

MAJOR ACCIDENT CASE STUDIES

Flixborough Explosion

CHEMICAL

Summary

In March 1974, at a chemical factory in England, a **temporary bypass pipe** was implemented to circumvent reactor vessel number 5 (in a series of six) which had been removed for repair following detection of a cracked shell. Approximately two months later, this inadequately supported **temporary pipe failed**, freeing 50 tons of hot cyclohexane into the atmosphere. This highly volatile gas mixed with the air and on **contact with an ignition source** the gas exploded **killing 28 people** (a low mortality rate due to the explosion taking place at the weekend), and partially demolishing the plant (www.hse.gov.uk/comah/sragtech/caseflixboroug74.htm).

Failings in technical measures

- A **plant modification occurred without a full assessment of the potential consequences**. Only limited calculations were undertaken on the integrity of the bypass line. No calculations were undertaken for the dog-legged shaped line or for the bellows. No drawing of the proposed modification was produced.
- **Plant Modification / Change Procedures**: HAZOP
- Design Codes - Pipework: use of flexible pipes
- No pressure testing was carried out on the installed pipework modification.
- Maintenance Procedures: recommissioning
- Those concerned with the design, construction and layout of the plant did not consider the potential for a major disaster happening instantaneously.
- Plant Layout: positioning of occupied buildings
- Control Room Design: structural design to withstand major hazards events
- **The incident happened during start up** when critical decisions were made under operational stress. In particular the shortage of nitrogen for inerting would tend to inhibit the venting of off-gas as a method of pressure control/reduction.
- Operating Procedures: number of critical decisions to be made
- Inerting: reliability/back-up/proof testing

Primary causes

The **inadequate support of the temporary bypass line** allowed the pipe to 'squirm' with a rise in pressure. This movement allowed the temporary pipe to shift, releasing the cyclohexane.

Underlying causes

The **plant was modified** despite the lack of an adequate assessment of the potential consequences. Therefore, **inadequate repair measures** were taken, the **integrity of the bypass line** was never fully investigated, and no drawings were ever produced.

The site layout was poor, failing to consider the positioning of occupied buildings. Meanwhile the control room lacked the necessary structural reinforcements, resulting in the windows shattering and the roof collapse.

Additional resources:

<https://www.hse.gov.uk/comah/sragtech/caseflixboroug74.htm>

https://www.hse.gov.uk/research/hsl_pdf/2006/hsl06117.pdf

<https://www.icheme.org/media/8955/xxiv-paper-60.pdf>

https://www.icheme.org/media/13689/the-flixborough-disaster-report-of-the-court-of-inquiry_repaired.pdf

https://www.icheme.org/media/12437/lpb269_pg14.pdf