SAFEX NEWSLETTER No. 34, 3rd Qtr. 2010

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This is your Captain Speaking

John Beevers – Orica Mining Services

John Beevers is the Chief Executive Officer of Orica Mining Services. The Company offers a wide range of commercial explosives and blasting systems with operations in Australia, Asia Pacific, North America, Latin America, Europe, the Middle East, and Africa. It is committed to developing and applying new technologies to achieve productivity, safety, environmental and financial gains for its customers

Joining Orica's Operations Division of Mining Services (Australia) in 1985, Mr Beevers held a variety of positions culminating with leadership roles in Technology, Operations and Commercial before his appointment as General Manager of Chemical Services in 2005. In 2006 he was appointed General Manager, Orica Mining Services Australia/Asia. In his current role since November 2008, Mr Beevers ensures that safety is at the forefront of his thinking and actions at all times.

The following paragraphs provide an insight into his view on safety within Orica Mining Services.

Orica's safety vision is "No Injuries to Anyone Ever" and that includes our people, contractors, customers and the general public. Strong environmental management goes hand in hand with safety and health. What I want to see in my management team, and cascaded into their teams is a constant state of unease about safety in all our operations.

My expectation for everybody in our business is to be trained to be aware of the hazards they face working in our industry, to understand the risk potential of these hazards, and how to work safely around them. To do this we must have manufacturing plants that are designed to operate safely, we need procedures that explain how to work safely, we need people who are trained to work safely, and most importantly, who want to work safely, and truly believe the business wants them to work safely.

In 2006 when I took over the Australia/Asia Region we were experiencing a worrying increase in serious injuries and incidents. I personally visited our sites accompanied by our Global Safety, Health and Environment Manager and regional operations managers to speak directly to front line supervisors and operators to better understand their issues.

These visits had the dual benefit of actually getting clarity on some root causes, and they also gave a clear message of commitment to the teams. It's worth remembering that quite often, the people who are injured are operators and front line supervisors. We need to be able to reach these teams at locations around the world which are often very remote and ensure their understanding that we are serious about their safety and to encourage them to be serious about safety. Of course this applies to every employee.

As the result of four fatalities in the Orica business in late 2008 I initiated Project Vital to ensure a focus on where we were heading in terms of safety within our company. I brought together a group of our senior managers and asked them to look at the world's leading companies and their approaches to safety. At the completion of Project Vital the following messages were found to be the key to achieving excellent safety performance.

- Leadership and senior commitment;
- Training;
- Clarity of purpose and standards;
- Recognition and involvement throughout the organisation;
- Acceptance and understanding of cultural differences;
- Analysis and action on high impact low frequency incidents;
- Safety auditing of your operations; and
- The successful integration and culture transfer with employees following merger and acquisition activity.

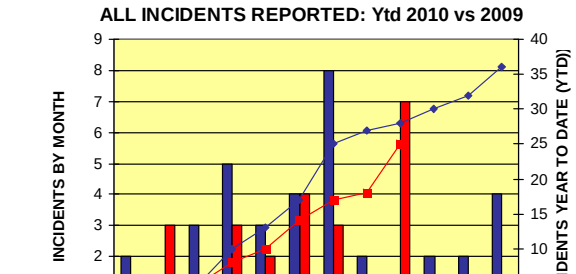
Throughout the last 12 months we have been working together to roll out these concepts in the mining services business and I am very clear on the need for leaders to be seen to be personally involved. As an example of our commitment to safety and to ensure the message reaches both the hearts and minds of our employees and contractors, we undertook a very expensive exercise where we staged the explosion of a company vehicle to ensure the attention of our people to the real and present risks of every day work. This footage continues to be shown to a wide internal audience today and despite the reaction at every viewing the challenge for Orica remains, how do we make safety communications an ingrained part of our culture?

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."

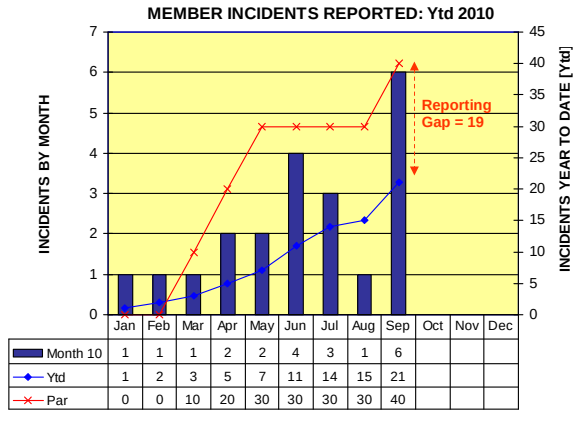
SAFEX learns from its members' experiences through the incident reports we receive. By applying these lessons we can prevent similar incidents recurring. Therefore, we track our incident reporting performance as follows:



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Month 09	2	0	3	5	3	4	8	2	1	2	2	4
Month 10	1	3	1	3	2	4	3	1	7			
Ytd 09	2	2	5	10	13	17	25	27	28	30	32	36
Ytd 10	1	4	5	8	10	14	17	18	25			

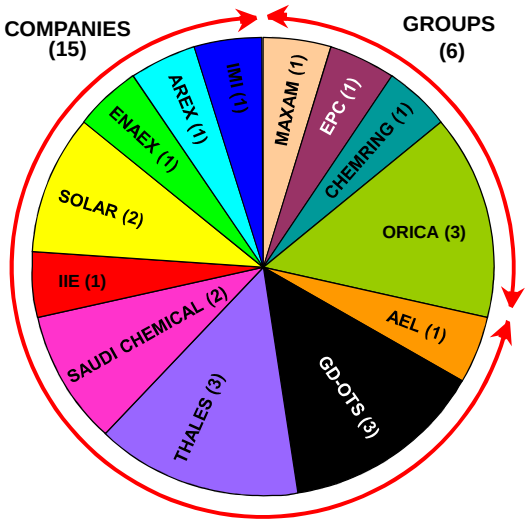
Member incidents reported. Because they give us the best learning opportunities, we track member incidents (MI's) separately in the chart on the right. PAR is an estimate of how many MI's are occurring based on the severity of the MI's reported. The gap between the number of MI's reported and PAR is our Reporting Gap. The Reporting Gap suggests only 50% of our MI's are being reported.

All the incidents reported. The sum of non-member *and* member incidents reported to SAFEX every month this year is compared to the previous year in this chart. In September more incidents were reported than in previous months in 2010. As a result the year-to-date number is similar to that of 2009. Every incident not reported is a lost learning opportunity. Remember, it's never too late to report an incident.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Month 10	1	1	1	2	2	4	3	1	6			
Ytd	1	2	3	5	7	11	14	15	21			
Par	0	0	10	20	30	30	30	30	40			

CONTRIBUTORS: MEMBER INCIDENTS Ytd 2010



Contributors of member incidents. This chart identifies those members who reported their incidents. It shows the number of incidents each of these members have reported related 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. The Group category now has about twice the number of operating units than the Companies category has.

On behalf of all SAFEX members, we thank these Members for taking the trouble to report their incidents. Without their efforts we will not be able to learn from the incidents we have.

Our Explosives Regulatory World

Transporting Class 1 Explosives in the USA using Dromedaries

Ben Barrett

Ben Barrett, an Expert Panel member, is an independent consultant specializing in regulation of explosives. DG Advisor, Ben's consultancy, is dedicated to participation in the development and modification of international dangerous goods regulations and helping clients comply with US and international regulations. Ben also provides training in the handling of dangerous goods including that required by ICAO.

Photograph of a dromedary trailer

Dromedary boxes or "droms" apparently got their name from the similarity to the humps on a camel. They entered explosives use in the 1960's when they were approved by the US Interstate Commerce Commission. The original purpose may have been to put droms on the back of tractors, allowing incompatible explosives to be hauled on the same motor vehicle by putting them in separate "transport compartments". For decades this system has expanded to offer explosives the flexibility and efficiency enjoyed by non-hazardous less-than-truckload (LTL) freight, while also offering the security otherwise available only to dedicated motor vehicles.

Whereas dromedaries may be common as a container on the back of tractors, only the explosives industry puts 7-8 droms on a flatbed trailer. Droms typically come in two sizes, designed to accommodate either two or four military pallets. The larger of the two has a volume of roughly 410 cubic feet. Per 49 CFR 172.512, freight containers must be placarded above 640 cubic feet, but below that they may be labeled. Dromedary shipments have the droms labeled and the trailer placarded. This complies with the placarding requirement for explosives to placard the lowest division present. Therefore a shipment of 1.4 and 1.5 explosives would show a 1.4 hazard, even though the definition of 1.4 is "no significant hazard" in the UN Model Regulations and "minor explosive hazard" in 49 CFR.

As a foundation to discussions about droms, the following definitions are of interest:

- *Motor vehicle* includes a vehicle, machine, tractor, trailer, or semitrailer, or any combination thereof, propelled or drawn by mechanical power and used upon the highways in the transportation of passengers or property. It does not include a vehicle, locomotive, or car operated exclusively on a rail or rails, or a trolley bus operated by electric power derived from a fixed overhead wire, furnishing local passenger transportation similar to street-railway service.

- *Transport vehicle* means a cargo-carrying vehicle such as an automobile, van, tractor, truck, semitrailer, tank car or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (trailer, rail car, etc.) is a separate transport vehicle.

As stated in the 49 CFR177.848 segregation requirements for highway transport, hazardous materials must be stored, loaded or transported in accordance with the segregation table provided. An ''X'' in the table indicates that materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation. Similarly, explosives which must be segregated based on the compatibility table in CFR177.848 must not be on the same transport vehicle. Most explosives of different compatibility groups cannot ship together, with some exceptions being that compatibility group C may ship with D, and S (other than fireworks) is compatible with everything except A & L

Reviewing the definitions of motor vehicle and transport vehicle, incompatible hazardous materials or compatibility groups can be propelled by the same semi-tractor if they are on different vans, flatbeds or the tractor itself, which is where a drom on the tractor comes in handy. However a further prohibition in CFR177.835(g) expands the compatibility restrictions to prohibit the shipment of detonators with Divisions 1.1, 1.2, 1.3, 1.5 on the same motor vehicle. They also may not ship with Division 1.4 detonating cord. The drom carriers in the US may overcome this by the use of Special Permit SP-14282, which allows various initiating explosives (included in a list) to be shipped with any other Class 1. Equivalent safety is gained by:

1. Allowing only entities passing a fitness check to perform this operation, i.e. only by special permit.
2. Full closed cases are required.
3. When other Class 1 is transported in a cargo van trailer attached to a motorized tractor unit, the detonators and assemblies must be isolated from them in a rugged, crush resistant locked and sealed metal or reinforced fiberglass cargo-carrying compartment (a.k.a. ”dromedary box”) located immediately behind the cab of the tractor unit.
4. No 1.1A explosives may be contained in the motor vehicle.

A second transport vehicle offers additional segregation alternatives

Another equivalent safety allowed is with Special Permit SP-9623, which authorizes the transportation in commerce of certain Division 1.5D and 5.1 materials in a cargo tank transport vehicle in a motor vehicle with a drom mounted on the tractor directly behind the cab. This eliminates the prohibition in 177.835(c) against hauling 1.1 or 1.2 in the same motor vehicle with a cargo tank.

Droms are not separate transport vehicles themselves, per an interpretation issued in June 2001 to the US Air Force, reference 01-0123. Therefore all the droms on a single flatbed trailer must contain compatible products.

Explosives haulers use dromedaries as part of their system to offer LTL shipments for military and commercial explosives. A host of difficult requirements exist which creates a niche for specialist services. Division 1.1, 1.2 and 1.3 explosive carriers are subject to stringent attendance, insurance, safety record and security plan requirements. Military shipments require many services beyond these, such as dual drivers, drivers with security clearances, satellite motor surveillance, signature and tally service, security escort vehicles and delivery deadlines. The carriers may also offer all these services to commercial shipments which do not require them. Each drom is capable of being separately locked and sealed as illustrated in the bottom photograph on the next page. Thus a small shipment

can be effectively secured without the inefficiency of hiring a dedicated motor vehicle to carry a few pallets of material.

While many companies offer dromedary services, Tri-State Motor Transit was a leader in escalating their use to higher volumes. Now R & R Trucking may be the biggest drom hauler, with up to 20% of their carriage involving dromedary flatbeds. Both these companies use an interesting system with one principal terminal instead of a network of terminals nationwide. At the beginning of each week the trucks leave to drop-off and pick-up locations all over the country. They return to the terminal at the end of each week. Over the weekend a special shift moves the droms between trailers to group similar destinations. The operation operates like a pulsing heart beat, sending freight out and returning with more to be sent out the next week.

While the freight is transitioned, the tractors receive preventive maintenance every weekend. Trailers receive maintenance at a slightly reduced interval, about every 3 weeks. While mainstream LTL carriers often haul Division 1.4C explosives, only specialist carriers haul Divisions 1.1, 1.2 and 1.3. Next time you have an LTL shipment of these products, consider using a dromedary service.

In Europe, which is governed by the ADR for highway shipments, compatibility groups B and D may be loaded together on one vehicle or in one container, provided there is no danger of propagation and the system is approved by the competent authority. Segregation is achieved by the use of separate compartments or specialized containment systems.

Satellite tracking is one of many security services available

SP-14282 specifies the dromedary box must be locked and sealed

Explosives Eco-talk

The impact explosives and explosives manufacture has on the Environment fall squarely in the SAFEX domain. We are as interested in the experiences members of the SAFEX community (Members, Associates and Expert Panel) have in minimizing explosives' environmental impact as we are in safety and health. 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 "Explosives Eco-talk" to contact the Secretariat.

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 have acquired expertise in specific fields. He must also be willing to make the same available to SAFEX members on a commercial basis which is agreed between the expert and the member. SAFEX merely "connects" the Expert and the Member who has a need and does not get involved in the detail arrangements.

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 could meet this need. It is then up to the Member to select an Expert and enter into an agreement directly with him.

PETER CARTWRIGHT

PERSONAL

Position: Director
Company: Carba Limited
Location: Scotland, UK
Education: BSc (Hons) Civil Eng
Affiliations: SAFEX Expert Panel; Chartered Engineer; Member Institution of Civil Engineers
Languages: English

CAREER OUTLINE

ICI & Nobel's Explosives Co. Ltd.
- 28 years in design of chemical and explosives manufacturing plants
- 14 years in leading explosives disposal, explosives plant decontamination and demolition projects.
- Soil and groundwater assessments
- Remediation.

Nobel Enterprises
- Head of Safety, Health and Environment

Carba Ltd
- Explosives related decommissioning and decontamination projects
- Audits, investigations and surveys

EXPERTISE

- Explosives decontamination
- Hazard studies, risk assessments and methods.
- Accident and Incident investigations.
- Safety Auditing.
- Designing closure plans for legacy chemical and explosives operations
- Defining remedial options, land use and development strategies
- Environmental Legacy Management

TYPICAL ASSIGNMENTS

2005 to present	**Independent consultant for the Chemical and Explosives industries**
Ongoing	**Various assignments for a wide range of worldwide companies dealing with explosives legacy issues, in particular those relating to TNT, lead styphnate, copper azide, nitroglycerine, nitrocotton, detonators, ballistite and HMX.**

Feedback from the Boardroom

The SAFEX Board of Governors met in Orlando, FL early in February this year. The focus of the Meeting was a review of the SAFEX Strategy. We have already summarised the Board's approach to developing strategy and the process it used. It consisted of establishing the Association's MISSION, determining its VALUES and then agreeing a VISION. The outcome will be STRATEGIC OBJECTIVES followed by TARGETS and ACTION PLANS. These are concepts with which member companies are familiar. In the last Newsletter we discussed how the Strategy Survey, in which members participated, influenced the SAFEX Mission. This edition outlines SAFEX's Value System as modified by the feedback from the Strategy Survey.

Readers are, of course, welcome to comment on the Board's thinking.

The Heart of SAFEX – Our Value System

Values are things we believe to be important - like equality, honesty, education, effort, perseverance, loyalty, faithfulness, conservation of the environment, etc. They help us make decisions in life; decide what we should and should not do. Because Values lie at the centre of our being it can be likened to the heart which is seen as the seat of our emotions. If the heart stops beating the body dies. Without being dramatic, we can also say if an organisation has no values and is not true to them, it too will die.

However, we know values are far more than emotions; we use them to guide our decision-making. In that respect they act much as a compass does. If you ask people who have had to travel through unknown terrain with few points of reference, they will tell you a compass is essential in order to arrive safely at your destination. SAFEX also has a Value Compass at its heart as it moves into the next decade. It also has four points. Instead of North, East, South and West, our Compass points are:

- **We are committed to the wellbeing of people and the environment.**
  We will conduct our business in a sustainable way by attaching equal importance to its economic, social and environmental demands (The Triple Bottom Line). We will honour Anti-Trust legislation wherever we operate and at the same time collaborate with competitors and relevant organisations on Health, Safety, Security and Environmental (HSSE) issues to the benefit of all stakeholders.
- **We believe in learning from our own and others' experiences.**
  We recognise that the negative experiences we have are costly in many ways. Therefore, we resolve to learn as much as possible from them so that we and the industry can prevent them or similar ones from recurring.
- **We respect and support each other**.
  It means we appreciate and look out for each other's vulnerabilities as well as support each other in preventing or recovering from a catastrophic event by any legal means and as best we can.
- **We accept collective responsibility for our industry's reputation**.
  The saying "an injury to one is an injury to all" also applies to our industry. We will readily provide and accept help from each other in order to conduct our operations in a way that does not damage the reputation of our industry in the short or long term. If our industry is compared to a chain, it means we are all links in the chain and the chain is only as strong as the weakest link.

An organisation's values establish the goals that are more important, provide stability and guide it as it encounters obstacles, distractions, opportunities, ambiguity, ambivalence and conflict. If SAFEX Members accept these as OUR values, it describes how we want to behave. Because Values and corporate Behaviours are so closely aligned, we will take them together and call it our Value System.

How healthy is the SAFEX Heart?

Heart disease has been described as the killer of our time. Despite the enormous strides made to understand the factors affecting the heart's health, doctors still recommend regular check-ups especially for those in stressful occupations. To this end they use a variety of instruments; some like a stethoscope are quite simple while others are very sophisticated. If Values lie at the heart of SAFEX how can we measure the health of the SAFEX heart?

SAFEX sees that Values and Behaviours go together and hence we call it our **Value System**. It means we should be able to get some idea of how serious we are about our Values if our Behaviours reflect them. What Behaviours should we see in SAFEX if our heart is healthy i.e. our Values are in place?

- **Participate proactively.**
  Members actively support SAFEX programmes and enhance its effectiveness by identifying opportunities whereby SAFEX can improve the HSSE performance of our industry. Our industry is only as strong as the weakest link of the chain. Expanding our membership to obtain greater participation from every relevant explosives company in the world is, therefore, an organisational imperative for SAFEX. In this way we can make the chain stronger

- **Contribute diligently.**
  Members share as soon as they can any explosives HSSE experiences and good practices that can lead to industry improvements. They give balanced incident information by emphasising both the good and bad aspects of it to identify learning points. Members also provide feedback (comments or suggestions) as necessary on the information and practice guides they receive.
- **Implement improvements responsibly.**
  Members accept accountability for their own and the industry's HSSE performance. They anticipate HSSE needs and do whatever it takes to operate at optimal HSSE levels. Any information they receive about others is handled sensitively.
- **Promote the common good of members.**
  Support other members in improving their HSSE performance and recovering from mishaps. In this way we strengthen the chain that is our industry and of which we are links.

These are the Board's initial thoughts and it will welcome your comments. We plan to capture the SAFEX strategy in a document that can be distributed to the SAFEX community. This task has been given to an editorial group which eagerly awaits your inputs.

Research Notes from CERL

UN TDG Test Series 8 for ANEs

Dr Phil Lightfoot

Introduction

The UN Transport of Dangerous Goods (TDG) system is an excellent example of international collaboration on best practices for handling hazardous materials. The UN Model Regulations for TDG [1] have been adopted almost verbatim in many countries and the associated Manual of Tests and Criteria [2] is widely accepted for the purposes of classifying explosives for transport. Having an international TDG system greatly facilitates commerce in what is an increasingly globalized industry. Of course, some variation from country to country is inevitable but, on the whole, the way that explosive products are classified for transport is fairly standard around the world. However, one disadvantage of a large, international system is that it can be an extremely slow and painful process to introduce improvements or changes of any kind.

One of the biggest changes in the UN TDG system related to explosives over the last couple of decades has been the introduction of the class of materials known as "ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives" (ANE) (UN No. 3375). There was a recognition that these bulk materials needed to be treated differently from "traditional" explosives such as dynamite, in that they were relatively insensitive, being only converted to blasting explosives at the point of use, and thought to be intrinsically less hazardous. After several years of debate, a workable definition for the chemical composition of materials to be covered under UN No. 3375 was agreed upon that included suspensions and gels as well as emulsions. Furthermore, any material whose chemical composition met the definition of UN No. 3375, would also have to pass a new series of tests in the Manual of Tests and Criteria: Test Series 8. Material that both met the definition of UN No. 3375 and passed Test Series 8, would be recommended for inclusion in Division 5.1, i.e., outside of Class 1. There was a great deal of debate over which tests should or should not be included in Test Series 8, but eventually a compromise was reached.

The purpose of this short article is to provide some insight into what considerations determine how tests are selected for inclusion in the Manual of Tests and Criteria, using Test Series 8 as an example. We also discuss the shortcomings of each of the tests as currently configured and provide our suggestions for how they might be improved. In the interests of full disclosure, we note that UN No. 3375 is not used in Canada, where we continue to classify ANEs as Division 1.5 materials, preferring to keep them within Class 1.

How tests get chosen for inclusion in the UN Manual

There are no fixed principles for selection of tests for inclusion in the UN manual, but the considerations discussed below are certainly relevant.

Tests should be reasonably easy to perform, so that they can be available to as wide a range as possible of laboratories throughout the world. This is a laudable goal. However, in practice almost all classification testing is done in a limited number of facilities around the world. These testing centres are normally well-equipped, modern laboratories. In many countries, the ability to test large quantities of material is a more severe constraint than access to laboratory equipment and techniques. Of course, the simpler a test can be made, the better, but in our opinion it is often better to have a slightly more complex test that is scientifically supportable than a simpler test that produces less meaningful results.

It is also easier (but not easy!) to introduce a test if it, or a slight variation on it, already exists in the manual. For example, Test 6 (d) (unconfined package test) that was recently added to the manual is a modification of Test 6 (a) (single package test) with the external confinement removed.

Before being included in the manual, it is certainly helpful that a test, or a close variant, be in use in a number of laboratories, so that there is a degree of comfort with the practicality of the method and the results it produces: it can be difficult to persuade other laboratories to adopt a test which they are not doing.

The test should address the hazard being evaluated in a scientifically justifiable manner. This does not mean that the test needs to be scientifically perfect, leading to unambiguous and unquestionable results. Many of the current tests already in the manual represent a best compromise between trying to assess a hazard and the considerations outlined above. For example, Test 6 (c) (External fire (bonfire) test) aims to determine whether there is a mass explosion hazard or other serious hazards when explosive substances or articles are involved in a fire. Very sensibly, the test involves directly burning the materials in a bonfire and observing the results. However, for practical purposes, the volume of the test material is generally limited to 0.15 m^3. This volume is much smaller than typically used for large-scale transport. Unfortunately, the response of energetic materials to

fire can be quite sensitive to scale: at larger scales, it is harder to dissipate any heat generated by burning materials, resulting in a greater tendency for transition to violent behaviour. The results of a large European Community program on fireworks safety (CHAF, [3]) demonstrated in quite a spectacular fashion that fireworks tested at the scale of full transport containers could mass explode (Division 1.1 behaviour) whereas they had only burned violently in the 6 (c) test (Division 1.3 behaviour). It would be totally impractical, not to mention extremely expensive, to test full shipping containers of fireworks or any other energetic materials in order to classify them for transport, so a scientifically justified method for extrapolating the results of smaller-scale tests to large scale would be most desirable.

Finally, it should be remembered that a test does not have to be in the manual in order to be accepted by the local Competent Authority (CA). The CA can decide that one test provides equivalent information to another, even if it is quite different. One area where the discretion is particularly important is where the materials specified for a test are difficult or expensive to source locally. Naturally, in order for the CA to make this source of decision, she or he must be fairly comfortable with its scientific basis. In Canada, we are fortunate to have an explosives inspectorate that has a strong science base, which greatly facilitates deviation from the prescriptions of the UN manual where appropriate. For example, the method for the Series 5 (c) (External fire test for Division 1.5) test recommends a wood fire made of a lattice of air-dried pieces of wood of square cross-section ~50 mm. Such a set up is fairly expensive as the wood has to be purchased for the purpose. Instead, we typically use excess wooden pallets as the fuel for external fire tests. Pallets are very inexpensive and the resulting fire certainly meets the intention of the test, which is to have a fire last at least 30 minutes or until the substance has clearly had sufficient time to react to the fire.

Current Series 8 Tests

As currently configured, Test Series 8 comprises three test types:

Type 8 (a): a test to determine the thermal stability;
Type 8 (b): a shock test to determine sensitivity to intense shock;
Type 8 (c): a test to determine the effect of heating under confinement;

In addition, while not being a requirement for inclusion under UN No. 3375, Test Series 8 (d) was included as a method to evaluate the suitability for transport in tanks.

Series Type 8 (a):

- Thermal Stability

A thermal stability test is clearly necessary for ANEs as thermal runaway is one of the principal hazards of these materials. The current Test 8 (a) is generally adequate, as it addresses the issue of scale by using a Dewar vessel to reduce heat loss so as to better approximate the large road tankers used for ANE transport. Heat loss is also minimized by maintaining the vessel in a heated oven. The test is carried out at 20°C above the maximum transport temperature which should provide an adequate margin of safety. The test is also based on a pre-existing test in the UN Manual that is used for self-reactive substances of Division 4.1 and organic peroxides of Division 5.2 (Test H.4: Heat accumulation storage test), which, as discussed above, facilitated its adoption for another test series.

There are some difficulties with Test 8 (a), however. Firstly, several hundred grams of material are tested, requiring that the procedure be carried out remotely in a robust test cell. Clearly a test requiring much smaller amounts of material could be carried out more conveniently. Secondly, Test 8 (a) takes at least a week to complete, tying up facilities and slowing down the process. A quicker test would be helpful. Finally, this is a pass/fail test that gives no indication of the margin of safety. When a test is negative at 100°C, it would be useful to know if thermal runaway would start at 105°C or 150°C, for example.

Many of the inadequacies of Test 8 (a) can be overcome using accelerating rate calorimetry (ARC). We have been using ARC to test ANEs and other energetic materials in Canada for many years. ARC is a well-established technique for assessing the thermal hazards of energetic chemicals, as previously discussed in this Newsletter [4], and has a fully developed ASTM procedure [5]. Many laboratories have ARC instruments. ARC experiments typically require 1-3g of material, and can be carried out in a normal laboratory environment. The experiments take only 1-2 days and have the further advantage that they provide a measured onset temperature. Furthermore, as ARC is an adiabatic technique, is simulates bulk quantities of material. We have demonstrated that ARC gives comparable thermal onset temperatures to Dewar calorimetry for ANEs and ammonium nitrate solutions [6]. We recently proposed that ARC be added to the list of Series 8 tests, as an alternative to Test 8(a) and 3(c) [7].

Series Type 8 (b):

- Shock Sensitivity

It is generally agreed that a severe shock sensitivity test is required for ANEs, to demonstrate that they are very unlikely to detonate even when subjected to a powerful initiator. The current Series 8 type (b) ANE Gap Test is essentially the Series 7 type (b): Gap Test for Extremely Insensitive Detonating Substances, except that it is carried out at the transport temperature. As a result, it could be easily adopted. On the other hand, Test 8 (b) is very inconvenient to carry out, as it requires a heavy-walled steel tube, a large booster and approximately 2.5 kg of test material. Positive results produce a lot of shrapnel that can be very damaging to blast chambers and there are many testing organizations that would be hard-pressed to do this test on a regular basis.

In addition to the experimental difficulties associated with Test 8(b), we note that it is less severe than Series 1 and 2 UN gap tests in at least one respect. In each case the product is contained in a steel pipe. High explosive boosters of similar composition are used, although the Series 8 booster is larger. PMMA spacers are used, when appropriate.

- Test 1 (a): Diameter 48 mm, wall thickness 4 mm, no spacer, length 400 mm
- Test 2 (a): Same as Series 1, but with a 50 mm spacer
- Test 8 (b): Diameter 95 mm, wall thickness 11 mm, 70 mm spacer, length 280 mm

The Series 8 test has a lower imparted shock pressure than the Series 1 or 2 tests, as they have no spacer or a 50-mm spacer, respectively. Based on a calibration in the UN manual, we would anticipate that the initial shock pressure in the Series 1,2 and 8 tests would be 15, 6 and 4 GPa, respectively, i.e., lowest for the Series 8 test. Of course, the diameter of the sample and its degree of confinement is greater for the Series 8 test, both of which increase its severity. Research has underlined the fact that the physics of gap tests can be very complex, providing results that can sometimes be counterintuitive [8], so it is not immediately obvious that the Series 8 test is much more severe than the Series 1 test, which is much easier to carry out. Of course, removing or reducing the thickness of the PMMA spacer in the Series 8 test would ensure that it would be obviously more severe than the Series 1 test.

Series Types 8 (c) and (d):

- Heating under Partial Confinement

Test 8(c), the "Koenen Test", is currently used to determine the effects of heating ANEs under partial confinement. Approximately 30 g of material is subjected to intense external heating in a thin-walled steel tube. The tube is partially sealed with an orifice plate. The limiting diameter is the largest orifice size for which explosion occurs in at least one out of three trials. For inclusion under UN No. 3375, the limiting diameter must be 2.0 mm or greater.

The Koenen test is widely used throughout the UN Manual. Versions appear as Tests 1 (b), 2 (b), 8 (c) and E.1. However, results presented at the meeting of the UN TDG Committee in July 2004 demonstrated clearly that ammonium nitrate emulsions and watergels can behave very differently under the conditions of Test 8(c) [9]. It was demonstrated that the interpretation of the results of the test could easily be ambiguous. For example, the physical properties of ammonium nitrate emulsions were such that there could be poor thermal contact between the sample and the walls of the vessel, leading to premature weakening and rupture of the sample vessel. There is also a widely recognized problem with the blocking of the orifice when testing ANEs as the sample tube is mostly filled and the orifice is directly above the sample. If the orifice becomes blocked or obstructed with sample material, the pressure can build very quickly, resulting in rupture of the tube and a false positive result.

Although Test 8 (d) (Vented Pipe Test, VPT) was included in Series 8 as a method to evaluate the suitability for transport in tanks, it is effectively a much scaled-up version of the Koenen test. Approximately 50 kg of product is placed in a vented cylindrical steel vessel and subjected to an external fire. If the test results in an explosion, the test material is considered to be unsuitable for transport in bulk.

Test 8 (d) has been studied in some detail over the last few years and the results presented formally at meetings of the UN TDG Committee [10, 11, 12]. One result of the discussions has been the inclusion of a second, more reproducible, version of the test in the UN Manual [2]. This Modified Vented Pipe Test (MVPT), features a gas burner as a heat source and a different vent setup.

We note that many jurisdictions (including Canada) have not adopted either version of the 8 (d) test, for a variety of reasons. For example, the test is difficult and hazardous to perform, requiring a large, outdoor facility, so many countries are simply not able to carry it out.

It is debatable whether either Test 8(c) or 8(d) are realistic worst-case simulations of what happens when a truck carrying ANEs is engulfed in a fire. In these tests, the ratio of vent area to sample volume is much greater than for a tanker truck, for example. Nevertheless, it is generally recognized that a truck fire represents a significant hazard for ANE transportation and that a test that provides useful information on the behaviour of large quantities of ANE in a fire situation is essential. Fortunately, we believe that other, smaller-scale tests could provide useful information, as is discussed below.

Alternatives to the 8 (c) and 8 (d) tests

The widespread dissatisfaction with the 8 (c) and particularly the 8 (d) test has encouraged researchers to investigate alternatives. We describe three potential alternatives, at different stages of development and readiness.

Minimum Burning Pressure test

It has been well established that sustained combustion in ammonium nitrate water-based emulsions can only happen if the ambient pressure is above some minimum threshold value, usually referred to as the 'minimum burning pressure' (MBP). CERL and Orica Mining Services have worked in partnership since 2004 to develop a small-scale test that provides repeatable and conservative estimates of the MBP. The test method has been significantly improved over the years and is presently in a state where it can be readily adopted. We have previously described our MBP work in the SAFEX Newsletter [13]. In brief, a sample of ANE is held in a pressure vessel under an inert atmosphere and ignited with a hot wire. If the initial pressure is at or above the MBP for the material, the sample burns completely. The MBP of a wide variety of ANE formulations has been measured. Figure 1 shows the effect of water content, and some oxidizers on MBP values. The results show a clear potential to differentiate among ANEs that would be typical precursors for "bulk" emulsion explosives and those that would be ANEs more typical of precursors to "packaged" emulsion explosives. For example, AN-only emulsions with more than 15% water display very high MBP values. "Bulk" ANEs typically have MBPs in the range 6 - 12 MPa (855 to 1725 psig), while "packaged" ANEs have MBPs in the range 0.45 – 3 MPa (50 – 420 psig).

The MBP is a clear measure of the propensity of an ANE to undergo self-sustained deflagration. That being said, the application of the MBP test to transport classification is not totally straightforward, as the test evaluates the potential for deflagration following a localized thermal ignition event, rather than a deflagration as a result of an engulfing fire scenario. Indeed, the primary focus of our MBP work is process safety. However, it is to be expected that materials with low MBP values will be most susceptible to deflagration-to-detonation behaviour in a fire scenario. Furthermore, the test clearly differentiates between products that are currently widely considered to be safe for transport and those that are not. As a result, we recently proposed that the MBP test be considered as a potential alternative to the 8 (d) test, with UN No. 3375 restricted to products with MBP values above a certain limit (e.g., 5.6 MPa (800 psig)) [14]. The proposal was fairly well received and we plan to continue to pursue this line of investigation.

Based on the criteria discussed earlier, in favour for adoption of the MBP test is that it is certainly scientifically well-validated, requires small quantities of material (~30 g) and has been greatly simplified over the last few years. One person can perform a full MBP measurement in approximately two days (10 to 12

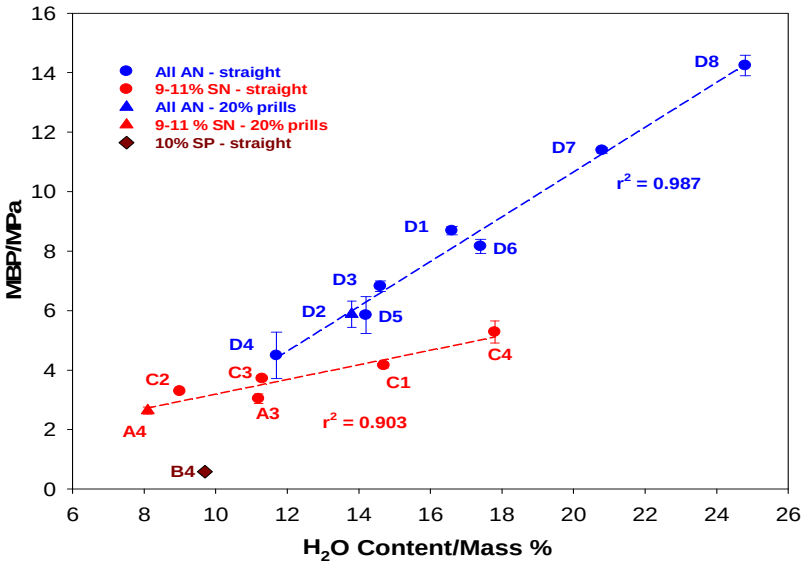


***Figure 1:** The effect of water content and oxidizers on the MBP of unsensitized emulsions*

tests) and a go/no-go test at a particular pressure can be done with just a few tests. On the other hand, the MBP test is very different from those already in the UN Manual. It is also not yet widely in use, although it is gradually being adopted, with facilities now in place in China, South Africa and Spain, as well as Canada. Inter-laboratory testing has also recently been initiated between CERL and laboratories in China and Spain.

1.5-L test (AIST, Japan)

Our colleagues at AIST in Japan have been working on an alternative to the 8 (d) test for several years. Some of the work has been done in collaboration with CERL. In particular, we have been working on making sure that we are able to produce emulsions with the same chemical and physical characteristics in our respective laboratories. The researchers at AIST have developed a medium-scale test, between the Koenen test and the Vented Pipe Test, based on an instrumented 1.5-L pressure vessel. As with the Koenen test, the 1.5-L test employs orifice plates with holes of different diameters to relieve the pressure as the sample is rapidly heated by an external flame. A bursting disk relieves the pressure if it exceeds 2 MPa. The characteristic result is the largest orifice for which the bursting disk is ruptured. A sample size of 100 g is used, which means that the test can be carried out readily in a hardened laboratory facility, such as might already be used for the Koenen test. The test is also not unduly complicated: two people can apparently carry out about four tests in a day.

The results presented by the AIST group to date have been quite encouraging: in a series of trials on AN-only emulsions, they have demonstrated that the limiting orifice diameter for a "bulk" ANE (~17% water) is significantly smaller than that for two "non-bulk" (11-13% water) ANEs. This work has not yet been fully published, but has regularly been presented at meetings of the IGUS group (International Group of Experts on the Explosion Risks of Unstable Substances http://www.oecdigus.org/) [15, 16].

A significant experimental advantage of the 1.5-L test over the Koenen test is that there is a much lower tendency for the orifice to block, as the volume of the sample vessel is significantly greater and the orifice is not directly located above the material being tested.

Modified Dutch Pressure Vessel Test (DPVT)

We have carried out preliminary work at CERL to investigate the use of an instrumented version of a pre-existing test in the UN Manual that is used for self-reactive substances of Division 4.1 and organic peroxides of Division 5.2 (Test E.2: Dutch pressure vessel test). This work has been done in collaboration with that at AIST in Japan discussed above. The E.2 test is used to determine the sensitiveness of substances to intense heat under defined confinement and is used in parallel with the Koenen test for self-reactive substances [2]. In many ways, Test E.2 is very similar to the Koenen test: 10 – 50 g of material is subject to strong heating under confinement; gases are allowed to escape through an orifice and a calibrated bursting disk is used to relieve pressure if it exceeds 620 kPa. The result of the test is determined by the size of the largest orifice for which the bursting disk ruptures at least once in three tests.

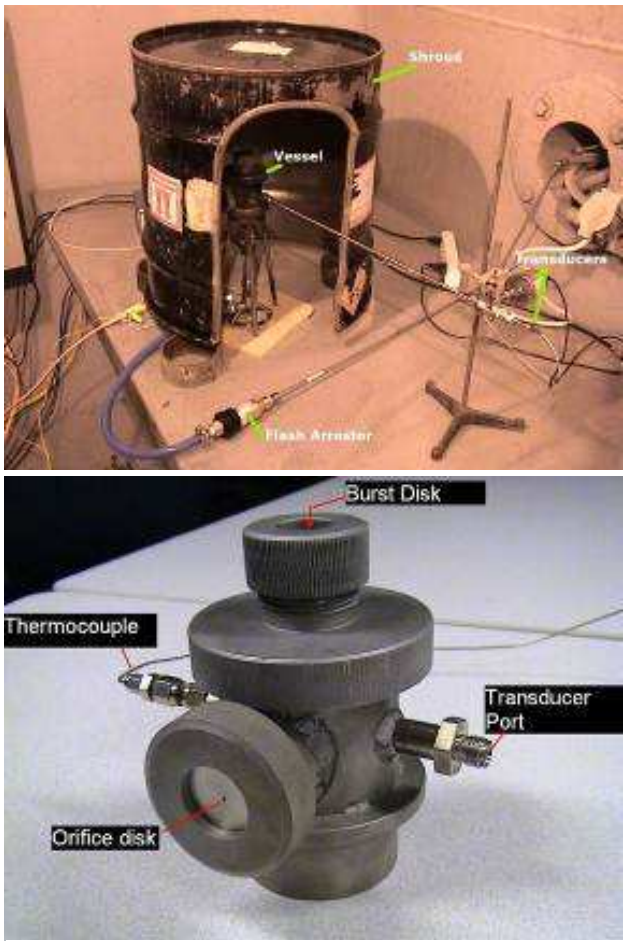


Figure 2: Modified Dutch Pressure Vessel Test at CERL. The overall set-up is shown above with the actual vessel below

Our apparatus is shown in Figure 2. In our modified version, we have instrumented the apparatus for both temperature and pressure. We also installed a bursting disk with a higher rating, so that the pressure could be monitored directly throughout the experiment. As with the 1.5-L test, a big advantage to the DPVT over the

Koenen test for ANEs is that there is a much lower tendency for the orifice to block, as the volume of the sample vessel is greater and the orifice is not directly located above the material being tested. The DPVT has advantages over the MBP and 1.5-L tests in that it is based on an existing test in the manual.

Initial results were promising, with a good differentiation in terms of critical orifice diameter between "bulk" (~17% water) and "packaged" (~10% water) emulsions. Our work in this area is still at a very preliminary stage. So far we have not published the results formally, although they have been presented at a meeting of the IGUS group [17]. We have not given this research high priority, as we do not use Test Series 8 in Canada because we prefer to keep ANEs within Class 1. However, in light of the interest in finding alternatives to Test 8 (d) in particular, we hope to pursue further work in this area in the near future.

Conclusions

We hope that this short article has provided some insight into the technical aspects of the UN TDG system and how tests are adopted in the Manual of Tests and Criteria. It is important to remember that, whatever the flaws in the UN TDG system, overall it represents a tremendous achievement in terms of international standardization; the global industry and regulators worldwide all benefit from it. The views expressed here are entirely those of the author, who would be pleased to discuss them with SAFEX members! In particular, we would be happy to hear from all who may have any thoughts on our ideas to improve the current Test Series 8.

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Congress Chat

The XVII SAFEX Congress will take place during the week **Monday, 23 May to Saturday, 28 May 2011** in **Istanbul, Turkey.** The planning framework for the Congress was communicated to members in Congress Bulletin No.1 which we distributed in March. At the end of April we issued Bulletin No.2 in which we called for Congress Papers and requested prospective authors to submit Abstracts by the end of June. Bulletin No.3 was issued at the end of August and outlined the Congress Programme. This gave members an indication of what to expect if they attend this Congress. This Newsletter elaborates on some of the Sessions.

Please contact the Secretariat for copies of the Bulletins if you are interested in them.

Congress Training Session: Covers essential safety elements

The Congress Training Session will focus on the application of Basis of Safety (BOS) and Good Explosives Practice (GEP) principles in explosives operations such as bulk and packaged explosives, pyrotechnics, initiation systems, ANFO etc. We asked Andy Begg, the Convener of the Training Session what BOS and GEP really mean. This is how he explained it:

"The BOS and GEP programmes were initially developed in ICI Explosives to address observed weaknesses at all levels in the organization in order to ensure that basic explosives safety practices were understood and implemented.

"BOS is the set of controls that help ensure an explosives operation is designed and conducted so as to avoid injury or damage by fire/explosion and will deal with:

1. Ignition sources and their control; as well as
2. Consequences of ignition and their minimization.

Participants will learn about the various sources of ignition for the explosives that we work with, how these can arise in typical explosives operations (from R&D through production to use and disposal) and how they can be controlled.

"GEP on the other hand deals with practical methods of ensuring that the BOS principles are implemented."

As we understand from Andy the introduction to BOS and GEP principles in the Sessions will be followed by the presentation of practical examples from current operations where BOS and GEP are being implemented. Examples will include plant design, incident investigation, risk assessment and hazard study, R&D safety, plant safety assessments and license to operate. There will also be exercises where participants will learn and practice how to prepare BOS and GEP systems for their own operations.

To the question as to who should consider participating in the Training Session, Andy responded: "The training is relevant to all company personnel including General Managers, Operations Managers, Plant Managers and Supervisors, Commercial Personnel, Maintenance Personnel, Engineering and Safety Specialists." He went on to say "It is hoped that participants would act as local champions for BOS and GEP on completion of the training and would lead the implementation of BOS and GEP programmes in their respective companies."

The training, for which there is no charge to SAFEX Members, will take 2 full days and be given by four experienced personnel from member companies who have active BOS and GEP programmes. As space will be limited to 30 participants, do register early when the Registration Form is issued next month.

Overview of Congress Sessions

The main Congress activities comprise the following Sessions:

- **Training Session**
- **Workgroup Sessions**
- **Plenary Sessions**
- **Special Sessions**
- **Social Programme**

The Plenary Sessions are divided into an Open and Closed Day. Participation in the Closed Day is restricted to members of the SAFEX Community. The following topics will be covered in the Plenary Sessions:

Open Day:

- Behavioural Safety
- "Green" explosives manufacture
- Risk management: Tools and best practices
- Risk management: Hazards and Regulatory impact

Closed Day:

- Incident investigation and reporting
- Incidents with initiating systems and primary explosives
- Incidents with other explosives
- Ordinary General Meeting of Members

Closed Day: It's about learning from the incidents we have

The reason for making the second day of Plenary Sessions a Closed Day is to provide members with a "safe" environment in which to discuss freely the incidents that are presented. You see, it is important for people to share the mistakes that were made as well as the good things which worked for them. How often have you not heard (and experienced) that "people learn from their mistakes".

It applies to SAFEX as well. However, it is never easy to talk about our mistakes. When we hear about others' unfortunate experiences in SAFEX, we truly believe in the expression "there but for grace go I". Instead of scorning others for their errors we admire them for their honesty and willingness to share those with us. It allows us to learn from their mistakes as well. Furthermore, we understand and respect other members' vulnerabilities (it is one of our Values, remember). Therefore, we do not talk about them with people who are not part of the SAFEX community. What is discussed in the Closed Day and the Proceedings that follow is restricted.

Incident investigation and reporting is key to learning

Without good incident investigation and reporting our ability to learn from the incidents Members report is compromised. It is therefore no surprise that the first Session of the Closed Day is dedicated to this topic. Martin Held (Austin International) is the Convener of the Session and describes its objective as: "To demonstrate the value of the SAFEX-EIDAS Database in analysing incident trends and show how good and bad reporting impact on the effectiveness of the Database. Case studies of good and poor investigations and their impact on reports will be covered. Good reporting practices will be discussed to eliminate reporting weaknesses and address the gaps that occur in many of our reports."

Peter Moreton (Individual Associate) will present a paper on the use of the SAFEX-EIDAS Database in analyzing trends and patterns in reported incidents. The paper looks at incident reporting and identifies the type of information that must be recorded if the Database is to have maximum value. Examples of the impact of good and bad reporting will be given.

We also have two papers on incident investigation practices. In the first Andy Begg (Individual Associate) reviews the Sierra Chemical Explosion in 1998. It is an example of a comprehensive investigation and good incident reporting. His paper will be followed by one from Martin Held (Austin International) who uses a series of fuse heads incidents as an example of a poor initial investigation. He also shows how root cause analysis can contribute to improve the outcome of an investigation.

Finally, David White (EPC-UK) examines the deficiencies in the reporting of accidents and incidents and possible reasons why they occur. He concludes his paper with strategies for improving reporting.

Learning from initiating systems and primary explosives incidents

Enrique Barraincua (MAXAM Corp) is the Convener of this Session. In it he wants to illustrate a range of situations in which the manufacture and handling of initiation devices and their components pose risk for manufacturers and users. By discussing the following incidents he wants to suggest different ways to assess and prevent them.

Risks in detonator loading will be the subject of Valentin Gorostiza's (MAXAM Corp) paper. He identifies risks in both manual and automatic loading operations at the hand of incidents. The relevant safety aspects to counter these risks are then highlighted.

Martin Held (Austin International) discusses an incident during the manufacture of HMX in order to highlight how a product regarded as having a low sensitivity can easily explode. HMX is the most common explosive used for the dusting a shock tube's inner wall.

Pablo Ramos (MAXAM Corp) addresses hazards and preventive measures using initiation systems in quarries and open pit blasting in his paper. He reviews some real accidents and incidents with the use of more common initiation systems such as safety fuse, plain detonators, boosters, detonating cord, electric, nonelectric and electronic detonators.

An explosion of primary explosive during a weighing process is the subject of Tomoji Sunagawa's (Kayaku Japan) paper. The investigation of the incident identified impact from falling objects as the cause. Learning points highlight the importance of maintenance and design when handling primary explosives.

Lessons from incidents with other explosives

The purpose of this Session is described by the Session Convener, Rahul Guha (Solar Explosives), as: "To provide delegates with an insight into and lessons from various incidents that took place with other explosives. Besides the learning that can benefit our industry, these incidents also demonstrate the need for thorough investigations to be carried out into each incident."

An accident at a bulk emulsion matrix plant will be discussed by Erode Mahadevan (Visfotak). He will give details of the incident, possible reasons behind it and remedial actions to reduce explosion damage. The details of a fire with an ammonium nitrate solution feed hopper, the causes of the incident as well as the key learnings is the topic of Bengt Folkesson's (EPC Sverige) paper. Mohammad Shasti (PCI) looks at a fire and explosion of granulated nitrocellulose in a rotary dryer in his paper. He will describe the incident, the safety measures which were in place and possible causes before concluding with the corrective action taken. In a case study of an incident that resulted in an injury using a Chub machine, Thierry Rousse (Groupe EPC), examines the lessons that can be learnt from it to modify behavior in the workplace. This includes procedural lapses and identification of training needs. The final paper is by N.V. Rao (Premier Explosives) who applies Fault Tree Analysis to identify the root cause for a fire in an air oven used for drying a pyrotechnic composition.

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.

Use the right tool for the job.

An operator was injured in a recent incident when he used a screwdriver to work inside a pipe contaminated with PETN and di-PENTA. This happened after the pipeline was decontaminated with steam and acid solution. The worker was using an unauthorised tool for the job.

It prompted Maurice Bourgeois (GD-OTS Canada) to comment as follows: Operators think that because they use non-sparking brass screwdrivers they can be safely used in any situation. That is completely false.

We had 5 deaths in 1951 and the investigation showed that a brass screwdriver was possibly used as a chisel. What happens is that the sharp edge of the brass screwdriver blade even though non-sparking, concentrates the pressure on the explosive much like the Picatinny impact test. Hence the ignition has nothing to do with sparks but rather with a high pressure point. The pressure is increased if impact is involved either by hitting the screwdriver handle with one's palm or with a hammer.

Ignore good Management of Change practices at your peril

A near-event occurred when minute quantities of nitroccotton (NC) based propellant ignited in the hinge of a buggy used to collect NC from a mixer. It was noted that the hinge arrangement at the time of the incident had potential for metal to metal contact. One of the learning points was the need to reinforce the importance of Management of Change (MOC) for all changes especially during maintenance.

Ernest Hodgson (Rheinmetall Denel) observed: This is indeed a good illustration of how important good explosives practices regarding MOC are to a company. Small changes could cause big incidents. This report illustrates a good lesson we should definitely take to heart in our company. Management cautions people on this matter numerous times. It is time Explosives as well as Project/Engineering Managers take note of the importance of MOC and ensure it is enforced. Other areas, like elements of the supply chain, must also be informed of the dangers of not following MOC practices.

Incident lessons are appreciated in non-related explosives fields

Problems with the initiation of electric detonators in the field were highlighted in recent Queensland Explosives Inspectorate Safety Alerts that SAFEX distributed to its Members. The lessons were primarily intended for manufacturers and suppliers of commercial electric and electronic detonators.

However, Dirk Kotze (Rheinmetall Denel) saw the Alert which his SAFEX Contact circulated within their Company and commented: It brought back memories when I was a student working with commercial detonators before I got involved in military explosives. I experienced a similar incident but with a different cause than highlighted in the Alerts. The same type of detonators was placed in series over a long distance instead of parallel. The variation in detonator resistance resulted in different heating profiles of the fuse wire and their ability to ignite the composition. Once the first detonators initiated there was insufficient current to ignite the rest with inevitable misfires. There was nothing wrong with the detonators; the application was at fault.

When the SAFEX Contact, Ernest Hodgson (Rheinmetall Denel) received this feedback he observed: Dirk's comments on his experience as a student illustrates that the information SAFEX distributes for one branch of the explosives industry often strikes a chord in another. It goes to show the importance of learning from all aspects of the explosives industry worldwide.

SAFEX incident reports translated into Farsi (Persian)

Mohammad Shasti is an engineer at PCI, a SAFEX member in Iran. He finds the incident reports SAFEX distributes to members of the SAFEX community very valuable. As many of their employees are not proficient in English, he battled to get the message from these reports across to them. We know this is a frustration many members from non-English speaking countries have. It prompted him to undertake a very praiseworthy project that could be an example for other members to follow.

He writes: I want to advise you that I have translated the incident reports we have on record dating back many years, into Farsi (Persian). They have had good result in reducing the likely incidents in our industry. We are willing to make these reports available in "MSWord" format to SAFEX and will have no objection if you wish to send them to any SAFEX Member that would like to make use of them.

SAFEX thanks Mohammad and PCI for their efforts and willingness to share the translated reports with others. If any Member is interested in accessing the reports in Farsi, please contact the Secretariat? It may challenge other Members to undertake similar projects in their local language in the interests of a safer explosives industry worldwide.

Safety Snippets

The Safety of Electronic Initiation Systems

Wm. J. Reisz and Raphael Trousselle

This article appeared in the Journal of Explosives Engineers, July/August 2010 and is reproduced in its entirety with the kind permission of the authors and Jeff Dean, Executive Director of the ISEE. SAFEX is proud of its relationship with the ISEE, which is a corporate Associate Member and active collaborator in the promotion of explosives safety. We thank the authors and Jeff for allowing us to publish their article in this Newsletter.

We are now well into our second decade of commercially available electronic initiation systems. Over this time, the technological advances have made electronic systems a very practical option for a wide variety of blasting applications.

It is now widely recognized that electronic initiation systems offer many safety advantages over conventional initiation systems.

From a safety standpoint, the ability to test the system in advance is undoubtedly the paramount advantage. This capability gives the blaster a sophisticated warning system to ensure that all detonators are properly connected, armed and operational before the firing button is pushed. One could assume that this feature alone will continue to prevent thousands of misfires industry wide each year.

While there are a number of systems in the marketplace today, it should be understood that no two systems are exactly alike. Due to this variety, it is very difficult to be specific when discussing electronic systems in general terms. Regardless of the system you are using, complete training is extremely important. Training on one system cannot substitute or suffice as training on another. Each system has its own unique safety features as well as its own programming, testing, troubleshooting, communication and firing protocols.

The term "electronic" attached to the initiation system does not guarantee safety by itself. Safety must be considered from the very beginning of the design of the electronic blasting system. It is precisely this "design-to-safety" approach that can assure the highest safety level not only into the detonator's electronic circuit but also into the software's and hardware's of the programming and firing equipment.

The various systems have distinctive safety and diagnostic features. One must know the specific system capabilities and work within the manufacturers recommended best practices and standard operating procedures. In some cases, the ASIC (application specific integrated circuit) chip is designed specifically for blasting applications. The chip design determines the communication and diagnostics capabilities which may or may not allow the system to rectify human error.

Protection from stray currents, electromagnetic fields and radio frequencies must also be designed into the complex circuitry. Some systems have more or less built in protection than others. So, one must be aware of the systems capabilities and limitations in regard to the potential risks posed by the surrounding environment.

Electronic detonators are less sensitive to stray currents because the fusehead is not connected directly to the lead wires. For this reason it is recognized that electronic detonators do not require shunting. However, a second line of defense is required to prevent malfunction due to electric or electromagnetic hazard.

There are however some similarities among the systems. Electronic systems in general are much more accurate than conventional pyrotechnic systems. This accuracy provides more control over the blast; reducing the potential for flyrock, as well as higher airblast and ground vibration levels. In a well-designed and executed blast, this accuracy contributes to more consistent burden to energy relationships which can in turn create a cleaner, safer wall.

Furthermore, in spite of all the safety advances, all electronic detonators still contain conventional primary and base charge explosives. This means that they are still susceptible to unintended initiation by way of accidental impact, heat or friction. So, they must still be transported, stored and handled with the same respect as any conventional detonator. Downlines and surface lines must always be protected from damage to prevent misfires and communication errors. When electrical storms approach; the blast area must be cleared and secured from unauthorized entry.

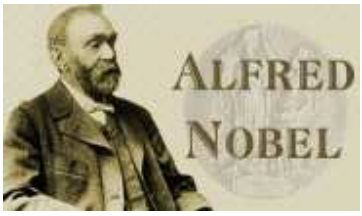
Some of the systems now have full remote firing capability. While this feature is by no means limited to electronic systems, the ability to fire the blast from a safe position is certainly a tremendous safety advantage for many operations.

While the technologies may change, the rules of the game are the same. Regardless of the system we are using, one should always consult the manufacturer and local regulations as to the specific recommendations and requirements. Blast area security is still one of our primary safety concerns. The safety of the public and all job site personnel is and always will be the blasters first and foremost responsibility.

The 6th International Disposal Conference
Örebro Castle, Örebro, Sweden 10-11 November 2010

Hans Wallin is our regular correspondent from Competence Centre for Energetic Materials (KCEM) which is a corporate Associate Member of SAFEX. He has brought this Conference to our attention and invites members of the SAFEX Community to participate in it. We encourage any interested reader to support this event. More details are available on the website at http://www.kcem.se/anmalan_sixth_int_disp_conf.asp

Call for papers and preliminary registration for *The Sixth International Disposal Conference and Exhibition* can be found on the website at http://www.kcem.se/anmalan_sixth_int_disp_conf.asp .Disposal of waste means "environmentally friendly and resource-conserving recovery of material and energy as well as landfilling or volume reduction by burning in the field". The International Disposal Conference Series focuses on zone reaction-related materials (e.g., propellants and explosives in ammunition) and zone reaction-related processes (e.g., waste incineration). Related problems are self-ignition (uncontrolled "disposal") and remediation of



contaminated soil.

On Tuesday evening, the 9th November there will be a buffet dinner for participants. The conference will start on the morning of Wednesday, 10th November and end late afternoon on Thursday 11th November. On Friday the 12th two optional guided tours will be held; either to the demilitarization plant at Nammo Vingakersverken or a guided tour to Karlskoga (Bofors Test Centre, Alfred Nobels mansion and laboratory). The tours will start at 09.00 and end at 15.00. Information about Nammo Vingåkersverken and Bofors Test Centre can be found at www.nammo.com/Locations/Sweden1/Vingakersverken-Vingaker and www.testcenter.se/index_en.html. Hans adds: "Alfred Nobel travelled a lot and was one of Europe's richest persons. He never lived for a long period at the same place. He lived at Björkborns Mansion from time to time during his last three years. Close to the Mansion you can find his laboratory which also is included in the guided tour

IMESAFR training: Are you interested?

Offer of a course before the start of the Congress in Istanbul

IMESAFR (**I**nstitute of **M**akers of **E**xplosives' **S**afety **A**nalysis **F**or **R**isk) is a Windows-based, semi-empirical quantitative risk assessment, software model designed for a wide variety of commercial explosives activities. It was created by modifying the U.S. Department of Defense's (DoD) software program SAFER V3.0 for commercial settings. The model takes into account many more site-specific parameters than just quantity of explosives and distance to the exposed site. IMESAFR's basis is that risk equals the probability of an event times the consequences of that event.

In April this year the Institute of Makers of Explosives (IME) conducted a very successful training course in the Netherlands. Some of our members used the opportunity to participate in it. By all accounts they found it very beneficial. However, other members were not able to justify the travel expenditure for the purpose of the Course alone.

If there is sufficient interest among SAFEX members, the IME is willing to run another course **before** the commencement of the XVII SAFEX Congress in Istanbul next year. In this way company delegates will be able to combine IMESAFR training with their participation in the Congress thereby saving on travel costs.

As the course is not an official part of the Congress week, it will not replace the Congress Training Session during the week of the Congress (See Congress Chat on p. 14 and 15). The IMESAFR course is a 3-day course conducted by dedicated professional trainers from APT, who the IME contracts to do the training. There will be a charge of approximately US$1,500 per participant to cover the cost of the training materials and the trainers who have to fly from the USA. Each participant will be responsible for his/her own travel and accommodation costs. A minimum of 15 people are required to make the course viable.

As it is a hands-on training course, participants will be required to bring their laptop computers with them.

The IMESAFR tool for analysing risks, especially Quantity/Distance (Q/D) issues, is gaining support among our North American colleagues.

SAFEX wants to give as many of its Members as possible the opportunity of being exposed to it. We will therefore be contacting you individually to assess your interest. If there is enough interest, we will approach our Board of Governors for their approval before reverting to you with the details.

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. You will notice we refer to this 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 of 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!

May I introduce Tony Rowe to you?

Let's be good mannered and allow me to introduce Tony to you!

Tony was born in Liverpool, Lancashire, England. He attended school until the age of 16 when he left to join the British Army. After some intensive training at Arborfield, Seme, Borden and Middle Wallop he served as an aircraft technician (A&E) on both fixed and rotary wing aircraft. He saw active service in the Middle East and, when transferred back to the UK, was attached to the air troop of a prestigious tank regiment.

On leaving the army he did a variety of things: house engineer in a well-known Liverpool night club; bus conductor; working with big cats in a safari park; fixing steam boilers; and even milling flour - to mention but a few.

During 1982 he responded to an advertisement in The "News of the World", a tabloid newspaper, and moved with his family to South Africa. After working in both Pretoria and Durban he applied to AECI for a job at Modderfontein in 1984. For reasons he has never understood (sic) he was accepted and subsequently took up a position in the Research and Development Department of AEL Mining Services where he has worked ever since.

A Crocodile's tail is much closer to his mouth than you think

Tony Rowe

Have you ever completed a crossword puzzle? Really? I never have, I get lost in the words you see. I'll give you an example. I was looking for an answer to the clue: "Toothy ambusher who sheds no tears". Had to be crocodile eh? But then, for no particular reason, I began to agonise around the fact that the words ***crocodiles*** and the word ***explosives*** both had 10 letters each. Odd that.

Were there any other connections? Well I thought, they're both quite dangerous and yet, on the face of it, neither of them appears to present any significant hazard until **BLAM**, out of the blue, it happens.

The crocodile is Africa's most successful predator. Forget about lions and leopards. They're just cats; pussies really and carrion eaters mostly. Few prey on man, but crocs; crocs eat people. A crocodile eats flesh that it catches alive. The still twitching victim is first caught, violently tenderised then stored underwater to allow the meat to age and mature. When the flesh is falling off the skeleton, it's ready to eat. The activities of the crocodile account for a good many unfortunates every year. Many of its victims are people.

For most of us, the thought of being eaten alive is the stuff of nightmares. It is almost beyond imagination! From out of nowhere comes a pair of massively toothed jaws. They bite down with incredible power. Violent rolling movements follow. Resistance is futile. Dragged underwater, bleeding and broken, the unfortunate probably drowns.

From the human perspective, what's even worse is that the victims all knew their ultimate fate even as the great jaws smashed shut. Even as the

primitive peg-type teeth penetrated their flesh they'd already made a rarely reversible transition, from person to protein.

Most of the victims knew the crocs were there. Most also knew that crocodiles eat people.

But wait a moment; the crocs didn't pursue them or chase them down, hunting them in the darkness. Nor did they wake up in the middle of the night with a pack of killer crocodiles at their throats. Not at all. Most went willingly to the crocs. The victims either got very close to the water, or actually got in. They knew the crocs were there and they got killed. So why are they dead? Some died because they had become complacent. A few died because of some practical necessity, the risks weighed and understood. Still others pushed the envelope too far or took a risky short cut, but the majority were eaten because they thought themselves too fast, too clever, too thin, too strong etc, etc, etc.

Explosives are like crocodiles. Oh, there are plenty of other dangers

out there, but explosives are the ambush predators of the chemicals industry. But they don't actively hunt you. Like the crocodile you go to them. You can usually see them. You probably even know what they are capable of.

The explosives, on the other hand, simply wait. They wait for you. Explosives are not capable of thought. Explosives have no brain, but they're endlessly patient. They wait for you to make a mistake, to take the extra step or push the envelope that little bit too far.

They're good teachers too. Abused explosives rarely go off the first time. They first groom their victim, convincing him or her that they present little hazard. After a few such sessions the person is ready for what may follow. Certain that they know the boundaries, the limits of the possible, the awful inevitability of too little knowledge becomes apparent. The trap is baited and set.

When explosives bite, they bite hard and at a terrifying speed. The results can be ugly and permanent, but there is no malice in what they do. No love. No hate. They do it because that's what they do. It is their nature.

So watch out for the crocodile. Don't poke him because he's old or laugh at him because he's only got three legs. Instead, remember the old saying: "The tail of the crocodile is much closer to his mouth than you might think". Take all the precautions. Too late is always too late and no matter how hard you plead, you'll never get that one second back.

You know it makes sense!

SAFEX International thanks the following for their contributions to this Newsletter:

- **John Beevers,** CEO of Orica Mining Services
- **Peter Cartwright,** SAFEX Expert Panel member
- **Ben Barrett,** President, DG Advisor and SAFEX Expert Panel member
- **Dr Phil Lightfoot,** Manager, Canadian Explosives Research Laboratory
- **Maurice Bourgeois,** GD-OTS Canada
- **Ernest Hodgson** and **Dirk Kotze** (Rheinmetall Denel)
- **Mohammad Shasti** (PCI)
- **Wm. J. Reisz, Raphael Trousselle** and **Jeff Dean,** Executive Director, ISEE
- **Hans Wallin** (KCEM)
- **Tone Rowe** (AEL Mining Services)

Boet Coetzee

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