St-Martin-de-Crau, le 16-12-13

TITLE - DETONATION IN A BURNING AREA WITH EMULSIONS CARTRIDGES

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1.INTRODUCTION :

EPC-France has a factory located in South of France, 60km North North-West from Marseille.

The main activities are:

- Civil explosive production
- Civil explosive storage

The main products are:

1. Emulsion explosives cartridges
2. Anfo in 25kg bags
3. Bulkemulsion matrix

16 000 to 18 000 Tons are produced every year. Total number of employees is 60.

425 T are allowed to be stored on site in 12 magazines.

The factory has been established and produced civil explosives since 1893.

The plant surface area is about 350ha.

The waste management is composed of 3 parts:

- Biological decomposition of waste water, containing Ammonium Nitrate with a 10ha lagoon. Protected birds presents control every year by inspectors (Ligue de Protection des Oiseaux).
- Significant effort for recycling many solids and liquids chemicals substances
- In some cases, some waste can't be recycled or reused. The pyrotechnical waste must be burnt. An assigned part of the factory is dedicated to burning.

Solid and liquid wastes are treated as explosives compositions. To limit the amount of solid and liquid wastes stored, a burning operation is organized every day. The burning operations are managed by qualified and experienced employees.

2.THE INCIDENT:

The accident occurred Monday 4th April 2011.

On Monday morning at 6:00 am, the operators collected, like every day, some of the waste with his dump truck.

After loading the waste, the operator went to the burning area and discharged the waste. On this specific morning two operations were conducted. He placed first the common waste and after that the pyrotechnical waste near the first pile.

The stack of waste contained:

- 250 kg production pyrotechnic waste = maximum quantity allowed
- 150 kg rags and packing soiled by explosive
- 2 empty drums that contained surfactant
- 12 bags containing paper
- 1 pyrotechnical initiator

Explosives contaminated other waste is routinely destroyed by burning on a burning ground within the factory area. The burning ground is remote and positioned some distance from the production facilities and employees. At the time of the incident there was no attempt to sort the waste prior to destruction. The drums that contained the surfactant were used in the process. The operation is governed by Operating Instructions (OI's) which defined the maximum quantity of explosives permitted; the distance at which the operator must stand to ignite the fire and the use by the operator of the shelter provided. The OI's contained insufficient details about the process required and did not state the requirement to sort the waste or how to lay it out on the burning ground.

The burning operation was in progress when an unexpected detonation occurred. The burning operation was conducted to destroy pyrotechnic waste. The pyrotechnic waste also contained emulsion explosive cartridges. No dynamite was present.

The facts in chronological order:

- **8h38 am, starting of the initiation on burning area.**
  After 12 min!...
- **8:50 am**, **strong detonation** felt on the plant and surroundings. **Enormous smoke** coming

from the western part of the plant.

- **8:50 am Manufacturing** immediately **stopped** after making safe and all the personnel gathered at the **meeting point** (POI)
- **8:52 am**, radio communication from the operator in charge of the burning announcing
  - An **explosion** on the burning area.
  - **Nobody injured**,
  - **Projectiles** around the burning place,
  - **No fire,**
  - the wall around the burning place **partially destroyed**,

- **8:57 am Emergency response team** set-up,
- **9:00 am Crisis management group** in place - organized between local managers and the hierarchic management line (Plant Manager was on a meeting in Paris),
- **9:10 am Information to the** administrations (local & regional)+ Gendarmerie + Firemen.
- **9:30 am**, situation on the plant fully controlled, efficient organisation within the team.
- A **consultation with the doctor** was immediately organized on the plant for the most **shocked** people,
- Suspension of work was **recommended** for 3 EPC France plant workers including the burning ground operator,
- Plant manager and General Director came **back immediately from Paris** to the plant,
- A press communication was prepared (just in case ! finally not used),
- A visit to the neighbours was organised in order to check if they had any damage. Very low impact on the area (except on the direction of the wind (about 3 to 4 km) = loud noise).
- **2:30 pm** Plant manager and General Director **met the personnel** and **made the decision** to restart manufacturing **after thoroughly checking the whole** production unit (done by the maintenance team).

3.PROBABLE CAUSES:

The following hypotheses have been proposed:

- Metal drum burst for some reason. While it may have been possible for a bursting drum to initiate the emulsion it is unlikely. An authoritative source suggested that for this to occur the emulsion should have contained an explosive sensitizer. The shock wave has to be in the order of 6 GPa and the origin of the shockwave immersed in the emulsion.
- Confinement effect due to the quantity of material which was burnt (pyrotechnical and non pyrotechnical material) and the way the material was laid out. The material was left in a pile.

The investigation highlighted the second hypothesis. Laboratory tests showed when the combustion gases were confined at 200°C, some of explosive product detonated.

The demonstration included the detonation of the drums with a cartridge inside. We found the position of the drum shrapnel was different to that of the accident (300m for the experiment and for the accident, 90% of pieces were within: 150m).

The metal drums projection was just a consequence of the explosion but they probably participated to increase the confinement effect.

4.PREVENTATIVE MEASURES :

The following recommendations were made:

- Reduce the explosives quantity. The estimated emulsion quantity during the accident is about 250 kg. This quantity will be reduced to less than 80 kg.
- In addition of that, the material will be laid out on the ground.
- The drums burning operation will be done separately to the explosives.
- Separation of pyrotechnic waste and non-pyrotechnic waste during the burning operation.

5.KEY LEARNING POINTS :

The following learning points and good practices were identified:

- 300 m separation distance between the operator and the burning area for a maximum quantity of 250 kg of explosives.
- Operator protected by a shelter.
- Established Emergency Response plan.
- Regular emergency exercises.
- The importance of sorting and spreading waste explosives so as not to confine the explosives. Separation of other explosives and emulsion is crucial. Furthermore, empty containers such as drums should not be burnt with explosives.
- Recycling of combustibles not used to fuel the fire is encouraged