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Message from our Chairman , John Rathbun

SAFEX CONGRESS XX
SALZBURG 2020

Dear SAFEX members,

Another year has quickly passed and we find ourselves at the end of the season, which permits some time to reflect on how the year was for SAFEX and its membership. It would seem that we are starting to see the realization of the benefits for member companies to use the e-Learning platforms. In speaking to the Secretary General, Dr. Piet Halliday, a week ago and when asked what was the biggest thing he saw changing through the year, this was his response:

"The e-Learning modules have really taken off for a significant number of member companies. In particular, Austin Powder, Davey-Bickford/ENAEX, EPC and Maxam".

This is partially due to the number of modules available, the increasing number of languages that they are offered in and a recent change in the access fee charged by the organization. This last item was decided upon by the Board of Governors this year whereby the largest member companies can have unlimited licenses for an additional 1,000 Euros. Individual companies can gain this for the small fee of 200 Euros. Since this decision, we have seen a significant increase in requests for licenses and usage and at the end of the day, this is a great way to disseminate knowledge throughout the industry and within companies. It is interesting to note that the largest companies in our industry have not seen their employees request access to the modules, perhaps this will change in the coming year.

For those who are new, SAFEX was founded in 1953 with the focused mission of sharing knowledge to prevent accidents and save lives. Industry leaders, mostly European at the time, recognized that the silver lining of a tragic event was the knowledge that can be gained from it to prevent it from occurring again. Recently, I ran across a biblical verse that speaks to this philosophy: John 6:12 – ***Gather the fragments left over, so that nothing will be wasted*.** I suspect this wisdom is captured in other religious texts and philosopher's writings the world over. But this sums up for me, what our mission is. From the beginning, the organization really was a repository for events, learnings, costly lessons, ideas, etc. as a supplement to the libraries and memories that individual companies maintained by themselves. In addition to the incident database there are also the congresses held every three years, where papers are courageously shared in front of industry colleagues as well as candid conversations are shared in the hallways and at dinner. Clearly SAFEX's mission is a one that selflessly is provided to help each and every company and individual within those companies to learn what others have painfully discovered.

We can all be thankful to the member companies and key individuals within those companies who have devoted time and energy to create these as lasting tools for sharing what we have learned along the way. If you haven't logged on and taken the time to become familiar with the eLearning modules, I encourage you to do so. They really are a great way to stay current and aware.

Finally, I would be remiss not to mention that our next congress will be staged in Salzburg, Austria in May 2020. We are in the process of collecting papers as we speak and preparing for the workshops. This is the highlight of the organization's mission and we look forward to seeing you there!

Happy Holidays and may 2019 be a great year for you, your family and your organization. Let's all continue to work towards an incident free year and help share the fragments of what we learn with those around us.

Sincerely,

John D Rathbun

Article on QNJAC development of Quarry Industry Metrics

By

Ashley Haslett

The Quarry National Joint Advisory Committee (QNJAC) in the United Kingdom is a stakeholder organisation focused on the improvement of health and safety throughout the quarrying and associated industries. In early 2017, the Board approved the establishment of a "task and finish" working group to consider how it could assist companies to improve their safety performance. Facilitated by the Camborne School of Mines, senior company health and safety managers discussed and identified good practice, with trade union and workforce input, basing the recommendations around twelve key areas. From the outset, the working group sought to provide a methodology that companies could apply to provide them with the most effective improvements, regardless of where they were on the safety journey. A simple survey to be completed by a cross section of the workforce was the starting point. A selection of 12 Indicator Areas provide examples of standards that would be expected, with proposed leading and lagging indicators for each. Some areas reflect defined procedures while others require consideration of people's actions at all levels within the organisation. Larger, well-resourced companies are likely to have much of this in place, but there are almost always some aspects of improvement that can be made.

INDICATOR AREA	GUIDANCE	MEASURE
1. LEADERSHIP	Objectives for improvement in safety and health should exist at high level, being appropriately cascaded through the management in large organisations, and be reviewed in a systematic manner. Improvement in 'trailing indicators' such as accident statistics is appropriate for objectives, but reviews should also capture some of the 'leading indicator' areas described within this document. Hard objectives are not suitable for some leading indicator areas as honesty in reporting is essential and some aspects require underlying understanding of the reasons for trends. Managers at all levels should see 'visible felt leadership' as a key part of their work. From senior levels, some of this is in the tone of messages sent across the organisation as well as actual visits. When visiting sites, it is critical that time is given so that conversations do not appear rushed and that safety aspects are followed by the visitor (correct safety clothing; following prescribed pedestrian routes, etc). Ask yourself: - Have I actively engaged with the people? - Am I reinforcing good aspects as well as observing for issues? - Do I always consider the impression that I am leaving? - Have I agreed anything? Will I be sure to follow it up? Site managers and local supervisors will clearly have a much higher expectation of visibility and related encouragement of safe working. The company must respect the importance of this core function against the more bureaucratic requirements placed upon them that may keep them in offices or responding to smart phones. Workforce safety representatives also have an important leadership role in ensuring a comprehensive site safety culture, with involvement in many of the areas described below.Leadership training, such as that offered by the Mineral Products Association, is an important dimension of competence development.	Improvement objectives with regular review Senior management company-wide messages supporting good OH&S Senior managers visiting sites to meet people Local managers' target for 'walking the job' Planned focus on specific safety aspects Also see 'Competence' below

2. NEAR MISS & HAZARD REPORTING	Does your company have a Near-Miss (Near-Hit) reporting procedure? These have often been successful using small, widely-available reporting cards or a hotline system. The procedure must be simple and easy to use. This should cover not only dangerous events but also observed unsafe acts, such as lack of 'locking-off' (correction is ideal but not everyone may feel able to intervene at the time or have authority to achieve permanent improvement), or unsafe conditions, such as poor guarding on machinery. Use of the procedure must be actively encouraged. It is essential to follow up reports taking an open-minded view of causes (e.g. was a vehicle issue partly the result of pressure from elsewhere to reduce time, not just a driver's fault). There must be prioritisation and an 'urgent' option for anything representing a continuing unacceptable risk. Similar issues may be grouped for investigation if useful. Incentives may be useful in commencing such a procedure, but should be treated with caution. The aim is for this to be part of everyone's day-to-day responsibilities. It is essential to let people know the outcomes, including wider publicity where useful.	Number of reports per head *(Judgement is needed as to whether higher or lower reporting is due to greater /less vigilance or deterioration/improvement in actual site safety)* Close-out rate Planned safety 'walkabouts' involving workforce reps
3. EMPOWERMENT TO STOP THE JOB ***EMPOWERMENT continued***	In a modern working environment with far fewer people on site and much lone working, individuals must be encouraged to take responsibility for the safety and health of themselves and others. This includes feeling able to say that an activity must not proceed if a risk appears too high. Does your company have a stated policy for this? Is this widely publicised, including to contractors? This fits well with dynamic risk assessment (e.g. Stop & Think!). It requires a high level of trust within the organisation. Do you support and give positive recognition to your people when they take such action?	'Stop' incidents Communication by management, e.g. in toolbox talks, *to ensure that people understand this need*

4. COMPETENCE	Does your company assess jobs for competence requirements? Do these requirements match the National Occupational Standards (underpinning NVQ)? Does the company provide regular appraisals of individuals and seek to provide timely development with clear timescales for delivery? (e.g. experience; on-job guidance; skills training; OH&S understanding) Care must be taken not to seem to threaten experienced people when such a system is introduced. Once established, it should be seen as a natural part of personal working experience. Supervisor competence should include consideration of their ability to communicate and lead, including presenting, explaining, listening and responding with their team.	Competence needs analysis for jobs Timescales to provide agreed personal development
5. COMMUNICATION ***COMMUNICATION continued***	It is of primary importance that the outcomes of incident investigations and reviews of risk assessments and safe systems of work are communicated in an effective manner to anyone who may need to know. The reasons for following good procedure and the potential consequences of not doing so must be made clear, such as examples of injury arising from failure to lock-off machinery or health-related outcomes that are likely in later life. Communication must be two-way, with opportunities for people to raise issues or ask questions. It is vital to provide a well-considered response. What means of communication with the workforce does your company have? (e.g. team meetings; toolbox talks; notice boards; posters; publications). Are safety and health regularly featured? Do you consider the style for different audiences? Do you encourage brevity and plain English and avoid over-complexity? Are memorable incidents or stories featured that people can relate to? Are clear flowcharts and illustrations used wherever possible to simplify instruction? (EAST *Easy; Attractive; Social; Timely)* Are there regular messages from senior management to reinforce safety?	Number of safety-related communication events per year that workforce members are involved with Safety committee meetings Issues dealt with and outcomes communicated back

6. OCCUPATIONAL HEALTH	Occupational health is the area with the most clearly defined cause and effect links due to research and consensus over years. The legal prescriptions are taken here as minimum standards. Have all health hazards been identified and risks assessed? Are people's exposures regularly monitored and assessed to be within prescribed workforce exposure limits (WEL – typically based on 8 hour time weighted average, e.g. noise; dusts; chemicals / or mainly equipment -based, e.g. vibration)?	All exposure within the prescribed Workforce Exposure Limits (WEL) - *See guidance such as EH40 list for COSHH controlled substances; HSE INDG362 for noise; HSE QY-COSHH series for silica dust and others*
OCCUPATIONAL HEALTH continued	Are there procedures in place to protect against other potential hazards such as sunlight or other radiation, used vehicle oils, bitumen fume, respiratory sensitizers, welding fume, poor workstation or cab design (strain or RSI), manual handling errors, Legionnaire's disease, rest room sanitation issues? Are employees consulted and their views on comfort and usability taken into account when new protective equipment, tools or vehicles are to be purchased? A hierarchy of risk control should be followed: removing people from risk; reducing the source (e.g. sound-absorbent materials); personal protective equipment (e.g. properly fitted, high quality masks). Health surveillance and related monitoring should be provided for all employees on a risk-assessed basis. 'Back-to-work' meetings should be held following absence and support provided as judged necessary. Other modern approaches include a 'well-being' programme for employees (noting an increasing age profile) and stress recognition and support training for supervisors.	Stress recognition training for supervisors Health surveillance schedules Inclusion of observable hazards to health in audit activity

7. CONTRACTOR MANAGEMENT ***CONTRACTOR MANAGEMENT continued***	Does your company have an effective assessment process for contractor selection, including review of safety standards? Is an approved contractor/supplier list maintained and revised where performance changes? Are contract works effectively planned, with necessary risk assessments and method statements being prepared? Is contractor equipment checked as appropriate? Is suitable supervision provided to monitor contract works? Are Permits to Work used as appropriate to control and coordinate work, and do they include a handover process? Do all personnel on site undergo a health & safety induction and use the approved documentation? Are certificates, safety passports and other evidence of contractor competence always confirmed? Does your company treat contract personnel as if they were employees when providing activities such as toolbox talks, safety bulletins, management 'walking-the-job', etc? Are contractor staff fully involved and considered as partners in planning of changes that will affect them or where their work may affect others? Are contractor-related incidents monitored and analysed to the same degree as employee-related incidents and recorded separately to assist in improvement action?	Contracts initially agreed where safety standards have been reviewed as well as quality and cost when comparing tenders Contractors reviewed for safety performance when renewing contract %tage of contractor-related incidents compared with overall
8. ROOT CAUSE ANALYSIS ***ROOT CAUSE ANALYSIS continued***	All significant incidents, whether accident or near-miss, should be subject to an in-depth analysis, seeking to identify all causes including aspects that may derive from pressures or failures apparently remote from the place and people directly involved. Techniques exist to assist with such analysis. Does your company have people trained in an effective approach to root cause analysis? Is this a team approach, using a proprietary method? Is there an open and honest approach to identifying and communicating the improvements that are recommended? It is acknowledged that there may be legal implications to some incidents, but non-specific learning may normally be shared without prejudice and improvement is vital if risk is significant, including communication across the industry if necessary.	Incident monitoring for potential for harm or frequency Incidents analysed for root causes Improvement actions resulting from analysis

9. RISK ASSESSMENT ***RISK ASSESSMENT continued***	Risk assessment is a legal requirement and it is unlikely that any quarrying companies have failed to put this in place. However, the effectiveness, currency, visibility and awareness may vary considerably. Does your company have a policy to involve employees in reviewing the hazards and risks in their work? Is an appropriate level of training provided? Is every employee made fully aware of hazards, risks and safe procedure, including when moving around to different work areas? Is every effort made in ongoing site design to make procedure easy for people to do in the safe way, such as avoiding long walks to put the preventive measures into place. People may be tempted to deviate from complex or time-consuming actions, especially when approaching the end of a shift or under pressure from multiple jobs. Is every employee encouraged to consider the hazards to their own and others' health as well as safety, and how these may be kept to a minimum risk of harm? Are they provided with a suitable level of training for this? Is there a systematic schedule of review of existing risk assessments, with appropriate maximum timescales? Do any changes in work, processes or equipment automatically trigger a review of risk assessment? Is there an easy-to-use procedure for one-off jobs? Is it made clear to people, including contractors, that work must not commence until this has been done?	Programme of reviews of existing risk assessments Frequency of involvement of each employee in assessment of risks Risk reduction plans in place Audit and checks to ensure one-off jobs are effectively assessed

10. RECOGNITION	Positive recognition of good work is a powerful reinforcement tool but busy people may sometimes be seen to give criticism more than praise, often being unaware of this. A specific effort is required to observe and to give genuine praise on a regular basis. The reason for any recognition must be clearly stated. Does your company encourage recognition of excellent safety performance? Some companies use formal recognition processes, which have included certificates, incentives or rewards. These must be treated with care and may be best used at a team level, but companies can use the presentations as an opportunity for wider publicity.	Recognition events of good safety performance expected of managers Recognition actions per month - at a personal level Recognition actions per year - at a more formal company level
11. JUST CULTURE	There should be a policy in place to treat people fairly in order to learn when things go wrong. The only errors justifying reprimand should be clearly inappropriate behaviour such as leaving a job in an unsatisfactory state in order to leave work early. Does your company treat errors as lessons to be learned? Do managers stand by decisions made by individuals even if something unexpected caused a problem later?	
12. INDEPENDENT AUDITING	There are a great many safety aspects to a large industrial site, some prescribed directly by law and others by the requirement to control risk 'so far as is reasonably practicable'. Good provision in all these areas should indicate good safety outcomes. Effective audit provides an overview of performance. The word 'audit' implies compliance to specified procedures, rules and regulations, but good auditors of safety and health (and environment and quality) may add useful commentary and advice beyond this. Audit may be carried out by internal company auditors. In a large company, these should act independently of a site or process being audited but often are also safety officers who have to be careful to separate responsibilities. Small companies may lack both independence and expertise. Consultants offer independent services, including those working through the British Aggregates Association. An effective option is for an experienced individual from a different site to audit, either within a large company or perhaps different companies assisting each other to provide the 'new pair of eyes'. Does your company have an effective independent safety auditing process? Once there is confidence in the audit, then the number of non-compliances provides a good leading indicator, noting that there may be a need to rate the risk level on some issues. Efficiency in dealing with these provides another indicator.	Effective independent audit regularly carried out Number of N/Cs Time to clear N/Cs effectively

A simple questionnaire that may be used from time to time to investigate perceptions amongst the workforce, to direct improvement effort and to establish trends is available. This has deliberately been kept short in order to be user-friendly in a time-restricted working environment. An annual survey using this questionnaire is recommended as a significant leading indicator tool. Areas showing lower scores (e.g. less than 8) may be discussed in team meetings or, for greater anonymity, investigated by safety reps in order to establish the reasons and to formulate an improvement plan.

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How safe are your personnel when working on customer sites?

By

Andy Begg

The incident described in this article occurred almost 20 years ago but the circumstances are - if not more - relevant today.

Those of us who have been in the explosives business for a good number of years will recall the switch from NG based explosives first to watergels and then to emulsions. The main driver – certainly in ICI, the company I worked for at the time – was for improved operator and plant safety. The newer products were considered to be much safer to manufacture and also use giving safety benefits for everyone involved. The newer technologies also offered an alternative to packaged products through bulk loading systems. In ICI Explosives we developed an emulsion system suitable for long hole applications underground at the request of our marketing department. One of the early applications was in Africa in deep copper mines. Not only was it safer to make and to load it also was safer in unstable ground so that preloaded holes) would not initiate by friction caused by shearing of the boreholes due to ground movement. (due to the size of the blast loaded holes could be left for many days before being initiated. NG and PETN based explosives were friction sensitive and had to be replaced by less sensitive products – in this case the emulsion.

The emulsion explosive was manufactured in one of our conventional explosives plants. The loading unit for use in the mine had been designed specifically for the operation - comprising a pumping unit for the emulsion and separate gassing solution, a static mixer and hose handling system. A hydraulic boom was used for final placement of the loading hose. A standard process.

The system had been successfully introduced to the mine in 1996.

On December 27th 1997 we were advised of a major incident in the mine – one of our operators and 2 mine operators had been killed in a massive rockfall. 2 others were injured.

By all our measures this was a very serious incident and an investigation team was assembled. Within a few days the team assembled in the regional business area. We had a new protocol for investigating incidents and this was to be used. I would facilitate the local business manager in leading the investigation. The team also comprised regional and local safety, operations and business management and field applications experts.

We had an immediate problem. The mine management would not permit us to visit the scene of the incident despite repeated requests by our regional executive. The reason given was that the mine management were afraid that any information gathered during the investigation could be used by the Chief Inspector of Mines to bring prosecution against the mining company who owned/operated the mine. This clearly interfered with the normal collection of information for analysis but we had to accept the situation.

The team was able to gather information about the mine and mining activities from other sources which allowed us to conduct the investigation.

The immediate cause of the fatalities was a massive rockfall of 60m of roof varying in thickness from 3m to 6m and 12m wide

The salient features of the investigation report are as follows.

The emulsion loading team were working at the 1100m level. The loading unit the team had been using developed a fault and a second was brought in. The faulty unit was pulled back from the production face. The supervisor observed a loose rock fall directly above the faulty unit and he ordered it be moved further back so that repairs could be done. Another operator then inspected the area around the production face and reported that he was not satisfied with the safety of the area. The

mine supervisor was advised that loading would not continue until the face had been made safe. Before any further action could be taken the tunnel suffered the massive roof collapse without any warning and all personnel and equipment were buried. Over a period of 26hours 3 of the team were rescued. It was 3 days before the body of the 4th operator could be recovered.

It transpired that the ground was known to be unstable and the mine adopted roof bolting to help stabilize. The mining experts in the investigation team questioned the robustness of the techniques being used.

Discussion with the operators revealed that they knew informally of 3 smaller rockfalls in the mine that could have been attributed to a similar mode of roof failure. However, there was no formal reporting of incidents and unsafe conditions that could be relevant to the safety of the loading team to the loading team management by the mine operator.

Business management had no process in place to review the safety of the mine working environment prior to establishing a new operation.

This incident was a "wake up call" for the international business in ICI where we were actively increasing both surface and underground bulk operations worldwide.

We were now exposing an increasing number of personnel to a new range of hazards that were quite different to those in our production plants. We had a long history of active safety management in our traditional plants and generally met our overall targets of Fatal Accident Rate – FAR. The FAFR is one commonly used measure of how safe a job or working environment is by using actual data for an established process or activity or expected data for a new process based on a detailed risk assessment. It can be calculated as follows:

$$\text{FAR} = \frac{\text{number of fatalities} \times 10^8}{\text{number of exposure hours}}$$

or the number of fatalities per 100 million hours

or number of fatalities per 1000 people for 50 years

To put this into perspective at the time of the incident typical FAR's for various activities were:

Typical FAR values

At home	3
Travelling by bus	3
Travelling by train	4
Travelling by car - UK	57
Travelling by car – South Africa	80
Skiing	71
Pedal cycling	96
Travelling by air	240
Travelling by motorcycle	660
Canoeing	1 000
Rock climbing	4 000
Chemical industry	3,5
Steel industry	8
Fishing	35
Coal mining - UK	40
Railway shunters	45
Construction workers	7

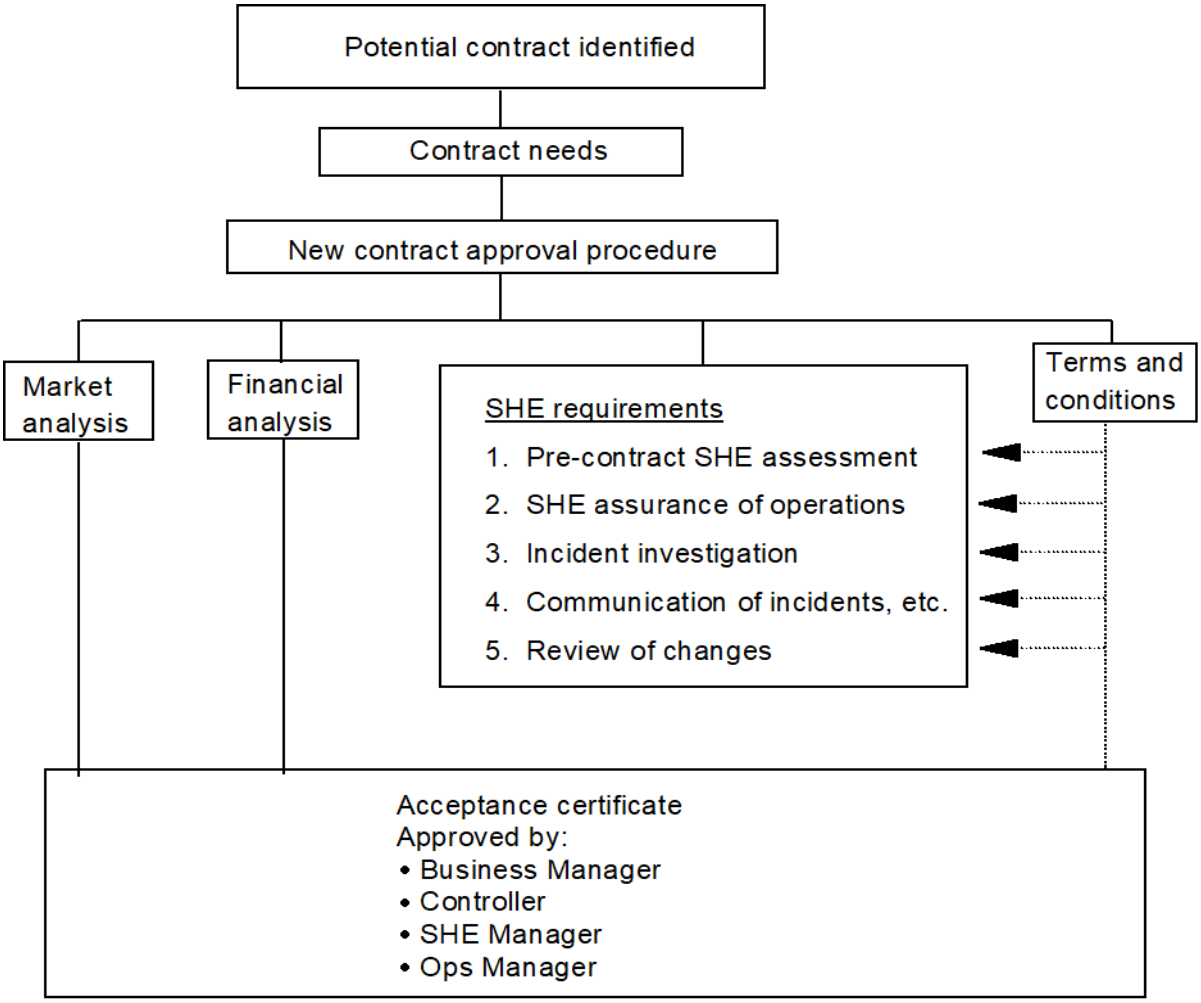
ICI used an FAR of 2 as the target rate for new processes (ambitious!) – basically no-one should be exposed to a greater risk when working than they would experience if they stayed at home, FAR 3.

As a result of this incident we looked at FAR figures for mining operations in some detail and – at that time - found the following based on actual incidents. (Please remember these are old figures and probably are not representative of these industries today due to the many improvements in safety systems/practices and safety culture)

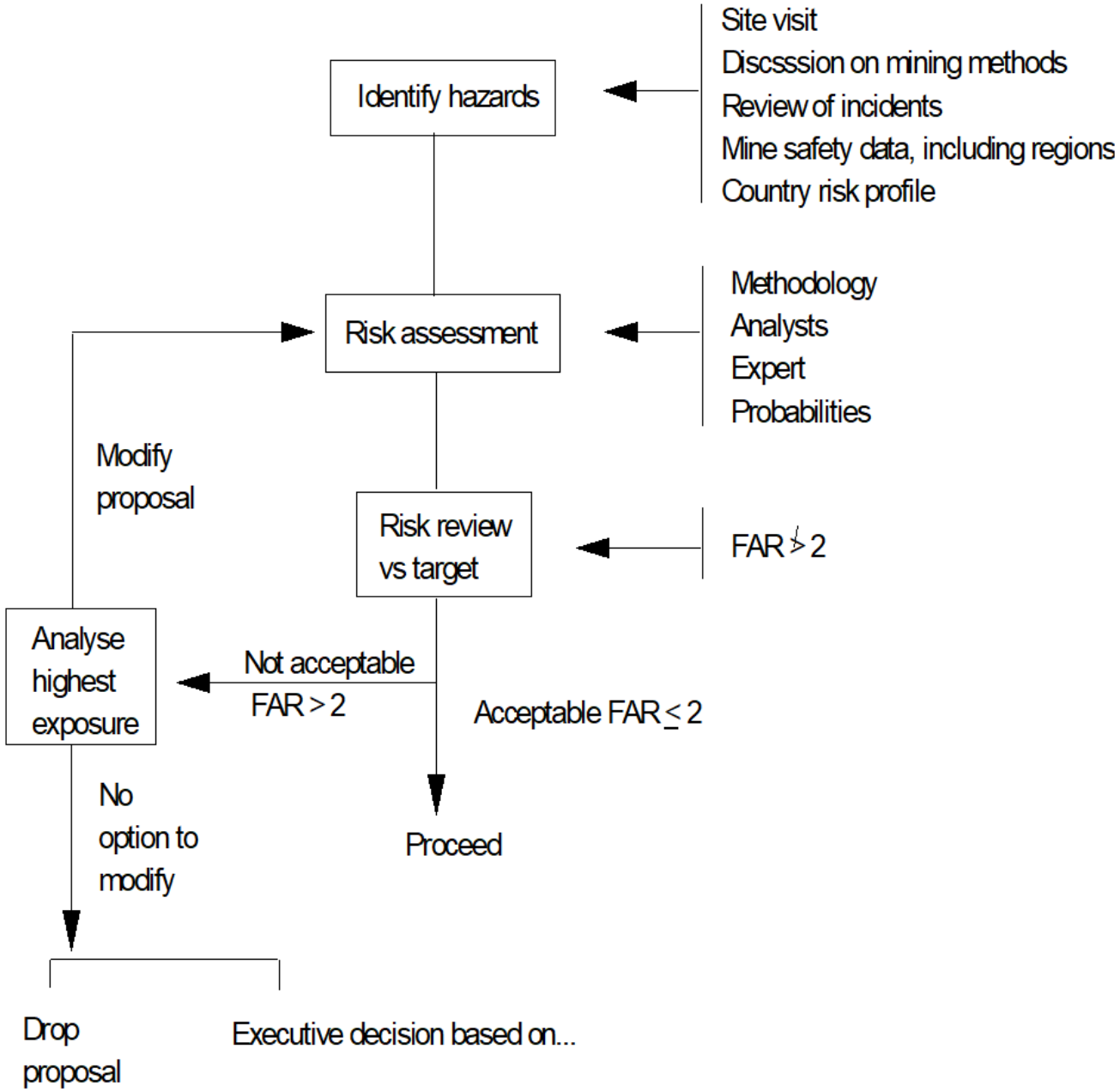
Situation	FAR
Australia underground coal	22
Australia surface coal	6
Ontario underground	14
South Africa underground coal	85

The message was clear. The average mine working environment was much more hazardous than a normal factory but we had not recognised just how significant the difference was. We had a safety management system designed round factory operations, but this was not appropriate for mines. A major difference is this. In our factories we have full management control and authority. We decide and maintain safety standards. In a mine we have much less or perhaps even zero authority over the mine environment safety standards and conditions. In our factories we conduct risk and safety assessments of the workplace, the operations, the equipment and so on. When we put our operators into new mines we did limited assessments of the workplace in general. We did require our own operations in mines to meet the company safety requirements but did not look at the bigger picture and realise this was not possible within our factory based safety systems. We did have some cases where our own personnel having visited new mines would comment on the observed level of safety in relation to our norms and raise it as a concern. However, we did not have a formal method of assessing safety on mines as part of a new business case review.

We then started to develop a simple risk assessment procedure for new bulk operations as part of the business proposal.



SHE ASSESSMENT MODEL



Ideally, we would have liked to be able to do a full quantitative risk assessment (to FAR level) as we would do for a new plant process but accepted that this would not be practical for mine situations but a qualitative assessment could be done. The overall risk review would make a decision based on the views of the assessment team. In some cases the view may be that the proposed operation does not and cannot meet the required standard of safety and therefore is dropped or that there are issues but they can be addressed by implementing certain procedures and controls.

The critical point is that there is a formal assessment of the safety of the mine working environment and that this assessment is documented and approved by the appropriate manager as part of the contract. The contract with the mine should also contain requirements on open sharing of safety issues etc between the mine and the company team.

Food for Thought

By

Gordon Morgan

Some years ago the company I worked for embarked on some fundamental research projects with a number of local and international universities. This involved handling small quantities of materials that could be classified as explosive or pyrotechnic. These university laboratories, which had functioned perfectly adequately for many years, were suddenly burdened with the need to comply with local Explosives Regulations. This was necessary in order for them to obtain a license to handle, store or manufacture the materials necessary for the research project. Whether this was a requirement known to the university or pointed out to them by the company is unclear to me. I would guess that if the university had not been involved with an explosive manufacturer previously they could well have been unaware of the need to comply with explosive regulations. I may, however be doing them a disservice.

There was a great deal of interaction between the company, the universities and the local explosives inspectorate even though the quantities involved were small. The company undertook to provide coaching and supervision in the do's and don'ts of explosive handling, and to supervise the safe desensitization and disposal of the materials. The universities also undertook to ensure acceptable storage and to follow the procedures provided and to not exceed the approved manufacturing and storage quantities.

Approval was eventually granted and small handling, storage and manufacturing licenses granted. The research project commenced without incident and the company benefitted significantly from access to state of the art analytical techniques and equipment that would otherwise have been prohibitively expensive and unjustifiable to the project. (*Access to analytical and manufacturing equipment for explosive and pyrotechnic manufacturers to conduct trials is extremely difficult and is often in conflict with the local explosive regulations. Suppliers generally do not have a licence allowing explosive or pyrotechnic handling. This often leads to trials being conducted on dummy non-explosive materials that actually bear little or no resemblance to the actual products, with costly financial and time delays)*.

The university benefitted through a research project for students that was sufficient for a Masters or Doctorate thesis.

Whilst the company engaged with the Explosive Inspectorate I often wondered how many other chemical laboratories in the world were, or are, oblivious to the potential dangers of chemical storage. Unless a laboratory has some insight into explosive or pyrotechnic material compositions would they, for instance, be as fastidious as explosive manufacturers are regarding separation of fuels and oxidisers. After all red lead and silicon powders are very close if the materials are stored alphabetically. Anyone who has manufactured a pyrotechnic material using these powders knows that the powders when mixed can be extremely sensitive to FISH (friction, impact, static and heat). The need therefore to ensure spillages are thoroughly cleaned and not allowed to mix is fairly obvious to explosive and pyrotechnic manufacturers. There will be many other incompatibility issues to be avoided. Are general laboratory operators similarly aware or unaware?

Most laboratories will have safety data sheets (SDS) and these tend to provide information on chemical toxicity, the potential threats to the environment and provide precautions and procedures to deal with spillages or ingestion.

Using as an example, a SDS for red lead, obtained from the internet and fairly typical of others. In section V: Fire and Explosion Data (see below) the information is extremely basic and really does not address any compatibility issues.

Section V. Fire and Explosion Data

- ***Flammability:*** *Non-Flammable*
- ***Flash Points:*** *Not Applicable*
- ***Auto-Ignition:*** *Not Applicable*
- ***Flammable Limits:*** *Not Applicable*
- ***Extinguishing Media:*** *This material is not combustible and is not anticipated to react with commercially employed extinguishing media. Use appropriate extinguishing media for surrounding fire.*
- ***Fire Fighting Procedure:*** *Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes. Contain all fire suppression run-off.*
- ***Fire/Explosion Hazards:*** *Incompatible with strong oxidizers, hydrogen peroxide, and active metals, such as sodium and potassium. This Product, when heated to decomposition temperature, may emit toxic fumes of lead.*

Obviously to provide information that covers all compatibility issues would not be practical and would make a SDS document too large to be useful. There is however significant scope to point out fundamental compatibilty issues in order to alert end users to hazards known and understood by other manufacturing industries.
Under section VII of the same MSDS, Handling and Storage, once again the information is fairly scant and largely ignores potential compatibilty issues.

Section VII. Handling and Storage

- ***Storage Temperatures:*** Store at ambient temperature
- ***Shelf Life:*** Unlimited in tightly closed container.
- ***Special Sensitivity:*** None
- ***Handling/Storage Precautions:*** Avoid breathing dust. Avoid getting in eyes or on skin. Wash thoroughly after handling. Store in a dry place away from direct sunlight, heat and incompatible materials (see Section X). Reseal containers immediately after use. Store away from food and beverages.

Section X that is referred to adds little extra information as shown.

Section X. Stability and Reactivity

- ***Stability:*** Stable
- ***Hazardous Polymerization:*** Will Not occur
- ***Incompatibilities:*** Reacts violently with hydrogen peroxide and other strong oxidizers to liberate hydrogen gas. Do not heat in the presence of aluminium, sodium metal, or potassium metal.
- ***Instable Conditions:*** Excessive temperatures (see Incompatibilities).
- ***Decomposition Temperature:*** Decomposes at 500°C
- ***Decomposition products:*** Oxides of lead

I suppose what I am trying to point out is that the Explosive and Pyrotechnic manufacturing industries are perhaps remiss in not highlighting these issues to other industries. How this would be achieved is difficult to imagine and probably much more difficult to accomplish. Particularly if you consider the number of industrial laboratories, university and school laboratories, other research facilities to say nothing of raw material manufacturers and suppliers.
It is fairly obvious however that reliance on the information available in SDSs is unsatisfactory at best.
Perhaps, as the old saying goes “ignorance is bliss”.

IME Publishes Guidelines for use of QRA at Ports

By

Dr. Joshua Hoffman with contributions by Bill Evans

Introduction

The Institute of Makers of Explosives (IME) is a nonprofit association founded in the United States in 1913 to provide accurate information and comprehensive recommendations concerning the safety and security of commercial explosive materials. IME represents U.S. manufacturers and distributors of commercial explosive materials and oxidizers as well as other companies that provide related services. Most IME members are “small businesses” as determined by the U.S. Small Business Administration. Many of IME’s member companies have global operations.

The ability to manufacture, use, transport and distribute commercial explosives safely and securely is critical to our industry. Billions of pounds of explosives are safely transported each year in the United States, which is a fraction of the global industry. The commercial explosives industry has achieved a remarkable safety record. That said, IME and the industry are not complacent. It is an uncompromising dedication to safety that leads to the investment of millions of dollars every year to produce safer and more stable products and to ensure that those products are manufactured, stored, used, and transported without incident.

International export and import of commercial explosives has been commonplace for many years. From a North American perspective, the volume of such shipments continues to grow for two primary reasons:

- There are fewer manufacturers of primary and molecular explosives in North America, so such materials need to be sourced from Europe, South America and/or Asia.
- Large explosives companies operate globally and increasingly have global supply chains.

Counter to this trend, some ports have reduced allowed quantities or have closed ports to explosive imports and exports, citing heightened risks at the ports. This is despite the absence of actual incidents involving shipments of commercial explosives through ports (the well-known incidents all involve munitions, Ammonium Nitrate, and/or practices long-since ceased by industry). As a safety and security association, IME is concerned that any arbitrary reduction in allowable net explosives weights through a given port shifts risk to additional ships, creates more handling, and/or necessitates greater surface transportation.

Background

As one example, risk assessment was successfully implemented following the 2016 closure of the Port of Halifax in Canada to Class 1 products (i.e., explosives). Approximately 85 – 90 percent of the explosives used in U.S. oil and gas development enter North America through the Port of Halifax. The Port had been used by IME member companies for many years not only because of sufficient capacity to accommodate our members' shipments, but also because of confidence in the Port Authority's implementation of the safety and security measures enacted and administered by the Canadian government.

Given the reliance on the port, it was both surprising and alarming to learn of the imminent Class 1 Goods Moratorium that took effect on March 1, 2016. IME learned of the closure only one day prior to its effective date. Because Class 1 shipments were already en route with additional shipments scheduled, IME members had to make immediate, temporary arrangements to receive their needed shipments. These arrangements were not optimum for a variety of safety, security, and economic reasons. Entry through ports with more limited capacities would require smaller cargoes and more frequent shipments, resulting in a greater number of trucks on Canadian and U.S. highways carrying Class 1 products to their final destinations. Entry through ports at a further distance, such as Grande-Anse in New Brunswick, Canada, led to greater exposure during longer surface transportation routes. From a safety and security standpoint, it is desirable to minimize, not to increase, the on-road shipments of these materials. In addition, the use of alternative ports in southern United States that can accommodate larger shipments (e.g., the Port of Houston in Texas), added appreciably to the cost of vessel shipment given the increased distance from originating ports in Europe. This put a tremendous strain on the U.S. oil and gas industry, which was already experiencing severe economic pressure due to the current downturn in global oil prices.

The moratorium had a significant and detrimental impact on the commerce of explosives in the U.S. and Canada as the oil and gas industry rebounds.

Interest of IME

Because IME member companies with facilities in the U.S. and Canada receive and ship finished explosive products and explosive raw materials through Canadian ports, IME has an interest in any guidance for regulatory compliance. In addition, IME supports the use of quantitative risk assessment (QRA) to advance safety in explosive operations, including the activities of loading and unloading materials at ports.

In furtherance of its mission, IME has developed and continues to enhance a QRA software program designed specifically for use by the commercial explosives industry. The Institute of Makers of Explosives Safety Analysis for Risk (IMESAFR) program was developed by APT Research, Inc. under contract to IME, and was originally based on the Safety Assessment for Explosives Risk © (SAFER) program developed for use by the U.S. Department of Defense.

Over the past few years, Quantity/Distance (Q/D) has been used as a rationale for reducing/eliminating the shipment of explosives through certain ports due to the proximity of certain ports to of populated areas. This is a very conservative approach and is arguably not valid for transportation scenarios (this is the only transportation mode where Q/D is applied). IME has been active in championing the use of QRA and IMESAFR as a scientifically-based, conservative option for making objective and transparent decisions regarding the shipment of explosives through ports.

Guidance Published

IMESAFR was not designed with ports in mind and as such certain considerations are warranted before an appropriate QRA can be conducted. To help with this, IME published new user guidelines for appropriately utilizing IMESAFR when conducting QRA at ports. The "Guidelines for IMESAFR-Based QRAs for Ports" are available on IME's website.

The purpose of these guidelines is to provide explosive companies, port officials and regulators with a conserva-

tive yet balanced method to assess the risk of importing and exporting commercial explosives through North American Ports. These Guidelines will also suggest the acceptance of tolerable risk criteria for both the Individual and Group Risks. The Individual Risk Target is widely accepted and used globally and has been validated for IMESAFR by a recent peer review conducted at the request of the U.S. Bureau of Alcohol, Tobacco, Firearms & Explosives (ATF).

Governmental Acceptance

IME is encouraged that regulatory officials in the United States, Canada, and other countries recognize the value of QRA in obtaining objective, scientifically-based, realistic evaluations of risk in the management of explosives. The United States Coast Guard (USCG) is the authority having jurisdiction over U.S. ports and the movement of hazardous materials therein. Currently the USCG policy allows for QRA as a valid means of assessing the risks associated with the movement of explosive materials at U.S. ports and the granting of waivers from QD, however it is up to the Captain of each port to determine the best means of conducting a QRA for that port.

Natural Resources Canada (NRCan) Explosives Safety and Security Branch/Explosives Regulatory Division (ERD) recently announced the publication of amendments to the *Explosives Regulations, 2013* as published in Part II of the *Canada Gazette*, dated November 14, 2018. The amended regulations are available at :

http://gazette.gc.ca/rp-pr/p2/2018/2018-11-14/html/sor-dors231-eng.html.

In addition to the regulations NRCan has drafted:

Guidelines for quantified risk assessments at Ports and Wharves.

These guidelines provide guidance for completing a QRA as required under the proposed regulatory changes. IME is in strong support of both the regulatory amendments and the draft guidelines.

Conclusions

For many ports, any Q/D analysis will severely limit, or even prohibit, loading/unloading activities for Class 1 materials. Such limitations have occurred despite the historical record that indicates that this is, in fact, a very low risk activity. QRA offers a objective, balanced approach to risk analysis, and IMESAFR is the best tool to support a QRA. Through its recently published guidelines IME has proposed options to conduct QRAs at ports using IMESAFR.

UNODA United Nations Office for Disarmament Affairs

July 2018 FACT SHEET

SAFE AND SECURE AMMUNITION MANAGEMENT THROUGH THE UN SAFERGUARD PROGRAMME

Presented by

Hans Wallin

In more than 100 countries over the past five decades, poorly-stored ammunition stockpiles have led to grave incidents resulting in accidental explosions and humanitarian disaster. Thousands of people have been killed, injured and displaced, and the livelihoods of entire communities have been disrupted. In addition to the humanitarian and socio-economic consequences, unsecured or poorly managed national ammunition stockpiles fuel insecurity. Massive diversion of ammunition to illicit markets has been a catalyst for armed conflicts and crime in various regions. Diverted ammunition is also increasingly used to assemble improvised explosive devices (IEDs). The Security Council has recommended that stockpile security and the management of arms and ammunition be promoted “as an urgent priority (S/RES/1952 (2010).”

The General Assembly requested the United Nations to develop guidelines for adequate ammunition management to ensure that the United Nations consistently delivers high quality advice and support (A/RES/63/61). In response, the International Ammunition Technical Guidelines (IATG) were developed in 2011 and the UN SaferGuard Programme was established as the corresponding knowledge management platform. The UN SaferGuard Programme, managed by the UN Office for Disarmament Affairs (UNODA), oversees the dissemination of the IATG: practical, modular guidance on the safe and secure management of ammunition for the benefit of all interested stakeholders. **See: Small Arms Survey: Unplanned explosions at Munitions Sites.**

www.smallarmssurvey.org/weapons-andmarkets/stockpiles/unplanned-explosions-at-munitions-sites.html.

Devastation from a 2012 ammunition depot explosion in Brazzaville, Congo. 200 people were killed, 2000 injured.

Photo: Erwan Morand

International Ammunition Technical Guidelines

The UN SaferGuard Programme serves as the custodian for the IATG – ensuring their highest technical quality through regular updates. The IATG are publicly available to assist national authorities – including armed forces, police officers and border control officials – as well as industry, private security companies and operational non-governmental organizations to enhance the safety and security of ammunition stockpiles. The aim of the IATF is a reduction of the dual risks of unplanned explosions and illicit diversion. The IATG are voluntary, practical guidelines for use by interested States and other relevant stakeholders to establish standing operating procedures. The IATG consist of 12 volumes that provide practical guidance for 'a whole of life' approach to ammunition management. Users of the IATG can opt for implementing the guidelines' basic, intermediate, or advanced levels, making the IATG relevant for all situations by taking into account the diversity in capacities and resources available. These increasingly thorough steps are called risk reduction process levels (RRPLs). The IATG are updated, at a minimum, every five years to reflect evolving ammunition stockpile management norms and practices, and to incorporate changes due to changing international regulations and requirements. The IATG are available in multiple languages.

The latest version of each guideline, can be found at:

www.un.org/disarmament/ammunition

IATG implementation support toolkit

Key IATG-support tools – ranging from a risk reduction checklist to an explosive-limit license generator – are available for immediate use to improve ammunition safety at :
www.un.org/disarmament/un-saferguard.

Assistance

The UN SaferGuard Programme can identify technical expertise to provide assistance to requesting national authorities. Under the UN SaferGuard Quick-Response Mechanism, UNODA arranges for ammunition stockpile management assistance, including technical assessments and/or clearance activities, in accordance with the IATG. Donors can contact UNODA to contribute. Affected countries and clearance specialists can also connect with UNODA for further information.

www.un.org/disarmament/ammunition conventionalarms-unoda@un.org

Exponential Technological Advances and Explosives– Is Safety on Track

by

Dr Henco Bezuidenhout

Abstract

Globally business executives agree that the pace of change in manufacturing and the broader ecosystem is getting faster and faster. It is critical, therefore, that manufacturers understand and harness the power of new disruptive technologies and business models. Such understanding may transform companies into agile and adaptable organizations that are able to take the exponential leap to achieve extraordinary results. The changing environment around us brings about many challenges. A noticeable change is the restructuring of businesses to be more in line with required trends. Personnel cuts are made in line with business objectives and less emphasis is placed on a balanced approach between business continuity and next generation technology. To compensate, companies turn to external means for solutions (technical as well as safety developments). Universities, research institutes, consultants and other trend setters in industry are more regularly being approached to fill these gaps. This approach is aligned with what is understood to be exponential technologies but rarely includes safety methodology that coincides with the latest developments. Safety systems and good explosives practise principles evolved with time and it would be unfair to insinuate that safety approaches are not aligned with advances in technology. However, technology currently experience exponential growth and safety approaches (including systems and good explosive practice) are not. Outsourcing safety as well as technical expertise in the explosives manufacturing environment is posing a potential risk rather than mitigating risk. I don't agree with everything he is saying but it is his view.

Introduction

The explosives manufacturing industry as we know it is rapidly changing with advanced technologies increasingly underpinning global competitiveness and economic prosperity. Artificial Intelligence (AI), automation and autonomous technologies are fast becoming part of the production and application environment of the explosives industry. Such exponential technologies enable change at a non-linear pace, facilitated by substantial progress in areas such as computing power (data collection) and data storage. Typical examples of such technologies include 3D printing, nanotechnology, advanced engineering materials, autonomous technologies, artificial intelligence and biotechnology. The fourth industrial revolution is enabling unprecedented change at a pace that is no longer incremental but rather exponential. This is illustrated in figure 1. There is a clear and compelling case for manufacturers to leverage exponential technologies. Innovation enabled by exponential technologies can help manufacturers grow faster, be more agile and unlock new forms of value.

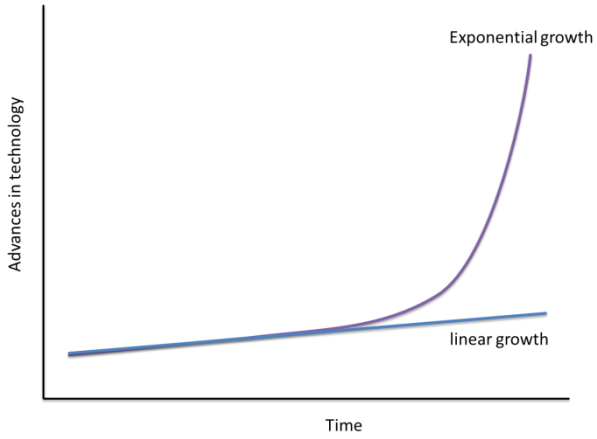


Figure 1. Exponential technologies vs linear growth in technology

Exponential technologies are also dramatically changing the "what" (technology), "who" (talent and open talent continuum) and "where" (workplace and physical location) [1]. A complete change in thinking and doing is thus inevitable. In any safety approach it is also the "what", "who" and "where". This fits perfectly when considering conventional technologies. Conventional technologies refer to melt cast facilities, pressing processes, volumetric dosing, blade and tumbling mixing processes, nitration and more (technologies dating back to as early as the 1980's that is still in use in the explosives industry today). Figure 2 then simply means that the longer you have been in this current conventional industry the more you will know (with regards to the energetic formulation, product and process problem solving and hazard identification). This situation greatly contributed to current safety approaches good explosive practises (GEP) and thorough understanding towards friction, impact, static and heat (FISH). Thus a constant "who, what and where".

In a conventional environment this can be described by looking at figure 2.

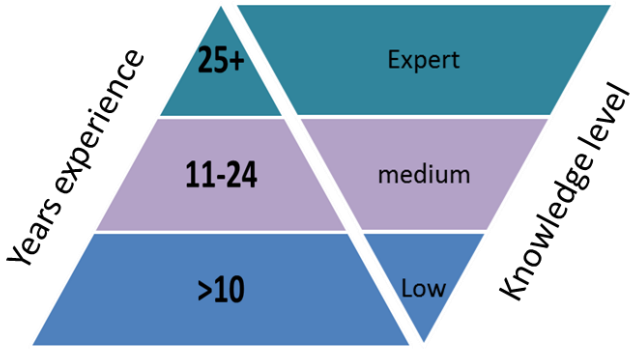


Figure 2. Experience triangle (applicable year's exposure) and knowledge level triangle (considering conventional technologies

The history of explosives was formed through technological advances as well as incidents and accidents. A proper in-house knowledgebase (nested in specific persons) provided answers to the following all too familiar questions [2]:

- "When did that change take place?"
- "How come we did not see that?"
- "What, I didn't know that could happen!"
- "So we have just been lucky up to know?"

Pre-empting and answering these questions at the right time contributed greatly to safe operations worldwide. But what does "at the right time" mean and who tables the right question? Corporate strategies (in terms of where the company wants to go) are often nested in its purpose, vision, technological direction, funding and prioritization of projects. Such strategies must ensure sales in order to warrant existence of the company. This process is all too familiar; there must be a market, and then a need in the market, a product is presented to satisfy the need and a sale is made and so it continues. The success of this process often lies in management models that are used by the company. In a modern way of thinking one business model suggests that no company can be all things to all people. Operational excellence, Product leadership and Customer intimacy are the main building blocks for this model [3]. Operational excellence here refers to the pursuit of optimal running cost. Product leadership refers to offering the best product (technically, and using the latest technology) and being the first to do so. Customer intimacy is to offer the best total solution by being the most dependable and responsive to the customer's needs. All of the above are applicable safety principles as well. What is often neglected is the adaption of safety approaches to align them with the latest business model. Considering figure 1 we can then anticipate an exponential increase in the safety gap between exponential technologies and linear technologies (giving figure 3). The reason this can be expected is that current expertise in companies might not have kept up with technological developments or that companies simply does not have such expertise anymore. Outsourced experts and young scientists/engineers are used and they may not have the knowledge (safety – FISH) of the explosive industry. Figure 4 can now be adapted to figure 5 by the addition of another triangle. This triangle is called the knowledge relevance triangle related to new exponential technologies (here reference is not to safety knowledge but the actual technology).

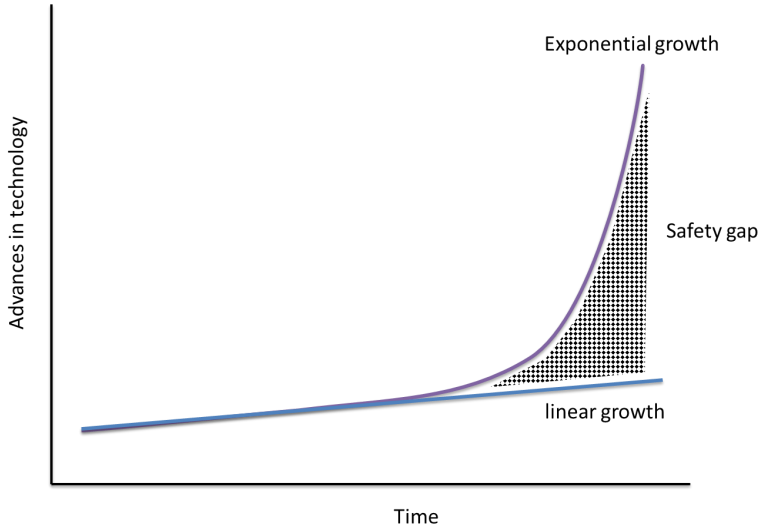


Figure 3. Exponential technologies vs linear growth in technology indicating safety gap

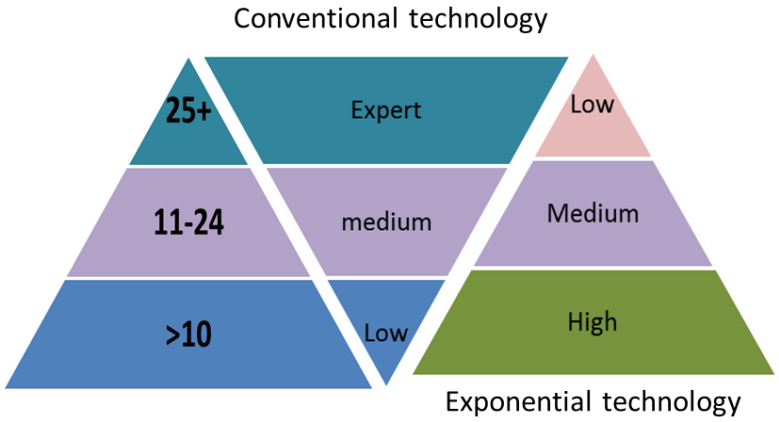


Figure 4. Experience, conventional knowledge level and exponential technology knowledge - relevance comparison.

The influence of exponential technologies on good explosive practice

Looking at dedicated safety departments within large energetic material manufacturing companies an argument can be formed whether the role of such a safety department is solely to ensure that the company is compliant with legislative requirements or does it also entail ensuring a safe work environment? A similarity can be drawn between large consulting companies and large corporate institutions in that young people are employed with an academic background in safety management. No time on process facilities, no understanding of energetic material characteristics and limited appreciation of good explosives practice. They are very good at auditing existing systems but can an eagle eye (safety related) be expected from them when it comes to new processes or next generation materials.

The same argument applies when consultants on safety and safety systems are used. The problem here is how many safety consultants know and understand the explosives environment. What answers can be expected when one should pose questions to them like;

- How important is compatibility of energetic materials in relation to a new manufacturing (advanced technological) process?
- What do impact and friction results mean when changing from one energetic formulation to another?
- How can impact, friction and electrostatic discharge characteristics of an energeticformulation assist in process design?
- How can impact, friction and electrostatic discharge characteristics of an energetic formulation be used to determine if a new explosive formulation is compatible with current process,
- When changing from conventional process to automated processes driven by artificial intelligence will there be a change in the origin of sources of ignition?

A gap is again identified. Although the younger generation have a good feel for exponential technologies and can keep pace, they lack the basic understanding of explosives characteristics and its behaviour under certain conditions. The older generation understand explosives but seldom keep pace with exponential technologies. We know that the condition of the energetic material and the environment it is used in change its characteristics and behaviour. Are old principles all relevant when considering exponential technologies or is change needed? Many good ideas have been seen smothered by an old way of thinking (around safety). Adapting figure 4 to this argument gives figure 5.

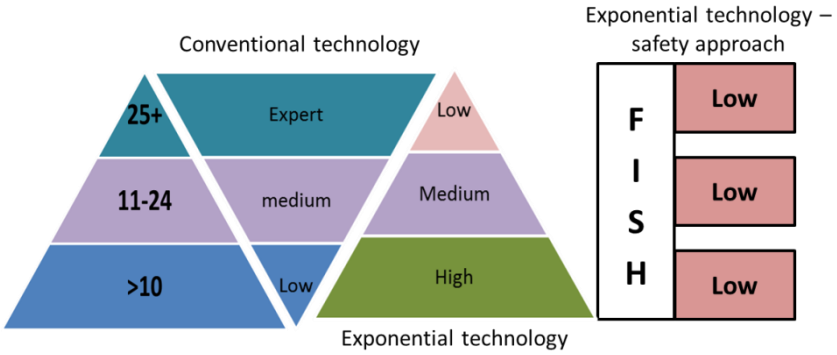


Figure 5. Knowledge base versus safety approach matrix

The problem is far greater than just loosing good ideas. Personnel turnover in companies and generation gaps combined with exponential growth technologies may result in a complete lack in safety principles keeping up with exponential technological growth. Safety will become the ball and chain slowing down growth (but definitely not stopping it). A typical example of this are wireless detonators currently being developed by a few explosive manufacturers. Radio frequency and explosives (more specifically electronic detonators) are considered a no go zone. This has been the case for many years and current legislation in many countries prohibits this and controls this in many ways. Technological developments have made it possible to use radio waves to communicate with detonators. The success of this technology (with regards to its implementation) will be a function of how safety systems have been adapted to accommodate technological developments and the influence hereof on good explosive practise (regarding RF and explosives specifically electronic detonators). Unfortunately only time will answer this question.

Exponential technologies and exponential safety

It is understood that here is a gap between technology and safety. The challenge is how the gap can be closed. Since the industrialisation of explosives many years ago good explosive practises and principles have been developed. Sadly these developments came with a number of accidents and many lost lives. Safety always followed technological advancements. On a positive side up until recent years technological growth was linear and safety approaches grew linearly with it (although slightly behind it). With the expectation of sudden change in the growing rate of technology (from linear to exponential) the challenge is for safety to keep up.

A complete rethink towards safety is needed if safety is to keep up with exponential technological growth. Impact, friction, static and heat might well the main sources of ignition (as it currently stands). The “but” part comes in the understanding where these sources of ignition may present itself. Remember these questions from section 1:

- “When did that change take place?”
- “How come we did not see that?”
- “What, I didn’t know that could happen!”
- “So we have just been lucky up to know?”

Both the old and new thought lines may easily answer the first question of “When did that change take place?”. This is merely a timeline exercise. The second question is less frequently asked in a conventional environment because of experience in

the “what” and the “where” often already answered by the “who” (experience expert) during the risk assessment. The third question/surprise statement “What, I didn’t know that could happen!” is where it becomes interesting. The experienced expert can be surprised because he/she does not understand the latest technology and the young scientist /engineer/ safety practitioner did not know what to look for. As for the last question/statement – let’s just hope it never gets to that.

Nanotechnology is one example. It has been thoroughly proven that particle shape and size of energetic materials influence its characteristics. Moving into the nano region of particle sizes is still unfamiliar territory and not acknowledging this can bring about challenges. It is not as simple as falling back to basic principles as the basic principles are becoming obsolete as technology progress. Processing PETN, RDX and HMX in the nanometre range (particle size) for application in printing of explosives is another example. How do the FISH characteristics of these formulations change in this specific application? Using nano PETN or RDX in plastic bonded explosives (PBX) increase or decreases its process safety? A new set of basic principles are then required in line with technological advances of that time frame.

At this stage there is no recipe to ensure GEP are up to date and inline with exponential progress of technology.

The following proposal may prove helpful to breach the gap:

- Educate safety practitioners in explosive principles and not only safety systems, I believe we do that.
- Safety practitioners must have entry level knowledge of the technology field they are involved in (they are not merely system auditors and statistical data collectors), Agreed but that often is done with training.
- Design engineers must work in conjunction with persons that is up to date with the scientific understanding of explosive characteristics (latest developments), Yes.
- Chemists and engineers (explosive formulation designers) must be aware of latest methods of synthesis and/ or manufacturing, Ideally yes.
- Plant design engineers must understand explosive sensitivity characteristics when using new technologies in plant design, I would hope they do through BOS or equivalane training.
- Multiple scientific and engineering disciplines must work close together in the design, manufacturing and application of energetic materials. Yes.

This approach may well be challenged by arguing that this is not new and current good explosive practice principles are built around the statements above. True, but a definite effort must be made to stay close to exponential technological developments. If not then the set of principles way well be written in blood again.

I think this is all pretty obvious and is in fact how companies are behaving – well, I would hope they are

Conclusion

Technology progresses at a rate neither seen nor experienced before. Generation gaps have different approaches towards technology and safety. At the end of it all can we really be at ease with current good explosive safety principles and safety methodologies given where technology is going. If the curve of linear growth in safety principles does not change to exponential then the future explosive industry is in for a rocky ride (figure 6).

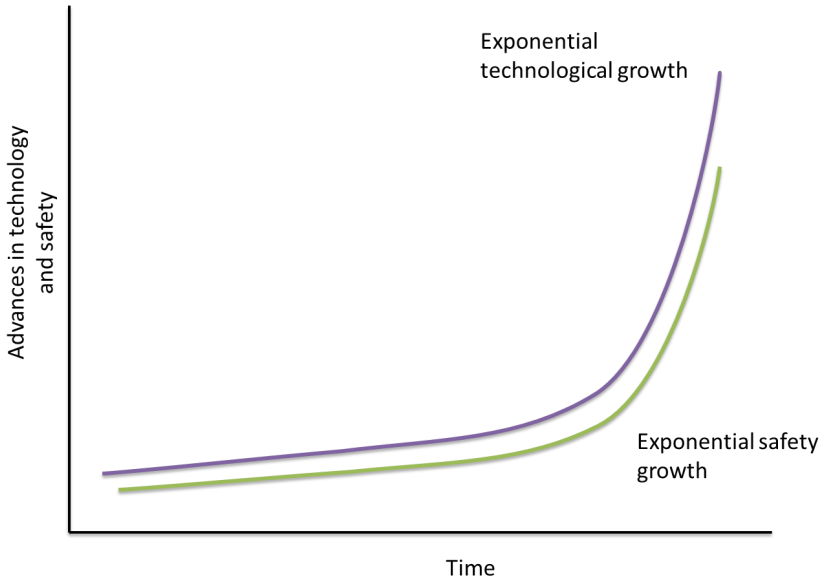


Figure 6. Good comparison between exponential technological development and exponential safety development.

AEISG AND THE EXPLOSIVES INDUSTRY
By
Bob Sheridan, Chief Executive Officer, AEISG

Introduction

Australia is a country, gifted with natural resources of benefit not only to Australians but to many developed and developing countries around the world. As such, the resource sector through mining and mineral exports contributes significantly to the national economy.

Australia exports large quantities of iron ore, coal, gold, aluminium and copper accounting for more than 50 per cent of total exports. Other mineral exports include uranium, silver, lead and zinc providing a total export value exceeding $AUD150 billion (2017).

Though relatively small in population, Australia has a three-tiered level of government – National or Federal Government, State (6) and Territory (2) governments, and local authorities or councils. Unlike most countries, Australia has no national explosives controls other than for Defence explosives and air/maritime safety. Commercial explosives and associated activities are regulated at the State and Territory level with limited coordination and consistency.

Explosives have long been subject to tight legislative controls for community safety and security reasons. These are acknowledged, understood and supported by the industry. However, in Australia, there has been continued increase and divergence of State and Territory legislation in this area over the years to the point where the explosives industry is now constrained by multiple sets of inconsistent, unnecessary and, at times, conflicting requirements. Further, there is little to no mutual recognition by state/territory explosives regulators or acknowledgement of various jurisdictional licences, permits or authorisations issued. The direct impacts are felt not only by the explosives industry itself but also by:

- its contractors and suppliers of services e.g. transport, engineering, construction industries, who need to work to varying standards, codes, specifications to comply with varying jurisdictional requirements; and
- its clients and customers, who are at times unnecessarily constrained by the differences in products and services able to be delivered.

The explosives industry in Australia is itself a multibillion dollar industry, supplying almost 3 million tonnes of explosives per annum across Australia, predominantly to the mining, quarrying and construction industries so important to the Aus-

tralian infrastructure and its economy. It consists of several national, and international, explosives companies manufacturing, importing, selling, transporting, storing, using and handling explosives with an overriding need to safely, securely and efficiently move products, people and equipment seamlessly across borders and around Australia to service their clients. The industry also exports explosives to neighbouring countries in the Oceanic region and beyond.

Background

An informal association of Australian explosives companies was formed in 1994 in response to issues adversely impacting all members of the industry, including the implementation of recommendations flowing from the disastrous explosion at an explosives facility at the Porgera mine in Papua New Guinea which claimed 11 lives. Explosives regulators were expressing a desire to liaise with the explosives industry as a whole, rather than as individual companies. This association was originally known as the Australian Explosives Manufacturers Safety Committee (AEMSC) and was made up of representatives from all the major explosives suppliers at the time.

AEMSC developed an industry code of practice for safely handling ammonium nitrate emulsion precursors which were involved in the Porgera explosion and published the first edition in 1999. Difficulties were experienced in progressing industry issues as the resources of the association were limited, there was no clear charter and activities were dependent on the input and motivation of the chairman of the day.

In 2004, it was decided to formalise the explosives association, and provide it with a formal constitution and ongoing resources, including employment of a Chief Executive Officer, to more effectively manage and promote issues. The Australian Explosives Industry and Safety Group Incorporated (AEISG) was established under the New South Wales Incorporations Act in 2005 and formally registered as a not-for-profit business with the New South Wales Department of Fair Trading in 2007.

Since formation, membership of AEISG has expanded and broadened to include all significant explosives manufacturers and suppliers within Australasia. Current membership includes:

- Applied Explosives Technology Pty Ltd
- BME Australia-Asia Pty Ltd
- Davey Bickford Enaex Australia Pty Ltd
- Downer EDI Mining-Blasting Services Pty Ltd
- Dyno Nobel Asia Pacific Pty Ltd
- Hanwha Mining Services Australia Pty Ltd
- Johnex Explosives
- Maxam Australia Pty Ltd
- Nitro Sibir Australia Pty Ltd
- Orica Australia Pty Ltd
- Platinum Blasting Services
- Redbull Powder Company Ltd
- Solar Mining Services Pty Ltd
- Thales Australia Ltd

AEISG Purpose and Methodology

The primary goal of AEISG is to continuously improve the level of safety and security throughout the import, manufacture, transport, storage, handling, export and use of explosives and their precursors, including Ammonium Nitrate (UN1942) and Ammonium Nitrate Emulsions, Suspensions or Gels (UN3375), throughout Australia for the benefit of its members and clients, their employees and the general community.

The following roles for AEISG and its members were incorporated into its Constitution:

- Create an environment and forum for open exchange of opinions/ideas on industry matters;
- Disseminate information to members in relation to explosives industry issues,
  - ⇒ health and safety (e.g. accidents, incidents)
  - ⇒ security
  - ⇒ environmental
  - ⇒ technological advances in safety and security
  - ⇒ regulatory changes;
- Represent the industry, nationally and internationally, to explosives regulatory bodies on safety, security and other matters;
- Liaise with relevant national and international

organisations to progress improved safety and security within the explosives industry;

- Develop and promote explosives industry Codes of Practice where needed (considered good practice and meeting acceptable standards);
- Promote consistency in Australian legislation covering the explosives industry;
- Promote community perception of a competent and responsible industry.

In undertaking the above functions, AEISG members hold regular general meetings at least quarterly with further technical meetings as required to address specific technical issues such as Codes of Practice.

AEISG, through the CEO or member representatives, is represented at national and international regulatory meetings (e.g. the Australian Forum of Explosives Regulators, United Nations Committees of Experts on Transportation of Dangerous Goods and Globally Harmonised System for Classification and Labelling of Chemicals, IGUS/CIE Conference) where it can meaningfully input to effective outcomes on safety and security issues involving explosives.

AEISG is associated with similar organisations such as SAFEX and the Institute of Makers of Explosives (IME) to gain benefit from relevant safety and security improvements being implemented elsewhere.

AEISG also prepares industry submissions on policies, legislation, standards/codes and other issues impacting the Australian explosives industry and, where relevant, seeks political and/or organisational support for the established explosives industry position.

AEISG Codes of Practice

Following on from its initial Code of Practice developed for the safe handling of ammonium nitrate emulsion precursors in 1999, since revised, the association has identified other areas where safety could be further improved by the development of relevant codes of practice establishing acceptable safety levels to which all AEISG member companies would commit to apply within their organisations. In most cases the need has arisen because of gaps in legislative requirements, inconsistency in design requirements, unacceptable practices, new products/technologies or desire for improved safety and security.

Once identified as an issue of significance to the explosives industry, or indeed to the explosives regulators, development of these AEISG Codes involves scoping of the issue by the AEISG Committee members, drafting by an appropriate and experienced industry consultant overseen by AEISG, reference to relevant explosives and mining regulators for comment and input, and a final review prior to publishing.

The AEISG Codes are regularly reviewed at least every five years but more frequently where particular safety or security issues arise.

While these codes remain copyright, AEISG makes the latest editions freely available on its website www.aeisg.org.au for use by any interested parties. Some AEISG Codes have been adopted directly into explosives legislation within Australia, while others have been accepted as 'approved codes' by regulators, thereby satisfying regulatory obligations. All AEISG Codes have general acceptance by regulatory authorities in Australia. Of course, legislative provisions always take precedence over AEISG Codes of Practice where there are inconsistencies, although AEISG would seek to amend its codes to ensure there was no unnecessary conflicting requirements. The Codes have also been made available to overseas regulators and organisations interested in their application.

AEISG is keen to continuously improve its codes and would welcome any relevant constructive comments on them. Input can be provided directly via email to :

info@aeisg.org.au

To date, the following explosives industry codes of practice have been developed, and reviewed, through AEISG, including:

Blast Guarding in an Open Cut Mining Environment (Edition 1)

The use of explosives to break rock is an intrinsically hazardous process. On a mine or quarry site the potential hazards are increased by the need to manage the blasting procedure to protect mine personnel, contractors and the general public from exposure to foreseeable, if unintended, adverse consequences of a blast.

Adverse consequences may include, but not be limited to, one or any combination
of the following scenarios:

- Persons inadvertently at risk from flying rock generated by the blast;
- Persons at risk from fumes generated by the blast;

- Persons at risk from misfired blastholes;
- Persons carrying out tasks other than blasting with workplaces inside an area subject to blasting effects;
- Electrical storms arriving when a blast is ready to fire;
- Unauthorized persons driving or walking inside a blasting zone; and
- Blast effects extending outside the mine boundaries

This Code has been developed to provide practical guidance on meeting regulatory requirements on explosives and mine safety.

Mobile Processing Units (Edition 4)

This Code sets out the requirements for the design and operational management of Mobile Processing Units (MPUs) used in the manufacture and blast-hole delivery of explosives used in surface and underground blasting as well as other operations, including field packaging.

Unless otherwise specified, this Code applies to the operational transport, manufacture and delivery of products using MPUs on public roads and private property throughout Australia, including mining leases.

This Code does not apply to the transport of dangerous goods in vehicles or equipment not specifically covered or included by definition. The intent of this Code is to ensure a level of consistency in the design and operational management of MPUs, and further the objective of increased safety across the commercial explosives industry;

Storage and Handling of UN3375 (Edition 5)

This Code sets out requirements and recommendations to control the risks (to people and to the environment) arising from the storage, handling (including transfer operations), transport and security of Ammonium Nitrate Emulsions, Suspensions and Gels conforming to UN3375. These materials are collectively referred to in this Code as ANEs.

As described in the UN publication 'Recommendations on the Transport of Dangerous Goods, Model Regulations', ANEs are non-sensitised emulsions, suspensions and gels consisting primarily of a mixture of ammonium nitrate and fuel in a desensitised matrix, intended to produce a Type E blasting explosive only after further processing prior to use. Although the UN system classifies materials for the purpose of transport, it is a convenient classification system which is used in this Code to define which materials fall within its scope.

The underlying philosophy of this Code is that ANEs do not explode without warning. Unlike Class 1 explosives, there have been no documented cases of an ANE exploding without warning in over 4 decades of widespread usage. In the only known case where a product similar to ANE did explode, the explosion was the result of over an hour of intense fire engulfment where the product had been stored with large quantities of fuel.

Requirements detailed in this Code are always supplementary to, and never take precedence over, explicit regulatory requirements. It is intended to supplement such regulatory requirements in a nationally uniform way and to, as far as possible, clarify any ambiguity or uncertainty in the regulatory requirements. The Code also sets out requirements and recommendations on aspects that are not explicitly covered by local regulations. These requirements and recommendations are based on industry best practice developed over many years, and are consistent with Australian Standards and regulations, international guides and codes, and advice from regulatory authorities. Although this is an industry code it is intended to be fully consistent with requirements in most jurisdictions and may be thought of as one way to meet the regulatory requirements. Some jurisdictions have endorsed or otherwise drawn upon this Code within their regulatory frameworks.

This Code is intended to cover only the ANE stage - that is, from the point after raw materials are initially processed to become an ANE, through the various stages of handling, storage and transport to the point where the ANE is processed into an explosive, or is otherwise converted such that it no longer conforms with UN3375.

Prevention and Management of Blast Generated NOx Gases in Surface Blasting (Edition 2)

The use of explosives to break rock is an intrinsically hazardous process. These hazards have been studied over the years and modern mining methods have evolved to minimize the inherent risks of blasting under most conditions.

These guidelines have been developed to assist the safe use of explosives in situations where a specific additional hazard may arise due to the generation of nitrogen oxides

(NOx) within the post-blast gases. These oxides are generally regarded as products arising from imperfect decomposition of ammonium nitrate explosives during detonation.

The purpose of these guidelines is to inform explosives users of:

- the hazards of NOx gases;
- the likely causes of their generation from blasting;
- possible measures to eliminate or minimize NOx generation; and
- to provide general management advice in the event of NOx incidents.

Elevated Temperature and Reactive Ground (Edition 4)

The aim of this Code is to enhance the safety of explosive suppliers and their customers when handling explosives and charging in elevated temperature and/or reactive ground conditions.

The Code:

- Outlines the nature of elevated temperature and reactivity, and the current understanding on the mechanisms of elevated temperature and reactive ground chemistry;
- Summarises the hazards and risks associated with blasting in elevated temperature and/or reactive ground;
- Provides recommended risk assessment methods including sampling and testing for reactivity and measuring elevated temperature conditions at new and existing sites;
- Provides guidelines for the risk management of operations at elevated temperature and/or reactive ground sites including blasting methods and systems; and
- Provides guidelines for managing misfires and premature detonations in elevated temperature and/or reactive ground.

The customer must establish whether there is elevated temperature and/or reactive ground, as detailed in this Code, on their site. In so doing the customer may request assistance from its explosives supplier to conduct appropriate risk assessments and to make recommendations as to the appropriate risk management procedures for the handling of explosives to ensure the safety and well-being of all personnel working on the site. The responsibility for implementing these procedures will always remain with the customer, and an explosives supplier may withhold supply of product for use in situations where the risk assessments undertaken based on the guidelines of this Code indicate that the risks are unacceptable. The customer has the responsibility of disclosing to its explosives supplier any history or suspected history of elevated temperature and/or reactive ground on the site and must reveal any changes in geological conditions that may indicate the presence of elevated temperature and/or reactive ground.

Should a customer carry out his own assessment of elevated temperature and/or reactive ground the explosives supplier will always have the right to review this assessment or to carry out their own assessment based on this Code, and decide whether there are appropriate controls in place by the customer to ensure that the supply of explosive products can be made to an acceptable and agreed level of risk. Explosives suppliers have a responsibility to ensure that employees are always offered a safe place of work to carry out their defined duties.

It is the 'duty of care' of explosives suppliers to advise customers of the risks associated with elevated temperature and/or reactive ground and to offer products appropriate to the site application. If the customer chooses to operate contrary to this advice, explosives suppliers reserve the right to withdraw their products and services. If a request is received from a regulator, the explosives supplier will inform the regulator of sites that have elevated temperature and/or reactive ground conditions as assessed by this Code.

Segregation Barriers for Transporting Mixed Loads of Detonators and High Explosives (Edition 2)

The safe and secure transport of explosives is covered by the Australian Code for the Transport of Explosives by Road and Rail, also known as the Australian Explosives Code (AEC).

Within the AEC there is allowance for the transport of mixed loads of incompatible explosives, such as detonators and other high explosives, provided the incompatible explosives are segregated by:

(a) an effective means of segregation demonstrated to prevent sympathetic detonation of the incompatible explosives; or

(b) other means specifically approved by a Competent Authority for that purpose

These guidelines have been developed to document and detail a suitable segregation barrier demonstrated to be effective in preventing sympathetic detonation within defined explosives loads and in minimising the risk of any communication of explosion from the detonators being transported to other high explosives on the same vehicle.

Mixed loads of explosives have been transported safely within Australia for over 25 years.

To satisfy the requirements of the AEC a substantial program of experiments, tests and computer modeling was undertaken to design and then demonstrate the effectiveness of a suitable segregation barrier for loads of detonators and other high explosives.

An historical summary of the developmental process is provided in Appendix 1, while a summary of tests, results and conclusions is included in Appendix 2.

In developing this Code, AEISG aims to enhance the safety of its members, customers, contractors and the general community by documenting a proven and effective method of segregating detonators from high explosive loads during transport to achieve a consistent standard of blast barrier design across the industry.

The Code covers the following areas:

- the minimum design requirements for a segregation barrier positioned between the detonator and high explosive compartments on a vehicle transporting large explosive loads;
- the design requirements for the detonator and high explosive carry boxes additional to those already specified in the AEC;
- the configuration and attachment of the segregation barrier and the explosive carry box for various vehicle types (including rigid vehicle, semi-trailer, B Double);
- the conformance checking of the segregation barrier to ensure compliance with this Code; and
- the types and quantities of detonators to be transported within the detonator carry box for mixed explosives loads incorporating segregation barriers specified herein (the types and quantities of high explosives in the carry box are limited by the AEC);
- process for seeking modifications or alterations to designs contained within this Code.

This Code does not cover matters already included in, or addressed by, the AEC such as placarding, vehicle design, security, transport documentation, stowage and/or transport procedures.

This Code maintains consistency with the AEC and provides additional guidance necessary to satisfy the segregation requirements outlined in Chapter 7 of the AEC in relation to transporting detonators and other high explosives on the same vehicle.

On-Bench Practices for Open Cut Mines and Quarries (Edition 2)

AEISG identified the need to provide guidance on establishing best practice systems and procedures for managing on-bench procedures for the loading and firing of blasts at open cut mines and quarries, to minimise risks for its members, its clients, their employees and the wider community.

The use of explosives to break rock involves the sudden application of large amounts of energy and is therefore a process requiring the effective management and control of activities to ensure that hazards are identified and appropriately controlled. On a mine or quarry site the potential hazards are increased by the need to handle sensitive initiating explosives while working in a harsh environment. The blasting process must be managed in a way that minimises the risk of the unplanned detonation of explosives, and associated undesired outcomes, and uncontrolled blast behaviour at the time of firing.

In considering the safety of mine personnel, contractors and the general public, hazards associated with the blasting process include, but are not be limited to, the following:

- Loss or theft of explosives from the mine/quarry site, representing a security risk;
- Unplanned detonation of explosives due to incorrect handling;
- -mpacts associated with operating equipment (e.g. as drills and excavators in adjacent areas);
- impact from passing equipment;
- Snap-slap-shoot risks from passing equipment;

- An external source of initiation such as hot/ reactive ground or lightning;

- he application of electrical energy for testing or firing of electronic initiation systems;

- Flyrock risks to persons, equipment and infrastructure, both outside the blast exclusion zone and within a blast exclusion zone that has not been adequately cleared prior to firing;

- Environmental compliance risks (overpressure and ground vibration) associated with overloaded blastholes, large (reinforcing) blasts, and unfavourable meteorological conditions;

- Persons at risk from dust and fumes generated by the blast, outside the blast exclusion zone or potentially outside the site boundary; and

- Persons at risk from misfired blastholes, particularly during subsequent excavation or re-drilling of the blast area.

This Code has been developed to provide practical guidance regarding those on-bench activities that must be considered as part of the risk assessment process, and during the development of a safety management plan and associated operating procedures and work instructions. The Code is necessarily generic in order to remain applicable across a broad range of applications, using a variety of explosive products, to achieve different blasting outcomes. It is understood that specific blasting practices and applications vary significantly across open cut coal operations, open pit metal mines and quarries, and therefore, a review of these guidelines must be carried out for applicability on a site-specific basis.

AEISG is currently in the process of drafting additional Codes of Practice covering:

Importation and Exportation of Explosives

This code will set out requirements and recommendations for the import and the export of explosives which are Class I dangerous goods. Regulatory requirements and the codes and standards they call up can differ and can cover explosives safety and security, transport by land, sea and air, and other related matters for customs and quarantine.

There is a need to integrate the functions and activities into a single set of requirements and recommendations for many different regulatory agencies who play a role. The importers and exporters work in harmony with contractors who include suppliers, packers, port operators, transporters, customs agents and forwarding agents.

This code will provide the requirements that apply in this complex system of regulatory requirements where importers and exporters and other contractors work together to satisfy the many differing requirements to import and export explosives.

This code will not cover the regulatory requirements for the country of origin for imports, or the destination countries to which explosives will be exported.

The role and responsibilities of importers and exporters, and their contractors will be covered.

The general requirements for preparing loads for import and export and the management systems that apply to these activities will be outlined to ensure a clear set of requirements for the many agencies and other industry personnel involved.

Storage of Ammonium Nitrate

This Code will set out the requirements and recommendations to control the risks arising from the storage, handling (including on-site transport and transfer operations), and security of AN, where AN means solid Ammonium Nitrate in Division 5.1 – oxidising agent, as classified into United Nations numbers UN 1942 and UN 2067.

Properties and hazards of Ammonium Nitrate will be detailed.

AN is the primary ingredient in the vast majority of com-

mercial bulk explosives, and as such it is common for mining and quarrying sites, (particularly the larger ones) and for bulk explosives or precursor manufacturing sites to have on-site AN stores, ranging in size from a few tens of tonnes up to hundreds and sometimes thousands of tonnes. Many of the Ammonium Nitrate Codes which already exist cover a much broader scope than this Code, as they can include:

- AN solutions
- additional UN numbers
- stores associated with activities other than mining, quarrying and construction (e.g. retail, farm supply, fertilizer mixing etc)

AEISG is producing this Code in order to focus exclusively on the storage and handling of AN as part of the commercial explosives industry in servicing mines, quarries and construction.

This Code has a great deal in common with the relevant parts of existing codes and relevant guidelines, including:

- AS 4326-2008: The storage and handling of oxidizing agents;
- Safe Storage of Solid Ammonium Nitrate (Third Edition, 2013) published by Resources Safety, Department of Mines & Petroleum, WA;
- Good Practice Guide: Storage of Solid Technical Grade Ammonium Nitrate (GPG 02 rev02, March 2014) published by SAFEX International;
- Information Bulletin No 53 (Version 5, 31 Oct 2017) published by Explosives Inspectorate, Department of Mines and Energy, Queensland Government.

However, these other standards and codes are not uniform - there are some significant differences between them. It therefore follows that this Code will differ significantly in at least some respects from some or all of these other codes. In preparing this Code, AEISG has already researched and drawn on these other codes, as well as other sources, and believes that the requirements detailed here will be the most appropriate set of controls for AN storage and handling at sites which fall within its scope.

The underlying philosophy of this Code will be that, provided there is an effective security plan to control the risk of sabotage, the risk of stored AN exploding without warning is negligible. That is, any explosion would be "with-warning" rather than "no-warning". This code therefore will allow some potential relaxation in separation distances based on credible evacuation.

Requirements detailed in this Code will always be supplementary to, and never take precedence over, explicit regulatory requirements. It is intended to supplement such regulatory requirements in a nationally uniform way and to, as far as possible, clarify any ambiguity or uncertainty in existing regulatory requirements.

The Selection and Use of Electronic Detonators

Electronic Detonators have been in use in Australia since 1999. There are a number of different systems and manufacturers that manufacture, sell and service electronic detonators and equipment. Electronic detonators do not yet have a unique UN number, although AEISG is in the process of addressing this through the relevant UN Sub-committees.

The Australian Standard AS2187.2 – 2006 - Explosives – Storage and Use – Use of Explosives is over 10 years old, and has one small section (8.2.2) covering the use of electronic detonator systems. Additionally Appendix B covers equipment for electrical firing that is not appropriate for electronic detonator firing equipment.

from states and territories when authorizing different systems. There is a need to help our regulators with authorization, investigation of incidents, and development of future legislation that protects our industry from products that may cause harm.

As electronic detonator usage rapidly increases across the mining and quarrying market, the same questions will be asked during risk assessments and investigations. There is also no standard document that assists drill and blast engineers or shotfirers when designing electronic blasts, with respect to planning and timing. A code will assist manufacturers, users and regulators.

Future AEISG codes will be added to the AEISG website upon completion.

Current Chief Executive Officer

Since 2011, the role of Chief Executive Officer of AEISG has been filled by Bob Sheridan, who commenced work (more years ago than Bob cares to mention) as an explosives chemist manufacturing, testing and developing explosives for the defence industry and its agencies, both here in Australia and in the United Kingdom. He has been a past member of the Australian Institution of Engineers and a National Association of Testing Authorities (NATA) Signatory for explosives testing.

In 1983 Bob became Chief Inspector of Explosives in Queensland and developed, reviewed, implemented and administered explosives legislation in that jurisdiction for more than 25 years. During that time Bob also chaired and input to national committees drafting the explosives codes and standards covering the storage, transport and use of explosives in Australia.

Bob retired at the end of 2008 and, after an all too brief period of rest and interesting consultation projects, joined AEISG in late 2010 taking over from the former CEO, Richard Morony. Since then Bob has been focussing and directing AEISG activities towards ongoing development and review of industry codes, seeking (and achieving) amendments to international legislative requirements for explosives through the United Nations Committees, pursuing national harmonisation of explosives legislation in Australia, and internally reviewing AEISG and its constitution.

Bob Sheridan says;

"*As a former explosives regulator I understand the need for effective legislation controlling explosives, as does the explosives industry I now represent. However, in Australia there are at least ten Commonwealth, State and Territory jurisdictions with multiple sets of inconsistent and, at times, dated, unnecessary, ineffective or conflicting requirements. Such varied and divergent explosives legislation across Commonwealth, State and Territory jurisdictions has now become counter-productive. It prevents the free flow of products, people and equipment across the country, creates an unnecessary administrative burden upon the industry and regulators alike, and has become the major impediment to improving safety, security and productivity within the industry in Australia.*

I believe we now need legislation at a national level to enable safety and productivity improvements to be realised, to significantly reduce red tape for our industry, to ensure responsibilities and accountabilities are clearly defined and appropriately allocated, but perhaps more importantly, to achieve the national security standards necessary to address our current high security rating of 'Probable'.

When 'explosives' cannot be defined consistently by jurisdictions, how can they be effectively controlled? To achieve appropriate levels of safety across Australia, consistency is desirable. To achieve appropriate levels of security across Australia, consistency is essential.

Government agencies now recognise this as a significant issue and have initiated a process of harmonisation of explosives legislation. AEISG will continue to push for an appropriate and effective outcome in this process".

Since its inception, AEISG has quickly moved to provide a significant explosives industry representation. It has gained national and international recognition as a competent and professional body, has increased its membership, meets on a regular basis with explosives regulatory bodies in Australia and liaises with similar overseas explosives associations such as SAFEX and the Institute of Manufacturers of Explosives (IME). Its industry codes of practice are universally accepted by explosives regulatory bodies, and members are obliged to work to these codes under the AEISG constitution.

Despite its success to date, Bob has indicated that AEISG will continue to work towards improving safety, security and productivity within the explosives industry in Australia for the benefit of its members their clients and the community.

In concluding, Bob posed the following questions to those involved with explosives in Australia:

"If you import, manufacture and/or supply explosives in Australia and are not yet a member of AEISG – why not?

If you are in the mining or construction industries and use explosives suppliers – are your suppliers members of AEISG? If not, why not? What confidence do you have in the appropriateness of the standards to which they are working?

If you are interested in entering the explosives market in Australia, why not join AEISG and benefit from the wealth of knowledge and experience that AEISG members can provide?

Further information can be found on the AEISG website www.aeisg.org.au"

IS THE WRITING ON THE WALL?

By

Tony Rowe

For me, this contribution represents a serious departure. It doesn't look back in time, but instead tries to look forward. That's definitely new and there are almost no big words. Best of all, it's mercifully short.

How did this sea change come about? Was it the little yellow pills, the hand-rolled smokes or the ice cold brown bottles? Strangely enough, none of my secret pleasures had anything to do with it. What happened was that I stumbled across an article in the open literature. It had been authored by a highly respected colleague named Mr. Mark Davis; not that he would remember me. I thought it an impressive piece of work. The article was entitled "A Quantum Leap in Electronic Detonators (EDD's) - Is the world ready"?

Not wishing to steal his thunder, but agreeing wholeheartedly with his conclusions, I thought to try to bring Mark's analytical vision to a wider audience. I hope he will forgive me for any liberties. Mistakes, as always, are mine alone. His original article is available on the web, just type in the title set out above and it will appear. It is certainly worth a read.

From my own rather limited experience – I am not a visionary – but even so feel somehow privileged to have been an active participant in many of the changes our industry has undergone over the last 30 to 40 years. For instance, I witnessed the heydays of dry spun, black-powder based, capped and connector capped fuse. Later on, it became my business to better understand how a slotted ignitercord connector actually functions. I saw first-hand the birth pangs of wet-spun safety fuse in both its slow and faster burning variants. I was a fly on the wall when consecutively-cut and finally plastic covered safety fuse went on sale. I spent many a happy hour in the company of the original Surlyn based NONEL and its early overextruded forms. I even had a very small hand in the development of NSA's, later called NRA's (NONEL Reefmaster Assemblies) in their original 50 ms x 400 ms offerings with its then revolutionary, plastic bodied, outhole detonator called a Minidet.

I later had a role to play in the development of monoplastic shock tubing (MPST) and from a distance observed its steady evolution into EXEL. I watched the changeovers from fuse to shocktube and even contributed in a very small way to the introduction of automated detonator assembly. More importantly perhaps, at least in historical terms, I was around when electronic delay detonators began their first tottering steps. I of course know nothing about electronics, but after extensive training can now tell a TV set from a microwave oven. I'd eaten lots of cold lunches and watched some pretty boring television until then. Despite such challenges I did get to play a very minor part in the development of the first commercially available and truly usable electronic delay detonator which one day would become SMARTDET. It was at 'Expert Explosives' that I met some of the research team involved in the project. One or two even spoke to me when I brought them their morning coffee. "Heyou" (one word) they would call. The team clearly believed that I was Mexican or maybe from Honduras. I suppose it was my jet black hair and swarthy skin. "More sugar amigo" or "less milk next time", "Hey Cabron, that's not my cup and you haven't even washed it properly".

No I lie. They were gentlemen to a fault and clever to boot……

I seem to remember trialing SMARTDET in underground coal. I cannot recollect the name of the mine concerned, but I do recall the long inclined shaft that our group sometimes had to walk up at the end of a busy working day. It seemed to stretch on for ever. In those days the control equipment for the detonators (I think it was called a Blast Programmer) was housed in a yellow-coloured and waterproof plastic attache case. It probably measured around 48 x 28 x 18 cm and it weighed a ton. It was the pair of rechargeable truck batteries that did it. On those hiking trips back to surface I would fantasize about throwing it onto a band conveyor or simply losing it. Perhaps in recognition of my disenchantment it was subsequently chained it to my wrist.

I even had a fingertips worth of involvement in the later evolution of the polycarbonate enclosed, mostly plastic delay detonator, ELECTRODET. This device, long disappeared from the marketplace, led us on a very merry dance indeed. I learned the Tango and the Quickstep at its knee, but the Polka always eluded me. In the ensuing years I even had some minor inputs into the design fundamentals of other electronic delay detonators, but like life itself, all jobs are finite. There is always an end.

What has proved so extraordinary in the intervening few years and what I could never have anticipated was the rate of innovation around electronic delay detonator development.

I had always viewed the mining industry as conservative in the extreme and thus highly resistant to change. I should

have known better. The final days of nitroglycerine-based explosives and the mass conversation to emulsions were, in hindsight, clear indicators of an industry ready for something new. It was just not apparent then.

How things have changed. Control equipment has grown smaller and lighter. In just a few short years programmable integrated circuits have given way to what are today known as ASIC's. What is an ASIC? Well the letters stand for "Application Specific Integrated Circuit" The letters represent a very complex piece of electronic circuitry created to do only one thing, but to do that one thing very well. The phrase 'application-specific' comes to mind. They're a bit like a ring spanner. A little less crude and perhaps a teeny-weeny bit smarter, but just like a ring spanner they do only one thing well.

Because an ASIC is only required to do one thing it can be small and in electronic terms, fast. In use it consumes less energy and offers more memory. These characteristics are very important. Even better, they are fully testable during manufacture as well as in use, safely, right up to the moment of firing. As ASIC's tend to be custom built for their specific application they are usually designated as proprietary technology. Manufacturer's claims include enhanced safety features, accurate delay times often incrementally programmable in one millisecond steps and the almost total eradication of an early problem, duplicate ID's.

Apparently, if you haven't got one in your product line then it is probably already too late to develop one. The reasons for this are simple: the research and development costs around any new ASIC are likely to be significant and even worse, any new entrant into the marketplace is already far, far behind, but while the entry costs can be enormous the production costs of a fully developed ASIC remain relatively low. In other words once you have a proven design and the masks are done, you can manufacture a lot for not a lot. The downside for the customer though is cost. There are costs to recover, so these little miracles don't come cheap, but that may soon change.

Perhaps unsurprisingly it's the Chinese who now lead the way in this technology. It is a massive advantage and one they are unlikely to relinquish easily.

According to Mark's analysis, what may soon have massive repercussions for the world marketplace has been a recent policy shift in China. The new strategy requires that the entire Chinese mining industry switch from the use of electric instantaneous and delayed action detonators to programmable electronic delay detonators built around ASIC's. The Chinese are huge consumers of raw materials and currently carry out blasting operations on a massive scale. At the minimum rate of one detonator per hole, that is a lot of detonators.

In China, ASIC manufacturers are already lining up. They're chomping at the bit while Chinese detonator manufacturers are pouring money into ASIC design. This will serve to stimulate innovation to a level previously unheard of. It will do something else too. It will almost certainly cause world market prices to plummet dramatically. For a best guess on just how far prices may tumble, I would suggest referring to Mark Davis's original piece.

Finally, according to Mr. Mark Davis:

"In addition to the economies of scale resulting from the prescribed use of EDD's, competition within the Chinese market between ASIC chip producers will propel a level of innovation that cannot be matched by foreign manufacturers simply because they do not have the resources or the volumes of sales to support their research. With this in mind the ASIC technology, which is constantly being improved by its Chinese manufacturers, is already streets ahead of the Micro-Chip technology employed by some South African and Indian producers so there very little prospect that it will ever be matched in either quality or price."
The message that these developments are sending to explosives companies worldwide, is that the detonator market be it EDDs or ST will never be the same again. The Chinese have signaled their intention, whether by design or not, and they will now dominate the world market in EDD's and the irony is we don't think they themselves realise the impact of what they have done. If any company is in the process of developing an EDD from scratch or replacing a micro-controlled chip with an ASIC we believe it is too late".

Remember too that China makes your own Christmas possible. Think about it. Your tree lights, decorations, cards and sound systems, indeed most of your electronics were probably manufactured in China. It is hard to find anything these days that hasn't got a 'Made in China" logo stuck on it somewhere.

For the record, China is the world's largest communist and thus non-religious state. Christmas Eve, however, is the biggest shopping day of the year. City streets and especially the shopping malls are usually ablaze with the sparkling, shimmering and flashing light shows so typical of the western Christmas tradition, but the Chinese people themselves don't actually get it. There is no 'tradition of Christmas' whatsoever. Christmas apples are popular gifts and Santa plays the saxophone.

By the way, in China, Christmas Day is not a public holiday.

圣诞节快乐 **or** Merry Christmas.

SAFE & STABLE

By

Tony Rowe

There is nothing like a spot of history to broaden the mind, but when the subject under discussion is explosives what we place

UPCOMING MEMBER EVENTS

The ISEE 45th Annual Conference on Explosives and Blasting Technique to be held from Sunday, January 27 till Wednesday, January 30 in Nashville , Tennessee, USA

25th EPP Working Group of IGUS

19th International Conference of Chief Inspectors of Explosives

Conference to be held in Swakopmund, Namibia From Sunday,10 March till Saturday,16 March 2019

Please let me know if there are any events in your area you want published in the SAFEX Newsletter.

ARTICLES FOR NEWSLETTER

This is a reminder that through the Newsletters we share knowledge in the areas of Safety, Health, Environment and Security pertaining to the Explosives Industry. SAFEX thus call on all members to submit articles on these subjects within their own companies and countries.

The deadline for articles for the March Newsletter is 10 March 2019 , I look forward to your support .

SAFEX BOARD OF GOVERNORS

SAFEX thanks all the authors and contributors as well as the editing team for their for their valuable support.