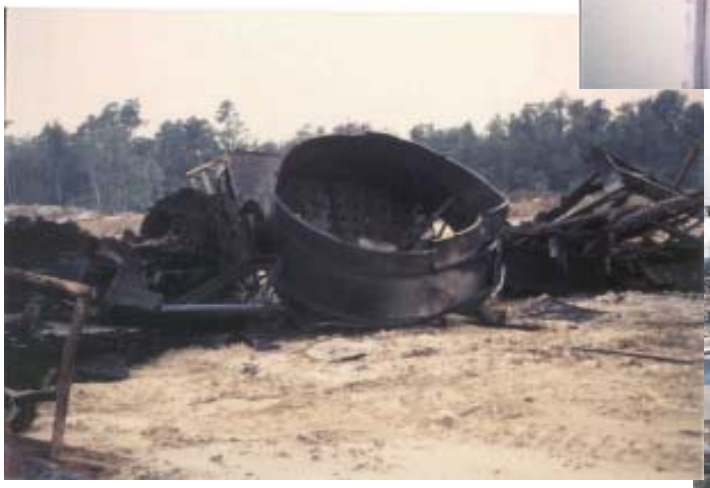
# ACCIDENT INVESTIGATION SERVICES



- ***Determine cause and establish procedures to prevent reoccurrence***
- ***On-site examination and evaluation of components***
- ***Accurate, complete documentation***
- ***Complete mechanical, materials, and corrosion laboratory services***

M&M ENGINEERING

M&M Engineering provides highly trained engineers with expertise in conducting comprehensive accident investigations. Most of our multi-disciplinary staff of materials scientists, metallurgical engineers, mechanical engineers, and chemists hold advanced degrees and professional certifications. We are supplemented further by a network of professionals in chemical, environmental and process engineering, as well as equipment design.

M&M Engineering has performed over 5,000 accident investigations and failure analyses since 1977.

## Broad Experience Base

The diversity of our staff and our extensive technical experience enable us to establish the cause of accidents and determine how to prevent them from reoccurring. Whether in the field or in the laboratory, we draw on our in-depth knowledge of the equipment and processes used in the utility, pulp and paper, petrochemical, manufacturing and other industries.

## Customized Investigations

Because each accident is different, we consider the client's short and long-term needs when formulating our investigation approach. Our analysis can be intensive and detailed, focusing on the failure mode of a single component. Or, we can design a broad-based study that includes a thorough examination of an entire process or facility.

M&M Engineering supports each investigation with the awareness of the acute potential for litigation. Using established procedures, we

# CASE STUDIES

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maintain accurate, complete documentation so we can provide litigation support.

■ During the start-up of the dryer section of a paper machine, the shell of one of the steam-heated dryer rolls ruptured suddenly, sending half of the dryer out the front side of the machine, injuring a machine operator, and causing hundreds of thousands of dollars in damage. *Was this a one-of-a-kind incident, or were other dryer rolls in the paper machine susceptible to this sort of failure?*

An M&M Engineering investigation team was at the paper mill within 24 hours, reconstructing the accident and getting eyewitness reports. Our team worked within the time frame requested by the mill for repair and restart of the machine. Sections of the dryer were returned to our materials laboratory for fractographic and metallographic analyses. A finite element analysis (FEA) was also performed to determine the stresses present in the dryer shell during the start-up sequence.

The combination of eyewitness reports and our FEA results indicated that the dryer was not rotating during start-up, causing uneven heating of the dryer shell, and creating thermal stresses sufficient to rupture the shell. Based on our investigation results, the machine start-up procedures were modified and reviewed with all mill operators to prevent similar incidents from occurring.

■ During the early morning hours, a boiler used for heating exploded, destroying the corner of a hotel.

*Why did it happen?*

M&M Engineering performed an on-site investigation within hours after the occurrence. Physical evidence was used to determine that the boiler had failed due to (1) internal overpressure caused by an improper safety relief system and (2) a malfunctioning high-temperature cutoff.

■ While preparing for a major refinery turnaround, a half-full, hot oil storage tank failed at the roof-to-shell seam. The resulting overflow of product started a fire at the base and up the side of the tank, and in the dike. *Was the storage tank safe for continued operation? Or did it need to be emptied? Could this situation be avoided in the future?*

An M&M Engineering investigation team arrived on-site within hours after the accident, assisting the refinery with the investigation and the determination of whether the tank was stable.

After interviewing various plant personnel and examining the damaged tank, we gathered additional evidence, including metal and weld samples and chemical properties of the stored product. Based on our findings, we questioned the integrity of the remaining storage tank, and recommended that it be completely emptied in as fast and safe of a manner as possible.

We also determined the extent of repairs needed on the storage tank. We assisted the plant in establishing the likely cause of the accident and helped them put systems into place that will decrease the likelihood of accidents in the future.

## Materials Laboratory

State-of-the-art, fully equipped materials, mechanical, and corrosion laboratories and a machine shop are available 24-hours a day to support our accident investigations.