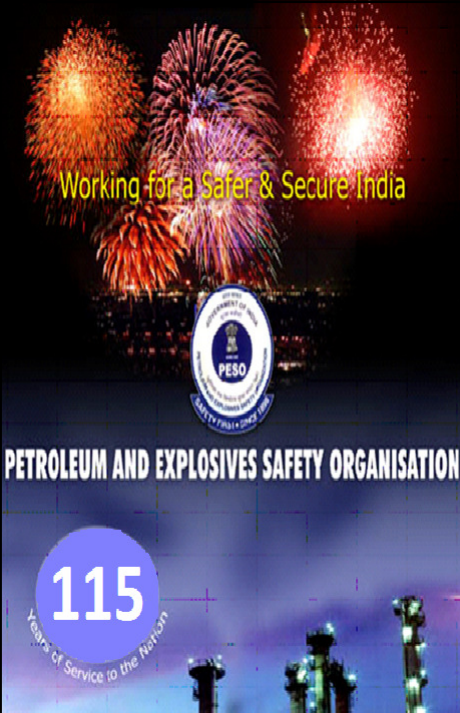


A Case Study
Vulnerability and Risk of Fire Works at Sivakasi

R Venugopal
Controller of Explosives, Sivakasi.

The slide features a blue background with a white PESO logo on the left. The logo is circular with a blue border containing the text 'SAFETY FIRST * SINCE 1898'. Inside the circle, it says 'GOVERNMENT OF INDIA' at the top, 'भारत सरकार' and 'सुरक्षा सर्वोपरी' in Hindi, the Indian national emblem, and 'पेट्रोलियम एवं विस्फोटक सुरक्षा संगठन (पेसो)' and 'PETROLEUM AND EXPLOSIVES SAFETY ORGANISATION' at the bottom. To the right of the logo, the title 'A Case Study Vulnerability and Risk of Fire Works at Sivakasi' is written in white. Below the title, the author's name 'R Venugopal' and title 'Controller of Explosives, Sivakasi.' are listed.



Working for a Safer & Secure India

PETROLEUM AND EXPLOSIVES SAFETY ORGANISATION

115
Years of Service to the Nation

- PESO is entrusted with the administration of Explosives Act, 1884, Petroleum Act, 1934 Inflammable Substances Act, 1952 and the Rules framed under these Acts.

The slide features a background image of fireworks at night. Overlaid on the image is the PESO logo and the text 'Working for a Safer & Secure India'. At the bottom left, there is a circular graphic with the number '115' and the text 'Years of Service to the Nation'. On the right side, a list item describes PESO's administrative responsibilities under various acts.



STATUTORY RULES

- **EXPLOSIVES ACT' 1884**

1. EXPLOSIVES RULES' 2008
2. GAS CYLINDER RULES' 2004
3. SMPV(U) RULES' 1981

- **PETROLEUM ACT' 1934**

1. PETROLEUM RULES' 2002
2. CALCIUM CARBIDE RULES' 1987

Fireworks

- Few things in life have the universal appeal of fireworks.
- Fireworks cross the boundaries of culture, geography and time.
- To all people of the world, young or old, rich or poor, fireworks are one of the most spectacular mediums of entertainment.



Fireworks

- Because of this unique characteristic, fireworks are one of the most dynamic, yet cost effective method of creating excitement, and leaving an indelible impression on your audience.



In one split second

The entire happiness ends.
When there is an accident and it embargos all the good you have done to make that fireworks. When the product of our profession does not work, everyone notices and it is often described as a DISASTER







Accident Statistics

Year	No of Accidents	No of Person Injured	No of person killed
2001-2002	6	0	6
2002-2003	6	2	3
2003-2004	20	11	7
2004-2005	23	27	17
2005-2006	39	42	40
2006-2007	17	27	36
2007-2008	17	15	20
2008-2009	8	0	3
2009-2010	9	12	27
2010-2011	13	17	20
2011-2012	15	13	34
2012-2013	19	63	54
2013-as on date	6	4	2
Grand Total	198	233	269




Insights

- I would like to share with you the many lessons learnt from the tragic accident at a fireworks factory in 2012.
- Many eyes have to open to this, and many hearts will have to work for preventing this.
- I invite you to focus on this.



A FAILURE OF OUR
OFF SITE DISASTER
MANAGEMENT OPERATIONS



Let me take your
thoughts to this tragic
accident happened at
Sivakasi in 2012



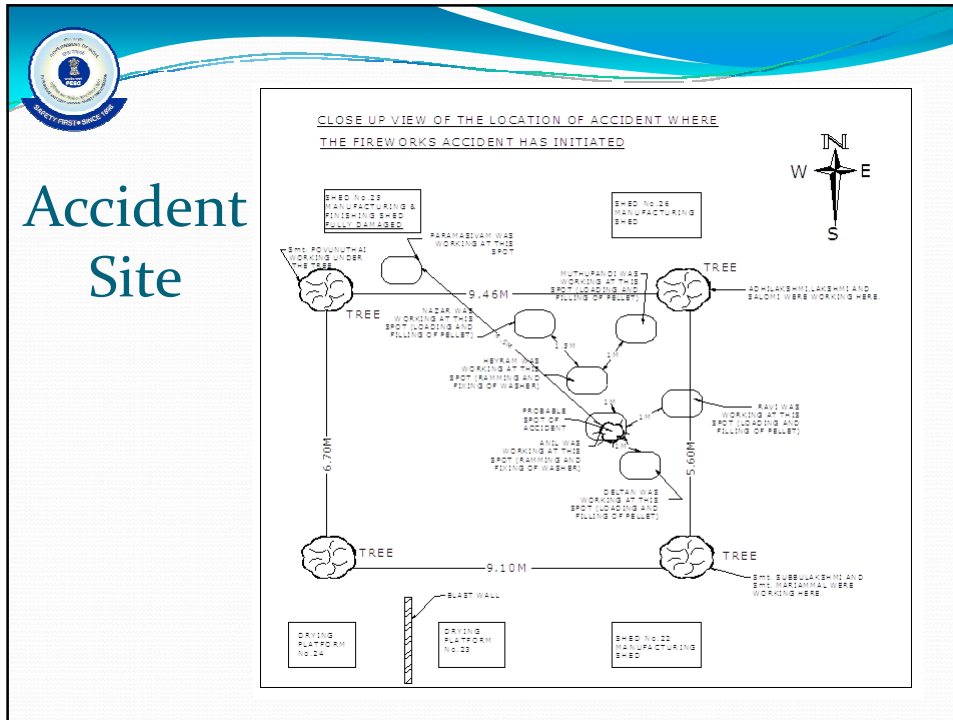
In 2012

- ❖ In this accident in 2012, 40 people were killed and 56, injured.
- ❖ It not only took the life of 4 workers at the work site, but also 36 people who gathered outside the factory to see the accident
- ❖ There were 17 manufacturing & finishing shed, 06 chemical mixing/filling shed, 3 transit sheds, 2 magazine & 24 other sheds for doing different operation.
- ❖ Fireworks manufactured in the factory are Atom Bombs, Bullet Bombs, Rockets, Chakkars, Flower Pots, Multi Shots and other aerial items.



Cause of the incident

- The manufacture of multi shot aerial items were carried out in open area between the sheds & drying platform encroaching the safety zone and also under the tree .
- 13 workers were involved in work in that area. Two inexperienced contract laborers among them who came from West Bengal for working in Sivakasi.
- They were using iron implements for the jobs as those were recovered during the investigation.
- On the day of the accident, one worker was engaged in loading and ramming of lifting pellets, and loading of inner shell containing colour pellets and blasting powder composition for quick ignition into an aerial item named 'Coconut Fountain'. He was doing the above work under the tree, sitting on the ground



A closer look at the cause

- While ramming the lifting pellets, suddenly at about 11.30 hours there was a flash followed by fire and explosion occurred. Then the fire started spreading fast everywhere as semi-finished fireworks were kept for drying and manufacturing in between sheds throughout the factory.
- The first fire and explosion set off a chain reaction involving other fireworks being manufactured and stored in some of the sheds and in between sheds.
- Pieces of shrapnel pierced the walls of various sheds causing fire to start igniting the entire fireworks, black powder compositions, pellets etc. kept in those sheds and in between the sheds.
- The fire then spread to the south east side where pellets were kept for drying in open area and also closer to the transit shed for fireworks, situated in the south east direction, where huge quantities of pellets were stored illegally.



A closer look at the cause

- Eventhough, the workers in the factory ran away for safety in different directions and were able to escape out, by that time the villagers from the nearby villages poured in towards the factory curious to know what is happening in the factory.
- They congregated on the western and southern side of the factory.
- Police tried their best to prevent the spectators coming near to the factory.
- The meager strength of the police personnel was not enough to prevent the people coming close to the factory.
- Also police tried their best to evacuate the onlookers from the main gate and western side fencing, the onlookers overpowered them.



A closer look at the cause

- The fire meanwhile spread to the south east side where pellets were kept for drying in open area and also closer to the transit shed for fireworks, situated in the south east direction, where huge quantities of pellets were stored illegally.
- At about 13.15 hrs, the transit shed detonated producing the second explosion, which was very powerful and threw the spectators who were standing at a distance up to 150 meters and debris shrapnel flew up to 400 meters from the transit shed on all directions
- Witnesses saw a fireball estimated to be approximately 150 m in diameter and a dark white red and black cloud of smoke of approximately 100 m tall



Extent of damages

- The Blast wave effects travelled in all directions and caused extensive damage to all sheds.
- The transit shed for fireworks was blown off completely and two craters were found at floor level & Shed for shell loading and shed for pellet making were found demolished in the accident.
- Manufacturing and finishing sheds, Sulphur room & Fuse dipping shed were found razed to the ground.
- At the entrance the asbestos sheet roofing in steel truss attached to the various sheds were fully blown into pieces and pierced into the trees in nearby locations.



Extent of damages

- The doors of the ingredient rooms, manufacturing sheds were found damaged and major cracks developed
- White Powder filling Shed was totally damaged with mound wall on southern side razed to the ground
- Doors were damaged and cracks developed on the roof of the twinkling star wrapping shed.
- White powder mixing shed & doors were found detached, cracks developed in the roof and mound walls.
- In manufacturing and finishing shed, doors were damaged and cracks were found developed in the roof.
- Fuse cutting shed, the asbestos roof was found blown off.

After blast

Deep crater formed at transit shed



Circumstances leading to the accident...

- The factory employed a huge number of workers much more than the total man limit of 100 meant for manufacture of fireworks in this factory.
- The manufacturing sheds were misused for different operations.
- The people were working in clusters on the ground under the trees with raw materials and semi-finished goods spread all around them due to their shabby working style, totally disregarding the provisions of rules and conditions of licence.



Circumstances leading to the accident

- Huge quantities of fireworks were stocked everywhere outside and inside the sheds unmindful of the explosives limits prescribed and encroaching the safety distances to be kept between the sheds.
- Black powder pellets and aerial items were dangerously being manufactured on the ground, near the sheds and even in front of transit shed located in the south east corner of the factory, meant only for the keeping semi-finished fireworks.



Most probable cause ...

- The main factors lead to the cause of fire /explosion occurred at the place where an unskilled worker was ramming the lifting pellets of the aerial fireworks item called “Coconut Fountain”. In the splash of fire, the others working close by also got injured.
- The impact & friction or heat while ramming explosives composition into a shell of an aerial fireworks item by an inexperienced worker might have caused a spark which initiated fire and explosion



Most probable cause

- The erratic stocking and drying of fireworks outside the working sheds contributed spread up of fire in the factory and to the fireworks transit shed which exploded later.
- Keeping of excess quantity of black and colour pellets, in this shed significantly contributed to the enormity of the power of explosion which instantly killed the people around.

The sad end

Nothing left behind but regrets



A Tragedy that could be avoided

Had the crowd heeded to Police instructions



Major casualty found at Western Side





Sulphur room



Conclusion

- Lease /subcontract/multi-lease to the other persons and excess storage to be avoided.
- The offsite emergency plan was not at all in operation.
- After the first fire/explosion, more than 500 people (Onlookers) congregated on the outdoors in close proximity to the factory fencing in the western side and southern side which overlooked the transit shed.



Conclusion

- The blast over pressure of the detonation of the transit shed had the effect of causing persons out door to be blown off their feet, sustain head injuries from fragments and flying debris, as well as hearing damage.
- The crowd did not listen to the words of police personnel who were present at the site.
- A lot of precious human lives could have been saved if the off site disaster management plan was activated, thereby preventing the onlookers coming close to the accident site.



A video presentation for
you on the accident

