TRANSPORTATION OF EXPLOSIVES – THE SAFETY GAP

INTRODUCTION

In today's manufacturing environment it is generally accepted that Safety is the number one operating priority. To deliver this, the industry invests significant resources in Safety equipment, Safety Training, Safety Management and Safety Culture.

For many manufacturers an effective Safety Gap is created at the moment the explosive materials or articles are transported. Whether in-house or sub-contract transport services are used, the explosives industry appears to accept the fact that they are less able to control and monitor class 1 products whilst in transit.

Transporting class 1 products by road, sea and air creates business risk. Accidents, theft, fire, piracy, and terrorism are regular occurrences. What may be a minor fire, theft or accident under other circumstances will often be a major incident where the carriage of explosives is concerned.

The consequences of the above are well known. Even if the manufacturer was in no-way culpable as regards any accident or incident, everyone will remember the product involved and which company manufactured it. The reputation of the manufacturer will be adversely impacted far more than that of the transport provider. Major incidents also often result in additional national and/or European legislation which impacts on the future operation of all European manufacturers.

So what can be done? How can the European explosives industry work towards mitigating these risks and ensure best practice? European Track & Trace legislation is one step in the process but there is more that can and should be done. What is current best practice as regards prevention of incidents and accidents? Conversely, what Crisis Management tools are available to limit consequential damages and provide a degree of accident preparedness?

The European explosives industry best understands the products and their associated risks. Some manufacturers will also be more advanced than others as regards safety and security systems for goods in transit. However, as with all chains, the weakest link is likely to fail and that will impact on the entire industry.

This paper proposes to explore the options currently available to the industry. This includes equipment and systems, as well as Crisis Management tools and services. It also proposes to expand on an EPC Groupe initiative to create supply chain synergies for European manufacturers.

BACKGROUND

While there have been some disastrous world-wide accidents involving the transport of industrial explosives, this has not appeared to be the case in the U.S. Over the past 10 years, accidents related to the transport of explosives used in mining and construction have resulted in 5 major injuries, 11 minor injuries, and no fatalities. However, explosives and ammonium nitrate (AN) transport outside the U.S. has not had such a good record; there have been 4 major explosives or AN transport accidents resulting in a total of more than 300

deaths. Most of these fatalities could have been prevented if the accident site had been evacuated once the explosive or AN cargo began burning.

A search of the internet identified a number of explosives and AN transport accidents, as shown in Table 1. The more serious explosives transport accidents all occurred outside the U.S. The most serious were the transportation accidents in Walden, Ontario, Canada (1998), Neyshabur, Iran (2004), Ryongchun, North Korea (2004), Mihailesti, Romania (2004), and Shengangzhai, China (2005).

On August 5, 1998 an explosives truck consisting of a tractor and trailer carrying 18,000 kg (40,000 lb) of blasting explosives went off the road near Walden, Ontario, Canada. A fire started immediately. Drivers passing by stopped and helped the driver exit the truck and took him to safety. Explosive placards and the driver's warning alerted people to the hazard and they evacuated the site. The truck exploded about 35 minutes after the accident. The explosion caused two minor injuries, threw fragments of the truck up to 2,740 m (5,800 ft), and damaged several houses. At the time the truck exploded firefighters were in contact with the Canadian Transport Emergency Centre (CANUTEC) and were advised against approaching the scene. Evacuation of the accident site prevented any fatalities or serious injuries. The accident scene is shown below:

Table 1. Notable explosive transport accidents over the past decade.

Location	Date	Product	Outcome	Comments
Walden, Ontario	8/5/1998	Blasting Explosives	Fire followed by explosion about 32 to 37 minutes later.	Two minor injuries, debris thrown 2,470 meters
Neyshabur, Iran	2/18/2004	Cargo included sulfur, petrol, fertilizers, cotton wool,	Explosion	More than 300 killed. 182 of those killed were emergency workers who apparently tried to fight the fire. 450 injured.

Ryongchon, North Korea	4/22/2004	Probably ANFO	Explosion	54 killed, 1,249 injured. Town severely damaged.
Mihailesti, Romania	5/24/2004	Nitrogen-based fertilizer	Fire, explosion	Killed: 6 firemen, 2 TV journalists, and 8 people who got out of their cars to watch fire. Police chief of Nechita injured. 5 firemen severely burned. Crater 10 meters deep. Damaged 20 houses.
Gwinnett County, Georgia	9/2004	AN, detonators, and blasting boosters.	No fire, no explosion.	I-85 interstate closed. Cleared 150-m (500-ft) radius around accident scene.
Wells, Maine	5/13/2005	3,000 lb of an AN-based liquid and detonation devices	No fire, no explosion	Nearby homes and businesses evacuated. 30 km (18 miles) of Maine Turnpike closed.
Salt Lake City, Utah	8/2005	35,500 lb boosters	Explosion.	Crater 6-10 m (20-35 ft) deep. 11 injured, 4 hospitalized.
Shengangzhai, China	9/12/2005	18-ton truckload of AN	Explosion	Crater 5.6 m (18 ft) deep, 18.5 meters(60 ft) in diameter, 12 villagers killed, 43 injured.
Ouray, Utah	5/31/2006	40,000 lb AN, 10,000 blasting caps, several hundred pounds of dynamite	No fire, no explosion.	Sparsely populated area. Authorities evacuated homes within 3.3-km (2-mile) radius.
Mesa, Arizona	6/16/2006	22,050 lb AN, 8 cases dynamite, and 1,466 blasting caps.	Fire, no explosion	Newspaper clipping suggests that emergency responder did not handle this correctly.
Tumbarumba, New South Wales	2/1/2007	AN	No fire, no explosion.	Truck rolled over into creek.

On May 24, 2004 a truck carrying more than 20 tonnes of “nitrous fertilizers” overturned 50 km (31 mi) northeast of Bucharest. The driver tried to extinguish the fire but when he was unable to he asked for help at a nearby village. A few cars stopped and some curious people watched the fire. A television news crew filmed the fire. Fire-fighters arrived and were preparing to fight the fire. The truck exploded killing 20 people, including 7 military fire-fighters, 2 journalists, 3 local people watching the fire, and 5 people who stopped their cars to watch the fire. Again the accident site should have been evacuated once the “nitrous fertilizers” started burning.

More recently, in October 2011 Modern Chemical Services was transporting bulk ammonium nitrate from the port of Dammam in the Kingdom of Saudi Arabia, to the MCS production facility at Somman. This was a four hour drive for a convoy of 14 trucks, each carrying 21 tonnes of AN. The haulage requirement has been sub-contracted to a local Freight Forwarding company.

During the journey, the third truck in the convoy noticed that the vehicle was handling erratically and that smoke was being emitted by one of the rear wheels. The convoy stopped and a fire extinguisher was sought. Although each truck was expected to carry two fire extinguishers, it transpired that there was only two extinguishers in total (should have been 28), only one of this was working. This was insufficient to deal with the burning wheel and the fire started to spread to the rest of the vehicle.

In this instance the Crisis Management was effective. The MCS staff that had been escorting the convoy immediately moved the other 13 vehicles to a safe distance (2km). Using key learnings from previous incidents, the container was opened to allow the AN to burn without containment. As a result, the fire completely destroyed the vehicle, but there was no detonation and therefore no injury or collateral damage.

Amazingly, when the incident was investigated they discovered that the contractors vehicle had only 7 rear wheels (instead of 8). One wheel was completely missing !!

Rim / Brake drum assembly of the missing wheel

The above examples would suggest that the US leads the way in the safe transportation of explosives, as well as crisis management. However, if we exclude acts of terrorism, Europe also has an excellent record of transport safety and crisis management.

METHODS

The Federation of European Explosives Manufacturers (FEEM) has published guidelines for the transportation of explosives. Those pertaining to road transportation are as follows:

Construction of Vehicles

1. All vehicles associated with the transport and distribution of explosives should comply with the national safety and constructional regulations governing such vehicles.

2. It is recommended that the load carrying part of the vehicle be separated from the driving cab.

3. All explosives carrying vehicles should have lockfast doors which are capable of resisting attempts at forcible break-in, or be attended at all times.

Operating Procedures

1. A detailed record of the vehicle contents shall be made as each vehicle is loaded.

2. Regular routine, timetables and routes should, if possible, be avoided.

3. Routes should be a matter of consultation with local police forces.

4. Wherever possible explosives van movements should be scheduled so that the journey can take place without stopover. If this can NOT be arranged then the stopover arrangements should be cleared with the police.

5. The crew should, unless local regulations demand otherwise, not be armed.

6. The crew should not oppose an armed attack.

This provides a good baseline for the safe transportation of explosives, but can be significantly improved by the addition of the following:

GPS Tracking

Reasonably priced hardware and web based software provides for real-time tracking of explosives vehicles and/or containers. In addition to knowing exactly where a vehicle is, it is also possible to monitor the vehicle speed, number of stops and load security.

Vehicle alarms and panic buttons

The load compartment of explosives vehicles should be independently locked and alarmed. A panic button fitted in the cab can be activated by the crew in case of accident or attack.

Vehicle roof marking

In France it is mandatory to mark the roof of explosives vehicles so that they are easily recognised from the air. This is good practice.

Digital tachometers

Commercially available systems provide real time information and reporting history of driver behaviour. All legal infringements are reported, including speeding and drivers hours.

Vehicle checks and maintenance

Commercially available systems exist for the provision of driver vehicle checklists and vehicle maintenance. As well as ensuring all legal inspections are complete, data is also available on fuel consumption, tyre usage, repair costs etc.

FEEM has also issued a baseline crisis management template as follows:

4.1 The immediate management of the crisis incident in an off-site crisis is in the hands of the transport crew.

4.2 The transport crew should be given full and adequate instructions and be trained in the appropriate immediate emergency procedures.

4.3 All transport crews should be given regular practice in carrying out these procedures.

4.4 The Federation of European Explosives Manufacturers recognises that the biggest problem in off-site incidents is to make the local emergency services and public, who might be in imminent danger, aware of the hazards and, most importantly, ensure that any of the emergency services which may attend the crisis are in no doubt as to the nature of the hazard.

4.5 Experience has shown that it is not enough to leave this communication problem to the transport crew.

4.6 It is, therefore, strongly to be recommended that the company explosives vehicles which, for security reasons, may be unmarked be fitted with devices which, in a crisis, would immediately disclose the nature of the cargo.

4.7 It is recommended that a convenient and effective way of achieving this is by equipping explosives vehicles with drop-sides which can be released immediately by the crew exposing in large luminous letters the word "**EXPLOSIVE**".

4.8 It is further recommended that this visible sign should be accompanied by an immediate and audible (preferably a pre-recorded taped message) warning to everyone in the vicinity to seek shelter as appropriate.

4.9 It is recommended that each explosives vehicle should be equipped with a mobile radio telephone so that one member of the crew can immediately get in touch with base and emergency service irrespective of his location.

It is strongly recommended that all crews be equipped with a luminous high visible jacket carrying the word "explosive" on front and back.

4.11 It is recommended that all explosives vehicles have available road signs appropriately marked such as "**DANGER EXPLOSIVES**".

4.12 All explosives vehicles must carry the appropriate emergency card - the **TREMCARD** - which gives details of the cargo, hazard, and immediate emergency procedures.

4.13 It is **most strongly** recommended that each member takes such steps as may be necessary to ensure that all emergency services on explosives vehicle routes be in possession of these Tremcards.

4.14 Part of the call-out telephone procedure by the crew to the emergency services should be the Tremcard number so that the police and fire brigade have an opportunity to look up the appropriate emergency procedures before they attend the crisis site.

The above guidelines provide a "front line" of what for most companies will be a comprehensive Crisis Management structure and procedure.

Crisis Management is made easier for those manufacturers that operate their own vehicles. But what of those who sub-contract ? When explosives are loaded onto a contractors vehicle, what assurances does the manufacturer seek that the above criterion (vehicles, procedures and crisis management) are met as a minimum.

When the stewardship of explosives is passed to a third party, the manufacturer could effectively compromise security, safety and sometimes cost. The greater the loss of control, the greater the risk i.e. subcontracting to a Freight Forwarder who subcontracts to hauliers, shipping lines, stevedoring companies etc.

DISCUSSION

In this paper, examples have been presented of when the transportation of explosives has gone disastrously wrong. In order to reasonably limit the scope of the discussion, the focus has been on road transport only. Air and sea transport are also worthy of consideration but subject to separate legislation (IMO and IATA) are outside the scope of this document.

In the background section various case studies have been presented. These incidents may already be known to most, but perhaps not the long term impact on the manufacturer ?

The Walden truck explosion (Canada, 1998) was reported by Safex as being probably due to the brakes or tyres of the truck; Had a vehicle checklist been completed that day ? Were all of the vehicle inspections and service up to date ? The consequences in this instance were greatly reduced by crisis management at the scene, which resulted in zero fatalities and no subsequent reduction in permitted quantities for transportation.

One means of ensuring that own or subcontracted transportation meets an agreed standard is via the ISO 28000:2007 security management standard for supply chains. The operation of this standard necessitates the creation of transport security plans which seek to both mitigate risks, as well as detailing the actions that will be taken in the event of a crisis.

The message to take home is: **Subcontracting your risk does not make it go away…..**

REFERENCES

Richard J. Maniero and James H. Rowland III, “A review of accidents involving explosives transport”.

Federation of European Explosives Manufacturers, guidance note No 9, guidance note No 16.