

SAFEX NEWSLETTER

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This is your Captain Speaking

Daniel Degove (Davey Bickford)



Daniel Degove accumulated thirty years of operational experience working for international industrial firms, including Corning Glass Works, Philips, CarnaudMetalbox, and Thomson. Much of this time was spent occupying leadership positions in executive management.

As the CEO of Davey Bickford since November 2010, Daniel Degove is targeting to consolidate the business for efficiency and cultivate its international development.

Davey Bickford was founded by William Bickford in 1831. Since 1901, production has been based in Héry, France, near the more widely known city of Chablis. Over 500 employees work in 200 buildings on the 42 hectares site

In the industrial sector, and especially in the field of pyrotechnics, company leadership of occupational risks is critical. We must consider the constraints, risks, and dangers associated with each stage in the life of our products, from production to end-customer use. As a Team, we take it one step further to protect our employees by anticipating these occupational risks!

Health, Safety and Environmental (HSE) actions are key in ensuring the longevity of our business, installations, and products and clearly essential for protecting our people. We must allow our employees to work in safe conditions, but we must also protect those who live near our production sites and the end-users of our products. At Davey Bickford, we have one predominant objective: Zero accidents.

To ensure this happens, several measures are in place, beginning with individual accountability. At each level of the company, and for the good of all, individuals must realize what consequences their actions might have. HSE teams must therefore raise employee awareness, providing them with the necessary information and training.

Almost two hundred years of operation have made Davey Bickford conscious of HSE considerations and the continued need to address them to guarantee a long life for its business and employee base. This experience, persistent application, and a strong culture of continuous improvement have endowed our company with the globally recognized skills behind the design of its products. We want to retain, and live up to, this benchmark distinction for safe, superior, high-tech pyrotechnic initiation.

To meet these goals, Davey Bickford's HSE team, 11 people strong, methodically analyses incidents to eliminate all potential causes of accidents. It also relies on feedback from employees, clients, and suppliers, and industries in the field. The scope and nature of our actions are broad. Among the themes addressed are production

site safety and conformity, product traceability, prevention of major accidents, improvement of workstations and work conditions, customer support, compliance with international regulations on transport safety (e.g. known loading agent, IATA, and UN recommendations), pyrotechnic qualifications, and user safety. Last of all, since we practice continuous improvement, efforts are under way to obtain ISO 14001 certification for Davey Bickford's environmental management system.

Meanwhile, our R & D (Research & Development) team works to create products that are completely safe and reliable at all stages in their life cycle - from design, industrialization, and production, to transport and use.

Lest we forget, Davey Bickford is a signatory of the Global Compact, a UN initiative which encourages companies around the world to adopt a socially responsible attitude. Participating businesses are asked to commit to following and promoting key principles related to Human Rights, Labour, Environment, and Anti-Corruption measures.

For all of these reasons, I am happy and proud to lead a company that shares in the philosophy and execution of continuous improvement!

Board appoints Secretary General Designate

The SAFEX Secretary General is appointed for the duration of a 3-year Congress cycle at a time. At the end of the next Congress Boet Coetzee would have been in this position for 9 years. After the last Congress, he indicated to the SAFEX Board of Governors that he does not believe it is in the best interests of organizations, especially small ones such as SAFEX, for executives to stay too long in the same position. Therefore, the Board decided to find a replacement to take over as Secretary General after the next Congress in May, 2014.

At its meeting in Fort Worth on 10 February 2013, the Board agreed to appoint Dr Piet Halliday as Secretary General designate. Piet will be retiring from his current position in AEL Mining Services at the end of 2014 and Boet will be happy to stay on until Piet is ready to take over as Secretary General. As a serving Governor Piet has had a long association with SAFEX and knows the Association well. He is also well-known and respected in our industry. There is no doubt that under Piet's leadership SAFEX will grow from strength to strength and the Board knows you will give him the same support Boet enjoyed during his tenure.

SAFEX Newsletter asked Piet to outline his background and hobbies for the benefit of our readers.

Dr Piet Halliday: Secretary General Designate



After completing a PhD on the synthesis of high energy sensitizers for explosives, Piet started his explosives career in 1980 at African Explosives Ltd (AEL) – then known as AECI. He was appointed as Research Officer to initiate the first research and development work on emulsions. 16 patents mainly around chemical gassing and pumpable explosives were filed as result of this work. In the mid 80's he built and commissioned as Project Manager the first packaged emulsion plants and pump trucks in South Africa.

During the time ICI Explosives owned AEL Mining Services (AELMS), he moved back to the Research & Development department as Technical Manager and became the Chairman of the Global Packaged Explosives Business which included the global packaged explosives technology. He also managed this product portfolio in Africa for the AELMS business. Piet is currently the Executive Director in AEL responsible for research and technology and also has executive responsibility for safety in the company. In this capacity he looks after the AEL Mining Services global technical portfolio covering its whole product offering. His duties include research and development, plant and field support, decontamination and remediation of NG sites as well as international liaison on products, systems and technology. He has since filed / co filed another 15 patents ranging from explosives to initiation systems.

Piet's experience and expertise is sought after by a number of institutions. During the early 90's he became chairman of the National Institute of Explosives Technology (NIXT) which serves the commercial and other manufacturers in Southern Africa. Besides being a Governor of SAFEX International, Piet has also served on the board of the International Society of Explosives Engineers (ISEE) as well as the National Council for Explosives in South Africa. He was one of the founder members of the Rheology Centre at the Cape Peninsula University of Technology and currently serves as the Chairman of the Southern African Society of Rheology (SASOR). He has twice received the Certificate of Merit from NIXT, has been awarded Life Membership of NIXT and was also awarded the prestigious Presidents Award by the ISEE for service to the institute and the industry.

You may well ask whether he has time for any personal interests and hobbies. "If not spending quality time with my three grandchildren I love sailing and motorcycling," says Piet. "And if you see a guy driving around Johannesburg in an AC Cobra over weekends, look carefully it may just be me."

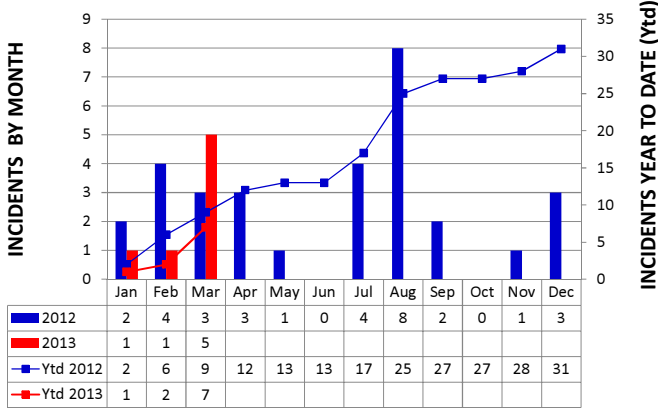
Incident Reporting

Monitoring our Reporting Performance

“Every incident that is reported may prevent another from occurring. You can save a life by reporting an incident - including a near-event.”

SAFEX learns from its members’ experiences through the incident reports we receive. By applying these lessons we can prevent similar incidents recurring. That is why we track our incident reporting performance as follows:

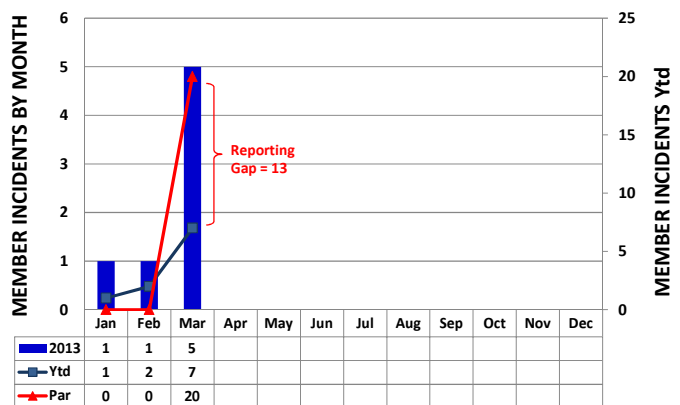
ALL INCIDENTS REPORTED: Ytd 2013 vs 2012



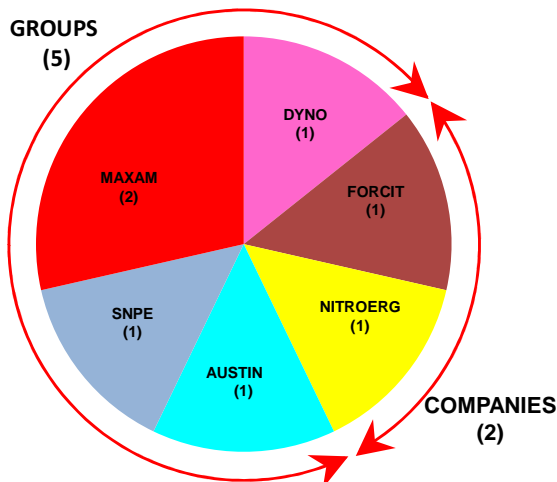
All the incidents reported. This chart compares the sum of non-member and member incidents reported to SAFEX every month this year to the previous year. We have reported 20% fewer incidents this year compared to the same period in 2012. Are we having fewer incidents or are we not reporting the incidents we are having? Every incident not reported is a lost learning opportunity. Remember, it’s never too late to report an incident.

Member incidents reported. Because they give us the best learning opportunities, we track member incidents (MI’s) separately in the chart on the right. PAR is an estimate of how many MI’s are occurring based on the severity of the MI’s that have been reported this year. The gap between the number of MI’s reported and PAR is our Reporting Gap. The Reporting Gap suggests that less than ½ our MI’s are being reported.

MEMBER INCIDENTS REPORTED Ytd 2013



MEMBERS INCIDENT CONTRIBUTORS: Ytd 2013



Contributors of member incidents. This chart identifies those members who reported incidents. It shows the number of incidents each of these members reported relative to the total number of MI’s received. The chart distinguishes between Groups and Companies merely to indicate the performance of the two membership categories. There are about twice as many operating units in the Groups than single Companies.

Know the Expert Panel

The **Expert Panel** comprises individuals who were nominated by members and approved by the Board. Such an individual must be associated with the explosives industry and possess expertise in specific fields. He must also be willing to make his expertise available to SAFEX members on a commercial basis which is agreed between the expert and the member. SAFEX does not get involved in the detailed arrangements but merely “connects” the Expert and the Member with the need.

To access the services of a SAFEX Expert, a client Member accurately defines the need it wishes the Expert to address. This requirement is captured in a Brief which is e-mailed or faxed to the Secretary General. The Member will be notified of the details of Experts that specialize in the fields of expertise designated by the client Member. It is then up to the Member to select an Expert and enter into an agreement directly with him.

Stafford A Smithies

PERSONAL

Position: Consultant
Company: Victor Solomon & Assoc.
Location: Pretoria, South Africa
Education: PhD (Eng) Natal 1984
 MSc (Eng) Wits 1969
 BSc Hons Natal 1965
Registration: C.Eng (UK)
 Pr.Sci.Nat. (South Africa)
Affiliations: MIET (London); SMSAIEE;
 Member: Safety-critical Systems
 Club (Newcastle, UK)
 Member: Surface Mount
 Technology Association (USA)
Languages: English;



CAREER OUTLINE

CSIR, South Africa (1969-89):

R&D Engineer
 Program Manager

University of Edinburgh (1972-73)

Researcher

University of Natal (1984-89):

Honorary Associate Professor
 of Microelectronics

AECI & ICI (1989-2007):

R&D Manager, Expert Explosives
 Senior Consultant, DetNet

Victor Solomon (2007-Present):

Consultant

EXPERTISE

- Compliance testing and documentation preparation for initiator systems for submission to European Notified Bodies and authorities in South Africa, Australia, Canada and USA.
- Hazard identification and risk assessments of explosives electronic systems in manufacture and use.
- Accident investigations, particularly involving electrical or electronic issues.
- Expertise in high-voltage and electrostatic discharge protection and safety in design and manufacture of electronic initiators and associated systems.
- Electromagnetic compatibility (EMC) compliance testing of electric and electronic initiators and EMC hardening of associated electronic equipment.
- Implementation of standards and other quality measures in electronic outsourcing to meet the requirements of safety-critical electronic systems for explosives

TYPICAL ASSIGNMENTS

- 1969 – 1972 Established and staffed a microelectronics R & D facility.
- 1973 – 1989 Involved in high-voltage, high-reliability semiconductor devices and developed direct explosives initiation on the surface of a microchip
- 1989 – 2000 Developing technology for on-chip explosives initiation; establishing safety parameters for electronic initiators; electrostatic discharge (ESD) and electromagnetic compatibility (EMC) testing and electronic detonator module manufacture
- 2000 – 2007 Risk assessments; investigations; compliance testing and approval of electronic blasting systems
- 2007 – Now Involved in contracts relating to detonators and explosives, covering approval testing, certification and CE marking. Other activities included studies of electromagnetic compatibility for safety in explosives plants and in the mining environment, with particular reference to electric and electronic initiators and blasting systems. Information was provided to explosives regulatory authorities in the development of EMC regulations for explosives manufacture and usage. Involved as technical resource in risk assessments of new initiating products and as an ESD authority in establishment of electrostatic protected areas for explosives manufacture.

Meet our Workgroups and their Leaders

The SAFEX Workgroups are an integral part of SAFEX's service offering. One can describe them as the engine room of SAFEX's efforts to identify good explosives practices. They focus on specific areas where members have common health, safety or environmental (HS&E) concerns. In the Workgroups members pool experiences and resources to produce an outcome that reflects their collective knowledge for that area of concern. Typical outcomes include a standard, guideline or good practice that promotes ongoing safe operation in the area concerned. The Board of Governors has established the following Workgroups with the designated Workgroup Leaders. Piet Halliday is the Governor responsible for overseeing the performance of the Workgroups:

- Good Explosives Practice (GEP) (Dr Martin Held – Austin International)
- Explosives Traceability - Track and Trace (Dr Noel Hsu – Orica Mining Services)
- Safe Technical Grade Ammonium Nitrate (TGAN) Storage (Dr Noel Hsu – Orica Mining Services)
- Explosives Transport (Henry Merrick – AEL Mining Services)
- Explosives Emulsion Manufacture (Dawie Mynhardt – BME South Africa)
- Explosives Remediation/Decontamination (Mervyn Traut – Expert Panel Member)

Given the importance of the Workgroups, SAFEX Newsletter will be introducing our Workgroups and their Leaders to you in each edition. We have done so in alphabetical order of the Leaders and it is now the turn of Henry Merrick.

Henry Merrick – Explosives Transport



Henry Merrick considers himself first and foremost a family man with a lovely wife and three boys. His more than 20 years' experience in safety and health management systems, auditing, training, etc. has equipped him well for his work in AEL Mining Services as the Group Safety and Health Manager. In this capacity he is responsible for all occupational safety and health aspects Group-wide. This includes all AELMS' business units. Henry has also worked at Ford Motor Company of Southern Africa in a similar role. Besides having a B-Tech Degree in Fire Engineering, he has also completed the Management Development Program, Safety Management Training Course, Dangerous Goods Safety Advisor and various safety and health related courses. He is doing a Master's degree in Management with the University of Southern Queensland, Australia and hopes to conclude it in 2014.

The Explosives Transport Workgroup recognises that the transportation of dangerous goods including explosives, initiating systems, chemicals and various other products remain a concern throughout the explosives industry. Numerous "near-events", incidents and accidents occur on almost a daily basis and the Workgroup wants to ensure that safety linked to the transportation of these products gets the attention it deserves. While the Workgroup was established a while ago, its efforts can best be described as disappointing. However, Henry is convinced it can add value and make a substantial difference if all concerned can put their heads together and work towards a common goal. That goal aims to:

- Exchange information with regards to transport related issues within the explosives business,
- Establish a formal workgroup to address on-going issues within the transportation activities,
- Communicate changes which may

affect our business or part thereof and

- Discuss previous incidents, share learning and promote international compliance.

By the next Congress we want to identify about 7 Core Members representing the major explosives role players and finalise at least two Good Practice Guides. Identifying the Core Membership of the Workgroup has proven to be a difficult task. As the Core Members will be people with a passion for explosives transport safety, they will be the engine that drives the Workgroup.

The Workgroup session at the 2011 Congress in Istanbul was attended by 15 delegates from the SAFEX members such as AEL Mining Services, EPC, Austin Powder, Exsa, Societe Suisse Cheddite, Enaex, MKEK, Orica Nitro, Hanwha and Saudi Chemical. The meeting decided to:

- Convene at least one Workgroup session between the SAFEX Con-

gresses. This is planned for 2013 and I am awaiting feedback from group members.

- Prepare at least two Good Practice Guides (GPG's) for explosives transport. One GPG on Emergency Planning and Response was distributed but only two members provided feedback.

Interest in the Workgroup appears to be very low and Henry has requested participants in the Workgroup session at Istanbul to suggest how the Workgroup can be improved to deliver the expected outcomes. Let's hear what Henry has to say about this: "It is crucial to get members onto the Workgroup who are committed and passionate about transport safety because they will make the time to address the objectives of the Workgroup. It may sound as if I am making excuses but there are difficulties when the Core Members need to address certain issues and they are spread all over the world. Having said that – we just need to make it work as it is essen-

tial to our businesses. We have to address the fundamentals linked to the transportation industry and cannot afford mistakes. Even if explosives transport has been outsourced, the “cradle to grave” principle applies – we remain responsible. Our immediate

objectives must be to establish the Core Membership and meet at least once during 2013.”

You can hear Henry’s plea from the heart. If you have a passion for transport safety and want to make a

contribution to this aspect of our industry, why not contact Henry. His Email address and telephone number are henry.merrick@aelms.com ; +27 11 606 0219 (Work); and +27 82 8509504 (Cell).

QRA Corner

Welcome to another instalment of the SAFEX Newsletter series called the QRA Corner. Each column will examine a particular aspect of state-of-the-art applications, large-scale testing, and algorithms associated with Quantitative Risk Analysis (QRA) models. Your authors will rotate between Lon Santis, Manager of Technical Services of the Institute of Makers of Explosives; John Tatom, Manager, Explosives Safety Group at APT Research, Inc; and Mike Swisdak, creator of the US Department of Defense’ ESKIMORE large scale test program and currently a senior scientist at APT Research. Our previous instalments comprised a series of questions and answers that often come up when the issue of QRA is first raised and the issue of large scale testing to enhance the algorithms used. This instalment focuses on how tests can be designed to produce results that can be used to anchor the elements of a QRA model.

Anchoring Models to Test Results

by

John Tatom (Explosives Safety and Testing Division Manager, APT Research, Inc)

As mentioned in the last QRA Corner article, accurate quantitative risk assessment (QRA) models depend on algorithms that are validated against full scale tests. Also previously mentioned was the concept that a semi-empirical model has to “err on the side of caution” for scenarios without such supporting data. Therefore, for efficient operation it is critically important to incorporate all available test results that are pertinent to the QRA model.

This article will begin to introduce the idea of how tests can be designed to produce results that can be used to anchor the elements of a QRA model. It is important to note that, although the test results “are what they are” (they shouldn’t be ignored or manipulated for some non-technical ulterior

motive), the tests themselves can be designed with the goal of supporting model needs.

DEFINITIONS OF EFFECTS AND CONSEQUENCES

As defined in the QRA Corner article in Newsletter 41, for modeling purposes, the effects of an explosive incident are the changes in the environment created by the blast outside the donor structure (if one is present). Such effects include overpressure and impulse, debris, and thermal. The consequences of a blast are the results on the target structure (if one is present), including glass and structural failure, and any exposed people. The vulnerability of the people must also be modeled. This model is depicted in Figure 1.

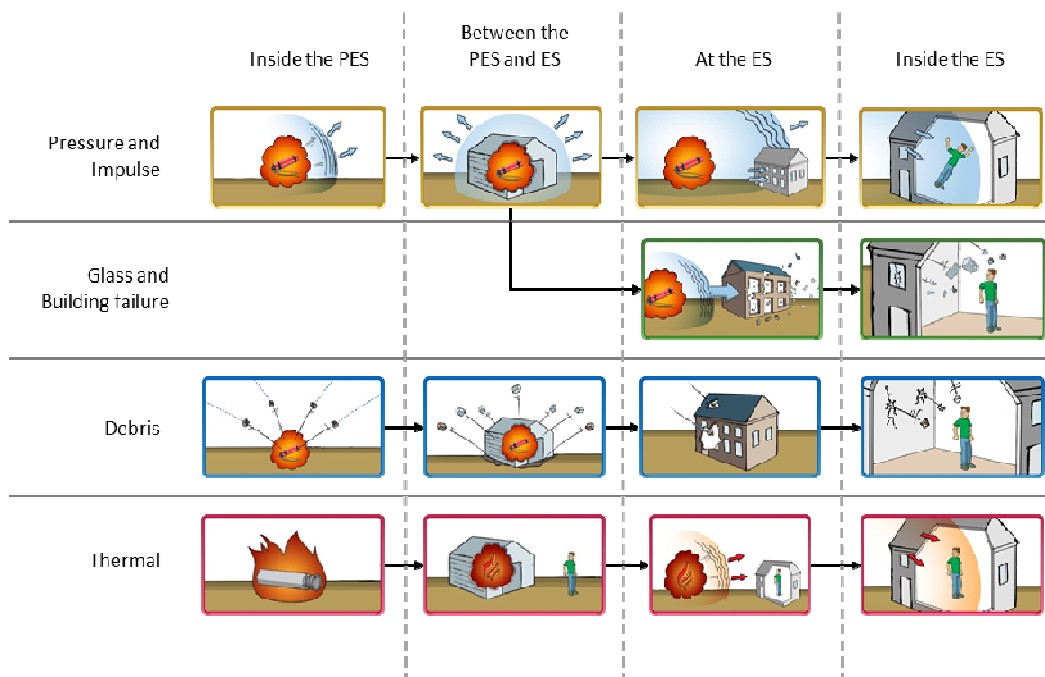


Figure 1: Blast Effects and Consequences

How then are test results used to corroborate or anchor the model?

Yield: Before any other blast-related effects and consequences can be considered, the size or strength of the event must be established. The “yield” of an event can be thought of “if this much stuff of that sort in this type of packaging in that sort of building were to explode, what amount of TNT in the open would create an equivalent overpressure?” (roughly speaking). The yield can be determined from test results with simple and relatively inexpensive pressure gauges; when there is only one variable (e.g., introduction of a concrete structure as a PES, containing an unpackaged TNT charge), the effect of that variable on yield is easy to characterize. In order to limit the variation to one parameter, a “calibration shot” is sometimes conducted to characterize the explosive articles to be used in the test.

Pressure and Impulse: Of course the gauge readings are also used to characterize the pressure and impulse at different locations, including the “blast load” at the face of any target structure experiments. Simple displacement gauges may also be used on targets to estimate loads. Depending on the location and purpose of the gauge, the readings may be for peak incident values or for reflected values – or even shielded values behind a barricade or inside a target structure. Measuring pressures and impulse inside a donor structure is more challenging, but is generally possible.

Structural Response: Given the establishment of yield and blast load parameters, the response of any target structure (or glass) experiments can be characterized. For QRA tools interested in consequences to exposed personnel, these structural response findings are then translated to expected human vulnerability. Of course, not all tests have target experiments, as they may actually interfere with the debris results.

Glass: Glazing targets can be stand-alone experiments or included as part of a target structure. The first question is whether the glass breaks, then whether it will become a hazard (versus staying in the frame or falling out with little chance of harming a person), and finally how significant the hazard would be. Breakage is relatively easy to determine, and the distance the glass shards have traveled can be measured after the event without much trouble. High-speed cameras can also be used to determine the velocity of the shards, as well as to tell more about the behavior of the glass before, during, and after breakage. The most difficult aspect is of course the human vulnerability; while gelatin targets can be used to simulate human flesh, it is difficult to model the human reaction and the timing of the glass interaction with the occupant. This consequence mechanism is considered by many to be well-characterized up to the point of human response, and poorly understood thereafter.

Building Failure: As mentioned, the response of the target building can be measured in terms of wall displacement or number of failed panels or such, but much of the information gained in this area is through interpretation of damage by

structural experts (example shown in Figure 2). The task is to establish a level of damage that can be translated into a consequence level for occupants. Critical determinations, such as whether the roof failed or not, establish key anchor points for the models .

Debris: Using test results to create a debris model can be tricky. The first decision is to physically capture the debris in some way (e.g., having the fragments strike a “soft catch” system) or to allow them to translate naturally. The advantage of a capture system is that information about the mass distribution and velocity can be obtained relatively quickly and without the need for a lot of land, but the downside is that the debris density as a function of range and azimuth cannot be observed (although it could be predicted). It



Figure 2: Sample Test Results (Damage Interpretation)

may also be costly to devise an adequate capture system, and it may only be feasible for small charge weights. The natural translation option allows for the determination of all of the information (with some complications, of course) when using a combination of high-speed cameras and a debris recovery crew, and can be done for any charge weight. However, this requires a large test range, and is very demanding in terms of time and effort (thus, money).

Primary Fragments: The fragments created by the casing or packaging of the explosives articles are typically not a dominant hazard for commercial explosives. If testing material other than bulk explosives, these primary fragments can be distinguished from other debris such that models can be created to represent their behavior.

It is important to note that in testing, all the explosives articles may be forced to initiate, rather than allowing natural communication. This is done in order to know the exact size of the event (i.e., the yield) and to minimize the danger of having unexploded articles thrown around the test range. However, this may create an unrealistic set of primary fragmentation results.

Secondary Debris: On a full-scale test debris recovery effort, the “big job” is to characterize all of the donor structure debris. For a concrete donor, this type of recovery effort can take a crew of 50 people several weeks to complete. Additionally, concrete or masonry debris may shatter on initial

impact, so the results have to be interpreted before use in the model. Further complicating the problem is the “bounce-skid-roll” aspect of the debris; after the test, it may be difficult or impossible to recreate the complete trajectory history, knowing only the final resting place. This problem applies to all material types of debris, and is to some extent dependent on the range conditions (which may match typical real-world conditions).

To help determine the starting point of a particular piece of debris, the different elements of the donor structure can be dyed or marked in some way that will survive the event. An example of this was shown in the QRA Corner article in Newsletter 43 on the SciPan test series.

Crater Ejecta: This category can range from massive clay “clods” to shattered elements of the floor slab under the donor structure. The slab concrete can also be dyed to distinguish it from the walls or roof of a concrete donor. The earth debris is readily identifiable as ejecta, unless there is earth-cover on the donor, or some sort of earth-filled barricade between the donor and the recovery area. Shatter is typically a

serious issue with ejecta, as the pieces tend to be falling at a sharp angle and are often in a brittle condition (post-event).

Thermal: Video review and simple inspection are often adequate for determination of the fireball radius from an event (which also must be considered when placing cameras, such that the desired information is not obscured by the fireball). Thermocouples or more advanced heat flux measurement equipment can be used, but may be beyond the level of detail required for the QRA model.

Vulnerability: With all of the hazard mechanisms, the most difficult part of the final answer is the human element. Tests do not include actual humans, of course, and substitute targets may not be as reliable as desired for determining human response. This leads modelers to review accident or terrorist event data to try to supplement test results, but then the controlled circumstances of the test are lost.

Future articles will discuss specific algorithms and how they are anchored to test results, and comparisons will be presented between model predictions and test (and accident) data.

Putting Science to Work

In this Newsletter Feature we try to publish articles with a technical bias that illustrate how our industry is putting science to work in the interests of explosives health and safety. We want to recognise those who are involved in research and development as well as encourage them to continue improving our understanding of the behaviour of explosives. While explosives have been around for millennia there are still big gaps in our understanding of how and why they sometimes behave the way they do. As long as those gaps exist we are vulnerable. This Feature is also a forum for explosives scientists to advance scientific theories on why certain incidents occurred. This can further enhance our learning from those incidents. SAFEX wants to put science to work in order to prevent the harmful effects of explosives incidents.

Spontaneous Detonation of Initiators

by

Edmund Demberg (Picatinny Arsenal, Dover, NJ USA)

In August last year, one of our Members experienced what appeared to be the spontaneous detonation of two cases of aluminium short delay detonators in a detonator magazine. This occurrence puzzled the SAFEX community who were asked for suggestions about possible causes. As a result Dr David Kennedy (Orica Mining Services) kindly brought this Paper to our attention.

This Paper was presented at the Fifteenth Explosives Safety Seminar, Department of Defense Explosives Safety Board (DDESB), San Francisco California on 18-20 September 1973. It is published as presented with the kind permission of the DDESB through the gracious offices of Lea Ann Cotton, Safety Engineer at the DDESB and Picatinny Arsenal. The DDESB pointed out they cannot guarantee the data in the Paper. Notwithstanding, we believe our readers can learn from the Paper and SAFEX Newsletter thanks the DDESB for allowing us to publish it.

My talk today is on the spontaneous detonation of initiators. I will indicate the severity of the problem, the mechanism believed to be the cause and the corrective action that must be taken to eliminate and/or alleviate the problem.

In discussing spontaneous detonation, I

will be referring to explosions that have occurred in non-electric detonators and relays without any stimuli from outside the packaged items.

In September 1961 at the Lone Star Army Ammunition Plant approximately 5,000 non-electric initiators in an isolat-

ed barricade exploded without apparent cause. Since that time there have been approximately 20 known instances in which non-electric initiators detonated spontaneously, the seriousness of this problem went unrecognized for many years due to the low frequency of occurrences, the absences of personnel

injury and the relatively minor amount of property damage. In 1968 to 1970, due to a major increase in production, the problem became painfully evident with a rash of spontaneous detonations resulting in extensive property damage and lost production.

The initiators involved in the spontaneous detonations are basically an explosive pressed and enclosed in a metallic cup. In general, they are classified in accordance with the method of initiation. Our particular interest is the stab or non-electric initiators. They are utilized as the component of an explosive train which can be activated by either a non-explosive impulse or the action of a primer. The initiators are capable of reliably initiating high order detonation in the subsequent high explosive component of the train. When activated by a non-explosive impulse, an initiator includes the function of a primer. An example of such a device is the M55 stab detonator. It consists of an initial charge of NOL 130 primer mixture, an intermediate charge of RD1333 lead azide and a base charge of RDX. It is functioned normally by the penetration of a pin through a coined bottom of the aluminium case into the primer mixture. The M55 detonator has the largest rate of production of the initiators and has been involved in the greatest number of spontaneous events.

Examples of items that rely on the action of a primer to initiate detonation are the M17 detonator and the XM relay. The M17 detonator has an upper charge of dextrinated lead azide and a lower charge of tetryl in an aluminum cup. The M17 has a large involvement in the spontaneous incidents. The XM relay is the simplest device involved in the spontaneous detonations. It consists of a dextrinated lead azide charge loaded into an aluminium cup. The XM relay has produced the highest frequency of spontaneous detonations.

The average frequency of all the events is one detonation in 80 million manufactured items, seemingly a very tolerable record. The items are small and in themselves, incapable of causing any significant amount of property damage. The safety precautions and shielding

incorporated during their manufacture provide a high degree of personnel and property protection. These non-electric initiators are, however, communal. After their manufacture, they reside 50 to a pack. Twenty of these boxes are placed in an outer package to give a total of 1000 items. Ten outer boxes are incorporated into an over-pack to bring the total of items that are in close proximity to 10,000. During manufacture or prior to shipment, inner or outer boxes are stored in rest or hold areas where their number could very well be increased. And when that one initiator in 80 million decides to go off, it takes all its neighbours with it. The result is a mass detonation with extensive property damage and a threat to personnel.

In Iowa Army Ammunition Plant on 27 November 1968, there were 334,949 M55 detonators in rest storage. These detonators, manufactured during the day and afternoon shift, were being placed in rest storage during the past 12 hours. Approximately 30 minutes after the last detonators were placed in rest storage, an explosion occurred resulting in \$105,389 property damage.

At Lone Star Army Ammunition Plant, on 22 March 1969, an explosion occurred in a trailer van parked in front of an igloo. There were 531,000 detonators in the van of which 100,000 were M55's. The detonators had been placed in the van approximately eight hours prior to the explosion. The minimum time since manufacture of any detonator in the van was 48 hours. The property damage resulting from the spontaneous detonation was \$35,411.

Another explosion occurred at Lone Star on 17 May 1969. The igloo contained 680,710 rejected detonators of various types (M55, M17, M24, M63 and M50). The last activity in the igloo occurred on the 15 of May 1969.

At Iowa on 25 February 1970, an explosion occurred involving over 900 lbs. of explosive. It was attributed to the spontaneous detonation of one of 248,850 M17's or 4,000 M7's in a rest storage building. Safety inspectors had checked the storage building 2 - 3 hours prior to the explosion and found no discrepan-

cies. No operations of any kind were being performed in the rest house or a service magazine, both of which were destroyed. The resulting property damage was \$304,574.

There have been some sixteen additional incidents with varying degrees of lesser property damage and miraculously no injury or loss of life.

Under the direction of MUCOM safety office, the spontaneous detonation committee was formed at Picatinny Arsenal in August 1969. The committee reviewed all data pertinent to the unexplained explosions and established and conducted a program to determine causes and necessary corrective action to stop or negate the devastating effects of spontaneous detonations.

It was quickly established that certain factors were common to all the occurrences:

1. Lead azide was utilized in all involved initiators and in some cases was the only explosive. Lead azide is extremely sensitive to electrical activation. Under certain specific conditions, lead azide can be initiated with as little as 10-3 ergs (4 volts, 20 uuf) of electrical energy. The sensitivity is greatest in dry samples of fine particles. Sensitivity to electrical activation is also increased with increases in the density of a lead azide charge.

Dry lead azide has a low conductivity. Under conditions of low humidity, electrostatic charges can be accumulated on individual particles of lead azide. Such electrical charges are generated during drying (dry air forced through lead azide), screening, dumping and automatic dispensing operations.

2. All explosions occurred within 72 hours after manufacture of the involved initiators. That is to say there were initiators involved in a mass detonation that had been at rest for 72 hours. However, there were also initiators involved in the same incident that had been at rest for a much lesser time. It is believed that spontaneous detonations occur at a much shorter time after manufacture,

more in the time frame of 24 hours.

There are two factors that govern this time frame. The charges built upon lead azide particles are consolidated into a metal cup. The electrical charge on the surface of the individual particles of lead azide becomes consolidated in the interior of the lead azide. The charge, although restricted by the low conductivity of the lead azide, will eventually "bleed off" to the bare metal surface of the cup.

The time period of the spontaneous detonation also coincides approximately with the internal movement inside an item coming off the Jones Loader. In the assembly of initiators, the explosive charges are consolidated and crimped into a cup at high pressure. Without a restraining force provided by the crimp on the end of an initiator, the consolidation charge springs back to a degree from its consolidated position. This relieves a great deal of stresses introduced by the consolidation operation. The confining force of the crimp only enables the consolidated crystals to relax and move about to relieve the stresses. This process can continue with gradually reduced intensity for periods up to as long as a week, the major movement is accomplished right after manufacture.

3. The metal cups of the involved initiators have been either aluminium or stainless steel. There have been no reported events involving items utilizing a gilding metal cup. Gilding metal cups are made of a copper alloy and are always shellac coated on the interior surface, prior to loading. The shellac coating would act as an insulator and prevent any rapid discharge at the interface of the lead azide and metal cup. The gilding metal cup is also softer than the aluminium or stainless steel; it would have more of a tendency to give and prevent or relieve stresses in consolidated charges,
4. Only non-electric initiators are involved in the spontaneous detonations. This phenomenon may only be

a temporary situation. The production of electric initiators is not as great as the non-electric variety. A large portion of electric initiators is not manufactured on the high speed, high volume loaders. The high internal pressures associated with the non-electric items are not incorporated into electric items. With increases in production and automation, the possibility of a spontaneous detonation grows. It might be a good time to look into preventive measures for electrical devices.

5. Two of the three plants loading army non-electric initiators have experienced spontaneous detonations. Kansas Army Ammunition Plant has never had an explosion that could be attributed to spontaneous detonation. Although Kansas AAP has not produced the quantities that Lone Star or Iowa has, it has manufactured sufficient numbers to statistically predict an incident. A review of plant procedures indicated differences between Kansas and the other plants. The area that seemed most pertinent to the spontaneous detonation study was Kansas procurement, inspection and rework of tooling,
6. The appearance of spontaneous detonations coincided with the introduction of automatic loading devices. Handline operations were automated and incorporated into a Jones Loader. The raw materials are fed into a Jones and finished initiators come out.

Two automatic dispensing devices, the frictionless and the Chamlee, were developed for dispensing lead azide. Both systems impart a great deal of movement to the lead azide before pouring a measured amount into a cup. The Gargile Loader, which simulates the hand scooping operation, is employed to meter out primer mix. In all cases of metering devices, the tolerance on the amount of powder in a charge is greater than a handline. Powder build-up on powder guides and punches can lead to variations in the amount of powder in a cup. Final crimping is done to a

fixed height and excessive pressures could be developed within an item that is loaded to the high side. Reconsolidation of powder charges is possible at the final crimp station.

The automatic equipment also deposits an excessive amount of powder around the loading station and on all outside surfaces of the detonator. Graphite must be employed to lubricate tooling and cups to facilitate the automatic loading. It is also employed as part of the lubricant-binder of selected base charge to aid in the automatic feed. In addition, there is little or no visual observation of the items during loading as there is on a handline. Mechanical controls are relied on to detect and reject an item that is being loaded incorrectly. This is especially critical if a die is scoring the inside of a cup. All these factors are pertinent to the spontaneous detonation investigation.

The technical program conducted by the spontaneous detonation committee generated several theories as to the cause of the unexplained explosions. The causes were attributed to explosive contaminants of cups, brittle fracture of work hardened cup, capacitor discharge of insulated disc and decomposition of lead azide initiated by ultraviolet light. The theories were reviewed, evaluated, revised and resolved into the current proposed mechanism for the cause of spontaneous detonations.

Lead azide is the prime suspect. The extreme electrical sensitivity is the basis for considering the spontaneous explosions are a result of the electrical activation of lead azide.

This theory postulates the generation of an electrostatic charge on loose lead azide during processing and loading. On consolidation, these charges are trapped in the lead azide charge in the interior of the cup. The electrical charge, although in a matrix of high resistivity, will migrate outward to the bare metal surface of the cup. This migration is enhanced by the graphite in the loaded items and the movement of crystals trying to relieve internal pressures. When a flow of electrons enters a crystal of lead azide with sufficient ener-

gy, decomposition and explosion result.

The concurrent program to prevent the devastation of a spontaneous detonation showed immediate and striking benefits. Under the spontaneous detonation program, packaging for nonelectric initiators was designed to prevent mass detonation in the event of a spontaneous explosion. The initial studies conducted at Lone Star Army Ammunition plant produced a pack for the M55 detonator that would prevent a spontaneous detonation of one item from propagating to a detonator in any other box. This M55 pack was scaled up and modified to produce a family of non-propagating packs for non-electric initiators.

The basic changes in the packaging to obtain non-propagation were as follows:

1. The spacer was made sufficiently thick to enable the item to be packed flush with or below the top surface.
2. The filler was changed from corrugated paper to a felt pad backed by a paper board stiffener.
3. The slide cover was made to provide a snug fit to insure items are held flush or below.
4. An additional paper board stiffener was glued to the outside of the slide cover to prevent vertical propagation.
5. The spacer was glued 100% on contact surfaces to prevent horizontal propagation between detonators.
6. Distances between centres of holes were designated to provide sufficient material between initiators to prevent propagation.
7. Holes in adjacent boxes were staggered and boxes were colour coded to insure they were positioned correctly in the outer pack.
8. Drawings and specifications were prepared to designate materials and

construction to insure non-propagating features.

The value of the non-propagating package was demonstrated almost immediately and with remarkable clarity. Where the spontaneous detonation of a single initiator had resulted in havoc, it now was regulated to an occurrence that presents little threat to property or personnel.

On 11 September 1970 at Lone Star AAP, the first spontaneous explosion occurred to an item packaged in the new non-propagating box. M17 detonators were manufactured and placed in storage. The next morning an operator removed a number of packs and transferred them to a painting area. On opening the boxes, the operator discovered the exploded detonator. None of the other detonators exploded in either the same box or in adjacent boxes. Cost – negligible.

A second occurrence took place at Lone Star involving the M55 (actually the mk49 navy version of the M55). Spontaneous detonation was discovered on the 6th of April in a package of M55's that had been put in storage on the 2nd of April 1971. The new safety package limited the explosion to the one detonation. Cost insignificant!

As a result of the spontaneous detonation program, certain controls were instituted on the manufacture of initiators to prevent or contain the spontaneous detonations.

1. Non-propagating packs were designed and designated for non-electric initiators.
2. Freshly manufactured items were placed in a rest area for 24 hours.
3. Humidity controls were imposed to prevent a dry atmosphere while processing or loading lead azide.
4. Procedures, specifications, drawings and documents used at Kansas AAP for the procurement and rework of

tooling used in the Jones Loader were recommended for adoption as standard for all loading plants.

5. All cups were stress relieved and sharp radii were required at the corner of the cup to prevent development of stresses during loading.
6. A "break-away" was required at the final crimping operation to control the pressures applied to an initiator.

In addition, studies are being conducted to determine applicability of establishing other controls to eliminate spontaneous detonation.

1. Specifying both a min and max requirement on the moisture content of lead azide.
2. Treating lead azide with anti-static agent to prevent build-up of a charge.
3. Monitor the individual charges of lead azide as they are being placed into an initiator cup to detect the presence of an electrostatic charge.
4. Eliminate use of graphite.
5. Coat loading tools to negate lubricant, prevent scoring and stop powder build-up on powder guides and consolidating punches.
6. Coat the interior surfaces of initiator cups with an insulating material.
7. Remove fine particles of lead azide.
8. Remove up-stand; the powder build-up along the interface of the cup and die at each consolidation.

In conclusion, I would like to emphasize, although the devastating effects of spontaneous detonation have been all but nullified, the cause is only postulated and the threat still exists. The spontaneous detonation committee is continuing its monitoring and its studies. Time will tell if the postulated theory and established controls have eliminated spontaneous detonation in initiators.

Safety rules are there to follow.

So take care and you'll see tomorrow.

Our Explosives Regulatory World

Explosives Regulations – The Balancing Act

by

Mike O’Lena (Explosives Program Manager, ATF)

We are very grateful to Mike O’Lena from the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) in the United States Department of Justice for his willingness to contribute to this Feature of our Newsletter. The ATF performs a vital role in regulating the USA explosives industry. SAFEX regards all explosives regulators as important collaborators in its endeavours and is therefore privileged to publish this contribution from the ATF.

This is a follow-up to Mike’s previous article, *Government and Industry – A Partnership to Secure Explosives in SAFEX’s Newsletter No. 41*. ATF continues to encourage partnerships between Government and the explosives industry.

The explosives industry was born of innovation and continues to thrive on ingenuity. The U.S. explosives industry ranges from large corporate manufacturers to single individuals who uniquely use explosives for extremely large jobs (e.g. coal mines), for surprisingly small jobs with great precision (e.g. air bags), and for various purposes along the entire spectrum. The explosives industry’s innovations—and use of innovations from other areas such as information technology and security—have and continue to improve the safety and security of explosives. Of course, explosives companies are often faced with difficult decisions regarding how much of their resources to devote to safety and security programs. Similarly, ATF and other explosives regulatory entities have the delicate role of balancing explosives safety and security while ensuring new regulations do not financially or otherwise unduly burden explosives industry members and commerce of their products and services.

The passage of U.S. Federal Explosives Laws in 1970—and their implementation in 1971—required ATF to protect interstate and foreign commerce against interference and interruption by reducing the hazard to persons and property arising from misuse and unsafe or insecure storage of explosive materials. However, the law’s purpose was not to place undue or unnecessary restrictions or burdens on law-abiding citizens or to impose procedures or requirements except those that were reasonably necessary to implement and effectuate the provisions of the law.

In staying within those constraints, ATF

has adopted many procedures and guidelines created by explosives industry organizations and associations. For example, ATF adopted from the Institute of Makers of Explosives the American Table of Distances and the Table of Separation Distances of Ammonium Nitrate and Blasting Agents, which are still required for most explosives storage within the United States. While perpetually evaluating whether regulations sufficiently address the hazards associated with explosives, we have partnered with explosives industry members in implementing safeguards specifically developed to address explosives hazards.

Each explosives industry member must evaluate whether meeting only the minimal regulatory standards provides sufficient protection and reduces risk to their workers and the general public. In many cases, there are no regulatory requirements in place that address a particular process or operation, although risk may still be present. Industry members should evaluate each step throughout their explosives operations (e.g. transportation, loading/unloading, storage) and determine if there is a required regulatory standard or, if not, whether they have implemented standard operating procedures addressing the risks and consequences associated with a potential incident. Industry members should be proactive and conduct this step-by-step evaluation before an explosives incident occurs. Companies that implement safety and security procedures that exceed those minimal regulatory standards may help alleviate the inevitable fall-out that arises follow-

ing an explosives incident. Many explosives industry members within the United States have demonstrated the foresight to implement safety and security procedures where no regulatory standards exist or that exceed regulatory standards.

Further, industry’s focus on technology and voluntary improvements continue to provide ATF with innovative examples for our own explosives regulatory operations. For instance, the introduction of alternative locking methods for explosives storage magazines has prompted ATF to secure some of its own magazines with locking mechanisms originally introduced by explosives industry members. We also encourage explosives industry members to submit requests to ATF electronically. We process and respond to these requests electronically, saving time and money. ATF has made it a priority to disseminate as much information as possible by modernizing its website and attending various industry meetings and conferences. These and other changes have contributed to the creation of better regulatory processes and clearer communications to help us all succeed.

The explosives industry’s development and implementation of procedures that exceed those already prescribed in the regulations help ensure industry remains at the forefront of explosives issues and solutions instead of waiting for regulatory entities alone to develop regulatory processes and requirements. Nonetheless, explosives regulatory entities bear a great responsibility for implementing regulations to protect their public. Therefore, regulators should

continue to work with industry to find reasonable solutions to issues that arise from explosives operations. ATF offers the following suggestions when explosives regulatory agencies initiate new rules or procedures to their existing regulatory framework:

1. Consult with explosives industry organizations prior to implementing new requirements or procedures. No matter what their background, most regulatory decision makers—and the policies and procedures they produce—can benefit from in-depth discussions with their industry members.
2. Reach out to regulatory counterparts across the globe. A new explosives or security technology in one region

of the world may have already been introduced in other regions. As a result, you can greatly benefit from the experiences and examples of other regulators.

3. Regulatory agencies contemplating new requirements should clearly identify the issue requiring a solution and ensure the benefits from implementing new requirements justify the potential costs to industry members.
4. Consider the potential benefits of innovation for streamlining your own operations. Simple changes like using electronic communications, applications, and data storage can save time and money for your agency and the industry members. Further,

these methods may already be in use by your industry members.

Ultimately, explosives regulatory entities and the explosives industry share the responsibility for explosives safety and security. It is ATF's belief that explosives regulatory entities can achieve this goal successfully by engaging the explosives industry before issues develop into larger problems. Similarly, the explosives industry and its associations should ensure that their regulatory authorities are aware of new technologies, techniques, and operations as well as the challenges associated with their explosives. ATF will continue to embrace and foster industry innovation, with the shared objective of increased public safety, and we encourage you to do so.

Improving Explosives Competence

All explosives manufacturers recognise the importance of training and developing people who work in and are responsible for explosives operations. SAFEX recently responded to a perceived need to develop leaders of explosives operations by embarking on the development of the *SAFEXplosives Management Course* in an e-learning format. We are not alone in trying to support SAFEX members in their quest for improved workplace competence. SAFEX is willing to partner with anyone or use any technology that can contribute to the competence of people working with explosives and thereby make our workplaces safer.

In this Newsletter feature we propose to present a series of articles that explain the UK's National Occupational Standards (NOS) in Explosive Substances and Articles (ESA). In the coming editions of the Newsletter, each article will examine a different aspect of the ESA standards and explain how they can be used for a range of purposes.

Introduction to Explosive Substances and Articles National Occupational Standards

by

Denise Clarke (Managing Director, Homelands Security Qualifications)

Homeland Security Qualifications (HSQ) is a British-based awarding body that specializes in the award of explosives-related qualifications. Denise has spent the last twenty years specializing in the specification and measurement of competence, working in a wide range of industries. Working with the industry, she has developed UK National Occupational Standards in Munition Clearance and Search and in Explosive Substances and Articles, creating qualifications and supporting assessment materials. HSQ now has five qualifications assessment centres, delivering a range of bespoke, industry-recognized and nationally regulated competence-based qualifications. Please visit www.homelandsecurityqualifications.co.uk for more information.

Why focus on competence?

Over recent years, there has been an increasing emphasis in the UK on "competence". Why should this be and is it really that important?

In the early – mid 1980s, like other industries, the chemical industry used traditional methods of training its workforce, using training inputs as the measures of what people should be able to do. However, the notion of measuring the outputs of people's performance became increasingly attractive

in order to target resources on identified training need and maximize the competitive edge through the investment in the workforce. It became clear that the outcomes of training were more important than the inputs: what someone was able to do was more important than how long they had taken to train to carry out the task. Following experimental research in this and other industries, it became clear to the UK government that a different approach was needed. The 1986 Review of Vocational Qualifications (de Ville) led to the development of a new type of vocational qualification – the

competence-based qualification. Achievement of such a qualification would be evidence of competence, not just of theoretical knowledge. A different approach to assessment of a competence-based qualification was therefore also needed.

The traditional method of assessing someone's theoretical knowledge through an examination would still hold true. However, an examination is not a valid test of whether someone is able to apply their knowledge and perform competently in the workplace. For example, would a written examination tell you that someone could ride a unicycle? No, it would not. The only way to know whether or not someone could ride a unicycle would be to watch them do it. Would answering questions about how you would go about baking a soufflé tell you whether someone could actually make such a delicacy? No, it would not. You could indeed set them questions about hygiene requirements, ingredients, the baking method and so on. But the ultimate test would be to eat a soufflé that the candidate had made.

So, the assessment of workplace competence should go beyond the mere answering of questions (whether posed orally or written). Assessment of workplace performance may include observation of the task, witness testimony, video and audio recordings, copies of documents, reports, correspondence, working notes and calculations etc. – all produced through the conduct of the candidate's daily workplace activities as, taken together and mapped to the requirements of a competence-based qualification, these forms of evidence would attest to someone's competence.

The ESA standards

The Standards Setting Body for Explosives, Munitions and Search Occupations (SSB for EMSO) was established in 2000 to develop UK National Occupational Standards and related qualifications for those involved in munitions clearance (i.e. bomb disposal – both EOD and IEDD) and search activities. Following the launch of this work, at the request of the Ministry of Defence, the SSB then went on to specify the competence of those who work with explosives. These became known as the Explosive Substances and Articles (ESA) standards. Over 250 specifications of competence in working with explosives resulted from this project.

Future articles in this series will explain the coverage and structure of these standards and examine their practical application. This article will introduce the series by providing a background to the notion of competence.

What is "competence"?

There are many definitions of "competence". Here are just a few:

"The ability of an individual to do a job properly"

"Competence = Knowledge + Skills + Experience + Attitude"

"The ability to perform consistently to occupational standards"

In short, there is no agreed definition of what "competence" is. However, rather than arguing about the number of angels that can dance on the head of a pin, let us accept the common features of these definitions and agree that competence is about being able to do a job and that this can be measured where statements of competence exist.

Do we mean "competence" or "competency"?

No one has agreed on a definition of the distinction between "competence" or "competency" either. However, "competence" is often considered to mean functional competence i.e. what people *do* whereas "competency" is often taken to mean behavioural traits i.e. what kind of person someone *is*.

A model of competence

The relationship between the ESA standards and other performance-related specifications can be described by the model below:

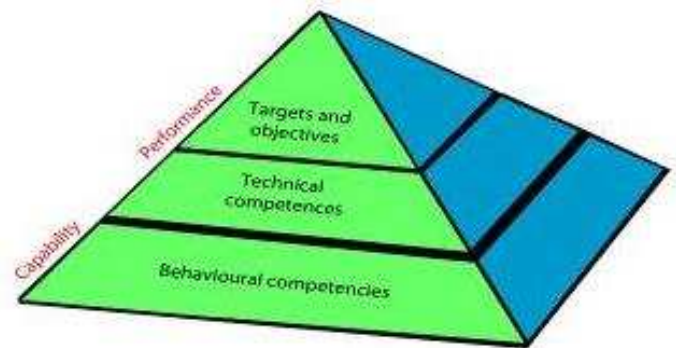


Diagram 1: A Model of Competence

There are three drivers to performance: targets and objectives, technical competences and behavioural competencies. The pyramid explains the relationship between these. Targets and objectives are agreed at performance appraisals and state the quantified annual expectations of staff. These will probably change every year and they represent actual performance. For example, a lorry driver will probably have targets about getting his lorry with its load intact from *a* to *b* within a given time.

However, in addition to achieving specific targets and objectives, people need to maintain the organization's standards of good practice in what they *do*: in other words, they need to achieve the requirements of technical competences. The technical competences describe what people do in their jobs and the standards they should maintain continuously. These are sometimes also known as *functional competences* or *standards*. This is where the ESA standards fit in. These quality expectations are permanent and they also represent actual performance. Taking the example of the lorry driver above, the standards that he might be required to maintain could be those of the UK Driving Goods Vehicles National Occupational Standards. These describe how a driver's competence would be measured e.g. *drive at the correct speed for the driving conditions; comply with the organisation's procedures and all relevant legal, safety and operating requirements relating to driving the vehicle on public roads;*

know and understand *how speed should be altered to meet different types of road conditions &etc.* The driver should also demonstrate his achievement of these measures in the different conditions that he might be expected to encounter such as driving different vehicles, and dealing with a range of hazards such as road and traffic conditions and so on. He should also get his lorry with its load intact from *a to b* within a given time but without breaking speed limits.

In order to help achieve their targets and objectives and maintain the required quality expectations described by the standards, people also need to exhibit certain personal qualities – what people *are* i.e. behavioural competencies (also often known as *personal qualities*). For example, if you are a sales assistant, it would be helpful to develop the quality of *customer focus*. The behavioural competencies support the development of the competence required to perform in the job, achieve the targets and objectives and maintain the requirements of the technical competences (standards). For the lorry driver above, this might be *concentration, self-motivation and resilience*.

The uses of standards

Standards lie at the heart of all human resources (HR) processes. There are in fact many possible uses of standards in a range of HR processes as described by the diagram below.

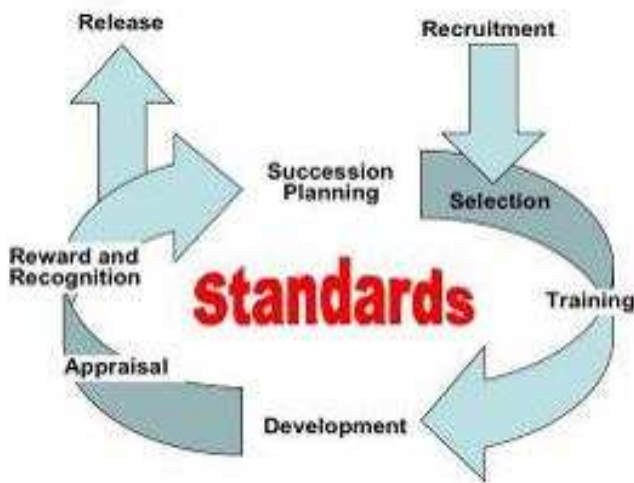


Diagram 2: Standards in the use of HR Processes

By describing what an organization expects of its staff, standards can be used for many different purposes such as:

- recruitment and selection – e.g. job adverts, interview aide memoires, job descriptions, role profiles;
- appraisal – standards amplify an organization's expectations so appraisals can be more objective & evidence-based;
- training needs analysis – through self-assessment, development discussions, 360° feedback, Personal Development Plans, audits of team strengths and development needs;
- training syllabus design – based on the requirements of the standards;
- career management – e.g. career maps, career planning tools;

- succession planning – systematic approaches to talent management based on an organization's analysis of development needs;
- demonstration of a commitment to known quality standards, investment in people and the ability to comply with legislation, regulation and codes of practice;

... and many more specific applications within each part of the HR cycle.

Why did the ESA standards come about?

The project to specify competence in working with explosives came about in 2003 as a result of the UK MoD's concerns about the dwindling numbers of people in the industry with the necessary skills and expertise needed to maintain the UK's defence capabilities in the short and long term. In his role as Director, Defence Ordnance Safety Group (DOSG) the Head of Profession for Ordnance, Munitions and Explosives (OME) was required to provide assurance of competence of all MoD OME staff (civilian and military) to the Defence Ordnance Safety Board (DOSB). DOSB's purpose is to provide top level direction of ordnance, munitions and explosives safety policy and to ensure the continual effectiveness of the MOD OME Safety Management System.

In particular, the issues facing the MoD were:

- a need to assure competence as one means of avoiding accidents by providing an objective method of assessment of training inputs;
- recruitment difficulties: ESA is a shrinking specialism within the MoD and a high level of commitment is required of applicants who will need to fulfil their training programme;
- a need to put in place objective criteria by which contracts placed with commercial companies can be assessed and managed;
- a desire to provide formal accreditation for individuals' competence
- the imperative of enhancing and maintaining safety standards.

The objectives of the ESA standards project, therefore, were to support the Head of Profession for OME in:

- providing recognized competence standards for the benefit of the UK workforce and MoD civilian and military personnel;
- ensuring that professional training and development is available, and wherever possible, provides individuals with recognized qualifications;
- providing a functional competence framework for the UK MoD OME community;
- setting appropriate standards of performance for all levels of competence.

In 2007, the MoD carried out research to enquire what might be the consequences of not making sufficient investment in the skills of the part of its workforce which was concerned with explosives. Hooper (2007) explains this:

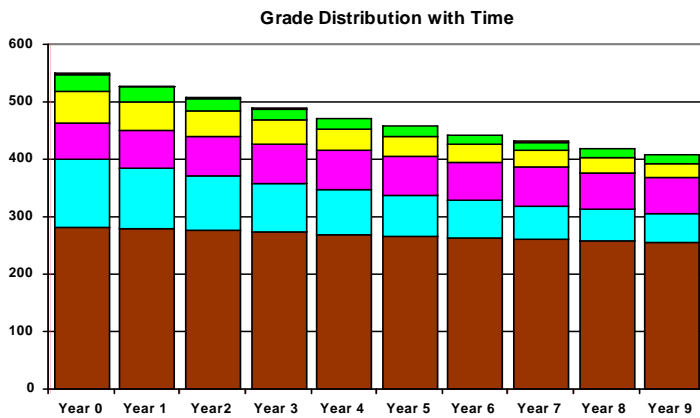


Table 1: Grade distribution over time – “Do nothing” option

The following tables show the consequences of the demographic decline and concomitant reductions in explosives-related expertise in the MoD. The underlying principle behind this is that the annual influx and efflux of staff at each skills level or grade is assessed. The influx comes from recruitment and from staff moving up from a lower skills level or grade through the acquisition of enhanced skills and competences. The efflux of staff results from retirements and resignations from each level and from staff being advanced or promoted. Using this process, the revised composition of the workforce at the end of each year can be determined, and the year-on-year development of the competence profile can be established. This enables any deterioration (or otherwise) in competence levels over time to be predicted. The diagrams above illustrate such a prediction. (The different coloured bars denote the different skills levels and the size of the bars the number of people at that level – Editor)

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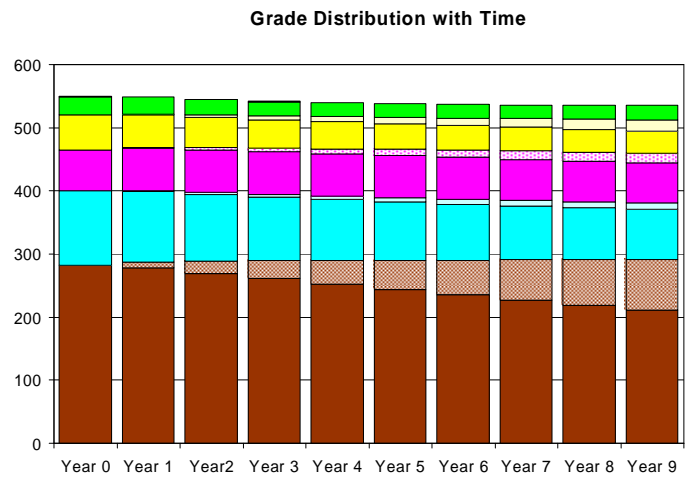


Table 2: Grade distribution over time – “Enhanced training” option

Table 1 on the left essentially shows what will happen if nothing is done. Table 2 on the right shows the result of enhanced training and development, along with extra recruitment at various grades or skills levels (*ibid*).

Clearly, the “do nothing” option is not acceptable and investment must be made in training and skills for future generations if explosives expertise is to be maintained.

Readers of this article who would like to know more about the background to the ESA project can download the *Occupational Map of the Explosive Substances and Articles (ESA) Occupations* (Clarke, 2004) from HSQ’s website. Booklets of the ESA standards can also be downloaded (free of charge) from the same site at: <http://www.homelandsecurityqualifications.co.uk/documents/>

The ESA standards provide the means of achieving these objectives. Having introduced the background to this work, future articles will explore how they can be used, the reasons for and benefits of doing so and different stakeholders’ perspectives on the standards.

Safety doesn't happen by accident.

Author Unknown

Explosives Eco-talk

The impact explosives and explosives manufacture has on the Environment fall squarely in the SAFEX domain. We are committed to publish the experiences members of the SAFEX community (Members, Associates and Expert Panel) have in minimising explosives' environmental impact. While most of our explosives incidents concern the safety and health impact, we are eager to learn about the environmental side of our activities. By way of this Feature we want to encourage readers to let us have contributions which create awareness of this facet of our operations as well as assist our industry to behave with environmental sensitivity and responsibility.

It is with regret that SAFEX is unable to provide an article for this Feature. We urge any readers who are able and willing to contribute appropriate material for this Feature to contact the Secretariat.

Pondering the Profession

This column is devoted to our 'Safety Professionals' in recognition of the important role they play in the explosive industry's health, safety and environment efforts. It is intended to be a forum in which we can talk about the Profession. Our aim is that this column will be read by all but that the Safety Professionals in our industry will make it their own.

Implementing a Safety Survey

by

Bob Woolley (EPC-UK) and **Thierry Rouse** (EPC Groupe)

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INTRODUCTION

For any business that wants to continually improve its safety performance the reporting, recording and investigation of accidents and near misses is crucial. This information can then be used by the organisation to identify and correct deficiencies in response to specific incidents; this is reactive monitoring or lagging indicators. Forward thinking companies complement this reactive monitoring with active monitoring in the form of leading indicators. Examples of leading indicators include the routine and systematic inspection and testing of work systems, premises, plant, and equipment.

However, these lagging and leading indicators may not be giving the whole picture. They are not able to measure equally important factors such as employee satisfaction and management trust. Other methods must be employed to quantify these factors and identify

improvement opportunities. The purpose of this article is to present the idea of the safety survey and show how one such tool was used by EPC to measure its employee's perception of its safety performance and complement the classical indicators.

Safety surveys are typically composed of a list of questions. The structure and design of the question set used by the EPC Groupe was developed by an organisation that specialises in this area of work. It is likely that the safety survey may identify two differing viewpoints, that of the management team and that of the employees.

THE SURVEY PROCESS

EPC did not want to reinvent the wheel as designing a safety survey that provides meaningful results is the work of a specialist team composed of psychologists, safety professionals and industry representatives. It is vital that each

question is phrased and presented in such a way that they can be understood by all respondents. This will ensure that the answers given will provide a true and meaningful measure of each individual's perception of safety within the business.

The survey tool that was selected is well established and has been used successfully by many businesses in the UK. It allows the respondents to either complete the survey electronically, in which case the results are uploaded directly to a central server, or printed as hard copies. Due to the geographical spread of the workforce and the need to translate the survey into eleven languages, the latter approach was adopted. Significant effort was required to ensure that the survey questions were translated accurately from the original English. The meaning of many of the questions and phrases could have been lost during translation if strict control had not been

applied. Errors in translation or interpretation could have adversely affected the survey results.

The first part of the survey consisted of forty questions and for each the employee had to gauge his or her agreement or disagreement by choosing one of five statements; strongly agree, agree, neither agree or disagree, disagree, strongly disagree.

Each of these forty questions were related to practical safety issues in his or her working area, for example "all near misses are reported" or "I sometimes turn a blind eye to some less important health and safety procedures".

The forty questions were followed by six demographic questions relating to age, length of service, gender, country of origin etc. Finally there were a further six open questions centred on safety improvements and positive or negative aspects of safety within the Company.

As EPC operates in nineteen countries throughout Europe, Africa and the Middle East the support and buy in of the local management was crucial for the success of the project.

Employees generally do not like surprises. For the survey to be well received it was vital to communicate the plans in advance. This communication included:

- the purpose of the survey and what

the company hoped to achieve,

- a request for participation,
- measures that are being taken to ensure anonymity,
- what will be done with the results,
- how the findings will be communicated.

As people may be reluctant to complete the survey or give truthful answers for fear of being identified, it was a requirement that they had the opportunity to complete the form anonymously. Anonymity was also paramount for ensuring that the results reflected what the employee really believes not what he or she thinks they should believe.

Once the forms were completed, the data was collated and inputted into a specialised software package that formed part of the survey tool. This then generated the results. Analysis of the results requires appropriate tools and knowledge to avoid misinterpretation. EPC used its own internal expertise to analyse and interpret the results but the provider of the survey package also offers this service.

Once the results had been analysed it was important to plan detailed feedback to the employees in a form that could easily be understood by all levels within the Company. This was done by producing a set of simple graphs that highlighted the areas that the personnel

felt the company was performing well and those that they felt needed improvement or about which they had concerns. An example of such a graph is shown in Figure 1 below.

This feedback presented in a number of ways and included newsletters, toolbox talks and safety briefings. As it is planned to repeat the process in the future it is important that all employees can see that their concerns and issues highlighted in the 2011 survey are being addressed and actioned.

EPC SAFETY SURVEY OUTPUTS

Outputs from the survey covered eight specific areas:

Organisational Commitment

- There are good communications (e.g. toolbox talks/safety bulletin/team briefings/ safety pauses ...) here about HS
- Being efficient is usually seen as more important than HS
- Management always acts quickly over HS
- Supervisor and manager rarely check that people here are working safely.
- The company encourages suggestions on how to improve HS.
- I don't think my immediate boss does enough to insure HS

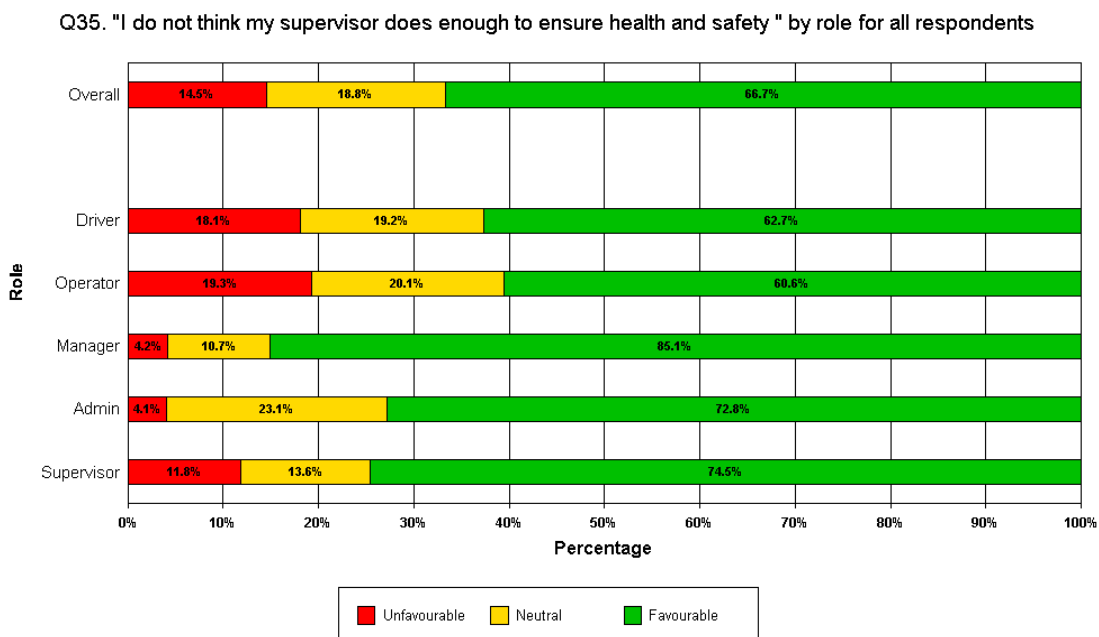


Figure 1: Example a results graph for one of the survey questions

Health & Safety oriented behavior

- People who work here often take risks when they are at work.
- People here always work safely even when they are not being supervised.
- Some of the workforce pay little attention to H&S
- Not all the H&S procedures are strictly followed here.
- People here are sometimes pressured to work unsafely by their workmates.
- People who work here sometimes take risks at work which I would not take myself.

Health & Safety trust

- Accident investigations are mainly used to identify who is to blame.
- Suggestions to improve H&S are not always acted upon.
- Management sometimes turns a blind eye to H&S procedures being broken.
- Management only bothers to look at H&S after there has been an accident.
- Some H&S procedures are only there to protect management’s back.
- The company really cares about the H&S of the people who work here.
- Supervisor and manager sometimes turn a blind eye to people who are not working to the H&S procedures

Usability of procedures

- Some jobs here are difficult to do safely.

- Some H&S procedures are not really practical.
- Some H&S procedures do not reflect how the job is actually done.
- Some H&S procedures are difficult to follow.
- There are too many H&S procedures given the real risks of my job.

Engagement in Health & Safety

- My immediate boss often talks to me about H&S.
- The company shows interest in my views on H&S.
- My immediate boss takes on board ideas on how to improve H&S.
- Supervisor and manager devote sufficient effort to H&S here.

Peer Group attitude

- Sometimes it is necessary to take risks to get the job done.
- I sometimes turn a blind eye to some less important H&S procedures.
- My workmates would react strongly against people who break H&S procedures.
- All the people who work in my team are fully committed to H&S.

Resources for Health and Safety

- The H&S equipment (e.g. PPE/ safety boots/gloves/goggles/ear defenders/ guarding/ lifting equipment/ harnesses/etc.) works well.
- People can always get the equipment needed to follow the H&S pro-

cedures.

- There are always enough people available to get the job done safely.
- Sufficient resources are available for H&S here.
- I can get more people to do a job if I needed them for safety reasons.

Accident and near miss reporting

- Accidents that happen here are always reported.
- Near misses are always reported.
- Sometimes accidents are not reported.

For the each of the eight factors rating was assigned depending on the results, favorable, unfavorable or neutral. Each rating was presented as a percentage of the total.

The results were also presented at different levels:

- Whole Group
- Business level
- Country level.

RESULTS

The main points are:

- 11 languages concerned.
- 19 countries covered.
- Participation rate measured was 68% versus an expected participation rate of 50%.

An example of a good result is shown in Figure 2 below. Excellent results were obtained for the following factors:

Q17. "The plant/site encourages suggestions on how to improve health and safety" by role for All Respondents

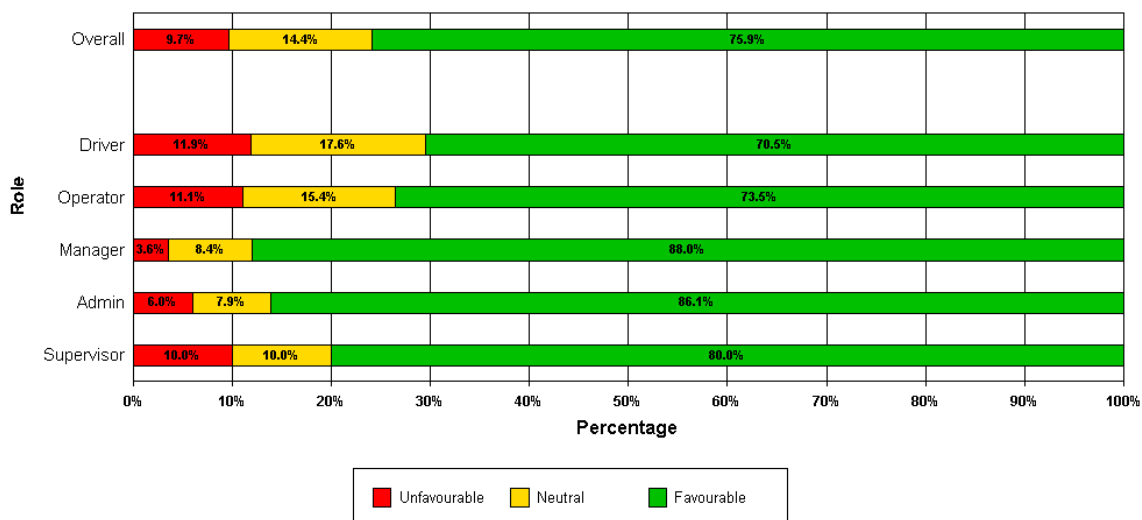


Figure 2: Example of a Good Result

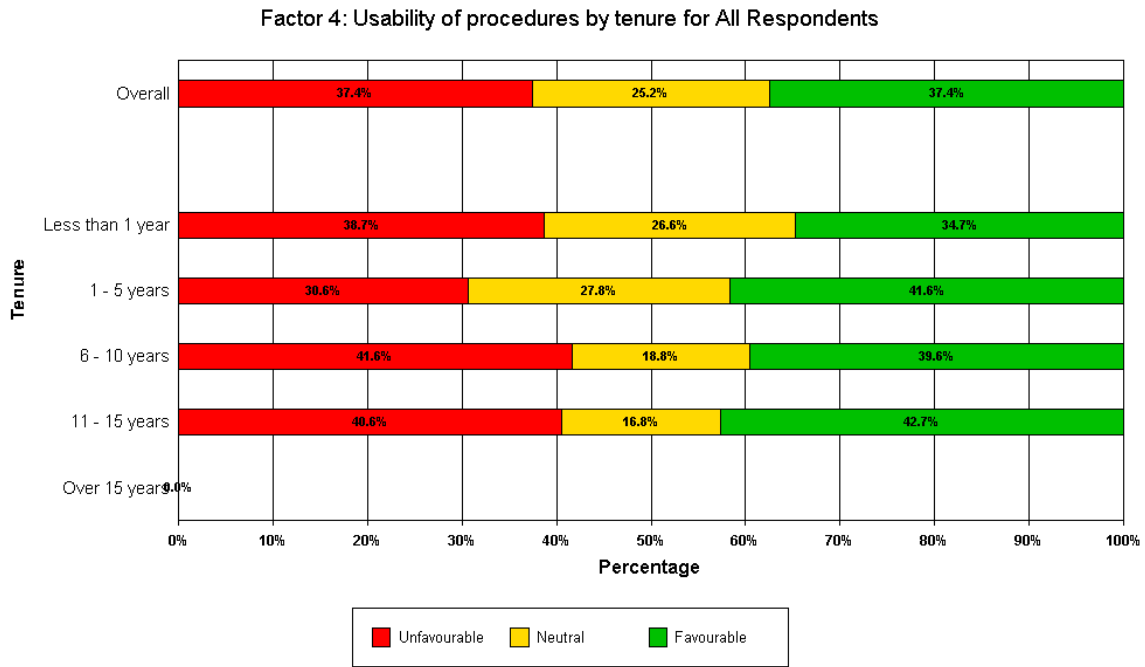


Figure 3: Example of a Poor Result

- 76 % favorable for ‘The Company encourages suggestions on how to improve HS’,
 - 66 % favorable for ‘People here are sometimes pressured to work unsafely by their workmates’,
 - 74 % favorable for ‘The Company really cares about the H&S of the people who work here’,
 - 73 % favorable for ‘Supervisor and manager devote sufficient effort to H&S here’,
 - 68 % favorable for ‘All the people who work in my team are fully committed to H&S’,
 - 77% favorable for ‘The H&S equipment (e.g. PPE/ safety boots/gloves/goggles/ear defenders/ guarding/ lifting equipment/harnesses/etc.) works well’,
 - 76 % favorable for ‘Accidents that happen here are always reported’.
- Figure 3 above shows an example of a poor result. Poor results were obtained for the following factors:
- 31 % unfavorable for ‘People who work here often take risks when they are at work’,
 - 29% unfavorable for ‘Accident investigations are mainly used to identify who is to blame’,
 - 43% unfavorable for ‘Some jobs here are difficult to do safely’. ,
 - 34 % unfavorable for ‘Sometimes it is necessary to take risks to get the job done’,
 - 27 % unfavorable for ‘Near misses are always reported’.

Difficulty was experienced in the interpretation of “neutral” response as this can reflect cultural differences between different groups of employees, for example in the Scandinavian countries approximately 33% of answers were “neither agree nor disagree”.

The results were used to develop the 2012 EPC Group Safety, Health and Environmental action plan and objectives with particular emphasis on driver safety, near miss reporting and employee involvement writing of risk assessments, work instructions and procedures.

A decision has been taken to undertake the safety survey on a three yearly cycle in order to measure the evolution of the Groups safety culture during the three year period and to address the issues highlighted by the employees.

Safety Snippets

When the US Chemical Safety Board (CSB) first announced their findings into the 2011 fireworks explosion in Hawaii, we were struck by the number of learning points for explosives manufacturers too. The fact that fireworks lie outside SAFEX’s scope should not deter us from learning from such experiences. Philip Kneisl (Explosives Examiners LLC) thought the same and sent us a copy of the Report.

Some of the issues that arose include the risk in disposing of explosives waste and the need for proper risk assessments; the importance of Management of Change; contractor management; adherence to basics such as the “minimums” principle (minimum quantity of explosives, minimum exposure of personnel, minimum number of operations in a building at a time, minimum equipment in the building, etc.); good housekeeping; opening boxes for inspection inside or within 50 ft. of an open magazine; introduction of sparking tools to the magazine; and others which you will no doubt pick up. In order to share this learning with our readers we are publishing the Executive Summary provided by the CSB report.

Lessons from the Fireworks Incident in Waipahu, Hawaii



Photograph: Scene of the incident (From the CSB Report)

In January 2013 the U.S. Chemical Safety and Hazard Investigation Board released its investigation report (Report no. 2011-06-I-HI) into the Donaldson Enterprises, Inc. (DEI) fireworks disposal explosion and fire which occurred on 8 April 2011 in Waipahu, Hawaii. The incident occurred at a magazine that was used by Donaldson Enterprises, Inc. (DEI) for seized fireworks storage and disposal-related activities. Five DEI personnel in the magazine at the time of the incident were fatally injured. DEI is an unexploded ordnance remediation company based on Oahu that employs fewer than 20 full-time workers. Pursuant to a contract with the Treasury

A US Federal Government contractor, VSE Corporation (VSE), was responsible for federal seized property management and awarded DEI a subcontract in early 2010 to dispose of imported fireworks seized in Honolulu, Hawaii. Three fireworks shipments were seized by federal law enforcement personnel as contraband because they were labelled as consumer grade fireworks but, upon inspection, appeared physically consistent with more hazardous commercial display grade fireworks. Federal contractor selection regulations did not require VSE procurement personnel to conduct a safety related review of DEI prior to awarding the company the sub-

contract. Nor did VSE procurement personnel involved in awarding this subcontract have training and experience related to fireworks disposal. VSE's procurement office selected DEI as the fireworks disposal subcontractor because DEI was already storing the seized fireworks at the time under a separate subcontract with VSE, and because DEI submitted the lowest-cost and most time-efficient bid, which VSE determined to be the best overall value for the government. VSE procurement personnel were unaware that DEI had no prior fireworks disposal experience when it awarded the subcontract.

Because seized fireworks requiring disposal are considered hazardous waste in the United States, DEI was required to obtain an environmental permit from the State of Hawaii Department of Health (DOH). In June 2010, DOH issued DEI a 90-day emergency hazardous waste permit authorizing "thermal treatment" (i.e. burning) of the fireworks at a local shooting range, and DEI began its disposal work soon after. The permit did not evaluate or address fireworks disassembly or diesel soaking. To dispose of the first seizure of fireworks, DEI personnel separated individual firework tubes from their original configuration and soaked the firework tubes whole in 55-gallon diesel-filled steel

drums inside the magazine. DEI then transported the soaked fireworks to a local shooting range to burn them in either drums or a portable incinerator.

The U.S. Chemical Safety Board (CSB) learned that because DEI was experiencing minor explosions with some types of fireworks while burning the initial shipment of seized fireworks, the company altered its fireworks disposal methodology in summer 2010. As a result of the altered methodology, DEI personnel began cutting open, or disassembling, individual firework tubes by hand on a loading dock just outside the magazine entrance and separating out the individual explosive fireworks components, the black powder and aerial shells, which are both susceptible to ignition from sparks, friction and static electricity. The accumulated explosive powder from the fireworks, referred to as "black powder," was stored in a plastic container lined with a plastic garbage bag. To improve diesel permeation of the shells and minimize explosions, DEI personnel cut one-inch slits in the aerial shells. They then soaked the shells in diesel and burned them at the shooting range. VSE personnel were aware of this procedure change, but did not question or express concern about it. DEI completed disposal of the initial seizure in late fall 2010 without incident.

DEI began work on the next fireworks seizure in December 2010. In early 2011, DEI again altered the fireworks disposal process to increase the fireworks destruction rate by maximizing the amount of aerial shells that could be burned at once. Expanding upon the modification DEI developed when disposing of the initial seizure, DEI personnel disassembled the firework tubes outside the magazine by hand and separated the individual explosive components, the black powder and aerial shells, into cardboard boxes. The cardboard boxes containing the black powder were lined with plastic garbage bags to minimize leakage. DEI personnel stacked and stored boxes containing aerial shells and black powder within the magazine and simultaneously soaked aerial shells in diesel. DEI notified VSE of this change in methodology via email in March 2011, but VSE again did not question the change.

Although DEI wrote a brief document presenting a hazard review of its fireworks disposal activities when it was awarded the subcontract, this analysis did not consider the safety implications of cutting into the fireworks and accumulating their explosive components. Because the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard does not apply to activities conducted under the umbrella of fireworks disposal, DEI was not required to conduct a

formal Process Hazard Analysis (PHA) of its fireworks disposal activities or a formal Management of Change (MOC) analysis when it modified its disposal process.

At the time of the incident, DEI personnel had abruptly halted their disassembly work due to rain and had taken the materials involved in the process to just inside the magazine entrance. Boxes containing aerial shells, black powder, and partially disassembled firework tubes were stacked inside the magazine near the entrance along with tools, a metal hand truck, and chairs. Once the materials were moved into the magazine, the DEI project supervisor stepped outside to make a phone call. While he was on the phone, a large explosion occurred inside the magazine near its entrance

The CSB determined that changes in DEI's fireworks disposal process resulted in the accumulation of a large quantity of explosive components just inside the magazine entrance, creating the essential elements for a mass explosion. Insufficient federal contractor selection and safety oversight requirements for hazardous activities, a significant gap in regulatory and industry standards pertaining to fireworks disposal, and a lack of hazard management by DEI personnel, enabled DEI to introduce significant hazards to its fireworks disposal process without those hazards being adequately identified or effectively controlled.

The CSB investigation into this incident identified the following key findings:

Technical Findings

1. DEI's hazard analysis of its fireworks disposal process was insufficient. The company failed to identify key hazards of handling, disassembling, and storing contraband commercial display fireworks, and did not adequately control the identified and evaluated hazards.
2. DEI personnel disposing of the fireworks lacked the training, experience, and knowledge of procedural safeguards for the safe conduct of the fireworks disposal.
3. DEI's modifications to the fireworks disposal process accumulated substantially large quantities of explosive material in boxes, greatly increasing the potential explosion hazard. This change to the disposal process was not adequately reviewed for safety implications.
4. The CSB, along with the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) and the Hawaii Occupational Safety and Health Division (HIOSH), identified a number of possible ignition sources in the magazine at the time of the incident, including sparking tools, a metal hand truck, a rolling office chair, and plastic bags capable of producing static discharge.

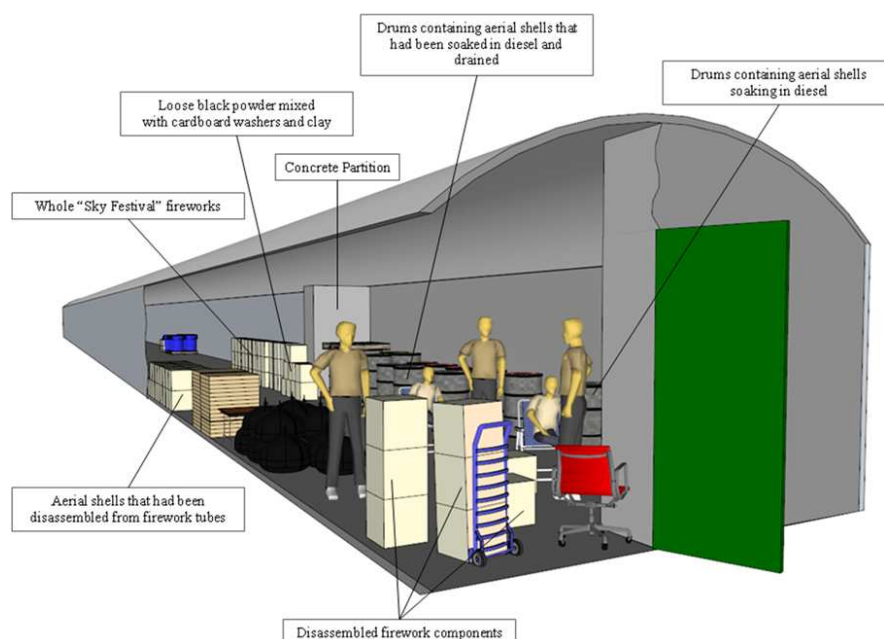


Figure: Magazine layout at the time of the incident (Diagram from CSB report)

Contractor Selection and Oversight Findings

5. The Federal Acquisition Regulation (FAR), which governs federal agencies' acquisition of goods and services, does not specifically require a federal contracting officer to consider safety performance measures and qualifications when determining the "responsibility" of a potential government contractor or subcontractor to handle, store, and dispose of hazardous materials such as fireworks.
6. The Department of the Treasury Acquisition Regulation (DTAR), the Department of the Treasury's supplement to the FAR, does not impose sufficient requirements for safe practices and subcontractor selection and oversight with respect to the unique hazards associated with handling, storing, and disposing of hazardous materials.
7. VSE's procurement office conducted a non-technical review of DEI and the competing offer for the fireworks disposal subcontract that did not

address health and safety.

8. VSE did not use personnel with the technical background or expertise to properly select and oversee subcontractors performing work with hazardous materials such as fireworks, nor did it consult with or hire anyone with that expertise.

Regulatory and Industry Safety Standard Findings

9. The CSB found a lack of regulations or industry standards that adequately address safe fireworks disposal. Federal or local codes, regulations, or industry standards do not establish safety requirements, provide guidance on proper ways to dispose of fireworks, or address the hazards associated with the disassembly of fireworks and the accumulation of explosive fireworks components.
10. While OSHA's PSM standard applies to fireworks manufacturing, OSHA has determined that the regulation does not apply to work activities related to fireworks disposal. Therefore, DEI was not required to imple-

ment a more robust PSM system for its fireworks disposal process. For example, DEI's change to its disposal process led to the accumulation of material that created a mass explosion hazard. PSM elements such as Management of Change (MOC) would have required a safety review of this change.

11. Emergency hazardous waste disposal permits are granted in Hawaii and throughout the country to entities seeking to dispose of seized contraband fireworks because they are considered an imminent threat to human health and the environment. However, the Resource Conservation and Recovery Act (RCRA) does not incorporate PSM-type elements in its hazardous waste permitting process, despite the extremely hazardous nature of the materials covered by these permits.

Acknowledgment

This Executive Summary was extracted from the complete report which can be viewed at http://www.csb.gov/assets/document/final_report_signed.pdf

Inbox @ SAFEX-International.org

From time to time we receive e-mails from members of the SAFEX community on a variety of issues. It is important we share such experiences and insights and if necessary debate them. Our quarterly Newsletter may just be the forum for doing so.

We therefore invite ALL readers to drop us a line at secretariat@safex-international.org if they want to raise an explosives health, safety or environmental issue or comment on any of the opinions received from our correspondents.

Separation distances for solid ammonium nitrate storage discussed

In the previous edition of the SAFEX Newsletter, Dr Peter Drygala, Chief Advisor Explosives and Dangerous Goods, Western Australia, gave an Australian perspective on separation distances between solid ammonium nitrate stores and off-site occupied buildings.

Peter's article prompted Gérard Chaloyard (formerly from SNPE) to comment (English translation kindly provided by Claude Modoux):

I was surprised to read Peter Drygala article on the treatment of ammonium nitrate (AN) storage published in the SAFEX NL 43. In fact, I can't understand his explanation about technical grade ammonium nitrate (TGAN). Technical grade or not, for me pure ammonium nitrate remains an oxidizing agent. This fact is clearly confirmed through all the results obtained by the classification tests. The TGAN can explode under some specific conditions as receiving agent and it

should not be considered as a giving agent. When the storage conditions are in agreement with the specification of the national regulations or good practice rules, this raw material cannot be considered as a transmitting agent of hazards as with an explosive. I realize that some manufacturers can have a stake in such an explanation. However, such rules shall be considered, for me, as fully unfounded and could be judged as crippling for many manufacturing and storage sites using TGAN. Furthermore, several other raw materials, which are much more "reactive" than AN, should have also undergone the same classification alteration.

SAFEX Newsletter also approached Prof Martin Braithwaite (Individual Associate) for his comment:

The Western Australian paper is consistent with other views expressed from different explosives inspectorates. The paper by Erik Nygaard referred to is also helpful. If AN can become explosive - either through contamination plus fire, fire or severe shock then there is not much to argue about. Gerard is concerned about solid AN (under ambient storage conditions) being treated as an explosive. If there is no possibility of contamination plus heat or fire leading to molten AN or severe shock in close proximity to the storage, then he is correct. Solid AN (pure or even with usual contaminants like wood and plastic bags) will not pose an explosion hazard unless it is subject to a thermal or shock insult. It is simply an oxidizing agent.

There have been a lot of catastrophic incidents with AN - well reviewed by Kish Shah (Fertiliser Society). We need only consider the non- processing plant ones and these can be divided into:

- shock initiation (prior to use of anti-caking agents) ex Op-pau where dynamite was used
- contamination plus fire e.g. ANFO type material
- fire (Cherokee in 1989)
- unknown (in general press) but possible contamination or malicious act - Toulouse

From a legislators' point of view they can point to the above (incomplete) history and insist on appropriate separation distances - one can hardly blame them as being perhaps over-conservative in protecting the public from blast damage. It is unfortunate but in recent years one cannot rule out deliberate malicious acts and there have been hints of such causes in recent explosions. One can envisage a safety system that would deal with a fire before uncontaminated AN became hot, hazardous and molten. However, for a deliberate act such as use of donor explosive inserted into the stack or alternatively use of catalyst/synergist for AN decomposition and more modest heat source, I cannot see how one could but agree with the legislators' approach. It is costly and will affect many other substances stored in substantial quantities capable of exothermic gas generating reaction.

Gerard points out that TGAN is not an explosive - in its normal uncontaminated solid state. It should be kept separate from any source of heat e.g. fire, high pressure steam pipes. And it should not be contaminated or be in the vicinity of any organic material, transition metal salts, halide containing materials, fuels or any reducing agents. If the site can guarantee this (and satisfy legislators), then the separation distances based on (contaminated) AN explosive properties are not pertinent. If not, then industry is stuck with them though distances can be considerably reduced by appropriate design of barricades, separation of individual stacks and, as far as possible, minimizing inventory.

One may be able to debate the actual figures used for TNT equivalency - estimates range from 10 to 40 %: I determined

a theoretical maximum (AN detonating ideally) at 42 %. Pure solid AN is a tertiary and highly non-ideal explosive with large critical failure diameter. There is no role in atmospheric oxygen generating more energy in late reaction during expansion of detonation products in contrast to the O₂ negative TNT. The question will be how one factors in possibly contaminants that will increase the equivalency figure to above the 25-30 % in common use.

It is a balance between reliance on the safety management of industry against the legislator's view that this is not sufficient - regrettably supported by Toulouse accident, if not others. As already mentioned, Noel Hsu and his Workgroup, Kish Shah (Fertiliser Society), or those associated with ANNA meetings will be worth consulting. With all the literature on use of separation distances I suspect any legal case involving an AN storage explosion and damage will side with the requirement for separation distances - Trevor Kletz's "belt and braces" philosophy.

When approached for his reaction to Gérard's concerns, Peter Drygala kindly responded as follows:

Thank you for passing Gerard's comments to me and thank you to Claude for the translation. First of all, it is important to state emphatically that I agree totally with Gerard - technical grade ammonium nitrate (TGAN) is not to be classified as an explosive, it is an oxidizing agent of Division 5.1. This is an important distinction to make since some states in Australia (Queensland and South Australia) control TGAN by using their explosives regulations and confusion can arise - there is a temptation to use the same quantity/distance relationships that are applied to class 1 explosives. Such quantity/ distance relationships for the storage of TGAN are not appropriate. So I agree with Gerard. These larger class 1 distances would impede industry needlessly.

On the other hand TGAN can explode under a number of circumstances (including detonation due to propagation of an explosion from a donor explosive; during fire under certain circumstances; and due to contamination with or without a fire). TGAN has explosive properties, but it is too insensitive to be included as a class 1 explosive.

Given the history of accidental explosions of AN and TGAN during storage, there is a need for society to receive adequate protection that comes to terms with the low likelihood of accidental explosion. The NSW Department for Planning has by way of a consultative process determined that the risk of an explosion should be limited. For instance, the individual fatality risk for residential purposes should be limited to one chance in a million per year.

To achieve these low risk objectives my paper argues that some form of protection by way of distance is required. It is not sufficient to rely entirely on the best endeavour of the dangerous goods operator to reduce the risk without any recourse to distance protection at all. The exact distance required will always remain under dispute. My paper suggests a method of selecting distances that are appropriate

for Australia and the particular building exposed to the risk.

Every society has to make its own choice as to the level of risk that should be tolerated. Some societies will tolerate a much higher level of risk than others and that is their right.

If the distances suggested in my paper are seen to be too large, then that is a reflection of the highly risk averse nature of Australian society. It should also be said that Australia as a rule has the luxury of open spaces that some other countries do not have.

Trends in explosives transport incidents questioned

We recently reported an incident in which an employee was killed and another seriously injured when a truck carrying cartridged dynamite collided with another heavy vehicle South of Yellowknife, Northwest Territories, Canada.

Erik Nilsson (KCEM) commented as follows on this Incident Notice:

It is of course sad that persons have been killed and seriously injured during transport of explosives. It seems to me that the number of accidents/incidents with the transport of explosives has increased in recent last years. If it is correct I think we should discuss the training of our drivers. I am of course fully aware of the fact that the accident/incident is not only depending on the driver with the explosives load.

May I make another comment about statistics. According to ADR this accident will not be an accident with dangerous goods because "nothing" happened with the explosive. I

think, and I have also mentioned this to the responsible authority in Sweden, that all accidents with dangerous goods should be reported. You can learn a lot from accidents where "nothing" happens with the dangerous goods i.e. if the preventive measures worked as intended.

(Editor's note: Coincidentally we are proposing to dedicate one of our Open Day plenary sessions in next year's SAFEX Congress to the transport of explosives. Hopefully we will receive some Papers form within or outside the SAFEX community that will address the issue of statistics raised by Erik. Has the number of explosives transport incidents increased - especially if it is normalised in terms of tons transported and distance travelled?)

Detecting and preventing propagation of in-process fires

In an incident where recycled single base propellant caught fire during milling, there were no injuries but the electrical system incurred some damage. The member concerned subsequently pointed out that there was a powder jam in the dispensing device before the operator saw fumes and shut-off the machine.

Maurice Bourgeois (GD-OTS) who pays careful attention to each Incident Notice we distribute shared the following insights:

I don't know the member's set-up but it's very difficult to prevent propagation of fire into the feeding system because of close proximity. Also it seems that the incident occurred when the feeding system shut-off and would not be related to the milling operation per se. Here the name of the game for fire propagation prevention is: detection, time of reaction and quantity and distribution of water. The problem with feeding systems is that ignition occurs in a closed environment where friction elements exist and propagates covertly under the stack. If a UV detector is used and the flame is totally enclosed the UV will see the fireball when it reaches the top of the feed hopper by then it's too late. The propellant is on fire from bottom to top and propellant grains are blown away all over the place by the time the deluge system reacts and water begins to flow. Some type of detection should be provided at the bottom of the stack (fast acting

thermo-couple or infrared or special UV with a special lens). Time of reaction is another factor and is usually measured in msec. The nozzles have to be the correct height and angle so that the spray pattern covers the powder bed with the minimum loss of water to the floor i.e. outside the area of interest. I have not seen it, but I would say a water pipe connected to the bottom of the hopper may work. If the detection system and its reaction time are fast enough, wetting the bottom part of the hopper could be an efficient way of preventing propagation. I would like to hear from other members on this topic.

The other interesting element is the shut-off device. While the shut-off device did not seem to contribute to the fire in this case, it can in other instances. If the shut-off device was a sluice, it can cause an ignition by friction. We don't use sluices to stop the flow of powder because propellant gets trapped in the slides which become a friction area when the sluice is moving forward to stop the flow.

Prepare and prevent, don't repair and repent.

Author Unknown

Inspecting items that can be easily overlooked

A recent Queensland Explosives Inspectorate Safety Alert reported that a fire on a mobile explosive manufacturing vehicle started in cloth rags left in contact with the high temperature exhaust. The exhaust was exposed because sections of the exhaust shield were missing. The driver was able to put out the flames using the vehicle's fire extinguisher.

Maurice Bourgeois (GD-OTS) observed the following: I think this incident brings to light inspection of safety items that are taken for granted once they are installed. Such items are overlooked during daily inspections because they are not easily accessible and they take a long time before they deteriorate. Exhaust systems and wiring should be inspected once a year by a qualified mechanic. As a matter of fact, in Canada we must submit an annual inspection report to demonstrate that the truck is in good enough condition to transport explosives for another year before our annual permit for trucks carrying explosives can be renewed. There are also inspection requirements after a repair.

Tony's Tale-piece

A tailpiece is something that appears at the end of a publication. I guess it is derived from the tail of an animal which is (normally) fixed to "the end" of it. However, we refer to this Newsletter feature as a "Tale-piece". It is not a spelling mistake but a different tale. This "tale" is about telling stories. While it appears at the end of our Newsletter, it is also meant to tell a story hence the play on words. Let me tell you what "Tony's Tale-piece" is about.

Tony Rowe from AEL Mining Services has kindly agreed to provide a regular feature based on truths he has discovered over many years in his work with explosives. He has a unique style of writing (perhaps "telling stories" may be a better way to describe it) which we hope gets a well-known message across in a new way. This Feature is there to remind readers of some explosive(s) truths in a different way!

Shelf-life – A Matter of Life or Death!

by

Tony Rowe (AEL Mining Services)

I have a corner office so you probably think I am a bit spoiled. It's not true though. In truth I have a very hard life. For instance, every day, I have to walk to my office from the car park 15m away. That's about 25 steps. Sometimes it is raining and I risk getting wet. Cold winds blow on occasions. The trouble is that the whole distance is open to the elements. When the weather is inclement, there is nothing for it except to wrap up well and walk briskly. I don't want to catch a chill.

Once inside the small dungeon-like room that constitutes my office I seek out and light the single tallow candle supplied at great expense to provide me with both illumination and heating. The floor is mostly grey concrete. To add a dash of colour - the original cement has been overlaid with a few dark blue carpet tiles. Such ostentation is almost unheard of. Please don't tell anyone.

There are a couple of downsides though. For instance, during the summer its gets so hot in here that the few

misguided insects that do find their way in here end up buzzing against the windows where they often spontaneously explode. They make a popping sound like bursting bubble-wrap.

In the winter, conversation literally freezes. If you wish to hear what someone has just said, you have to pick up the words and thaw them out first. Time wasting is discouraged. Running on the spot is frowned upon as is aimless shivering. If you have to shiver, then shiver constructively. Sandpaper something! For a seat I have a wooden stool. My manager said I was lucky because it was made from softwood not like the hardwood equivalents issued to the rank and file. To stop anyone from stealing it, the stool has been bolted to the floor. I do have one small secret though. Don't tell anyone, but I have a small bar fridge hidden in the corner. I've wrapped it in a cocoon of fibreglass wool to keep the winter inside. In the summer I can store a couple of cool drinks, some sauces and sometimes the odd sandwich. It's a small indulgence.

With the Christmas holidays completed, money, or at least its absence, required that I return to work. It was time: 2013 needed me. The month was January and it was hot. I knew what to expect when I opened the door. The hinges creaked and groaned, well why not, like me they hadn't worked for weeks. The blast of superheated air that followed was also not unexpected, but what was that smell? Had I forgotten to change my socks? Apparently not; so was it a dead skunk, a couple of cadaverous cats? No! Horrors, it was even worse. My fridge had mysteriously been turned off and unplugged.

This did not bode well.

Sensing disaster I immediately dug out my PPE elbow length neoprene gloves for starters. A gas mask and safety glasses seemed appropriate, so these too were quickly put on. Using binoculars I carried out a quick reconnaissance. A couple of passers-by were then hurriedly enlisted. For a small stipend, the brave volunteers entered the room

and opened the fridge door. The full scale of the inner hell was instantly exposed. It was true then. Not quite the beast from the tar-pits, but a full scale medical experiment was certainly ongoing within.

It was terrifying. A cheese roll and a steak pie had both grown fur coats. Not only was a fashion statement in full swing, both items had also grown substantially. Worse, they had changed colour too. The offending bread roll – now pulsating slowly – had turned a greenish blue. On what was once a crispy golden crust there had appeared a series of soft and leprous looking patches. Was the thing actually growling at me? Couldn't be, but just for a moment there I would have sworn that it was still alive. The steak pie on the lower shelf was another story. This one was loudly proclaiming itself to be a reincarnation of Al Capone and was threatening to take over the entire fridge. A good job I found it in time; a couple of hefty swats with a recalcitrant sauce bottle soon had it begging for mercy.

The horrors were not yet over. On a shelf in the door was a 2 litre plastic bottle. It was still about three quarters full. It had once contained milk, but no longer. A subtle transformation had taken place. Whatever was inside the container, definitely wasn't milk anymore. It was rather some sort of two-component liquid. A translucent top layer with a slowly rolling grey/white mass poised beneath. Like the cheese roll, the milk container had also swelled considerably. Cartoon-like in its obscenity, but with a clearly uncomfortable and as yet untapped potential, I was scared in case it suddenly ruptured. Horribly swollen, like an old carcass, the polyethylene shell was showing distinct stretch marks. It was already bulging outwards and I could see it growing as I watched. Something had to be done and quickly. There was no time to enlist the aid of passers-by. I was brave and didn't panic. Seizing the moment, I reached inside and in one quick motion liberated the hellish device, Working swiftly I eased open the screw top. There was a sound, long and sibilant, like a bucket of S's or a mamba with a



stutter. Accompanying the sound was a smell that simply beggared description. I believe I passed out. It was shocking, the odour appalling. When I came around I could see that my hair had turned white. I was also bleeding from my gums. Even today, just thinking about it is traumatic. Please nurse, I need my teddy bear. Sorry, I can't talk anymore and yes that is a lump in my throat.

Another drink Mr. Rowe? Yes please, but make it a double this time.

There, my story is done. Would you have used food in such a condition? Would you serve it to your friends and colleagues? After all it was only about a month old.

Is there a lesson here?

If there is it's probably something like this. Normally none of us would serve or eat old food, but we'd all quite happily use old explosives. Eeee by gum, we're a contrary lot. Just like food, explosives based products deteriorate according to age and storage conditions. People do too! Old folk are grumpy, sometimes wrinkly and despite what they might tell you often don't work half as well as they used to.

In the world of explosives, the range of products and devices designed and produced with military applications in mind do tend to be a little different. Why, because such items are manufactured

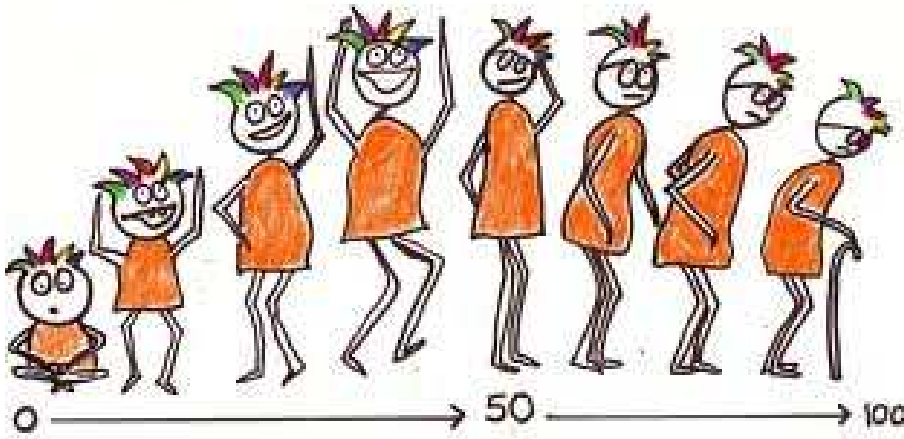


to an exacting set of specifications. The quality control checks around military explosives are usually stringent in the extreme as most items have shelf-life expectancies of 10 years or more. The reason? On the battlefield, there are no second chances and so they'd better perform as expected in whatever environment they are called upon to operate. Meeting such requirements of course translates directly into money. Costs to you and I, so as a general rule, products meeting military specs are generally much more expensive than their commercial counterparts.

The requirements for commercial explosives are you see much less demanding. Naturally enough, end-users want them to be as cheap as possible. Commercial explosives then are in a different league. Cheap and cheerful probably says it all. They do not have to function reliably after being buried under muck and bullets for 10 or 20 years. Nor are they designed for use under the polar icecaps or in the vacuum of space. The range of temperatures and conditions that they must function under, whilst unpleasant, is just so much narrower and as a rule well understood. Manufacturers can also more clearly define how they should be used. On the battlefield that's just not possible.

So what happens as explosives age? Well it's pretty much what happens to people and animals. They get grouchy and unreliable. Their heads grow through their hair which moves away and instead flourishes in ears and noses.

Older folk tend to talk a lot more than they used to do and repeat the same stories endlessly. Old explosives do much the same, but if they start to talk to you personally, tell your doctor right away. They're unlikely to become more sensitive, although in certain rare instances that too can happen. More often they go the other way. As they degrade, just like my fellow age-challenged folk, getting them to do anything becomes more difficult with each passing day. Even when forced into action, they're slow and their energy output will almost certainly be far less than it once was. With electrical initiators, their internal metal parts can corrode.



When used, the presence of rust can interfere with the flow of current and they become unreliable. My wife is nodding. I assume she agrees.

With regard to pyrotechnic based delay detonators, the timing can change as the intimate mixtures of finely divided oxidisers and fuels that make up the pyrotechnic train grow tired of one another's company. Just like granny and granddad their interactions together grow less and less over time.

The core of safety fuse can get damp as moisture is absorbed from the air. When stored underwater the combustible core can get wetter still.

Emulsion explosives have gas bubbles that grow and coalesce. Plastic grows brittle, metals age harden or begin to oxidise. Abuse that they would have shrugged off just a few months ago now causes permanent damage. Let's think about granddad again. With old people, their skin bruises and tears easily. Teeth fall out, blotches appear on the skin, eyes grow rheumy. Like an old dog

whose teeth have all fallen out, he's not what he once was. Burglars suffer only a nasty suck. There's truth in the phrase, nothing succeeds like a budgie with no teeth. Explosives deteriorate too; outer sheathings change, the plasticisers leach out and the coatings become less flexible and more inclined to split. Packaging too degrades. Boxes rot. Fungal moulds and bacteria infect and attack the wood pulp, breaking down the matrix and feeding off the by-products. Old age isn't for sissies.

We can't stop stuff growing old, but we can manage the process. Part of this is never to use explosives that appear degraded. That said, until stability is restored, try to use the oldest stock first. The acronym is LIFO. Last In – First Out. It's a fact that a small pinch of horse manure can affect a lot of ice cream. It's the same with explosives. Small mistakes can have serious consequences.

So avoid the hazards of misfired holes and don't use old explosives!

Boet Coetzee

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