Lecture PA7

Incident Involving Carrick Fuseheads at Initiating Explosives Plant

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SUMMARY

An explosion occurred at 2.40 pm on 13th November 1999 during the classification/cutting of pyrotechnic fuseheads from combs at the IES plant at Gomia. One operator received major injuries and the building/equipment were severely damaged. Investigation indicated that fusehead combs ignited during feeding to the classification/cutting machine (Classifier) and the ignition spread rapidly to the other fuseheads in the compartment causing up to 3 explosions.

PROCESS DESCRIPTION

Fuseheads are small pyrotechnic devices (similar to matches) that are made by applying multiple coatings (dips) of highly energetic and sensitive pyrotechnic mixtures to a preformed fusehead combs at the tip having very thin Nickel, Chrome wire. After the coating and drying operation, fuseheads are classified (based on resistance band) and simultaneously cut on Classifier. Fuseheads are then crimped to lead wires (PVC coated Copper/Galvanized Steel wires) which in turn is crimped to detonators to make electric detonators.

When the free ends of the lead wires of an electric detonator are connected to a source of electric current, Ni-Chrome wire of the fusehead becomes sufficiently hot to initiate the pyrotechnic dip composition over it to produce a very high temperature flash which initiates the explosives charge weight in the detonator.

INCIDENT

On the morning of 13th November, combs of Carrick fuseheads were dipped and after drying transferred to Classifier room. Classifier room had two Classifier machines operated by one operator. At 2.00 pm, at the start of the second shift,the operator of Classifier machine started cutting fuseheads from combs produced in the morning shift.

At 2.40 pm the incident occurred and personnel nearby reported up to 3 explosions in very rapid succession, the last being the loudest.

Operators of the near by buildings, helped the injured operator out of the building. Ambulance and Fire Tender arrived and operator was rushed to the Hospital and the fire was brought under control within few minutes.

The lower portion of the left arm between elbow and wrist of the operator had auto-amputated and there were burn injuries. Classifier machine involved in the incident was severely damaged and there was extensive damage to the compartment interior, windows and roof of the building.

POST EVENT TECHNICAL INVESTIGATION

The evidence indicated the following sequence of events :

1. Ignition of one/more fuseheads on the comb being slid into the slider of machine.
2. Propagation to the remaining combs on the adjacent feed tray and subsequent localised flash / possibly small explosive noise.
3. Almost instant propagation of the flash to the remaining combs in the tray kept on the side of the machine resulting in explosion/flash that destroyed the operator's left hand and blasted the machine.
4. Almost instant propagation of the large flash to the remaining fuseheads/combs in the cupboards/shelves in the compartment and subsequent mass explosion and fire that caused most of the structural damage.

CONCLUSION REGARDING ROOT CAUSE

In this incident there are 2 important root cause considerations.

1. Root cause of ignition: The ignition of the first fusehead(s) was caused as a result of friction when the comb was slid along the feed tray and into the machine slider.
2. Root cause of consequences of ignition: The ignition of the first fusehead propagated to the comb which in turn ignited the remaining combs on the feed tray. The resultant fireball ignited the remaining combs in the wooden tray causing an explosion. Explosion of combs in the wooden tray ignited the remaining inventory.

RECOMMENDATIONS

The characteristics of present Carrick fuseheads and their manufacturing methods are such that it is not possible to guarantee that another ignition will not take place at some time in future. Therefore, it was suggested that fusehead classification/cutting operation is re-designed to ensure that an ignition cannot propagate to and reduce the level of exposure of the operators to the hazard.

ACTIONS TAKEN

1. Two Classifier machines have been located in two separate compartments to minimize consequences in case of such incident.
2. Size of the Feed Tray for combs on the machine has been reduced to accommodate only 5 combs from earlier 50 combs. Material of construction of Feed Tray has been changed from Steel to Brass.
3. Protective Steel sheet between operator and machine and blow off panel at the back side of the machine have been provided.
4. Total inventory of fuseheads has been reduced from 200000 nos. to 5000 nos. in each compartment.
5. Total ESD protection has been provided.
6. Systems have been introduced to prevent generation and use of cracked fuseheads which are more susceptible to initiation through static/friction.

For more information please write to :

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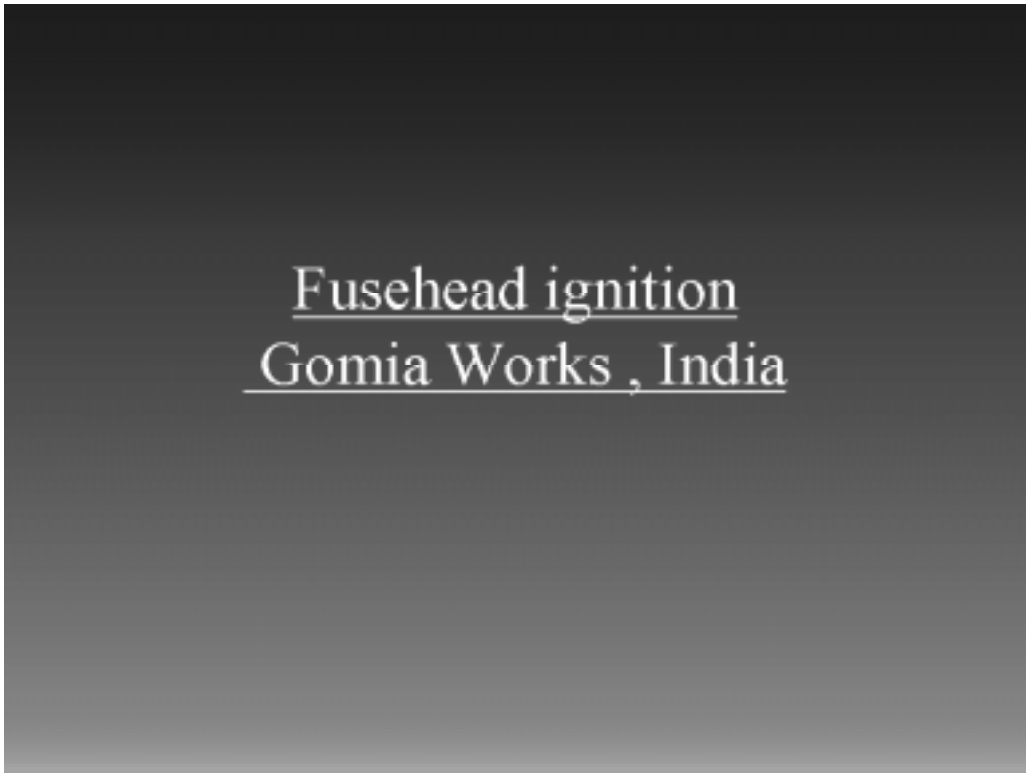
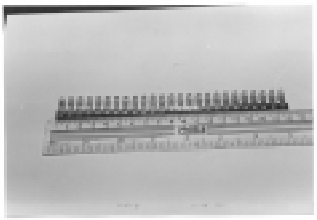

Fusehead ignition
Gomia Works , India

Fusehead comb



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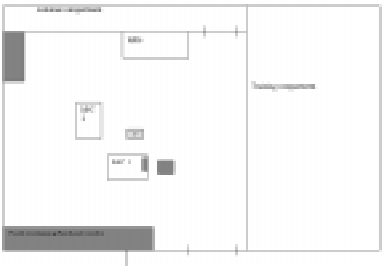

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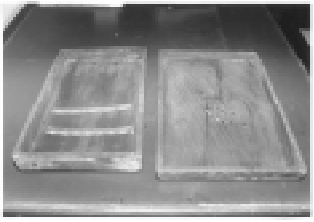
Fusehead comb/cut fuseheads



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Wooden tray of combs

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Classifier machine

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Scene after the fire/explosion

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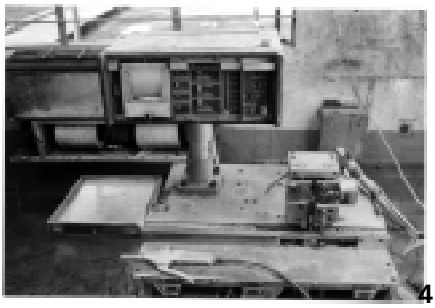

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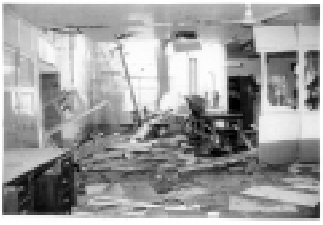
Compartment after the blast



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Injuries sustained

- Left hand auto-amputated
- burns and wood splinters down left side
- Eyesight not affected

9

Similar incidents

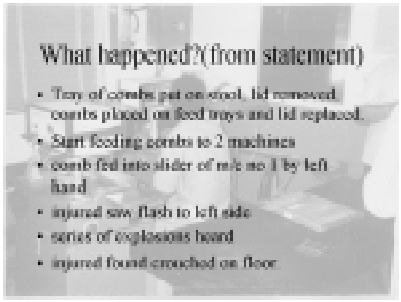
- Process set-up in 1987
- 4 previous ignitions, 3 due to friction between combs/slider table,1 during cutting a stuck comb
- all ignitions involved only one fusehead.

10

Other relevant information

- Carrick fuseheads involved have history of being more "sensitive"
- Compartment could hold up to 200,000 fuseheads -- estimate actual 120,000.
- Training given as per WR/OI's
- Plant design was based on no mass explosion risk

11



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Why did it happen?

- Carrick fuseheads very sensitive to friction
- previous action to reduce friction hazard not 100% successful
- friction ignition of one fusehead

14

Why were the consequences so great?

- Lack of understanding of the hazards
- Failure of "Corporate Memory"
- Inadequate plant design

15

Lessons

- We are good at learning but not so good at remembering
- Corporate memory is about people's actions and not about information in an archive
- Complacency when nothing goes wrong creates the environment for something to go wrong

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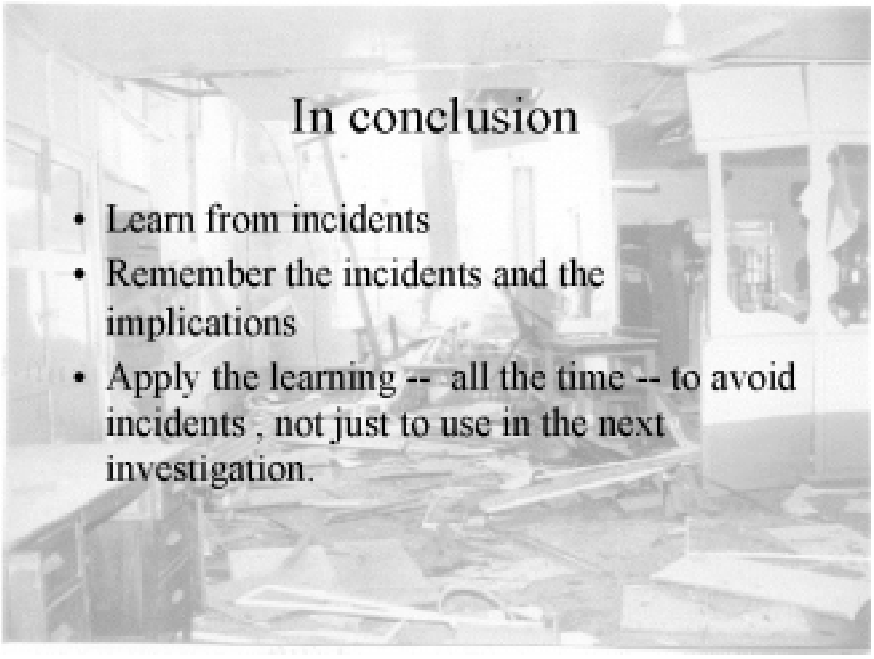
In conclusion
• Learn from incidents
• Remember the incidents and the implications
• Apply the learning -- all the time -- to avoid incidents , not just to use in the next investigation.