AN SHIPMENT FIRE – THE EVENT AND KEY LESSONS

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INTRODUCTION

At 2 am on the 4th of October of 2011, a truck carrying 21 metric tons of porous technical grade ammonium nitrate from Dammam port to MCS Somman site in Saudi Arabia, catches fire. The fire is propagated to the load inside the container.

This paper will show the happenings that followed this accident, and will go back to cover the causes that led to the event, review the suitability of the actions undertaken after it happened, analyze the emergency response procedures and provide key learnings to minimize risks in the future.

BACKGROUND

Modern Chemicals and Services (MCS) is a manufacturer of civil explosives and a blasting services provider in the Kingdom of Saudi Arabia. It is participated by Modern Investment Group (Saudi Arabia) and EPC Groupe (France). MCS produces in the country ANFO and Emulsion, in cartridges and bulk. The site of Jamoom manufactures all of these products, while the site of Somman manufactures only ANFO.

Ammonium nitrate is subject, according to Saudi Arabia's customs procedures, to direct delivery. This means that all containers received by vessel have to be loaded directly into the flatbed trucks without intermediate storage in the port. This situation obliges to have all the necessary trucks ready and waiting for the arrival of the vessel. If only one of the trucks would not be there, the shipment would be cancelled. Economic reasons lead to making shipments of minimum 300 tons (14 trucks).

The deliveries of ammonium nitrate are normally escorted by Saudi Arabia's security forces.

Saudi Arabia has one of the highest road accident death tolls in the world. There are increasing efforts from the authorities of Saudi Arabia to improve road safety generally and for transport of dangerous goods specifically.

HAPPENINGS

On 4th October 2011, 14 trucks of ammonium nitrate were unloaded from a vessel in the port of Dammam, destination to MCS Somman site. The transport was executed from a subcontracted freight and forwarder company. The containers are transported in flat bet trailer trucks. The whole process from custom clearance to start of the road shipment was supervised by representatives of the company, but no specific inspection of the trucks was executed. The convoy was escorted by a car and 2 employees of MCS.

80 km from Somman site, the right rear tyres of the 3rd truck catch fire. The truck is parked on the side of the highway and the drivers tries to extinguish the fire with 2 DCP fire extinguishers, but it is rapidly out of control. There were no more fire extinguishers in the whole of the trucks. The other 13 trucks are parked away from the incident location. A safety distance perimeter is established.

Figure 1: Location of accident and Somman site

The sequence of events from this moment is:

2.10 am – Tyres on the truck catch fire

2.15 am – Civil Defense is informed

2.16 am – Somman site and Head Office management is informed

2.35 am – Civil Defense arrives to the accident site

2.53 am – Somman site incident intervention team arrives to the accident location

2.55 am – Truck head is removed from the trailer

3.05 am – Circulation on road was reopened. At this time also the other 13 trucks continue their way to Somman site.

2.35 am to 5.45 am – Firefighting takes place

1.00 pm – Container is moved to Somman site with a replacement truck

Firefighting:

The heat transferred from tyres ignited the plywood under the container. The ammonium nitrate jumbo bags caught fire and a big amount of smoke and fire started to come out from the containers.

The container was opened to avoid confinement and allow extinguishing the fire.

The extinguishing agents used were water and foam

Fire was initially fought from 2.35 am to 4.30 am (1 h 55 m). Subsequently, the area of the fire was under observation, detecting flares after 10 minutes. At 5.45 am the fire was totally extinguished.

Figure 2: Image taken during fire fighting

IMPACT

Fortunately there was no fatality or injury to persons. The 21 tons of ammonium nitrate that were affected in the fire were declared as waste. Whatever was left of the material after the fire fighting was destroyed.

Figure 3: Condition of the ammonium nitrate big bags after fire has be extinguished

Figure 4a: Condition of the container after removal of ammonium nitrate load

Figure 4b: Condition of the container after fire extinguishing

Other effects were: disturbance of general traffic on the road, environment affected by toxic fumes and flames, delay in the delivery of raw materials and economic losses for the company.

INVESTIGATION

The investigation of the incident started just after the accident. The evaluation of the causes leading to the accident was divided in:

- Immediate cause starting the fire
- Basic cause: Reasons that led to the immediate cause to happen
- Conditions that increased the gravity of the incident

Immediate Cause

The fire started in the back right axle of the trailer, when one of the tyres caught fire probably due to friction in the rim. After the accident, it was found that there were only 7 wheels in the 2 rear axles, when it was supposed to be 8 (see figure 5 A and B). It is believed that the disk of the rim got damaged, and the sparks of the disk ignited the tyre.

The fire of the tyre subsequently transferred to the plywood under the container, and from there to the load.

Figure 5a: Condition of the rear right axle after the fire

Figure 5b: Detail of the rear right axle

Basic Cause

The reasons that led to the tyre to fail in the way described above have to be found in the maintenance of the vehicle. The mentioned missing wheel in the axle where the tyre burst was a weak point present in the truck due to defective maintenance and to lack of control of the conditions of the truck.

A subsequent detailed inspection of the rest of the trucks of this shipment indicated several deficiencies like: excessive wear of tyres, insufficient training of drivers, lack of firefighting equipment or defects in the lights of the vehicle, non-availability of safety triangles to warn other road users, etc. There could have been additional incidents within the same shipment for any of these deficiencies.

Conditions that increased the gravity of the incident

The non-availability of the necessary fire extinguishers made that an incident that could have been solved in an early stage, propagated to affect the load of the truck. Only 2 fire extinguishers were available in the 14 trucks of the shipment, and they were not maintained properly and lacked the hoses.

Moreover, drivers were not trained in the use of the fire extinguishers; neither tried other extinguishing methods as the use of sand at the initial stages.

To better understand how these problems of maintenance, control of the conditions of vehicles, lack of safety gear, or training, were found in the trucks and were not solved before, it is important to understand the relation between the involved parties. MCS contracted with a freight forward company the clearance of the containers, all port protocols, and the transfer from the port to Somman site. This company at the same truck subcontracted the transport to a different establishment than the one used in previous deliveries, without prior notification. As a result, the control and evaluation of prior shipments were useless. The incident showed an insufficient control from MCS on the conditions of transport. It made it clear that there had to be a deeper homologation process, additional contractual provisions, and continuous evaluation, part of which would be done prior to the departure of any delivery.

At the time of the accident, MCS was already applying several measures of verification of the conditions to our own trucks, but these same controls were not applied to subcontracted trucks. It was highlighted the necessity of having a consistent approach on safety that included both own and contracted vehicles in the say way.

Emergency procedure

Once the incident happened, the emergency procedure was activated. The personnel from MCS escorting the truck after the accident:

- Gave instructions about the safety distances to be kept from the accident
- Coordinated the firefighting attempts with the fire extinguishers and drivers
- Contacted and reported the accident to Civil Defense and Security Forces

- Informed Civil Defense about the nature of the materials, and jointly decided to open the container to avoid confinement and fight the fire
- Contacted the persons in charge of first actions in case of emergency, Somman manager and safety officer.

After being contacted by the escort personnel, Somman site manager:

- Informed the General Manager and maintained update of the situation
- Mobilized to the accident site with the rest of Somman intervention team (Safety Officer, Somman Security Supervisor, Somman firefighting brigade) and coordinated the internal actions

Safety Officer:

- Coordinated the firefighting actions with Civil Defense from the moment of his arrival
- Gave technical guidance about product properties
- Maintained update about the status of the accident
- Prepared incident report.

Security Supervisor communicated with Civil Defense and Security Forces

General Manager:

- Mobilized to site and coordinated the actions subsequent to the extinguishing of the fire regarding waste management, administration and insurance issues, etc
- Informed MCS and EPC corporate, and centralized official communication to third parties
- Coordinated the investigation of the incident and improvement action plan

Some of the points to be improved that were evidenced after reviewing the execution of the emergency plan are:

- Need to improve the communication channels. Some of the key persons were not immediately reachable
- Part of the communications that were urgent were done by email instead of phone call
- Some actions regarding firefighting were not clear at the moment of the accident from the emergency procedure. The decision to open container and fight the fire was taken by judging the situation when the event happened, but the emergency procedure did not specify exactly what to do in case of this kind of incident in which the load of AN resulted affected. This decision was finally taken only 2 hours after the incident happened.

CONCLUSSIONS

- The immediate reason of the accident was defective maintenance of the truck

- The severity of the accident was increased due to unavailability of the necessary firefighting equipment and insufficient drivers training
- The reason that led to these problems not being detected prior to the shipment was insufficient control from MCS of the subcontracted service and incomplete inspections of the trucks. These being the points that are considered the biggest source of potential risks in the future, most of the measures of the action plan are focused on them.
- Difficulties to implement a cost effective logistic solution or finding the right subcontractors (in this case transporters of sufficient size and quality) can lead to the selection of outsourcing options that are not the optimum from the safety point of view.
- The actions after the accident were most of them correct and executed according to the emergency procedures, and the communication chain was effective. However, deficiencies regarding the channels used for the communication, and not clear actions for specific situations, were detected.
- Prior training of MCS personnel in past events of similar nature (Mexico 2007, Romania 2004) helped in evaluating the risks of the situation. However some of the key learnings of those accidents were not implemented in the firefighting.
- The main decision taken during the reaction to the accident was to open the container. This decision is considered correct from the point of view of avoiding confinement of the gases that could result in an explosive atmosphere inside the container. This action should have been taken before or soon after the load got affected, but not 2 hours later. However, the decision to fight the fire in the load once the container was open is considered an action that could lead to serious personnel injuries and casualties in case of detonation, and should be avoided, creating a safety perimeter and maintaining distance to the fire.

ACTION PLAN

In order to prevent the repetition of the problems that led to the accident, the following action plan was implemented in the company:

- Establish a procedure of homologation of transport companies that comprised the safety perspective, including the selection of specific trucks and drivers within those companies.
- Establish a certification system for MCS employees in key positions related to transport, use of industrial vehicles and use of explosives
- Specify in the subcontract agreement the minimum safety and maintenance conditions of the trucks
- Inspection of all vehicles (own and subcontracted) before and after the deliveries. Use of verification checklists
- Review emergency procedures
- Perform mock trials in coordination with Civil Defense and Security Forces
- Clarify key actions for key events. Train personnel in these situations (decision to open container; and fight or flight)
- Review the communication process

The actions were fully executed in a period of 6 months after the incident

KEY LEARNINGS / TAKE HOME MESSAGES

- It is necessary to have total control and understanding of the subcontracting chain for those services that affect directly the safe transport, handling and use of dangerous goods.
- An event that could have been controlled at early stages became an important incident because of defective maintenance and insufficient inspections of the vehicles, lack of safety and firefighting equipment, and incorrect training of the drivers involved.
- The simulation of crisis situations would have helped in preventing the deficiencies in the emergency procedures. Continuous training and improvement is necessary in crisis management situations. Automatic reactions to some specific events have to be achieved by repletion.

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To be completed

REFERENCES

To be completed