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It's been relentless. For months, the 24-hour news cycle has been shining an intense spotlight on several high-profile workplace disasters around the world.

Regardless of what their causes are eventually determined to have been (and the possible design flaws and/or geophysical and environmental factors that may have helped set them in motion or expand their impact), accounts of these events magnify the challenges faced by maintenance teams everywhere.

This article details a number of other incidents that made the news over the past three decades. Now is a good time to reflect on these tragedies, as each makes a strong argument for thought being given to more than just lean in workplace decisions.

Maintenance plays a key role in protection and safety, not just of a plant and its personnel, but also of communities and inhabitants in areas surrounding the facility. Thus, in a profit-driven environment, cost cutting can never be allowed to compromise existing safety standards. If safety standards aren't rigorously adhered to—*and proper maintenance procedures aren't followed* —disasters CAN happen. Consider the following:

Case #1: Chemical processing

On January 2, 2011, cable television's History Channel aired an hour-long documentary on industrial disasters, including what has been considered to be the worst such event ever: On December 3, 1984, in Bhopal, India, a Union Carbide pesticide plant exploded, resulting in the release of toxic gas that quickly killed 3800 people. In the weeks that followed, the death toll grew to more than 15,000. According to the Indian government, the number affected increased to over 500,000.

This accident occurred when water was added to a large volume of methyl isocyanate, which, in turn, generated a massive poisonous gas cloud over the city of Bhopal. An independent investigation of the catastrophe concluded that the cause of the accident stemmed from poor plant management, operations and maintenance. (There also has been some conjecture that deliberate sabotage—*introducing the water into the methyl isocyanate*—may have been involved.)

Although Union Carbide has paid at least $470 million dollars to victims of the Bhopal disaster, 25 years after the event, the matter may still not be completely settled.

Case #2: Transportation
Turning to a sad chapter from the transportation sector, on May 25, 1979, American Airlines flight #191 scheduled from Chicago O'Hare to Los Angeles crashed on takeoff. At the time, this was the worst aircraft disaster in U.S. history. All 271 passengers and crew on board the DC-10, along with two people on the ground, were killed. Their fate was sealed when an engine separated from the plane during takeoff.

The official investigation revealed that proper aircraft maintenance procedures had NOT been followed. In servicing and reinstalling the engine in question on the doomed plane, damage to a structural part occurred. (Note: The aircraft manufacturer had not approved the method of maintenance that was used.)

Subsequently, the entire DC-10 fleet was grounded for inspection—*which found six other planes with structural damage, including four at American and two at another carrier that had adopted the same non-OEM-approved maintenance procedure.*
This procedure had been implemented without a thorough evaluation to ensure that it would not cause structural damage to a plane.

Case #3: Food processing

In the food-processing industry, on April 9, 1985, the U.S. experienced what was, at the time, its worst outbreak of Salmonella poisoning. Nine people died and over 16,000 were sickened across six Midwestern states. The outbreak was traced to Hillfarm Dairy, a unit of Jewel Food Stores.

On the surface, it appeared that a piping problem may have allowed a small quantity of raw milk to mix with pasteurized milk. After an extensive probe by authorities, a study concluded the salmonella poisoning resulted from a “unique micro-biological engineering phenomenon.” The dairy has since closed. All legal claims were settled out of court by Jewel Foods.

Case #4 (A and B): Refining

A. The 2005 Texas City refinery accident…

On March 23, 2005, the U. S. suffered one of its worst refinery accidents. It happened at what was then the third-largest refinery in the country—*the Texas City, TX, site owned and operated by BP* —when an explosion and fire on the isomerization plant occurred. (A distillation tower became flooded with hydrocarbon and over-pressurized, releasing explosive material.) Fifteen people died and over 170 were injured as a result.

This disaster led to fines in excess of $50,000,000. The compensation that’s been paid out as a result of the accident has reached one *billion* dollars. The final BP report noted several underlying causes for the event:

- Breakdown in communication
- Management and employee mistakes that contributed to or caused the explosion
- Errors made by personnel responsible for the startup of the unit
- Failure to follow startup procedures

An independent investigation by a panel chaired by James A. Baker identified key areas that must be focused on to improve plant safety. A formal document prepared by the panel is to be used by all refinery operators. All U.S. refineries now require state inspections as a result of the 2005 explosion in Texas.

B. The 2010 Tesoro Anacortes refinery accident…

On April 2, 2010, a deadly blast occurred in the Naphtha unit of Anacortes in the state of Washington (a refinery owned by Tesoro). This accident occurred when routine maintenance had just been completed, and the unit was in the process of being restarted. Seven maintenance workers died.

The investigation of this incident noted the following facts: The maintenance crew failed to check for cracks in equipment that was 40 years old. Workplace rules concerning the protection of workers and the postponement of maintenance of older equipment were not followed.

Case #5: Nuclear power

The U.S. nuclear-power industry experienced its own major accident on March 28, 1979, when Pennsylvania's Three Mile Island Nuclear Plant suffered a partial core meltdown. While no loss of life or injury occurred at this plant or in the community, a five-mile radius around the facility was evacuated.

As a result of this incident, the reactor in Unit 2 was so badly damaged and contaminated that it could no longer be used. This unit was gradually de-activated and mothballed. It took two years for radiation levels to drop before crews could enter that area of the plant. Cleanup started in August 1979, and officially ended December 1993. Cost for this cleanup was enormous. Compensation to the public—*including to residents for loss of business revenue, evacuation expenses and health claims* —totaled $82,000,000.

Metropolitan Edison, owner and operator of the Three Mile Island plant, faced criminal charges. In a plea-bargain agreement, the company pleaded guilty to one count of falsifying test data and no contest to six other charges. Later, four other charges were dropped. The company agreed to pay a fine of $45,000 and set up an account of $1,000,000 to help in emergency planning in the area around
the facility.

This accident involved the mechanical failure of the reactor coolant pump, a critical valve to the reactor area and human error in operations. The event led to major changes in regulations and oversight in the nuclear power industry.

In the final analysis

Accidents and catastrophic events can and do occur in any industry sector—*although many of them never make the news, they can be devastating.*
They can endanger both plant personnel and innocent "bystanders" (including entire communities) and lead to significant economic losses and environmental damage.

Each of the incidents referenced in this article highlights the importance of good maintenance (and the following of correct maintenance procedures). Intelligence-based maintenance can eliminate or substantially reduce the risk of an accident. This requires the plant staff to know:

- The manufacturing process
- The safety requirement of the process
- The proper repair of equipment and components
- How to identify and correct problem areas

Management, operations and maintenance must have open lines of communication to promote a culture of safety. Furthermore, educational/training programs need to be implemented for all plant personnel including all on-site contract working staff. **MT**

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A Personal Perspective: You Are Not Alone

For many years, I helped teach a seal technology course for industry offered by Georgia Tech. In the section on identifying the causes of equipment/seal failures, the class would discuss problems and solutions.

One scenario we explored involved mechanical distortion transmitted to a piece of rotating equipment. The example was an end-section pump in a nuclear power plant. As it was related to safety, this pump was always kept on hot standby. Suction piping to it expanded, distorting the pump casing by as much as 0.015 inches. This resulted in an out-of-square running condition for the seal. Seal failure occurred every three months. The solution involved an expansion joint in the suction piping to the pump.

After presenting this problem to the class, a student noted that his plant had the same—*exactly the same*
—situation. He shared his experience that the plant had tried three different suppliers yet still experienced multiple failures on the equipment in question. The real solution to his problem, however, and the ability to achieve satisfactory equipment life, required that the mechanical load from the expansion to the piping be eliminated.

The lesson learned (and why it is important to safe operations, whether you work in a nuclear power plant or elsewhere) is simple: When continuous equipment failures occur, seek expert, third-party help. Don’t go it alone.
…JPN