management. Special ammunition schools were established in France and this paved the way for the establishment of a permanent ammunition school after the war.

The Germans also had their share of blinds, estimated at 25%, so shells littered the battlefield.^{ix} They often sank into the mud and were left where they were. When they presented a problem IOOs were formally responsible for disposing of them, but often RA and RE officers were tasked on an ad hoc basis. This was logical as there were many more RA and RE officers than IOOs, they were often closer to the front and both had a background in explosives from their training at the Shop.

³ A fougasse is a buried explosive charge designed to project rocks or other fragmentation.

IOOs and Laboratory Foremen deployed to the South African War of 1899 - 1902. Most of their work was centred on the supply and maintenance of British army ammunition, but they also disposed of large amounts of British and Boer ammunition. This included blind shells on the battlefield and stocks of artillery ammunition in storage. The latter frequently necessitated the demolition of several tonnes of explosives at a time.^{vi}

The Esher reforms of 1904 created the Army Council and, at the same time the AOD and AOC were placed under the Quarter Master General. As a product of this, Ordnance Officers were appointed to formation HQs.^{iv} This was the beginning of

² "Misfired" munitions are those which have failed to fire while still in the weapon or at the firing point. "Blinds" are munitions that have been successfully fired, launched or dropped but which have failed to function on arrival at the target. Both are dangerous but, of the two, blinds present the greater danger as the fuzes are normally armed by the process of being fired, launched or dropped. The munition may truly be a "dud", but is just as likely to have received insufficient stimulus to cause the fuze to function and may just need one more touch or movement to complete the action. The EOD operator usually has no way of knowing which is the case.

Britain was first subjected to bombardment from the air in 1915, when German airships attacked ports on the east coast. Before long London became a target and by 1917 the airships had been replaced by Gotha bomber aircraft. 8578 aircraft bombs were reported dropped on the UK and one source has estimated that around 500 failed to function.^x IOOs were mainly responsible for their disposal, evidenced by instructions contained in Intelligence Circulars that referred to Regulations for Army Ordnance Services^{xi} although RA and RE officers were also involved, as the following passage shows:

The presence of an expert in explosives is necessary; he may be either an R.A. or R.E. officer of the district, a duly qualified Inspecting Ordnance Officer, or, under special circumstances, particularly in the case of a bomb of unknown type, an expert detailed by the War Office.^{xii}

The 'expert detailed by the War Office' was usually an IOO from Woolwich Arsenal.

Although the First World War provided the impetus for many new weapons – aeroplanes, tanks and gas for example – it also saw the return of older forms of warfare. One of these was the traditional role of the military engineer – sapping and mining. In December 1914 the Germans dug mines under the British lines, filled them with explosives and detonated them. RE tunnelling companies were formed in February 1915 in response. They were manned mostly by ex miners. A deadly game of mine and countermine ensued for the next three years. The tunnellers became adept at handling explosives – both British and German – and frequently came across enemy booby traps underground. There was no one they could call on to assist them, so they learnt to deal with them themselves. When this skill – and their willingness to exercise it – became known, tunnellers were employed to deal with booby traps above ground. When tunnelling activity decreased in 1917, tunnelling companies were employed as booby trap specialists. Many of the principles they established were sound and remain applicable to this day, but at the end of the war miners were urgently needed in the civilian economy. The companies were quickly disbanded and much of the knowledge left the army with the miners.^{xiii}

1919 – 1938

At the end of the First World War, the AOD and AOC were merged and were conferred with the 'Royal' title to form the RAOC. The need for technical support to ammunition had been recognised and a permanent school was established at Bramley in 1923. Initially entitled 'B' Branch, School of Instruction, it would eventually become the Army School of Ammunition. At the same time, the title of Laboratory Foreman was changed to Ammunition Examiner (AE).

An indication of the type of work IOOs performed is given by an incident that occurred in Shanghai in 1932, when the British Garrison was caught in the crossfire of Sino-Japanese fighting. An unexploded shell landed in the garrison and the IOO, Capt Townsend, was called. The shell exploded as he dealt with it, injuring him and causing the first recorded RAOC EOD casualty.^{xiv}

As a second war against Germany became ever more likely in the 1930s, official minds turned to the possibility of air raids. Most of the effort was directed towards civil defence and gas precautions. The RAOC remained responsible for the disposal of air dropped bombs as well as all other land UXO, less mines and booby traps, as the following passage from the Police War Instructions of 1936 shows:

The War Office have undertaken general responsibility for the disposal of unexploded bombs, through their Inspecting Ordnance Officers, unless a suitably experienced officer of the Navy or Air Force is available nearer at hand. This work may involve especial danger having regard to the development of bombs fuzed to burst at any time up to 24 hours after being dropped. The police should not touch unexploded bombs until the arrival of the I.O.O.s, and should keep all persons at a safe distance. The I.O.O., or other appointed officer, will have to decide whether a bomb can safely be removed or whether it is necessary to blow it in situ.^{xv}

1939 – 1945

By March 1939, the War Office believed that there were too few IOOs available to cope with the aftermath of a modern air raid. Various suggestions were made, including using Air Raid Precautions (ARP) Department wardens and even a force of retired soldiers recruited by the British

Legion. The Home Office objected, stating that the task was a military responsibility.^{xvi}

The matter was still unresolved in November 1939 when a War Office letter reiterated the problem of there being too few IOOs:

...the Police will report all cases of unexploded bombs to the nearest Military Authority who will arrange for the disposal of them. The military personnel finally responsible for this service are the Inspecting Ordnance Officers who are few in number and most of whom would accompany any land force which might be sent overseas.^{xvii}

It was agreed that a civilian force would be raised to undertake the disposal of air dropped bombs at home, but until this force could be fully trained the war office would retain responsibility. As a stop gap it was decided that the RE would provide Bomb Disposal Parties. This is the first instance of any military unit with the title 'Bomb Disposal'. RE were allotted the task for the following reasons:

- There were too few IOOs.
- Unexploded bombs might be expected to be buried, so digging would be required to gain access.
- RE were trained in such skills as sandbagging, field fortifications and the use of demolition explosives.

The original BD Parties RE consisted of a Junior NCO and two sappers. It was initially envisaged that their role would be limited to gaining access to a bomb, sand bagging and destruction in situ. In more difficult cases an IOO was to be called.^{xviii}

The civilian Bomb Disposal organisation never came to be and the War Office formally accepted responsibility for Bomb Disposal in the UK on 11 May 1940:

I am directed by the minister of Home Security to refer you to Air Raid Precautions Department Circulars 233/39 and 239/39 and to pages 32 and 33 of the ARP Training Manual No 2, and to inform you that it has now been decided that the duty of dealing with unexploded bombs and ammunition except where they fall on Admiralty or Air Ministry property shall remain the responsibility of the War Office.^{xix}

Originally, RAOC retained the responsibility for dealing with unexploded



RE BD WW2 deep buried.



RE BD Section WW2.



WW2 BD Section.

Anti-Aircraft (AA) shell, as these were items of Land Service Ammunition (LSA).^{xx} It was found that BD sections were frequently called to buried AA shell, so this responsibility was also passed to RE on 11 May 1940.^{xxi}

Two military documents, GHQ Standing Operation Instructions and The Manual of Bomb Disposal (Provisional) 1941, laid down the division of responsibility for EOD between the services. They also gave definitions and it is worth pausing here to examine what was meant by 'Bomb' in 'Bomb Disposal', as this has led to much confusion in the public's mind and a great

deal of inter cap badge rivalry in the army over the years. Before the Second World War, 'bomb' was used to describe any explosive device that was placed or thrown by hand or projected in some way, other than an artillery shell. We have the examples of what would now be termed an

Improvised Explosive Device (IED) being used by Fenians and anarchists in the late 19th century and variously described as 'infernal machines' or bombs and frequently accompanied by terms such as 'outrage'. From the First World War onwards, projectiles fired from mortars were and still are called bombs. The use of hand and rifle grenades increased dramatically in the First World War and they were often referred to as bombs. Grenade specialists were formed into 'bombing parties', led by 'bombing officers' and they were taught at 'bombing schools'. Finally, explosive filled projectiles dropped from aeroplanes were also called bombs. They were initially dropped by hand, so the word fits well with the other usages.

GHQ Standing Operation Instructions said:

The term "bombs" includes all missiles (other than mines), however filled that may be discharged from aircraft and all AA shell, however filled^{xxii}

The Manual of Bomb Disposal (Provisional) 1941 stated:

Bomb Disposal comprises the disposal of unexploded projectiles of various kinds eg high explosive bombs of various sizes, incendiary bombs, A.A. shell, parachute mines of the magnetic and non magnetic type, gas bombs and any other form of missile dropped from enemy aircraft.^{xxiii}

It is clear from the above two statements that the meaning of the word 'bomb' had shifted to denote air dropped ordnance to the exclusion of land service munitions. This was a perfectly logical step, as air attack presented the greatest threat at the time.

Formation Order of May 1940 authorised the raising of 25 BD Sections RE, which absorbed the existing BD Parties. These were controlled by the Inspector of Fortifications, a War Office department. Another 109 Sections were authorised in June, and this was raised again to give a total of 220 sections in July. These were to be organised into 25 BD companies. On 29th August the title Inspector of Fortifications was amended by the addition of Directorate of Bomb Disposal (IF & DBD). Later in the year the BD Coys Companies were organised into BD Groups, which covered a specific area. The RE BD organisation eventually grew to a strength of some 10,000 personnel and gave sterling service throughout the war. 151 officers and 339 Other Ranks were killed.^{xxiv}

At first there was no formal training for Bomb Disposal Officers (BDOs), but some were sent to the RAF armaments school and eventually an Army Bomb Disposal School was formed. Courses were initially of two weeks duration, but grew to four weeks by the end of the war.

RAOC continued to deal with aircraft bombs when this was necessary, for example when bombs fell on their depots^{xxv} or when there were no RE BD units available. Two George Crosses were awarded to IOOs for aircraft bomb disposal on Malta, and two George Medals were awarded for similar work on Gibraltar. However, the RE BD organisation disposed of the vast majority of air dropped bombs – over 52,000.^{xxvi}

1946 – 1966

At the end of the war there were huge stockpiles of ammunition and explosives requiring disposal. Some of this was stored in British ammunition depots, others in captured enemy ammunition sites and more still on the battlefields. There were minefields at home and abroad, as well as individual items of UXO from grenades to large aircraft bombs that had been fired or dropped in training and on operations.

In the western desert RE BD Companies cleared and destroyed enemy ammunition dumps under the technical supervision of IOOs and AEs.^{xxvii} In Europe RAOC Enemy Ammunition Depot Clearance Units and Mobile Ammunition Repair Units undertook similar work.^{xxviii} In the UK RE BD Companies were employed clearing mines from beaches, a task which took decades to complete.^{xxix} The RAOC Explosives Disposal Unit (EDU) was formed at Trawsfynnedd, with outstations at Poole and Cairnryan. This unit was responsible for the disposal of the majority of British LSA. The EDU was disbanded in 1947, with the disposal of surplus as well as stray ammunition passing to the Command Ammunition Inspectorates RAOC.^{xxx} A Battlefield Area Clearance Unit (BACU) was formed, consisting of Polish and Ukrainian civilian searchers, supervised by RE SNCOs. This unit came directly under the Director General Military Training at the War Office.^{xxxi}

DBD was renamed HQ BD Units (UK) RE in 1948. The RE BD organisation was rapidly reduced after the war and by 1949 consisted of three BD companies

(renamed squadrons) and a plant squadron. The BD Squadrons were disbanded in 1950, with all personnel concentrated in a HQ and 5 troops. In August 1950 HQ BDU (UK) RE moved from London to Broadbridge Heath Camp at Horsham. This unit eventually became 33 Engineer Regiment (EOD) RE. In addition to the regular unit, there were six TA BD squadrons. In 1950 an Army Emergency Reserve (AER) was formed, made up of specialist units. By 1955 there were three AER BD Regiments which replaced or absorbed the TA squadrons.^{xxxii}

In a repeat of the proposals made in 1938–39, the War Office attempted to divest itself of the bomb disposal role in 1954–55. Again the Home Office agreed to take on the responsibility in principle and again the idea came to nothing.^{xxxiii}

From the mid 1950s to the mid 1980s it was assumed that any future air attack on the UK would be mainly nuclear and that any conventional attack would be in the form of guided weapons. There was a great deal of controversy in the 1950s and 60s over who would dispose of any unexploded nuclear weapons and guided missiles. RE proposed a BD organisation based on the AER BD Regiments with RAOC technical support, while RAOC counter-proposed an organisation based on the Ammunition Inspectorates with RE plant support. The argument rumbled on until the 1970s with no decisive conclusion. The same disputes occurred over the disposal of Chemical and Biological weapons.^{xxxiv}

While the nuclear debate was ongoing the future of BACU came into question. BACU had to task IOOs and AEs from the Ammunition Inspectorates to dispose of explosive arisings. In 1960 it was agreed that BACU would be taken over by RAOC, but this was reversed in 1962 and the unit was absorbed into HQ BDU (UK) RE.^{xxxv}

At the same time that these debates were beginning, a terrorist bombing campaign had begun in the Crown colony of Cyprus. In earlier campaigns, such as that in Palestine, many of the devices were based on military booby traps and were dealt with by RE field units. More complex devices were referred to IOOs who were acknowledged as subject matter experts in explosives and explosive devices. In Cyprus, the government wanted any devices that were made safe to be used as evidence against captured terrorists. They asked the War Office for the assistance of

explosives experts and a team of IOOs and AEs were seconded to the Cyprus police. These were later formed into 1 Ammunition Disposal Unit (Internal Security). Between 1955 and 1960 thousands of devices were dealt with and two AEs were killed. This campaign established the principle of securing convictions from forensic evidence gained during EOD operations.

In 1960 the titles of IOOs and AEs were changed to Ammunition Technical Officer (ATO) and Ammunition Technician (AT). This was to reflect the growing complexity of modern munitions and terrorist devices. In the UK the Command Ammunition Inspectorates were brought under the command of a single unit entitled No 1 Ammunition Inspectorate and Disposals Unit (1 AIDU).^{xxxvi} This later became 11 Ordnance Battalion (EOD) RAOC, then 11 EOD Regiment RLC. Shadow EOD units were also formed for rapid deployments to emergencies. One of these was 321 EOD Unit which was deployed to Northern Ireland in 1970 where it remains to this day as 321 EOD Squadron RLC.

There was much debate within the army during the 1960s as to who should have responsibility for IEDD, RE or RAOC. The RE case can be summarised as follows: RE were the army's 'bomb disposal experts'. This was borne out by their experience with air dropped bombs during the Second World War. In counter insurgency operations, IEDs were more akin to booby traps and presented problems of mobility to friendly forces, both RE tasks. RE claimed that RAOC were too inclined to dismantle devices by hand to gain evidence, and doubted whether the gain justified the risk.

The RAOC case was based on the following: Existing doctrine placed the role with them. Indeed, the whole bomb disposal role had been theirs until 1940. More importantly, RAOC was already successfully undertaking the task. The scientific and technical training ATOs underwent allowed them to operate from first principles, meaning that new IED developments could be countered as they were found. RAOC claimed that RE were insufficiently trained – their EOD courses were only a few weeks long. Also, the RE's preferred solutions at the time – moving IEDs with 4 in 1 buckets and/or destruction in situ, were impractical in most cases and lost valuable evidence.



German Sd 500 -
Suffolk 1992.



What had actually happened was that in the 1950s, there was still a real threat from air attack, particularly with nuclear weapons. RE had considered this to be the growth area in EOD and had concentrated on it. At the same time RAOC recognised the growth of counter insurgency and capitalised on this. When the air attack threat receded, only the RAOC had the capability of dealing with the newly emerging terrorist devices.

In the US forces the term 'Explosive Ordnance Disposal' had been in use since the Second World War. This term more accurately described the gamut of disposal tasks being undertaken by all three services. In 1966 NATO adopted this term and terms such as bomb, mine or

ammunition disposal became obsolete. However, 'Bomb Disposal' has stuck in the mind of the public and has been retained with varying degrees of official recognition. EOD vehicles of all three services carry these words and in the RE, BDO is still the official term for an EOD operator.

This article takes us up to the adoption of the term EOD in 1966. Over the next few decades EOD was to undergo massive changes in some areas, while retaining many of the features of earlier decades. IEDD was to grow and change in Malaya, Hong Kong and Northern Ireland, while Conventional Munitions Disposal was to remain the mainstay of both RAOC/RLC and RE.

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- ii JSEODOC Statistics, 11 EOD Regt RLC, Didcot.
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- vii Croll M, The History of Landmines, Leo Cooper 1998.
- viii Terraine J, The Smoke and the Fire - Myth and Counter Myth in War 1914 - 1945, 1982
- ix Macksey, K. For Want of a Nail - The Impact on War of Logistics and Communications. Brassey's (UK) 1989.
- x Hogben A, Designed to Kill- Bomb Disposal from World War One to the Falklands, Patrick Stevens 1987.
- xi Intelligence Circular No 8, July 1916. TNA WO 158/990
- xii Ibid.
- xiii Jones I, Malice Aforethought: A History of Booby Traps from World War One to Vietnam, Greenhill Books 2004.
- xiv Steer F, To the Warrior His Arms - The History of the Royal Army Ordnance Corps 1918 - 1993, Pen and Sword, 2005.
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- xvi Home Office Memorandum, 15 Mar 1939 TNA HO 186/2827.
- xvii War Office 79/H.D./697 (M.O.3) 05 Nov 1939. TNA HO 186/2827.
- xviii SD.1/C/91/40, 19 Nov 1940. TNA WO 199/427.
- xix Home Security Circular No 88/40, 11 May 1940. TNA HO 186/2827
- xx K997, 1940. TNA HO 186/2827.
- xxi Home Security Circular No 88/40, 11 May 1940. PRO HO 186/2827
- xxii GHQ Standing Operation Instructions. Sect 20. Disposal of Unexploded Bombs and Mines. 2nd edition April 1942. PRO HO 186/2827.
- xxiii Manual of Bomb Disposal (Provisional) 1941. TNA WO 287/159.
- xxiv Wakeling EE, A Short History of Royal Engineer Bomb Disposal, BD Publishing 1997.
- xxv 79/HD/1340 (S.D.1) 11 Dec 1940. TNA WO 32/9760
- xxvi Wakeling EE, A Short History of Royal Engineer Bomb Disposal, BD Publishing 1997.
- xxvii Report on a Bomb Disposal Coy Employed on Demolition of Shell Dumps and Explosives, MEF 31 Jan 1946. TNA WO 201/2817.
- xxviii Phelps, LTH A History of the Royal Army Ordnance Corps 1945-1982. Royal Army Ordnance Corps 1991.
- xxix Wakeling EE, A Short History of Royal Engineer Bomb Disposal, BD Publishing 1997.
- xxx TNA WO 271/146 and WO 166/17392
- xxxi TNA WO 32/18972
- xxxii Ibid.
- xxxiii 20/Engrs//7201/MOS) 04 June 1954. TNA WO 31/17417.
- xxxiv TNA WO 32/18739
- xxxv Ibid.
- xxxvi Phelps, LTH A History of the Royal Army Ordnance Corps 1945-1982. Royal Army Ordnance Corps 1991.

Cunard's three Queens celebrate 175th anniversary with fireworks spectacular

By Hilary Robertson



Showtime. (Photo courtesy of James Morgan).

Cunard was founded in 1840 with Sir Samuel Cunard's first mail steamship, RMS Britannia, beginning its transatlantic service from Liverpool. Two barge-based firework shows fired on consecutive nights created a high profile event marking the gathering of the three Cunard liners in Liverpool on the 175th anniversary. Around 1.3million people lined both sides of the River Mersey when the Cunard ships Queen Mary 2, Queen Elizabeth and Queen Victoria sailed down the river together.

The Fully Fused team, who were responsible for the firework display, were engaged by FTF Worldwide Event Management, who also arranged everything from 640m² of red carpet for the VIPs to special lighting along the quayside. There was a helicopter giving film crews and photographers great access to imagery. Flutter fetti gave a sense of occasion for those onboard and those on shore waving the Queens off on their voyages.

To make sure everyone on shore and on board could enjoy the show, FTF set up synchronised sound between the ships for the dance and firework display. There were spectacular pyrotechnics and red, white and blue smoke effects from the roof of the Cunard building.

Event Co-ordinator Tracey de Vere White said: "Liverpool's Three Queens spectacular was the biggest waterfront event in the history of the city and we're proud to have been a part of that. This is one of our biggest ever events and it was one of the biggest for both the city and Cunard itself, as well."

"An event like this takes hours, weeks and months of careful planning," said Fully Fused's Chief Designer Clifford Stonestreet. "The FTF team put many of the elements in place and we were charged with laying on a spectacular firework display accompanied by music. The challenges included the size of the ships and the Cunard building on shore and using them all to the



75mm – 125mm shells, 25mm-30mm candles and Cat. 4 cakes. (Photo courtesy of Kevin Finch).



Queen Mary 2 and Liverpool skyline in background. Effects - 75mm-125mm shells, 25mm-30mm candles. (Photo courtesy of Kevin Finch).



Effects - 75mm-150mm shells, 25mm-30mm candles, single shot effects and Cat. 4 cakes. (Photo courtesy of Kevin Finch).



Queen Mary 2 and Liverpool skyline in background. Effects - 75mm-150mm shells, 25mm-30mm candles, single shot effects and Cat. 4 cakes. (Photo courtesy of Kevin Finch).

best possible advantage. As it was at the end of June and we couldn't begin until late, the remaining daylight on one of the first sunny days of the year was also difficult.

"Licensing is always an issue and our careful planning included several lengthy discussions with all the organisers and the Health & Safety teams everywhere on ship and shore. Safety is always our top priority and we dedicate a great deal of time to making sure we've considered all the various elements of our displays. The displays were required to be completely different as many of the guests and spectators would be watching both nights' shows. In addition, another display for Queen Mary 2 had already been fired in Greenock 48 hours before. So in all it was necessary to design three shows synchronised to music that were completely different."

The shows were all created by chief designer Clifford Stonestreet using his 30 years' experience and extensive product knowledge. Cliff said: "The fireworks for the shows come from personally selected factories in China, France, Italy, Spain and the UK. This ensures the greatest possible selection of effects and top quality. Nobody wants to watch a show full of shells that don't perform properly. We spend many hours working with our suppliers in factories ensuring that a shell that says it is a red ring actually produces a ring of stars and not a random selection of stars."

The design process starts with the music selected for the display – and, of course, the budget. It's no good asking for a show set to Flight of the Bumble Bee and then saying that the budget is actually only adequate for a funeral march!

Cliff uses a mixture of design tools to prepare the display. In the first instance, he storyboards the display on paper to get the outline and format of the display. This is then translated into a scripting tool called Showsim, which enables the show to be created in a format that the firing system can read. This includes creating layouts and set ups for all the modules needed to create the intricate designs in the show.

A simple digitally-fired display can still use as many as 10 x 32 cue field modules giving 320 individual cues in the show but on these there could be up to 10 igniters attached so as many as 3200 effects. Getting all of this scheduled correctly takes years of experience and hours of preparation.

"For the Liverpool displays, the shows required 25 x 32 cue field



(Photo courtesy of Christian Trampenau).

modules, so 800 cues in five minutes,” said Cliff. “It’s not our biggest ever, as we’re currently working on a proposal for a show in India that has 200 x 32 cue modules for a five minute show to celebrate a sumptuous wedding.”

Once the show has been scripted, it is then exported to the firing software FireOne. This is the leading firing system and is used by most of the leading companies in the world. It was used to control some of the biggest displays with huge audience figures including the Olympics and New Year’s Eve in Dubai, London and Brazil.

FireOne is a wholly digital system allowing the team to fire cues at the rate of 100th of a second – far faster than the human brain can process in a show. The cumulative effect of fireworks fired at this speed is the creation of walls of colour and intricate patterns. This reaction time is best used when firing long chases of effects such as around the roof of a stadium or across the width of the site.

Cliff said: “We use digital technology for the precision it gives. It also allows us to fire many effects from different locations simultaneously – something that was always a challenge when hand firing shows in the past.”

FireOne uses a capacitor discharge system so it operates at a nominal 12V but the field modules can be over a kilometre away and still fire when required.

The system works by downloading the show firing sequence to each individual module on site so that all that is required is the firing instruction. This removes the delay of sending the power and instruction from the controller to the individual modules and improves synchronisation.

“For the displays in Liverpool, the design process was also affected by the fact that the show was fired from a barge,” said Cliff. “This meant we had a limited amount of space in which to place all the effects. We’re always keen to rise to a challenge. To counter the space factor, the equipment was mounted on special frames to angle the effects outward. This increases the spread of the fireworks and fills more of the sky.”

Cliff and the Fully Fused team pride themselves on technical accuracy behind the scenes that gives a spectacular display for the audience. “We have to balance the aesthetics of the display – from all the angles that people will be enjoying it – with budget, safety and the client’s requirements. It’s a constant balancing act.”

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Fully Fused and FTF

The FTF in FTF Worldwide Event Management stands for Face to Face, with a business ethos of the same faces seeing an event through from initial client meetings to event completion. It grew out of an original firework company named FTF Worldwide, where the FTF stood for Fireworks, Technology and Fantasy. FTF Worldwide bought up a smaller firework company known as Fully Fused.

As the need became apparent to provide the infrastructure to support a firework display event with staging, lighting, lasers, toilets, stewarding and general event management, the business split into FTF Worldwide Event Management and Fully Fused Fireworks, supplying world class firework displays. FTF Worldwide Event Management now delivers specialist events on an international platform as well as a local level but all with the same ethos of care and personal touch.



(Photo above and below, courtesy of Christian Trampenau).



Ammunition and Explosives Regulation in the Department of National Defence and Canadian Armed Forces

By Icol/LCol C.A.(Tony) Heron MSc MIEpE

This paper was first presented at The Institute of Explosives Engineers 2015 Annual Conference.

This article provides a brief introduction into the governance framework for Ammunition and Explosives (A&E) in the Department of National Defence (DND) and the Canadian Armed Forces (CAF).

In Canada, explosives are regulated by the *Explosives Act*¹ and its associated *Regulations*². The *Regulations* are administered by Natural Resources Canada (NRCan) with the NRCan Chief Inspector of Explosives being the national regulator. Ammunition is regarded as an explosive under the *Explosives Act*.

Due to the unique technologies of defence ammunition and CAF operational context DND and the CAF are exempt from the Act:

"Except as provided by the Regulations, this Act does not apply to or in respect of any explosives under the direction or control of the Minister of National Defence."

The *Regulations* themselves state that:

"5.(5) Explosives that are under the control of any armed forces that are cooperating with the Canadian Forces are deemed to be under the direction or control of the Minister of National Defence."

Notwithstanding this exemption, DND and the CAF are obligated to establish and maintain a parallel regulatory environment and safety program for all ammunition and explosives (A&E) that are deemed to be under the direction or control of the Minister of National Defence. This is the role of Director Ammunition and Explosives Regulation (DAER).

DAER is a fairly recent organisation created in 2006 to address concerns raised by a Chief Review Services evaluation in 2005³:

"...DND is the only organization excluded from regulation under the Explosives Act. This places onus on the DND/CAF to establish its own regulatory and safety measures for ammunition. In this respect, ...CRS has concluded that certain essential elements of a sound regulatory regime and corporate safety program are either missing or require significant improvement. In our view, regulatory oversight is not currently sufficient to assure that ammunition activities are being conducted safely..."

The tasks given to DAER were as follows:

- Establish a regulatory framework that is independent, objective, visible, and has authority delegated to it;
- Strengthen management of policies and standards and verification of compliance;
- Manage ammunition safety as a program with resources and a business plan;

- Ensure that safety reporting is timely, complete, analysed and briefed to senior management;
- Adopt a risk-based approach to safety management and regulation;
- Develop improved and more accessible safety program tools;
- Establish a communications strategy and plan to promote dialogue and information sharing; and
- Establish a system to assess competency and Terms of Reference for ammunition positions, including adequacy of training programs & skills.

In order to accomplish this, an organisation of 16 individuals, all either serving or former Ammunition Technical Officers (ATO) or senior Ammunition Technicians (AT), was stood up. The mandate of DAER derives from Departmental Administrative Orders and Directives (DAOD) which give functional authority for:

- Regulatory, policy and process authority governing the control and custody of defence ammunition and explosives;
- Establishing and managing relevant policies and standards;
- Authorising the licensing of ammunition storage and processing facilities;
- Overseeing, verifying compliance and reporting;
- Conducting research and analysis in collaboration with Assistant Deputy Minister (Science & Technology) (ADM(S&T)) and international partners;
- Providing advice on safety and prudent risk management; and
- Managing the DND/CAF Ammunition & Explosives Safety Program.

In essence DAER regulates, but does not deliver, the ammunition program and related activities.

The scope of our mandate covers the full life cycle of A&E from Pre-concept to Retirement and includes In-service storage, distribution, handling and use, including deployed operations, as well as Professional standards for DND and CAF A&E specialist personnel, in collaboration with Managing Authorities.

Over the past several years DAER has developed a new policy framework that has made significant changes to and replacement of the old publications. In particular major policy gaps in following areas have been addressed:

- Risk Management;
- Explosives Safety Regulations for Deployed Operations; and
- Demilitarization policy.

The end result is a restructuring of policy framework that better matches life-cycle for enhanced coherence. The new publication framework is shown below:

NDID Number	Title
C-09-005-001/TS-000	Volume 1 - Program Mgt & Life Cycle Safety
C-09-005-002/TS-000	Volume 2 - Storage and Facility Ops
C-09-005-003/TS-000	Volume 3 – Transportation
C-09-005-004/TS-000	Volume 4 – Demil and Disposal
C-09-005-005/TS-000	Volume 5 – Deployed Ops
C-09-005-006/TS-000	Volume 6 – Naval Vessels
C-09-005-007/TS-000	Volume 7 - Certification of A&E and Accessories for Use
C-09-005-008/TS-000	Volume 8 – Construction Standards
C-09-005-009/TS-000	Volume 9 - HERO

Figure 1. Policy Framework.

In 2013 the DND/CAF Ammunition Program was restructured, which resulted in the creation of a new strategic level ammunition organization, the J4 Ammunition Branch. Under the new structure, Assistant Deputy Minister Materiel (ADM(Mat)) is the designated Program Authority. Level 2 (L2) oversight is jointly exercised by Deputy Chief Of Staff (DCOS) Materiel and Director General Land Equipment Program Management under a structured co-management framework, and program delivery is co-managed by J4 Materiel and Director Ammunition and Explosives Management and Engineering (DAEME) in collaboration with Director Land Procurement (DLP). DAER provides regulatory support and advice, but is deliberately located (physically and organizationally) apart from the program delivery elements.

The program is overseen by a core governance committee, the Ammunition Program Oversight Committee (APOC), which convenes twice a year. The APOC provides the necessary oversight and DND / CAF representation required to ensure the Ammunition Program activities are prioritized, monitored and governed efficiently and effectively. The APOC reports to Program Management Board (PMB).

Under the restructured Ammunition Program DAER continues to set the regulatory framework through DAODs, program and safety manuals, and utilizes Ammunition & Explosives Instructions (A&EI) to issue short term guidance and directives. This framework encompasses the entire life cycle of A&E (procurement, storage, transportation, inspection, maintenance, authorized modification, issue, use and disposal) including A&E used for research and development. These are top level orders and directives that may require interpretation and further guidance at Level 1 (L1)⁴.

Within the above framework, DAEME is the equipment program management (EPM) organization responsible for procurement, inventory management, and design management of A&E commodities. DAEME manages the Safety and Suitability for Service (S3) process and chairs the Ammunition Safety and Suitability Board (ASSB). All A&E entering the DND or CAF must first be passed through the S3 process. DAEME validates the qualification of personnel assigned the role of Qualified Ammunition Technical Authority (QATA).

Strategic Joint Staff (SJS), in cooperation with L1 Ammunition Technical Authorities (L1 ATA)⁵, manage A&E requirements and, when stocks are in short supply, will decide on priorities for issue. The SJS J4 Ammo is responsible for policy not under the mandate of DAER and for doctrine (i.e. strategic and corporate AP framework, A&E material accounting, security policy for storage, transportation, etc...); Overall integration of the Ammunition Program including design, planning, management and delivery; and support capability management, including business leadership for specialist HR development (Ammunition Technicians and Civilian Ammunition Technicians), A&E management systems and A&E support equipment and infrastructure.

L1 ATAs advise their L1s and organizations on matters relating to A&E including risk management and manage the A&E Safety Program within the L1 organization. They may support stockpile planning and A&E allocation management activities and they have a formal role in storage licensing.

Finally, all formations and bases have an individual appointed as the Explosives Safety Officer (ESO). The ESO advises the commander on A&E safety matters.

More information can be found in the DAER annual reports to the Deputy Minister and the Chief of the Defence Staff which are available on the internet at the Government of Canada Publications site <http://publications.gc.ca/site/eng/home.html> by using the search function and entering DAER Annual Report.

- 1 Explosives Act
- 2 Explosives Regulations
- 3 1258-101-2 (CRS) Evaluation of DND/CF Ammunition Safety Program February 2005
- 4 Level 1 is the term given to the major organizations of the Canadian Armed Forces and the Department of National Defence i.e. Royal Canadian Navy, Canadian Army, Royal Canadian Air Force, Assistant Deputy Minister for Materiel, Assistant Deputy Minister for Infrastructure and Environment, etc.
- 5 Each Level 1 within the Canadian Armed Forces and the Department of National Defence has an appointed Ammunition Technical Authority (ATA).

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Achieving safety-led design and operation in explosives engineering

By **Dr Steve Gilbert** CEng MChemE PhD BSc (Hons) and **James Bingham** CEng MChemE MEng (Hons)

Introduction

The inherently hazardous nature of explosives means that safety is a primary consideration when designing or operating systems and facilities. Whether it is in product design, manufacturing processes or use of explosive substances and articles in a military or civil application, there is a need to fully understand the associated hazards, safety risks and controls. In principle, the process of producing a risk assessment or safety case provides a mechanism for managing the associated hazards. However, there are numerous examples across industry where risk assessment is viewed as an activity that happens long after the opportunities to influence design or operation and deliver real safety and operability benefits have been missed.

Even when formal regulations, procedures and processes exist, poor application can lead to undesirable outcomes – ranging from business impacts (cost overruns, delays) through to poor safety performance and accidents.

This article presents some of the authors' experience of helping organisations to make most effective use of their risk assessment and safety case processes across all system lifecycle stages. We present examples of good practice where excellent outcomes have been achieved through approaching safety cases as a truly integrated and effective part of safety-led design and operation. Through the use of innovative methods and ways of working, we describe how an organisation's capability to manage risks can be developed, with particular emphasis on highly hazardous activities such as explosives processing. This article demonstrates ways of working that go beyond the risk assessment to achieve real and tangible benefits in facility and system safety.

Legal and moral requirements; economical benefits

The requirements to "reduce risks so far as is reasonably practicable" (SFAIRP) and to carry out a "suitable and sufficient risk assessment" are long established in UK law. These are intended to be applied in a proportionate manner. A simple form of assessment is "suitable and sufficient" for an office environment but something more considered and robust would be appropriate for hazardous activities such as explosives processing.

Regulation 26 of the Explosives Regulations (ER) 2014¹ requires that any person who manufactures or stores explosives must take appropriate measures to prevent unplanned fire/explosion, limit the extent and spread of fire and communication of explosions from one location to another, and to protect people from the effects of fire/explosion. The associated guidance suggests that

these safety measures be identified using a structured approach, that arrangements be put in place to manage these safety measures, and that roles and responsibilities for implementing and maintaining the safety measures be specified and understood. Approached properly, development of a safety case is an effective way of doing this. For example, in the domain of military explosives, a safety case is required to justify the safety risk associated with Ordnance, Munitions and Explosives (OME)². There are associated military regulations and corresponding safety cases covering OME in various environments, e.g. on warships, aircraft, ranges, etc..

Properly applied, a safety case should "encourage people to think as actively as they can to reduce risks."³ Statements such as "all risks are as low as reasonably practicable" need to be supported by due consideration of what else might be done to reduce safety risks further.

The legal and moral aspects described above are complemented by economic drivers – efficient and effective risk management is one of the cornerstones of a 'capable organisation'.⁴ If the risk assessment or safety case is deficient or has not been acted on then projects may be delayed, require significant rework, incur additional cost or lack the support of regulators. All too often, safety cases are regarded as an end in themselves, meaning that the process delivers little more than documents that are often bulky and of limited use and quality, with consequential impacts on programmes and capabilities. Conversely, what we advocate as 'safety led design and operation' is an effective means of delivering a fit for purpose system underpinned by a Right First Time Safety Case (RFTSC), i.e. one that is technically correct, appropriate for the system and has not entailed excessive cost or delay. This approach moves away from a 'tick-box' approach to safety and delivers real and tangible benefits throughout the system lifecycle.

The pillars that support the RFTSC goal stand on the foundations provided by the formal aspects of the organisation's Safety Management System (SMS). These are underpinned by the organisation's (safety) culture which is recognised as the bedrock upon which all else depends (figure 1 illustrates).

The safety case process can only function effectively when the right conditions exist in the organisational structures and culture. Hence, in order to achieve safety led design and operation, attention needs to be paid to the people, plant and procedural aspects of the process to enable the project or organisation to deliver the right outcomes (figure 2 illustrates). Our experience, gained through leading, coaching, mentoring and facilitating change

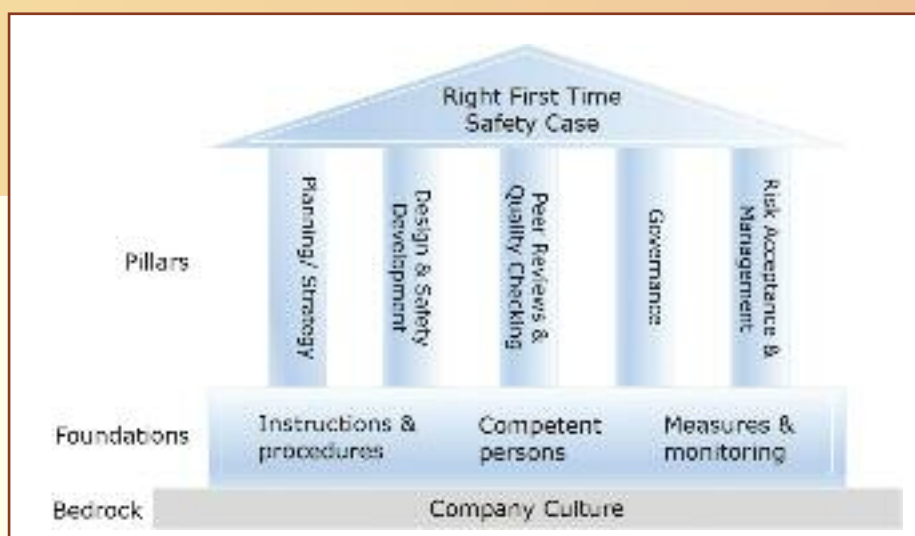


Figure 1. Conditions for achieving a right first time safety case.

People	Culture, integrated working. Shared aim, focus on delivery.
Plant	Systems, equipment.
Procedures	Project / design process. Operation / maintenance instructions.

Figure 2. Elements covered by the safety-led design approach.

in project and programme environments, is that organisations which adopt this approach become more efficient and effective in delivering solutions that are both safe and operable.

The role of the safety case, as part of safety-led design and operation, is to:

- Identify and analyse major accident hazards;
- Select preferred options, with *due consideration* of safety, cost and operability;
- Determine safety requirements, safe operating procedures, training needs, etc.;
- Provide a *continual* process of safety risk identification and management;
- Provide a *baseline* for design, operation and risk-informed decision making;
- Provide a suite of documentation that evolves and is configured with the design definition / material state of the system;
- Communicate important safety information to those who are not safety specialists;
- Justify that activities may proceed or continue, with *commitment* to safety risk reduction; and
- Above all, minimise safety risk and justify to ourselves and others that it has been reduced SFAIRP.

Getting projects off to the right start

All aspects affecting future stages of delivery should be captured formally in the project plans from the outset, including the risks, assumptions and the dependencies between various elements of the project delivery process. By understanding the technological, political, safety and environmental risks and issues likely to be encountered, organisations can build confidence in the viability of a project, prepare to deal with uncertainty and pay sufficient attention to novel or contentious issues. Explosives present specific hazards that are often not straightforward to control. It is therefore important that project delivery strategies and plans identify explosives engineering and safety assessment explicitly within the competencies and resources required.

Beyond individual competencies, the culture and conditions within an organisation directly influence its ability to manage risks and achieve a RFTSC. The authors' experience is that it is never too early in a project to embed the principles of safety-led design and operation into processes and ways of working. Various techniques can be used to achieve this, all with the aim of aligning personnel (staff, contractors, suppliers and other stakeholders) to the shared aims of the project and an understanding of the processes by which it will be delivered. The planning itself should be an integrated approach – engineers, operators, safety personnel and other disciplines working together to understand the various interactions that need to take place throughout the system lifecycle.

The start of any project presents the ideal opportunity to consider options for eliminating or reducing risk at source. This often has the benefit of avoiding the need for 'added on' safety measures – engineered and procedural – later in the process. It can be both time-consuming and costly to adapt a design to satisfy safety requirements that were revealed later in the process or even identified retrospectively. Getting it 'right first time' extends to cover the handover, operational and disposal phases, and minimises the likelihood of late design changes introducing operating inefficiencies that mean the plant may never be able to perform safely at the desired capacity.

OTS procurement – in principle and in practice

For general applications, OTS equipment is relatively simple to procure, with shorter lead times and fixed costs, making it attractive to purchasers. However, it is unlikely that OTS process plant and machinery will have been developed specifically for the explosives industry. Often it is necessary to adapt OTS equipment to some extent to make it fit for use in explosives processing environments. Common ignition hazards that OTS equipment can pose to explosives include dust traps, metal-to-metal contact, electrical/electrostatic ignition sources and chemical incompatibility with explosives. As process complexity and/or 'sensitiveness' of the explosives being processed increases, so too does the likelihood that some element of bespoke design will be required.

It is also the time when key philosophies can be established – for example the balance between (commercial or military) Off The Shelf (OTS) equipment and the need for bespoke design. Such factors can have a significant impact on costs and schedules, and frame the project in terms of the desired outcomes, budgetary aspects and the resources required to deliver it. As the above example shows, an estimate that is based purely on OTS equipment may not adequately cater for the amount of design and/or adaptation required for explosives applications.

Integrated approach to safety-led design and operation

Figure 3 presents a simplified illustration of how the safety case workflow could align with the project schedule through concept, detailed design, construction, commissioning, handover and operation. It may be the case that safety is best subsumed into the overall project plan. For large, novel, or contentious projects, a separate Safety Management Plan (SMP) is likely to be beneficial.

In either case, the plans should be fully integrated and provide sufficient understanding of the interactions and dependencies.

Key safety deliverables featured in the Figure 3 representation include the Hazard Studies (HS), Hazard Log (HL), list of Engineering Controls (perhaps presented as a set of Safety Functional Requirements (SFR)), list of Procedural Controls, Safe Operating Boundary and Safety Case Reports. For large, novel or complex projects, Safety Case Reports are likely to be issued in stages, with the Design Safety Case Report (DSCR) coming first, followed by the Operational Safety Case Report (OSCR). The DSCR would focus on making the argument that the equipment would be safe to operate, maintain, decommission and dispose of, and that the safety risk had been reduced SFAIRP by design. The OSCR would also look to make this argument, but would incorporate the experience built up during the construction and commissioning phases, and would provide more information on the procedural

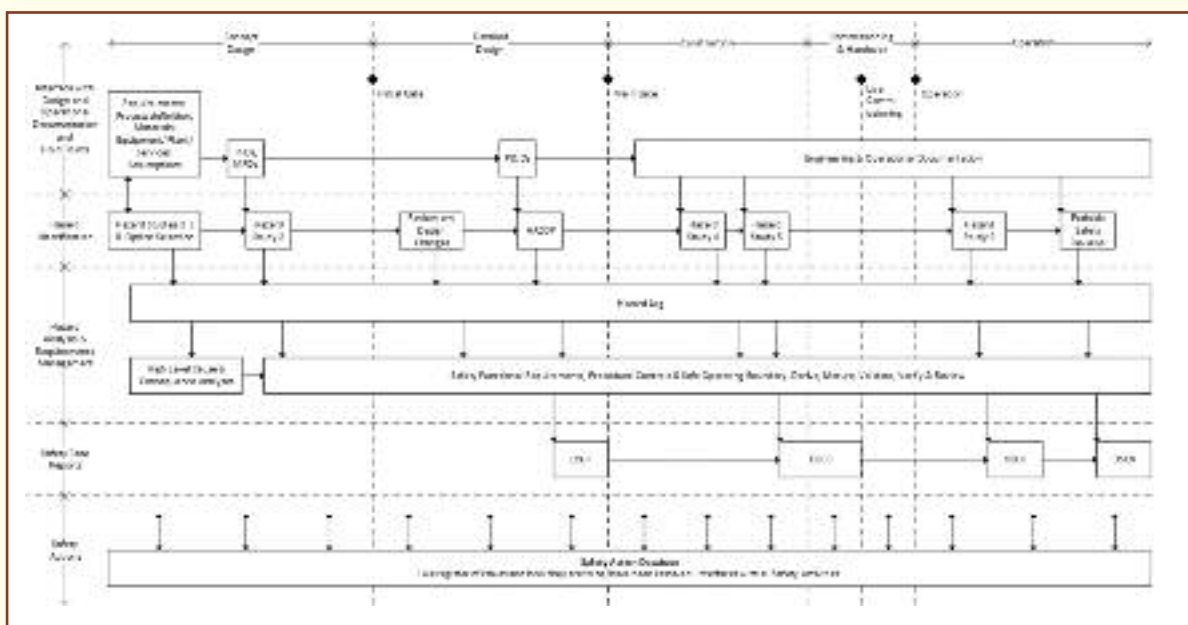


Figure 3. A simplified example of how the safety workflow could align with the project schedule.

Requirements as a cohesive force in design and operation

Requirements management plays an important role in ensuring safety and engineering remain integrated. SFRs should convey information derived from the safety case and are an important subset of the full requirements set. Proving that the system satisfies, and continues to satisfy, the SFRs is essential to demonstrate that the claims made in the safety case are valid and that the safety characteristics of the system in *practice* are being delivered. Figure 4 provides an example Validation and Verification (V&V) process that can be applied to confirm that each SFR is valid and then to verify that it has been implemented. Verification may be subsumed into the HS4 and HS5 activities shown in Figure 3. Communicating SFRs clearly and making sure they are understood is vital. Applied properly, SFRs can be considered to be the ‘glue’ that keeps the safety case, design intent and material state aligned to provide a clear picture of system integrity and risk.

safety controls. Additionally, an explosives licensed site is likely to have a SMS in order to implement arrangements under Regulation 26; any project work undertaken on site would have to conform to this SMS. Novel or contentious projects might even require the site’s SMS to be amended and re-issued.

Depending on the circumstances, additional safety deliverables or influences could include, for example, an overarching Control of Major Accident Hazards (COMAH) site Safety Report, a facility emergency response plan, or a technical justification for explosives licensing purposes. It is important to note that the OSCR does not replace mandatory health and safety assessments such as Control of Substances Hazardous to Health (COSHH) or manual handling assessments.

Figure 3 highlights the use of staged HS⁵ that influence design and operation throughout the project delivery process, which is a recognised means of ensuring that hazards are identified systematically throughout the equipment lifecycle⁶. The illustration is necessarily a simplification. In practice, the ‘formal’ aspects depicted must be complemented by ‘informal’ aspects to enable flexible and effective interaction between the different disciplines and levels of management within the organisation. It is not just *what* people do on a project, it is *how* they do it and influence others.

Decommissioning and disposal of explosives processing facilities is a specialist subject in its own right, usually performed by specialist contractors, who would play a leading role producing the applicable SMP, risk assessments and method statements. This activity could include a specific HS (HS7), however it is never too early in the design phase to consider how buildings and equipment that have been in intimate contact with explosives can be safely decommissioned and disposed of.

Tailoring the output for users

There can be various outputs from the safety case programme at various times and this information should be presented in an appropriate form. Consideration should be given to how different

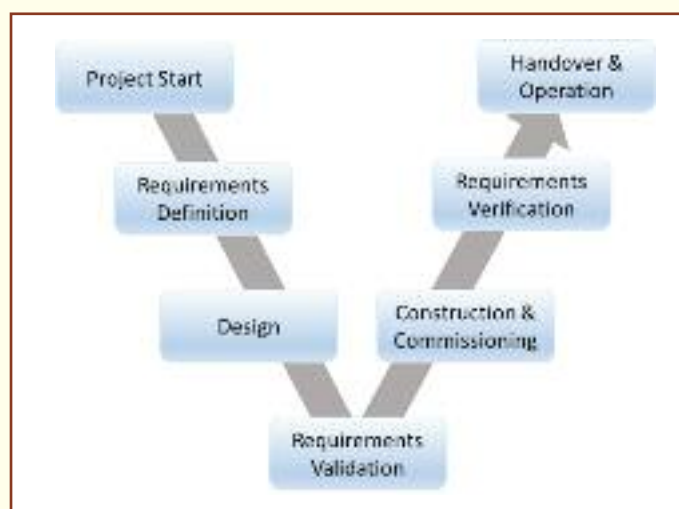


Figure 4. Example requirements validation and verification (V&V) diagram.

groups will use the information and how best to communicate its safety significance. Figure 5 presents a non-specific example of how graphical means can be used to concisely summarise the relationships between threats, hazards, controls and accident consequences. The SCR does not have to be a single output, e.g. a big bulky document. This ‘one size fits all’ attitude is unhelpful and can even be dangerous if important safety information becomes buried amongst swathes of text.

Are we on track?

At all stages of a process, but particularly in the early stages when substantial resource is about to be committed, it is important to create incentives and conditions that shape culture and drive performance. Performance measurement should not be limited merely to cost and time elapsed – these tend to be lagging indicators – but should be broader such that they reflect quality of design, safety and other factors that influence success. Our experience of reviewing projects, building on the learning and applying various people-oriented methods shows how it is possible to effect change and improve performance in major hazard

Do we have safety-led design and operation in practice?

What do we do to encourage interaction between disciplines and build awareness of safety?

Are our engineers and operators actively involved in hazard identification and analysis?

Do we actively seek opportunities to reduce safety risk further?

Where in our process do engineers and operators pick up safety issues?

Once identified, how are safety issues registered, managed and resolved?

When changes to design or operation are proposed, who consults and updates the safety case?

How are safety case findings and implications communicated to our engineers, operators and managers?

If it is safety-led, where do safety activities come on the programme relative to other deliverables, i.e. do they lead or lag?

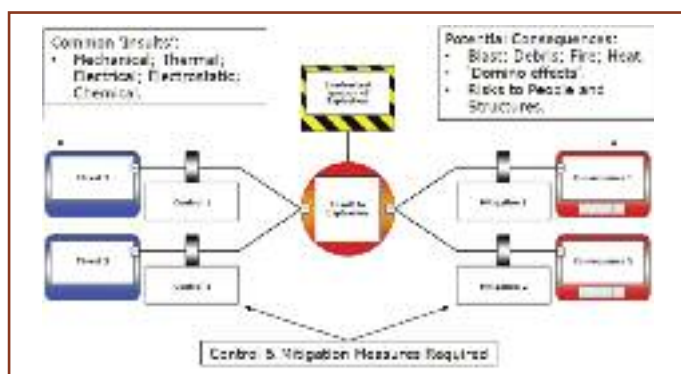


Figure 5. Bowtie diagram for explosives safety – template to adapt to specific circumstances.

environments. The issues and solutions that affect behaviours and performance of people are unique to each organisation and project. We provide some questions for the reader to use by way of a 'health check' in the box above. – How does your organisation or project measure up?

Conclusion

Explosives present specific hazards that are often not straightforward to control. Risk assessment and safety cases are an effective way of managing explosives safety risks, but need to be fully integrated into broader project / business processes in order to realise their full potential.

Each individual site and project will be different and there will be various ways of managing explosives safety risks. Properly applied, the safety case approach is a way to: select the safest practicable design option; demonstrate that safety risk has been reduced SFAIRP; communicate the important safety information required by different user groups; and provide a baseline for risk-based decision

making and management. The authors present the principles of safety-led design and operation, along with their experience of working with projects, programmes and organisations to move away from safety as a 'tick-box' exercise and instead achieve real and tangible benefits in explosives safety management throughout system life.

- 1 Explosives Regulations 2014, Safety Provisions, Guidance on Regulations, HSE Publication L150, ISBN 978 0 7176 6551 8.
- 2 JSP 520, Safety and Environmental Management of Ordnance, Munitions and Explosives over the Equipment Acquisition Cycle, Part 1: Regulations, v4.0, March 2014.
- 3 Lord Cullen, The Public Enquiry into the Piper Alpha Disaster, Vol 1-2, 1990, Dept of Energy, HMSO.
- 4 Richards, Day & Gilbert, Approaches to Demonstrating a Capable Organisation, Ministry of Defence, Environment and Safety Assurance Symposium (ESAS) 2008.
- 5 Developed from the original 'six stage' HS process attributed to ICI, with the addition of HS0 and HS7.
- 6 HAZOP Guide to Best Practice, Crawley, Preston & Tyler, 2nd Edition, 2008, Published by IChemE, ISBN 978-0-85295-525-3.

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Rockbourne and Ebeni are independently owned and operated consultancies. This article is the product of five years' collaborative working on behalf of our clients - bringing together our safety and risk management expertise, and utilising our specialists in explosives safety, culture development and change management.

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Countering the IED Threat: industry's role in the fight

By UK Ministry of Defence Attack The Network

This is the last of four articles from JIEDAC which detail:

i) the evolving threat from IEDs

ii) how an IED is made

iii) how we have tried to fight this threat and

iv) how industry can help in this fight.

The **Improvised Explosive Device (IED)** is used by insurgents, terrorists and criminals around the world, due to its ease of manufacture, relatively low cost and potentially devastating effect on people and property.

The first article, by the UK Ministry of Defence (UK MOD) Joint Improvised Explosive Device Analysis Centre (JIEDAC), published in SAFEX Newsletter No. 49, and in *Explosives Engineering*, December 2014, assessed the history, evolution and associated technologies of the IED threat, which have led to the IED becoming a significant weapon of choice for terrorists, criminal organisations and individuals worldwide over the past century.

The second article described the typical construction of an IED noting in particular the use of Commercial Grade Explosives (CGE), to inform readers of their use in order to prevent further catastrophic events. It was published in SAFEX Newsletter no. 51 and *Explosives Engineering*, March/April 2015.

The third article dealt with Countering the IED threat: the Government approach and appeared in *Explosives Engineering*, June 2015.

Introduction

While the conflicts in Afghanistan and Iraq are no longer of the size and scope of the last decade, their signature weapon, the Improvised Explosive Device (IED), endures not just in these regions, but globally. From June 2014 to May 2015 there were 55,950 casualties from 23,335 incidents globally.¹

With cunning and adaptive terrorists operating on an ever changing battlefield, IED design is constantly evolving as counter measures are developed against them. IEDs are often designed according to the target, the skill of the manufacturer and the person emplacing them, and the resources available. Terrorists often make use of items that have a legitimate use and are readily available or easy to procure, such as agricultural grade Ammonium Nitrate (AN) for the production of Home Made Explosive (HME). However, terrorists usually prefer to acquire Commercial Grade Explosive (CGE) products due to the increased reliability for the operator, compactness, and explosive efficiency.

Many explosives and HME chemical precursors originate from, or transit through, states and territories neighbouring those where IEDs are deployed. Vulnerabilities in the control of energetic materiel increase the opportunities for legitimate products to be diverted to illicit ends. In response, good practices by industry, backed by robust law enforcement, are instrumental in disrupting and deterring the illegitimate use of explosives and HME precursors.

Robust controls on explosives and HME precursor chemicals are beneficial, enabling the protection of ordinary people and the security forces that protect them. However, due to the dual-use nature of many precursor chemicals and commercial explosives there is a need to ensure that regulatory controls do not negatively affect commercial industries.

The UK Ministry of Defence's (MoD's) Attack the Network (AtN) Team (formally the Joint IED Analysis Centre (JIEDAC)) exposed the history of the threat, the construct of a typical IED and the approach to countering this threat in three past articles. The last article focused on how governments, particularly within NATO countries, are working together to combat the threat of IEDs. This article will focus on initiatives that affect industry, including oversight and accountability of products as well as how governments can better work together to find solutions that benefit all parties.

Oversight and accountability

The importance of maintaining oversight and accountability of commercial explosives and HME precursors cannot be overstated. Simply put: knowing where these products are; where they are destined; who has access to them; and how they are accounted for is the foundation upon which the security of dangerous goods is based.

Oversight and accountability is therefore closely associated with good practices in supply chain management. Maintaining effective management, from the point of manufacture to end-user, aims to keep legal materiel within legal channels and reduce the risk of illegitimate acquisition. Responsibility for ensuring good supply chain management lies with both government and industry and can be achieved through a combination of regulatory and voluntary actions.

The basis of most of these actions is the improvement of practices relating to oversight and accountability. Europe has taken steps to improve oversight and accountability of explosives and HME chemical precursors. Several initiatives are worthy of mention as being examples of regional and international cooperation:

- **The European Commission (EC) Directive 2008/43/EC and its interpretation into UK law - the Identification and Traceability of Explosives Regulations 2010 (ITOER):**

This Directive led to the development of ITOER 2010, both of which have subsequently been revised.² The revised ITOER legislation came into force in April 2013. It is significant because it will improve end-to-end oversight of the commercial

explosives supply chain by requiring explosives producers to use identification markings and to maintain records in order to ensure proper stock accountability. This Directive is an example of a regional approach as it requires each member state to develop similar controls for commercial explosives.

- **The European Union (EU) Action Plan on Enhancing the Security of Explosives:**

This EU Action Plan was enacted in response to the Madrid terrorist attacks. It forms the basis of the EU approach to impeding the terrorist use of explosive materiel. The action plan focuses on three key areas:

- Prevention – Aims to address the traceability of explosives and precursors, awareness and security issues.
- Detection – Aims to establish a regional consensus on detection standards and to introduce a European wide certification scheme.
- Response – Aims to improve the exchange of information and sharing of good practice in addition to developing specific preparedness and response measures for terrorist threats using explosives.

It is proposed that these aims will be achieved through a mixture of voluntary activities and regulation.³

- **The Regulation of the European Parliament and the Council on the Marketing and use of Precursor Chemicals:**

This regulation seeks to control the sale of a list of eight precursor chemicals in certain concentrations⁴, to members of the public. A further list of seven concentrations requires suspicious transaction⁵ reporting.

The application of technology to commercial explosives and HME precursor chemicals can support regulation and oversight. Such voluntary activities undertaken by industry can be used to improve controls over the supply chain and in some cases support investigations into terrorist IED events. Technology that aids in the identification of materiel involves the application of labelling or markings onto the product or product packaging to assist in traceability.

Traceable markings also assist in forensic investigations where such products have been misused. The use of traceable markings or unique identification numbers (UINs) enables better stock management, accountability, and oversight of the supply chain. Examples of these markings include alpha-numerical marks and pictorials or barcodes that are applied to numerous product types such as detonators and detonating cord.

Simultaneously, computerised stock management and identification systems improve the traceability of explosive products and HME precursor chemicals. This can be a localised system, for example stock management within an explosive magazine, or part of a wider traceability framework that tracks materials from manufacturer to end-user.

For example: A fertiliser company has trialled a system that uses Radio Frequency Identification (RFID) technology combined with a Global Positioning System (GPS) to provide oversight and control of their stock distribution; not unlike the technology used to track and trace items through a postal system.

Government to industry outreach

There is growing awareness that industry can be the first line of defence in the fight against IEDs due to their daily interaction with trading partners, understanding of the networks (i.e. when something is out of the ordinary) and wider expertise through the manufacture, development and sale of products.

Several nations have developed systems of energetic materiel control that rely on a combination of regulation by government and good practices by industry. These systems aim to prevent dual-use items from entering the illegitimate supply chain and highlight possible nefarious activity. Through governments working together with industry, they can understand the industry's concerns and work towards mutual and reasonable solutions.

Examples of initiatives to which industries voluntarily abide include:

- **Know Your Customer' schemes⁶:**

These schemes aim to raise awareness among business owners and industry customers about the potential misuse of some of their products and to give basic advice on how they can ensure that they supply those products only to known and trusted customers. They also encourage them to be more enquiring of new customers and to report suspicious enquiries to police. Awareness and education with business owners is managed by dedicated Police Counter Terrorism and Security Advisors (CTSAs) who develop relationships with the local business community.

- **United Nations (UN) Transportation of Dangerous Goods (TDG):**

UK MOD's AtN team is working alongside US Department of Defense's Joint Improvised-Threat Defeat Agency (JIDA)⁷ to support the Institute of Makers of Explosives (IME). IME has put forward a proposal to the United Nations Sub-Committee of Experts on the Transport of Dangerous Goods (UNSCETDG) to introduce a new section to the sub-committee's model regulations Chapter 1.4 for a globally harmonised standard for explosive security marking. Although the model regulation's implementation is not mandatory, it provides countries that do not currently have a marking scheme with a best practice model. The proposed marking scheme is based upon the format of European Commission Directive 2008/43/EC with certain exclusions specified for bulk material, ammunition and pyrotechnics. Should this proposal be implemented and countries adopt the standard, it will provide explosives manufacturers with the ability to put a single marking on a product whether destined for home country use or international export. It will significantly improve the ability of international law enforcement agencies to trace commercially manufactured explosives materials recovered on the battlefield to the point from where the explosives were diverted and addresses any issues of security and accountability in the supply chain.

- **Industry Awareness Programmes:**

UK MOD along with international partners have conducted a number of presentations and written articles to inform industry of the threat posed by the misuse of explosive products by nefarious actors. Partners have also organised IED awareness days where industry are able to view recovered IEDs, understand how they were made and procured, and the destructive power they yield. Industry awareness programmes

have been tailored and localised according to the audience to ensure that both industry and government understand each other's problems and can work together.

- **Specific Industry Outreach:**

UK MOD and its international partners have reached out to companies whose products have been found on the battlefield in order to identify and rectify weak links in the supply chain. Often the problem lies outside the company's immediate area of control, either with distributors or at the end user level. By working together the parties have found a potential solution that will revolutionise how explosives are managed not just by the company but by the country of origin as a whole. The company has implemented an internal tracking system that will be mirrored by a government system tracking items to the point of detonation supported by the US DOD and the UK MOD.

Industry to Industry Partnerships

Industry partnerships provide a key enabler in the battle against IEDs by providing forums where best practice can be shared and encouraging self regulation to avoid potentially invasive regulation and controls that could ultimately undercut operations and profit margins. Voluntary activities include those actions that are undertaken by industry to improve their own security and safety and can be undertaken by all elements along the supply chain, from manufacturers, distributors and end users. These activities may be conducted for reasons of reputation, the smooth running of operations and, ultimately, commercial performance.

A good example of industry self regulation that has had an impact on the effort against IEDs within the UK is the Fertiliser Industry Assurance Scheme (FIAS).

FIAS was launched in early 2006 following a request from the UK Home Office to develop a system of best practice to manage the safety, security, and traceability of fertilisers. Of particular concern were fertilisers containing AN, including those below the oxidiser threshold. The Agricultural Industries Confederation (AIC), the trade association which represents the fertiliser manufacturers and merchants in the UK, was approached to lead in developing the scheme, under the oversight of a "Steering Group" which included representatives of several UK government departments as well as other stakeholders such as farmers' representatives. The brief for development was simple: The fertiliser supply chain needed to adopt best practice in relation to security of fertilisers containing AN, or run the risk of legislation which could involve licensing of all steps in the supply chain, or even an outright ban.

During the initial development process AIC received substantial input from the National Counter Terrorism Security Office (NaCTSO) in developing the correct approach to managing security and public support for the scheme from UK government ministers.

As well as drafting a workable and effective standard, the other crucial element in developing FIAS was to establish a robust verification procedure to monitor compliance. This was achieved by engaging an independent certification body who committed to achieving EN45011 (ISO Guide 65) accreditation for the scheme. This was granted by the UK accreditation Service (UKAS) in 2006 and ensures that assessors are trained and monitored and certification decisions are made in a consistent, fair and impartial way. Due to the sensitive nature of issues the FIAS covers, clear rules on confidentiality are also extremely important, and trust between some scheme participants and the certification body took some time to develop.

Nine years after the launch of FIAS there are now over 680 sites certified covering the operations of approximately 450 companies representing well in excess of 90% of the fertiliser produced in and imported into the UK.

Conclusion

IEDs are likely to remain a weapon of choice for terrorists worldwide and therefore the implementation of measures to disrupt and deter illegitimate acquisition of dual-use energetic materiel will have long-lasting benefits. End-to-end traceability, such as the indelible marking of commercial explosives at source; the use of RFID tags on products; and the implementation of effective record-keeping systems can assist the oversight, accountability and traceability of commercial explosives and HME precursor chemicals along the supply chain. To benefit industry, monitoring commercial explosive products and dual-use precursors in this fashion improves stock management and product custodianship throughout the commercial supply chain. Additionally, improved traceability assists in the investigation of misuse of such products, allowing attribution of component sources, supporting investigations and prosecution through exploitation capabilities.

Responsibility for the security of commercial explosives and dual-use chemicals lies not only within governments but also within the industries that produce these goods. Overt government outreach to these industries that aims to raise awareness, both of the dual-use nature of particular materials and of the industries' roles and responsibilities regarding the security of these products, encourages self-regulation, reducing the requirement for formal government intervention in the form of legislation. The promotion of good practice, alongside the introduction of voluntary codes of conduct, allows industries to be recognised as responsible entities, therefore benefiting from the positive association.

This article has outlined regulatory action, technical options, and industry-led initiatives which collectively assist in addressing the issue of diversion of licit energetic materiel to illicit channels in the UK. It is acknowledged that many of these solutions may not be effective or appropriate in other countries or regions. However, the concepts which these solutions are based on, i.e. the development and implementation of good practice may be applied to problem sets encountered globally. Crucially, industry and government working collaboratively can make a tangible contribution to reducing the threat of IEDs.

- ¹ Joint Improvised Threat Defeat Agency (JIDA) (formally the Joint IED Defeat Organisation (JIEDDO))
- ² European Commission Directive 2012/4/EU and ITOER Amendment 2012, respectively.
- ³ Commission Directives 2008/43/EC and 2012/4/EU, the UK's Identification and Traceability of Explosives Regulations 2010 and Amendments 2012, and the EU Action Plan on Enhancing the Security of Explosives are freely available online.
- ⁴ Hydrogen peroxide, Nitro methane, Nitric acid, Potassium chlorate, Potassium perchlorate, Sodium chlorate, sodium perchlorate 5 Hexamine, Sulphuric acid, Acetone, Potassium nitrate, Sodium nitrate, Calcium nitrate, Calcium ammonium nitrate, Ammonium nitrate (in concentration 16% by weight of Nitrogen or higher)
- ⁶ For further information see www.nactso.gov.uk/hazardous-materials
- ⁷ Formally the Joint IED Defeat Organisation (JIEDDO)

Further information: JIEDAC@iexpe.org

The Bennett file

Our columnist John Bennett recalls the initial excitement of imported fireworks

It was interesting to me when a Dutch collector contacted me about some Chinese dummies I had which I was prepared to exchange for old English fireworks. I must admit I hadn't expected anyone to be interested. It just goes to show that whatever you fired in your youth becomes a fascinating object in later years. While I salivate when looking at a Black Knight Sputnik Rocket dummy, he was desperate to obtain a Red Lantern Assorted Colour Pearls with Whistles and Bangs.

I obtained the small collection of Chinese dummies when one of the first mass importers to this country (Sohni (Esco) Ltd) received a set from Chinese manufacturers as an enticement to add to their range. The late Mr Jackson was only too happy to pass them on in 1983!

The approach raised the question of whether 'Fireworks' in twenty years' time might be providing glorious colour pictures of such items – instead of pictures of penny bangers and Wilder's dummy boards (such as appear in the latest issue). The thought does not appeal but, as they say, things move on.

The seventies were a period of decline for the British firework industry and the rise of importation on an increasingly large scale. China was the most common source but Malaysia and Macau also provided early imports – and, of course, being the best rockets around, Germany sourced many of these. Brock's were the first to provide a complete range of Chinese fireworks; in 1975 British Brock's fireworks featured little in the company's publicity – although they began to creep back in increasing numbers in subsequent years.

And one has to admit that there was a fascination about the imports. They were certainly a novelty – screaming rockets, delightful names and even strange lighting requirements. There were copious instructions supplied in shops as to how to apply a flame. Many appeared to have no fuse until the paper top was broken and it was pulled out. Fuses have always been used to ignite fireworks but, since we had – for so long – applied a match to touch paper before it fizzed down to the fuse inside the case, many had not considered that fireworks' effects had always been initiated in this way.

While Brock's openly declared their new ranges as foreign novelties, other manufacturers had – even prior to this – used imports and disguised them with their own labels. Benwell had done this with Dancing Lights and others in their range – although they were conventionally presented with touch paper. Dancing Lights' performance featured juggling microstars – an effect not seen in English fireworks since the sixties (when it was very rare). Sultan was a new brand with fireworks obtained from Sohn Esco, although many of their range appeared with English labels.



Above: Some of my own fireworks ready for Guy Fawkes – British and Chinese – in 1986 – including re-packaged items.



Chinese items.
Photo: Christopher Thompson
(other photos – John Bennett).



Dancing Lights – looking remarkably British!

Standard featured fireworks from Macau – effects like crackle and microstars in fountains free standing with a plastic base had not been seen previously and this type, provided with Standard's exceptional range of large English shop fireworks, made their range a very attractive one. Kimbolton were another British manufacturer of shop fireworks to import large parts of their retail range – from Germany and China – and a 'Which?' type report of this range was provided in 'Fireworks'.

Everyone will have their own favourites of this time. One in the Kimbolton range was the Weco Tolle Lola – a screaming rocket that had you covering your ears. Perhaps my recollection of the Chinese Tigers Roaring Fountain (with three levels of whistle) reveals my own preference for whistling fireworks which had only previously been satisfied by Standard's British made Whistle Stop. Whistle Stop began to seem quite tame and even the Chinese Phoenix Tail Howl was no match for these screechers

Of course one of the big attractions of the Chinese ranges was the multi-shot and, although Standard had toyed with such an idea, the Chinese were the first to produce retail items like Singing Birds and News Transmitter which combined numerous tubes of Roman candles.

We are now of course very familiar with Chinese effects but it is difficult to under-estimate the effect they had when first they appeared. And, yes, the fuses were poor and the number that fizzled to a halt before producing their effect was high. But novelty is a very effective marketing tool!

So, perhaps I can understand the enthusiasm of my Dutch correspondent!

John Bennett is editor of Fireworks, a magazine for enthusiasts and the trade. It is obtainable, by credit card on the website www.fireworks-mag.org or, by post, from Fireworks, PO Box 40, Bexhill TN40 1GX (tel: 01424 733050; email: editor@fireworks-mag.org). £10 annual subscription payable to Fireworks Magazine. Fireworks is also available electronically (See website).

The views expressed are those of the author:

Our columnist Sidney Alford OBE MSc PhD reflects on accepting an honour

Statement by the Author - I have never donated more than a million pounds to any political party.

How delighted I was to receive a letter from the Honours and Appointments Secretariat of the Cabinet Office asking whether I would be willing to accept an honour but wondered if the offer was genuine. A range of questions enquired whether I was British (and if so what colour), Bangladeshi or Chinese, whether I was homosexual or "straight", etc. and whether I was disabled under the Equality Act 2010. My initial doubts were dispelled.

In a moment of reverie the thought occurred to me that I might have misread my proposed OBE for a proposed ORB¹. A cold shower flushed away such pretentious considerations and reminded me to visit my optometrist.

When the time came The Queen had another birthday and, sure enough, the better class of newspaper informed me that I had become an Officer of the Order of the British Empire.

I fell to contemplating what this implied. I had recently read that consideration is being given to the introduction of a new range of honours, presumably because the most devoted subjects of the Empire cannot but notice a degree of shrinkage thereof. True, the amount of red on the globe of the world² has diminished greatly even during my own lifetime but, on the other hand, a domain whose real existence is unprovable, such as Heaven, or contrived for use as a threat, such as Hell, does have an air of esoteric richness which inspires higher thoughts than contemplation of reactionary behaviour still manifest among the natives of a remote corner of Africa.

What then are the residual powers and duties of an officer of an esoteric domain? Clearly they no longer have the authority to order the women of an African village to dress more modestly and to take their children to Sunday school, nor even to insist that the men stop boiling missionaries at a rate which exceeds our ability to replace them – an instruction which clearly served our interests to an extent that we seem to be a net importer of missionaries at the moment. An officer today, finding himself, for example, in India and demanding that an elephant be saddled up to enable him to go out and shoot a few tigers before dinner would either be thrown out of his hotel or would be returned home with as much discretion and sedation as an embarrassed consul could arrange.

A colourful reflection of our former glory dropped through my letterbox within days of Her Majesty's birthday: the Garter King of Arms had sent a congratulatory letter and took the opportunity to inform me that I was now eligible to petition for a grant of Armorial Bearings (in case I had none already). I hesitated to reply until I had considered how my deep commitment to health and safety might be represented thereupon without making me seem a bit of a coward rather than a smiter of the heathen and tearer down of his temples³.

In real, contemporary, terms, what does the award imply? First, that I must thank my Nominator and the surprising number of Supporters for a lot of goodwill, thought and time expended on my behalf with no hint of the matter, which took many months, coming to my attention. When I learned their names, I recognised professional

colleagues and acquaintances who had done a great deal to support me in good times and bad, within the Empire and beyond it, and one or two whom I believe to have placed their own careers at some possible risk when they demonstrated to officialdom that I was being treated unjustly.

A complication as far as any recognition of my main field of invention and development was concerned is the fact that things which go bang and are intended mainly for military use are not expected to be invented and developed by keen amateurs let alone tested initially in one's back garden, as was reflected by blockage by the Establishment of my early attempts to obtain intellectual protection. Might life have been easier if I had been offered a place within an Establishment research organisation to develop my ideas? In fact I might have turned out not to be a very good team player and being memorably told that, at the age of forty, one cannot be expected to have any more really new ideas anyway, probably constituted a spur⁴ to the imagination. Also it spared me the sadness of an ever closer retirement date, little mitigated by the implied probability of a gong when the time came.

I acknowledge the kind encouragement occasionally given quietly by individuals in much larger organisations and hope to mitigate any hurt that my occasional remarks may have given to those professionally concerned with safety. It is several years now since any of their number was foolish enough to threaten me with prosecution and I still feel gratitude for the kind offer of a job by one of HSE's more open minded explosives inspectors during breakfast at an Institute AGM: I just could not see myself agreeing that agricultural grade ammonium nitrate is not an explosive. Of course my two eyes and ten fingers attest to careful handling of explosives but I have no delusions of a protecting hand which would reach down from the sky and protect me *in extremis*. They are simply a reflection of the fact that I have developed cowardice to a professional level.

How fortunate it is to enjoy most of what one does for a living with just enough of Walter Mitty's genes to help me through occasional boring moments. I am spared a half-hearted urge to play golf, even mention of which reminds me of a golfing headmaster who really did not like me. Occasionally I wonder if a change of career might be possible and desirable, but one cannot do everything and I am less versatile and polymathic than many.

I often think of one of the predecessors of my professor of organic chemistry in the Muséum National d'Histoire Naturelle in Paris, Michel Eugène Chevreul. After a life which saw him through the French Revolution and a distinguished career in natural product chemistry⁵, he launched into a pioneering study of gerontology shortly before his death in his 102nd year!

- 1 A rapid calculation told me that a four inch golden ball would have a volume of 549cc whence a weight of 10.6kg. Looking up that morning's price of gold gave £206,000 – not counting the cross on top.
- 2 Actually, of course, rather effeminate pink because the black lettering was found to be illegible on the more regal red of early versions.
- 3 However fashionable that has once more become.
- 4 You see, Dear Reader, how quickly my vocabulary is becoming more heraldically inspired.
- 5 In 1854 Chevreul published a paper entitled "De la baguette" in which he debunked the divining rod and gave one of the first explanations of the ideomotor effect as used by today's vendors of quack explosive detectors.

Industry news



Symposium Round-Robin Session.

Early Careers Symposium Group.

Early Careers Symposium 2015

On 7th and 8th July the Early Careers Focus Group successfully held the first Early Careers Symposium for those working with Weapons and Explosives in the Defence Sector at Heythrop Park in Oxfordshire. The event attracted almost 100 engineers and scientists who are in the first 10 years of their careers from eight major Defence companies and was well supported by senior figures in the Industry. In total, 15 companies were represented at the Early Careers Symposium, which was hosted by ISSEE as they branch out into events and conferences.

The first session focussed on UK Defence Capability, with an overview of how different Defence companies contribute to delivering military capability. Heather Goldstraw from the Technology Office at Defence Equipment & Support (the MOD's procurement organisation) delivered the keynote speech, speaking about the Defence Enterprise and how important it will be for us to innovate and to embrace change as the defence budget continues to be squeezed. The second session was about Empowering Yourself and Others and gave tips on how to use assertiveness in different situations. The final session of the day was a round-robin of stands with a variety of themes; some were opportunities to speak to presenters and Subject Matter Experts about their experiences, there were also opportunities to discuss Professional Registration, skills development and STEM (Science Technology Engineering and Maths) initiatives to encourage young people to get involved in science and engineering.

The day was rounded off with a networking reception followed by a formal dinner. There were 117 guests for dinner, as VIPs attending the Sector Skills Strategy Group meeting (held separately), also at Heythrop Park, joined the Symposium delegates. Between courses we heard from three speakers. Gordon Storey, CEO of ISSEE encouraged us to professionalise the industry and encouraged the IExpE to be the centre of excellence. John Wolstenholme told us how strongly he supported the Early Careers Symposium and encouraged the early careers delegates to get involved with the Institute by joining Branch committees or the Institute Council. John then presented the Poster Competition prizes on behalf of the Explosives Engineers Education and Research Trust. John Anderson, Managing Director of QinetiQ's Weapons Division gave the closing speech, encouraging us all to grasp every opportunity and to make the most of the Early Careers network that is being developed.

Prizes for the 2015 Poster Competition

1st Place: Ellen Madden, MBDA

2nd Place: Amy Mitchell, AWE

3rd Place: Lee Webb, AWE

Keep an eye out for the poster competition entries over the coming issues of the Journal. One example is published on the opposite page.

Day Two consisted of more technical presentations. The Protection, Detection and Analysis session kicked off with an entertaining and informative presentation from Paul, CPNI, about the blast protection of critical infrastructure. Throughout the day there were a good range of presentations including some by Early Careers Symposium delegates, especially in the Technical Lifecycle session. The final session, Emerging Technologies, covered advances in modelling, the utility of 3D printing in research and development, and the world of directed energy weapons.

The feedback from the Symposium was excellent, with 90% saying that they would attend another Early Careers event in the future and 96% saying that they would recommend the event to their peers.

As part of the registration package for the symposium, membership for the IExpE was encouraged and 87 early careers delegates became Student Members for 12 months.

Delegates of the Early Careers Symposium are reminded to join the LinkedIn group to ensure they don't miss out on visit opportunities and other announcements.

The next Early Careers Event will be on Wednesday 9th September when QinetiQ will host a group of up to 20 people on an extensive visit of the ranges at MOD Shoeburyness. The itinerary will include: environmental testing, large calibre guns, small arms demil, and a static firing.

In November we will also be holding a visit to Roxel, Summerfield for a number of early careers engineers and scientists to get a chance to look at the laboratories and testing facilities. Please join the Linked In group and let us know if you are interested in attending.

Many thanks to everyone that helped make this event happen and please get in touch if you would like to help arrange an event in future: earlycareerssymposium@gmail.com

Holli Kimble MEng CEng MIEpE MIMechE
Chairman, Early Careers Focus Group

Slapper detonator development

Amy Mitchell, Scientist, Explosive Trains and Devices

An Introduction to Slapper Detonators

Exploding Foil Initiators (EFIs), known colloquially as slapper detonators, are fired by discharging a capacitor, typically charged to 1000-5000 volts. Current flows through the conductors to a bridge, heating the bridge through resistive heating. If the heating is rapid enough, the bridge is vaporised; and forms a high pressure gas. This shears a dielectric film that acts as a flyer which accelerates through an air gap, known as the barrel, and into an explosive pellet. The impact of the flyer into the pellet delivers a high-pressure, short-duration shock pulse; resulting in the prompt initiation of the explosive. Typical flyer velocities range between 3-5 km.s⁻¹.

Modern electrical slapper detonators provide enhanced performance and safety compared to other, more traditional detonators like hotwires and exploding bridge wires (EBW's). Some of the benefits of slapper detonators include:

- Specific electrical signal required to function
- Increased timing precision
- Simple construction
- Physical separation of the electrical and explosive components
- Removal of low density fill

Flexible Foil Characterisation

An investigation was performed using high-speed imaging to examine how altering manufacturing processes of flexible foils affected bridge burst and flyer formation. The frames below show a copper/Kapton flexible foil slapper cable during flyer launch. The top set of images show the foil as it undergoes vaporisation and then the Kapton flyer in flight. The bottom set show significant differences in bridge burst as a consequence of the manufacturing method used. The orientation of the bridge is as shown in the schematic of the detonator bridge above.

Another diagnostic tool that is used for characterisation is photonic Doppler velocimetry (PDV). This provides time of arrival (ToA) with significantly improved spatial and temporal accuracy compared to ToA probes, as well as providing flyer velocity. This same technique is also applied to detonators, measuring the velocity of the detonator can. The velocity data acquired can then assist in validating 3D magnetohydrodynamic models. Electrical data obtained using a current monitor and voltage probes can help validate 1D electrical models.

Further information: Amy.Mitchell@awe.co.uk

Second placed poster in the 2015 Poster Competition, Early Careers Symposium.

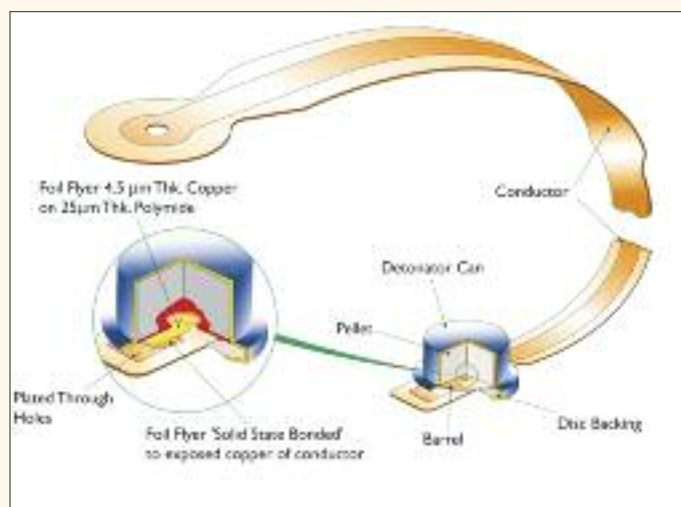
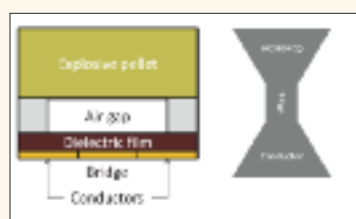
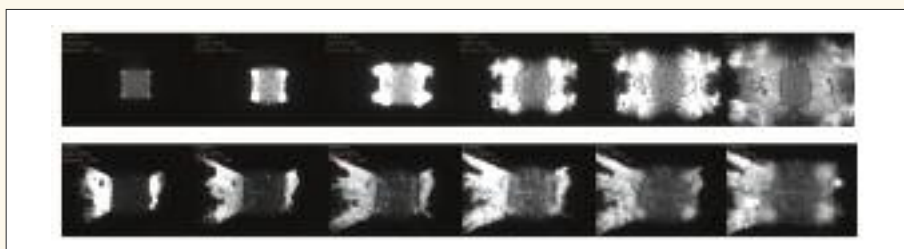


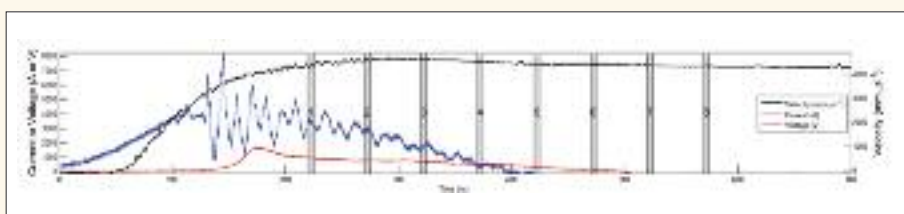
Image of a slapper detonator.



Simple schematic of a slapper detonator (left), and schematic of a slapper detonator bridge (right).



Images from EFI experiments showing evolution of bridge burst from left to right (top image) Merlin Flexible Circuits cable W. Neal & M. Bowden. (bottom image) AWE cable M. Bowden & A. Mitchell



Current and voltage measurements across the foil of the Merlin cable in above EFI experiment with the flyer velocity measured using PDV. Camera exposures are overlaid in grey. W. Neal & M. Bowden.





The All Party Parliamentary Group on Explosive Weapons

New Scottish MP to head crossparty group on explosive weapons

Roger Mullin SNP MP for Kirkcaldy and Cowdenbeath was unanimously elected as Chairman of The All Party Parliamentary Group on Explosive Weapons in July.

Commenting on his election, **Roger Mullin** said "Explosive weapons – whether they be landmines left over from previous conflicts, or suicide bombs used by misguided and callous dissident groups today – are an insidious and indiscriminate menace."

UK charity **Action on Armed Violence** (AOAV) reported earlier this year that global civilian deaths and injuries in 2014 from explosive weapons have gone up for a third consecutive year.

In 2014, 41,847 people were killed or injured by explosive weapons – of these 78% were civilians (32,662). In populated areas civilians made up 92% of casualties. (*Explosive States, monitoring explosive incidents in 2014*,

<https://aoav.org.uk/wp-content/uploads/2015/06/AOAV-Explosive-States-monitoring-explosive-violence-in-2014.pdf>)

Mr Mullin continued "International agreements to control the impacts of such weapons are a helpful start, but there are countries yet to sign and ratify the agreements, and countries who even today, fail to see the repugnance in the use of explosive weapons in areas where they impact on innocent civilians.

"The post 2015 sustainable developmental goals will be impossible to meet in many parts of the world while people are frightened to leave their homes, and in many cases, frightened to stay in them.

"Through the APPG on Explosive Weapons, I and my fellow concerned parliamentarians will keep a spotlight on the humanitarian consequences of the use of these weapons and the UK government's response to there use." more/...

In 1997 the UK signed the **Ottawa Treaty** - the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction and in 2008 signed the **Convention on Cluster Munitions**.

In November 2013, the UK Government published its approach to humanitarian mine-action 'Clearing a path to development'. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260365/mine-action-policy.pdf

Since 2008 the UK, through its international aid budget has contributed around £12.1 million per year to the global mine-action programme. (*Landmine Monitor 2014*, http://www.the-monitor.org/index.php/cp/display/region_profiles/find_profile/GB/2014)

Roger Mullin MP was elected to the UK Parliament in May 2015 with a majority of 9,974. He is an Honorary Professor at the University of Stirling where he previously taught postgraduates Applied Decision Theory, The Political Environment, and Organisation Change. He used to write a monthly column in The Times Educational Supplement Scotland and has worked as an educational consultant.

The All Party Parliamentary Group on Explosive Weapons draws attention to the humanitarian consequences of the manufacture, possession, sale, purchase, transport and unlawful use of explosive weapons, and to raise the profile of the humanitarian benefits of mine action work around the globe, awareness training and capacity building, campaigning for appropriate policy change and acting as a focal point for debate and the exchange of ideas, views and information.

Group membership

- **Chairman** – Roger Mullin MP, Scottish National Party;
- **Co-Chair** – The Lord Elton TD, Conservative;
- **Co-Chair** – Mark Durkan MP, Social Democratic & Labour Party;
- **Vice Chair** – The Lord Dubs of Battersea, Labour;
- **Secretary** – Mark Pritchard MP, Conservative.
- Richard Arkless MP – SNP
- Rt Hon Sir Kevin Barron PC MP – Lab
- Richard Burden MP – Lab
- Rt Hon Hilary Benn MP – Lab
- Sir Peter Bottomley MP – Cons
- The Viscount Colville of Culross – CB
- The Baroness Cox – CB
- The Rt Hon, the Lord Boateng – Lab
- The Lord Hannay of Chiswick – CB
- Fabian Hamilton MP – Lab
- Pauline Latham OBE MP – Cons
- Jeremy Lefroy MP – Cons
- Dr Matthew Offord MP – Cons
- The Lord Ramsbotham GCB CBE – CB
- The Lord Redesdale – LD
- Lord Steel of Aikwood – LD
- Lord Williams of Baglan – CB

Contact for more information

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Giant rats sniff out landmines in Tanzania

African giant pouched rats are trained by the Belgian NGO Apopo in the southern highlands of Tanzania in a nine-month bootcamp to sniff the scent of the remaining TNT from some of the 1,500 deactivated landmines that have been sown in the earth. Each time they find a mine and communicate their discovery with scratching, the rats are rewarded with a click and a mouthful of fruit. Already Angola and Mozambique have been reclaimed with Mozambique expected to be declared mine-free soon, and the rats are likely to be deployed in Cambodia where Apopo is working to clear up the explosive legacy of three decades of conflict.

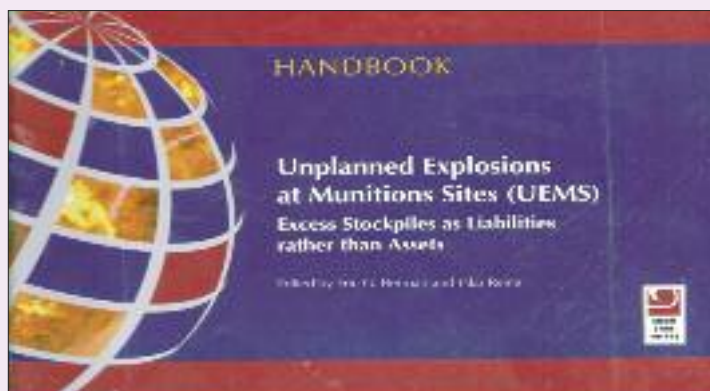
The idea comes from Apopo's founder Bart Weetjens 20 years ago who chose the African giant pouched rat, *Cricetomys gambianus*, for their intelligence and sense of smell which rivals that of dogs. They live up to eight years and with an average weight of about a kilo are too light to set off pressure-activated anti-personnel mines. Despite the £4,500 cost of training each animal, they are far cheaper and quicker than their human rivals. Apopo says that its rats can each search 200 sq.m. of land in just 20 minutes while people using metal detectors would take five days to search the same area.

In Mozambique, which was heavily mined during the independence struggle and the country's subsequent 15-year-civil war, Apopo's rats, handlers, manual demining teams and armoured vehicles have so far found and destroyed more than 13,000 landmines, reclaiming more than 11 million sq.m. of land.

Other rats are being trained to identify samples of human sputum for tuberculosis. Apopo received an award of £200,000 last year from the People's Postcode Lottery to further research.

Extract from article by Sam Jones in Morogoro, the Guardian, 5th March 2015, <http://www.theguardian.com/global-development/2015/mar/05/heroic-giant-rats-sniff-out-landmines-in-tanzania>.

Industry news continued on page 36.



Unplanned Explosions at Munitions Sites (UEMS): excess stockpiles as liabilities rather than assets

Edited by Eric G Berman and Pilar Reina

Book review by Mike Groves MIEpE MIMCSE who has a lifetime of experience both personally and on behalf of his professional bodies; IExpE (past President) and IMCSE (President).

I can vouch for the initiative, diligence and sheer hard work that went into this unique handbook by Eric Berman and his colleague Pilar Reina of the Small Arms Survey unit of the Graduate Institute of International and Development Studies, 47 Avenue Blanc, 1202 GENEVA. Switzerland:

Telephone: +41 22 908 5777, Fax: +41 22732 2738,
E-mail: sas@smallarmssurvey.org Website: www.smallarmssurvey.org

It took several years to come to fruition, another indication of the research and consultation that went into this most valuable project and we consulted often. The result is a handbook that records many Unplanned Explosions at Munitions Sites (UEMS). One must qualify the result in this way as it depended on the recording of such events, many of which remain private to the countries and organisations holding munitions. For example, I was once approached by an Embassy official not to declare that an event I was investigating was caused by incompetence as no international aid would be forthcoming if the official version reflected that decision. Just a small incident in the declaration "game". The correct version is in this handbook.

The handbook is a "must have" for: students researching such situations for government and international bodies, as a record that is consulted by the various authorities, the media when researching related events and related university libraries. It is a "must have" for those whose professional status involves such incidents and their investigation. Copies are held by IExpE and IMCSE for their members use and the address above can be used to order personal and other copies.

As a Reviewer I make a plea... That any professional who can add to knowledge and the circumstances of an event, officially or anonymously, will be helping his or her profession to enable the correct interpretation of UEMS events to take place.

Indeed, the Small Arms Survey has created a UEMS Incident Reporting Template (IRT) to facilitate the reporting and collating of improved data... the UEMS IRT can be found in English, French, and Russian (with versions planned for Arabic, Chinese, Spanish and Swahili) in Research Note 40:

http://www.smallarmssurvey.org/fileadmin/docs/H-Research_Notes/SAS-Research-Note-40.pdf

MP Groves MIMCSE, MIEpE

Conferences/Exhibition Diary

DSEI 2015

ExCol, London, 15th to 18th September 2015

Defence and Security Event for Security and Special Forces covering the latest technological developments from the security sector and the rapidly evolving challenges within the cyber domain.

Further information: enquiries@dsei.co.uk

ORDNANCE MUNITIONS & EXPLOSIVES SYMPOSIUM

Defence Academy of the United Kingdom, Shrivenham, 29th to 30th September 2015

Held on behalf of the Sector Skills Strategy Group (SSSG) of the explosives industry and Cranfield Defence & Security

Further information: www.symposiaatshrivenham.com

ISEE'S 42ND ANNUAL CONFERENCE ON EXPLOSIVES AND BLASTING TECHNIQUE

Paris Hotel, Las Vegas, Nevada, USA, 31st January to 3rd February 2016

Further information: mangol@isee.org

HILLHEAD 2016

Hillhead Quarry, Buxton, Derbyshire, 28th to 30th June 2016

Quarrying, construction and recycling.

Further information: www.hillhead.com

In a Flash Holli Kimble

MEng CEng MIEExpE MIMechE



Your age:
27.

Occupation: Explosives Engineer.

Current position: Trials and Technology Manager, Defence Equipment & Support.

Responsibilities in job/work activities:

I manage a small team of engineers in the development of safe trials programmes for weapon systems including the delivery of robust safety cases. I am responsible for managing the complex stakeholder relationships from the Project Sponsor through to the contractor organisations responsible for delivering the trials, ensuring clear, achievable requirements.

Why are you involved in IExpE?

I joined as a Student Member while I was studying on the Explosives Ordnance Engineering MSc at Shrivenham and I find that being a Member is a good way to meet lots of people and hear about what is going on across this varied industry.

What are the benefits for you of the IExpE?

The Institute is small and relatively close-knit, especially the South (Central & West) Branch, which means that there are lots of people to meet. Being elected to the Council of the Institute also means that I am able to contribute to the way the Institute is moving forward, which is rewarding.

What alternative career might you have followed?

I was quite keen on becoming a Regular Army Officer in the Royal Electrical and Mechanical Engineers.

Who do you most admire on the current world stage and why?

I admire Angelina Jolie. When she was filming Tomb Raider in Cambodia in 2000 she was shocked by the on-going humanitarian issues and shortly afterwards became a UN Goodwill Ambassador in her efforts to make a positive change, since then she has spent a huge amount of time and money doing what she can to help displaced people.

Who would you most like to meet from any century and why?

I would choose to meet my Aunt Judy, who was a source of pride and inspiration for my family.

What are your favourite activities/hobbies?

Travelling is my absolute favourite thing to do, but I also love reading, cooking and trying new food.

What is your ideal holiday?

It would have to be something adventurous and ideally somewhere hot. If money were no object then I would love to backpack around the world.

What is your favourite type of food?

It's a tough one, but it would have to be a type of Asian cuisine. I especially like Thai food, though I have recently been introduced to Sushi and am a huge fan..

Industry news continued....

STOP PRESS



As we go to print, we report on a massive explosion that rocked the Chinese city of Tianjin on Wednesday 12th August. Two blasts occurred in a warehouse storing "dangerous and chemical goods" in the port area. The first explosion at 23.30 was followed by a second more powerful one and a series of smaller explosions.

The impact of the blasts could be felt several kilometres away and was registered as seismic activity at a US Geological Survey monitoring unit in Beijing 100 miles away. The China Earthquake Networks Centre said the magnitude of the first explosion was the equivalent of detonating three tonnes of TNT while the second was the equivalent of 21 tonnes. At least 100 people died and 700 were injured.

China Central Television (CCTV) said a shipment of explosives had detonated but this has not been confirmed. There has been some criticism in China media that a warehouse containing such dangerous chemicals should have been sited near a main road, housing complexes and office blocks.

Further information: www.bbc.co.uk/news/world-asia-33900268

From 30th September emails will be as follows:

President@iexpe.org - Dave Welch
 Director@iexpe.org - John Wolstenholme
 Secretariat@iexpe.org - Vicki Hall
 Membership@iexpe.org - Andy Pettitt
 Editor@iexpe.org - Diane Hall
 vp.operations@iexpe.org - TBC
 vp.projects@iexpe.org - Paul Harris
 Finance.director@iexpe.org - Ian McKay
 Registrar@iexpe.org - Ken Cross
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 Please see final list on the website www.iexpe.org

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IExpE Journal calls for papers

Deadline for December 2015 issue is October 31st 2015.

1500 - 3000 word articles and papers will be considered for publication and should be accompanied by digital illustrations eg. photographs, drawings and tables.

E mail the Editor: editor@iexpe.org

PLACE UNITS ON MAPS



TRACK YOUR UNITS AND PROJECTS

Units

Showing 1 of 11	Sort	Unit Name	
East Off Ramp Minimate Pro®	0	MP1294	Assigned I-50 Substation
South Face Near Crusher	0	UM5012	Assigned TCO Quarry
West Property Line Remote Station #1	0	UM9006	Assigned Light Rail Project
West Jones House Remote Station #2	0	UM9482	Assigned Light Rail Project
	0	UM9876	Assigned I-50 Substation

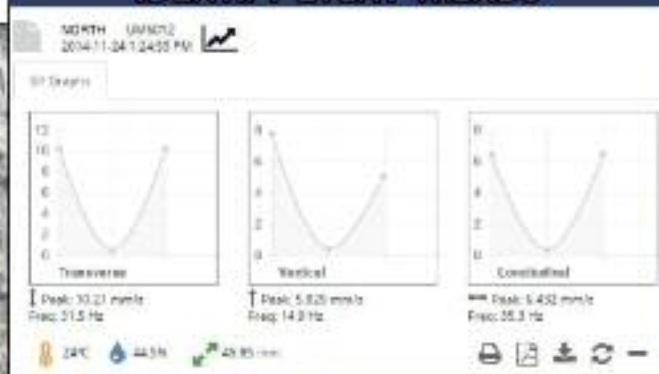
VIEW PROJECT INFO AT A GLANCE



ADD NOTES TO REPORTS



IDENTIFY EVENT TRENDS



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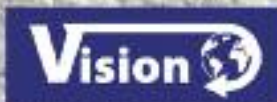
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