Incident

Post accident remediation and decontamination: a plea for Bhopal

Ken Patterson

This edition of *LPB* is published close to the 39th anniversary of the accident at Bhopal. Despite the passage of so much time, the aftermath of the Bhopal accident in 1984 continues to harm the living and the unborn, shortening lives and malforming children[1]. Following other major accidents, we have spent huge quantities of effort, skill and money recompensing the bereaved and injured, clearing up the environmental effects and setting right the damage done. BP has — quite rightly — had to spend huge sums on the environmental clean-up required after the Deepwater Horizon accident (estimates of the total cost of the accident to BP are over $50 billion) and it seems that the Gulf of Mexico is now returning to its pre-2010 condition.

What about other accidents?

Flixborough

I was a student in June 1974. My then girlfriend (now my wife and also a chemist) lived in North Lincolnshire and had a motorbike. I visited her early that month and she drove us both round the perimeter of the destroyed and still gently steaming Flixborough site. For both of us it was a stark introduction to the potential dangers of the chemical industry that we were about to join. Maybe it is no accident that we both ended up as SHE Managers.

The pictures of the destroyed site are familiar to many — but now? As an HSE inspector, I visited a paint factory on the site in the late 1980s. If I had not known where I was, I would not have known what had happened. Today the site is a light industrial complex on the banks of the River Trent in North Lincolnshire, UK.

Flixborough 2022 (Google Earth)

Trinity Mirror / Mirrorpix / Alamy Stock Photo

Flixborough 1974 (Alamy)

knowledge and competence

engineering and design

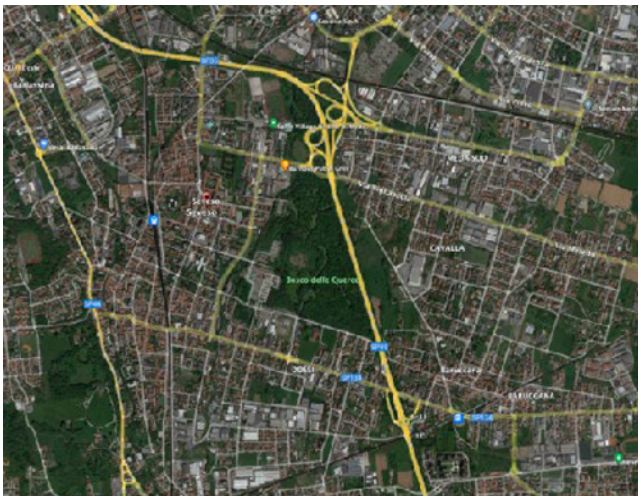
systems and procedures

0260-9576/23/$17.63 + 0.00

SIPA/Shutterstock

Chloroacne affected child, Seveso 1976

The 'Bosco delle Querce' park, Seveso, Italy, present day (Wikicommons)



Aerial view showing the park's location (Google Earth 2021)

Seveso

What of Seveso, the site which gives its name to the EU (and is the basis of the UK's) Major Hazard legislation? There are no pictures of the plant wrecked in 1976 for there was no wrecked plant. The reactor's emergency relief venting system had been well sized and coped with the runaway reaction. But it had not been designed to contain the release, and what it released to the environment were extremely toxic dioxins. Though there were no direct human deaths, many were affected (for example with chloracne), thousands of animals died, and an enormous area of land was contaminated.

The solution was to entomb the contaminated plant in a concrete sarcophagus and to incinerate the contaminated land returning the soil, over time, to beneficial use. Today, the site of the Seveso plant is an attractive — and safe — public park, the "Bosco delle Querce" (Oak Wood), in the middle of the Seveso built up area.

Toulouse

A third example is the Grande Paroisse chemical plant in Toulouse, 2001. The explosion of 300-400 tonnes of off-spec ammonium nitrate caused 31 deaths, roundly a third off-site (by far the worst off-site death toll in Europe since the middle of the 20th century). The explosion occurred on a large chemical site in a populated area, near to a major motorway intersection. It left a warehouse-sized crater, up to 7m deep and 40m long, and wrecked a large part of the surrounding chemical plant.

Today the site has been cleared and what was a chemical plant is a large, green space with a memorial to those who died at its centre. The crater, where the explosion occurred, is kept as a reminder of what happened. Twenty-two years later, the site is partly parkland and includes a research centre and one of the City's bus depots, and is bounded by a large solar farm.

0260-9576/23/$17.63 + 0.00

Vincent Dargent/ Abaca Press / Alamy Stock Photo

A huge explosion ripped through a chemical fertilizer plant AZF in Toulouse, France, on September 21, 2001

Of course, our first duty is to prevent accidents occurring. But we know that sometimes, despite our best efforts, things will go wrong. Then our first duty is to care for the injured and our second is to restore the environment as far as we can. The three examples above show what can be done. Tragically, the story of Bhopal is quite different.

Like Seveso and Grande Paroisse the Bhopal plant was in an urban area and the area around was densely built up. There are no useful Google Earth images going back to 1984/85 but the site of the plant is the green area in the upper central part of the left-hand aerial photograph (the area labeled "Arif Nagar"- see page 8). The right-hand picture (from 2023) shows part of the former site at much higher resolution, with decaying chemical plant and buildings, and the site's road layout still visible. The pictures in Fiona Macleod's article show what the site is like at ground level. Nature is reclaiming the ground but the plant lives on, not yet made properly safe and on land still toxic with abandoned plant, chemicals and waste.

Most readers of LPB are probably familiar with the accident at the Union Carbide India Ltd (UCIL) site in December 1984. Water entered a tank containing methylisocyanate (MIC) and an exothermic reaction ensued, boiling the MIC which was ejected as a deadly, toxic cloud. The cloud killed over 5,000 people that night and injured many, many more, thousands of whom have since died. The site has been abandoned and left un-decontaminated for nearly 40 years, with toxic materials leaching out into the ground water. The result is contaminated water and high numbers of children in the area nearby born with deformities — and often short lives. The grandchildren of those harmed on the night of the accident in 1984 are still being harmed in 2023[1].

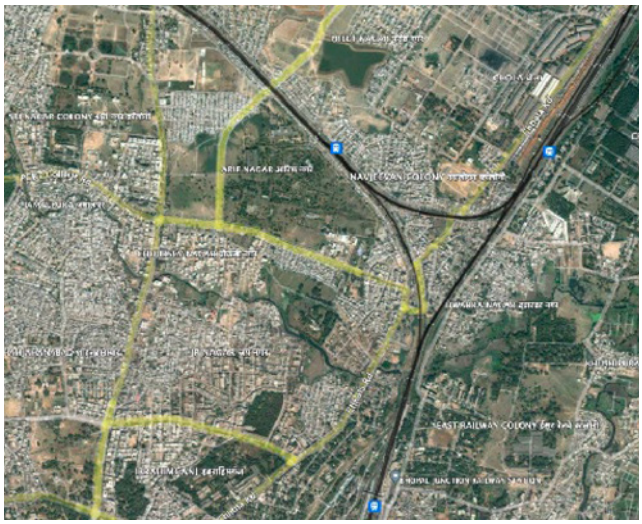
Understanding what happened and the problems that led up to it is important, as is the question of who bears responsibility. But neither of those questions is any justification for harming people — children — nearly 40 years after the event. Chemical engineers and chemists know how to stop the pollution. Indeed, India has great expertise in decontamination, as shown in the improvements made in (for example) Vapi in Gujarat,

Grande Paroisse, Toulouse, 2002 (Google Earth)

Grande Paroisse, Toulouse, 2022 (Google Earth)

0260-9576/23/$17.63 + 0.00

View of the abandoned Industrial gas leakage site in the Union Carbide Factory at Bhopal, Madhya Pradesh, India



Central Bhopal, including former UCIL site and Junction (main) railway station (Google Earth 2022)

Part of the site becoming overgrown but with plant and buildings still visible (Google Earth 2023)

once sixth on the Blacksmith Institute's[2] list of the ten most polluted places in the world.

The site needs comprehensive and fully effective remediation, which with goodwill and determination could be done. We know that many groups, organisations and individuals across the world are ready to help. As we enter the fortieth year since the world's worst industrial accident, let us all raise our voices in the hope that we can make it the last one before the harm comes to a stop.

References

1. *The harm still being done by the toxic material on the Bhopal site has been widely discussed. Two useful sources are:*
   - *The report of an expert roundtable discussion in 2013 which discusses the materials left on site and the way they are leaching off-site:*

     https://www.jstor.org/stable/resrep38062
   - *A discussion of the longterm health effects around the site, published this year:*

     BMJ Open 2023;13:e066733. doi:10.1136/bmjopen-2022-066733

     Summarised at:

     https://www.chemistryworld.com/news/repercussions-of-bhopal-disaster-found-to-echo-on-down-through-generations/4017672.article
2. *The Blacksmith Institute is now know as Pure Earth:*

   www.pureearth.org.

   Their Toxic Sites Identification Programme (TISP) is described at:

   www.pureearth.org/our-projects/toxic-site-identification-program-tsip

0260-9576/23/$17.63 + 0.00