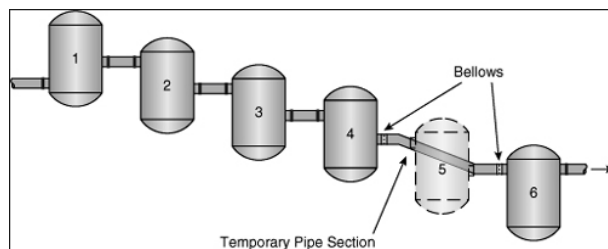


### Process Safety Incident of the Week: by Christina Meyer Flixborough Disaster

<http://www.informit.com/articles/article.aspx?p=1717264&seqNum=8>

The accident occurred in Flixborough, England on a Saturday in June 1974. This accident had a major impact on how safety was looked at in England. The plant, Flixborough Works of Nypro Limited, was designed to produce 70,000 tons per year of caprolactam, a raw material in nylon. The process uses cyclohexane at 155C and 7.9 atm. When depressurized to atmospheric conditions cyclohexane volatilizes immediately. This process was using six different reactors in a series, which oxidized cyclohexane to cyclohexanol using injected air in the presence of a catalyst. The product is gravity-fed through the reactors and each contains about 20 tons of cyclohexane. Months before the accident, reactor 5 in the series had a leak in the vertical crack in its stainless steel structure. Reactor 5 was removed for repairs and in order to continue they connected reactor 4 to 6.



The feed pipes that connected the reactors were 28" in diameter. Only 20" pipe stock was available at the plant, so the temporary connections were made using flexible bellows-type piping. It is hypothesized that the by-pass pipe section ruptured because of inadequate support and overflowing of the pipe section. Upon the rupture of the by-pass pipes, an estimated 30 tons of cyclohexane volatilized and formed a large vapor cloud. This cloud ignited from an unknown source about 45 seconds after the release. This explosion completely destroyed the entire plant, 28 people died, and 36 others were injured. 18 of the fatalities occurred in the main control room where the ceiling collapsed. The loss of lives would have been much higher if this occurred during a weekday. The explosion caused damage to 1821 nearby houses and 167 shops and factories. The fire from the explosion burned for 10 days straight.



#### Lessons Learned

Following proper safety procedures could have prevented the accident. First of all, the bypass line was installed without any safety review or adequate supervision by experienced engineering personnel. The bypass system was sketched on the floor of the machine shop using chalk. Second, the site contained excessively large amounts of dangerous compounds. This stock included 330,000 gallons of cyclohexane, 66,000 gallons of naphtha, 11,000 gallons of toluene, 26,400 gallons of benzene, and 450 gallons of gasoline. The excessive amounts contributed to how long the fire burned after the initial blast. As a rule, any modifications should be of the same quality as the construction of the remainder of the plant.