



# Investigation Digest

## Reactive Explosion at First Chemical Corp.

Pascagoula, Mississippi October 13, 2002

Early in the morning of October 13, 2002, a 145-foot-tall chemical distillation tower exploded at the First Chemical Corporation plant in Pascagoula, Mississippi, injuring three workers and hurling large pieces of debris that damaged plant equipment and ignited fires.

The crashing debris fortunately missed hitting nearby storage vessels containing ammonia, chlorine, sulfuric acid and other hazardous materials.

The tower was used to distill mononitrotoluene (MNT), a raw material used to produce dyes, rubber, and agricultural chemicals. MNT is chemically related to TNT (trinitrotoluene) and it can become explosive when exposed to high temperatures. At the time of the accident, First Chemical was the world's second largest producer of nitrotoluenes.

At about 5:00 a.m. on October 13, plant workers heard a loud rumbling noise and observed a smoky substance venting rapidly from the MNT distillation tower. The concerned workers took shelter inside the control room, but the room was located just 50 feet from the base of the tower. A short time later the tower exploded violently. All three workers in the control room were knocked to the ground and showered with broken glass.

The force of the explosion blew off the upper 35 feet of the tower and sent tons of debris flying up to a mile away. One piece of the tower punctured a storage tank approximately 500 feet away that contained more than 100,000 gallons of MNT, igniting a fire that burned for about three hours. Another piece of debris weighing six tons narrowly missed hitting a crude oil tank at an adjacent refinery. A third fragment struck a pipe rack directly above a tank containing 500,000 pounds of toxic anhydrous ammonia, but luckily the tank was spared. The seven-foot-wide top of the tower was blown skyward and was never found.

Several fires broke out on the plant grounds and along a nearby highway as hot debris rained down. Jackson County emergency responders alerted community members to shelter



**Remnants of 145-foot distillation tower that exploded due to a violent chemical reaction.**

inside their homes, but not everyone in the affected area was notified or knew how to respond appropriately.

### CHEMICAL BREAKDOWN CREATED HAZARD

Plant workers were not aware that a dangerous chemical reaction had started weeks before the explosion. Five weeks prior to the accident, the company temporarily shut down the MNT distillation process. During the shutdown, 1,200 gallons of MNT were left inside the tower, which continued to be heated by steam pipes. Later, operators closed the steam supply valves to the MNT tower and shut off the facility steam system. On October 5, however, the steam system was restarted. Although the steam valves for the MNT tower were left closed, these aging valves had developed leaks, and steam began once more heating up the MNT inside the tower.

During the days leading up to the explosion, the hot MNT began to decompose, forming unstable chemicals. Plant operators did not monitor the tower's internal temperature, which CSB investigators later found had hovered above 400°F. On October 12, a liquid-level alarm activated from high on the tower, but no action was taken. The following morning, the rumbling began.

### HAZARD INFORMATION NOT SHARED WITHIN PLANT

The CSB found that the facility lacked an effective system for evaluating hazards and for sharing safety information between different facility operations. The 2002 explosion occurred in the plant's continuous MNT production process. In 1996, the company analyzed the hazards of a separate MNT batch production process at the same facility. Thermal testing was performed which indicated that the temperature of MNT should be kept below 370°F to avoid decomposition. As a result, temperature limits were incorporated into the operating procedures for the batch process, and an interlock system was

### RESPONSIBLE CARE REQUIREMENTS

**Responsible Care** is a voluntary code of environmental and safety practices that companies commit to follow as a condition of membership in the American Chemistry Council (ACC) and the Synthetic Organic Chemical Manufacturers Association (SOCMA). In a self-audit conducted in 2001, First Chemical stated that it had complied with the components of the Responsible Care process safety code — including the complete documentation of material hazards and the use of measures to prevent a single failure from leading to a catastrophic event. However, CSB's investigation found significant differences between what was asserted in the audit report and the actual situation at the facility before the accident.

installed to prevent the batch distillation equipment from overheating.

However, the results from the 1996 hazard analysis were not used to modify equipment or procedures for the continuous MNT process — which had been operating at the plant since the late 1960s — even though the same chemical was involved. The training, procedures, and material safety data sheets (MSDSs) provided to operators of the continuous process did not adequately warn of the danger of heating MNT or the potential for an explosion. No interlock system was added to the distillation tower to prevent overheating.

## INEFFECTIVE PROCEDURES FOR ISOLATING EQUIPMENT

The company's instructions to its employees did not provide effective guidance on how to shut off the steam supply to the MNT distillation tower. In this case, the steam was a source of heat that should have been isolated from the MNT. There are two widely accepted good practices for preventing the flow of hazardous material through piping. In one method, a flat metal plate or "blind" is temporarily inserted into a pipe junction.



**Chemical storage tanks dot the landscape near the explosion site.**

Alternatively, in the "double-block and bleed" method, two sequential valves are closed and a drain located between them is opened. First Chemical's procedures did not explicitly require the use of either of these methods, however, and neither was used in this case. Furthermore, operating procedures did not require workers to take steps that could have revealed the failure of the steam shutoff valves — such as monitoring the temperature inside the tower after the valves were nominally closed.

Because the steam shutoff valves were critical safety equipment necessary for preventing the tower from overheating, the valves should have been regularly inspected and maintained. However, CSB's investigation found no evidence that the company had ever evaluated the maintenance requirements for the valves. When the valves were examined after the accident, they were found to have significant steam leaks due to internal corrosion and erosion.

## SAFETY PROTECTIONS MISSING

The facility did not have adequate safety measures, sometimes referred to as layers of protection, to prevent a major explosion involving MNT. The tower lacked high-temperature alarms and interlocks that could have warned operators and automatically shut down the heating source. The tower also lacked an effective pressure-relief mechanism in case the MNT decomposed to produce gases. Finally, the CSB determined that the control room was located too close to the distillation tower and lacked important safeguards. For example, the control room windows were not reinforced to withstand excess pressure, and they burst inward when the accident occurred, injuring the operators.

## RECOMMENDATIONS

Prior to this accident, in September 2002, the Board recommended that the Environmental Protection Agency and the U.S. Occupational Safety and Health Administration strengthen their process safety regulations to help prevent accidents involving reactive chemicals.

On October 15, 2003, the CSB completed its investigation of the accident at First Chemical and made a number of safety recommendations to reduce the risk of similar accidents in the future.

### To the DuPont-First Chemical Pascagoula Facility:

The Board recommended that the First Chemical facility (now owned by DuPont) establish a program for analyzing the hazards of reactive chemical processes, install appropriate safety equipment and warning systems, revise operating procedures, and improve preventive maintenance programs. The facility should also ensure the safety of occupied buildings in the event of a reactive chemical explosion.

### To Jackson County, Mississippi:

The Board recommended that Jackson County officials update their community notification system to ensure that residents are immediately notified of serious accidents and are informed about how to respond.

### To the American Chemistry Council (ACC) and Synthetic Organic Chemical Manufacturers Association (SOCMA):

The CSB recommended that ACC and SOCMA ensure that member companies fully understand and apply the Responsible Care audit requirements to address gaps in their safety programs. The Board also recommended that the Responsible Care guidelines be amended to require that the lessons learned from analyzing the hazards of one process be applied to other similar processes.

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## NOTICE:

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