Decisions Do Matter

by Mark Smith

What's an API inspector? Just someone who passed a long test & has an expensive certificate? NO! It's much more. It's someone that is recognized by the API Codes and is assigned the responsibility to make specific decisions that are important to the health of our pressure equipment! Don't take your code-ordained decisions lightly. Because ... decisions do matter! Here's a true-life story about the consequences of poor decisions. Could this happen to you?

In the mid-1800s, in the hills of Pennsylvania, a 75 ft high dam was built to create a large lake. The lake was needed to provide water for a canal system (like the Erie Canal). Appropriate engineering practices were used to select construction materials and design the dam. During construction, engineering and inspection personnel closely followed the job activities. To control the lake level, large discharge pipes with slide valves were installed at the base of the dam.

But by the time the dam was finished, the lake was not needed. Railroads had become a cheaper form of transportation and canals were being phased out. Since the lake was no longer needed, most of the water was drained from the lake and the dam was not maintained. Over the years, the central portion of the unmaintained dam failed around the discharge pipes.

Years later, the old dam and surrounding areas were purchased to be developed as a hunting & fishing resort for the rich and famous. This was a big project. The dam would be rebuilt, the roads improved, trails created, and a lodge constructed. The resort's managing group was responsible for all decisions, including those about the reconstruction and maintenance of the dam.

Let's review some of their key decisions.

Decision #1: The large discharge pipes were abandoned and not repaired. A spillway was created that allowed excessive water to overflow when the lake was full. Without the discharge piping, the lake could not easily be drained for repairs. The bottom of the spillway was about 7 feet lower than the top of the dam.

Decision #2: Some of the repair materials were inferior. Instead of following the original specifications, the failed section of the dam was filled with readily available materials. (Even tree stumps were used.)

Once the dam was completed it took a couple of years for the lake to reach full height. The new lake was now 3 miles long. The lodge and vacation homes were built overlooking the lake.

Decision #3: Once the lake was full, some of the lake's fish escaped downstream through the spillway. A screen was placed across the spillway to keep the fish in the lake.

Decision #4: The road going to the vacation homes crossed the dam, but was only wide enough for one carriage. This was inconvenient, so the dam height was lowered a couple of feet making a wider road. The spillway height was not lowered.

Decision #5: Within a few years, the center section of the dam sagged about a foot, probably the result of the inferior construction materials. The center section of the dam was now only about 4' above the bottom of the spillway and was the lowest part of the dam. Since the dam had worked well for the last few years, the sagged section was not repaired.

All was well until Memorial Day weekend 1889. Unusually heavy rains began to fall. The inlet streams to the lake became torrents. The lake level rose and water overflowed through the spillway. But the

fish screens trapped leaves and debris, significantly reducing the "relieving capacity" of the spillway. The heavy rains continued and the spillway was not keeping up! The lake was rising about 1" every 10 minutes.

Tremendous last minute efforts were made during the downpour to keep the water from cresting the dam. But it was too little, too late. Since the sagged center portion of the dam was only 4' above the bottom of the spillway it was just a matter of time. At 3:10 p.m. the water crested the center section of the dam. Rapid erosion began and soon the entire center section catastrophically failed. In just 40 minutes, the 3-mile lake would be entirely gone!

Once the dam failed, a wall of water up to 70 feet high rushed down the canyon at speeds up to 40 mph! Small towns along the riverbank were totally washed away. Downstream about 20 miles was a large steel-milling town, Johnstown. That afternoon, the small river through town was out of its banks and many townspeople were helping those in the lower sections of town move belongings to upper floors.

Late afternoon, the townspeople heard a train whistle coming from up-valley. This was unusual because the whistle just kept blowing. Those curious went outside and heard a deep rumble in the distance, a rumble that was rapidly increasing in volume. Coming toward the town was a wall of debris backed by a 35-foot wall of water. Many ran for hills, some made it, but many were engulfed by the wave of debris. Those too far from the hills gathered loved-ones and ran upstairs and into attics. The tidal wave crushed many houses and swept others off foundations. People still alive in attics, chopped holes in the roofs to gain access to the top of the house.

Hundreds floated downstream hanging on to debris or perched on top of floating houses. Miles of barbwire from an upstream wire-mill entangled individuals in the water and the debris. At the train bridge west of town, the entangled debris lodged, creating a huge dam. Hundreds of townspeople were entombed in the rubble. Hundreds more were alive but trapped by the debris and wire. Stunned rescuers quickly started freeing those trapped.

But this story has yet one more unexpected disaster. Oil from upstream businesses and homes floated on the surface and covered much of the debris. Fired materials floating from up-river flooded steel mills floated to the debris pile, and the rubble caught on fire. Hundreds who lived through the flood, died by the fire while trapped in the debris.

The final tally: over 2200 dead, about 100 families entirely gone, 100 children lost both parents. But why? The obvious answer is simple, the large upstream dam catastrophically failed. But why did it fail? The answer to that question is important to all inspectors & engineers. OUR DECISIONS DO MATTER!

Debris at the train bridge

How does this disaster apply to your job as a Pressure Equipment Inspector or Engineer? If this dam had been an API piece of equipment, would you have prevented the same poor decisions? What roles are assigned by the API Codes during inspection, repairs, alterations & rerates?

Alterations: During the dam rebuild, the discharge pipes were abandoned. These pipes probably would have allowed the excess water to be drained without cresting the dam. *"API says, All repairs & alterations must be authorized by the authorized inspector and engineer."*

Repair Materials: Inferior materials were used to repair the dam. *"API says, All materials must be approved by the authorized inspector…."*

Rerating: The dam height was lowered to allow 2-way traffic. But the spillway elevation was not lowered. This significantly reduced the maximum relieving capacity of the spillway. *"API says, During a rerate, the relieving device should be checked to assure it has appropriate capacity for the new conditions. And ... the rerate is acceptable to the authorized inspector."*

Management of Change: Installing the fish screen at the spillway was just a "minor alteration", but one that would have major impact on the "relieving capacity" of the spillway. Do we solve one problem, only to create another? Maybe create an even bigger problem? *"API implies, With any change, get the right people involved in the decision. Make sure you understand the complete potential consequences."*

In-service Degradation: The center of the dam sagged a couple of feet. The center should have been the highest part of the dam. *"API says, An external inspection shall be performed by the authorized inspector. All NDE data shall be evaluated and accepted by the authorized inspector."*

Bottom line: If this dam had been an API piece of equipment AND if the engineers & inspectors were following their API designated responsibilities, this failure would not have occurred.

But there is one more side to this story. There was a new engineer assigned to the club, but this was his first job, and he didn't want to do anything that might anger his new employers. So he turned a blind eye to all that was wrong at the dam. Despite the heavy downpour, the engineer was confident that the rain would let up, and the already high level in the reservoir would not be a problem. But when the rains continued, he discovered that he had been wrong. He did make valiant last minute repair efforts, but it was too late. He is also remembered for his efforts in issuing a last minute warning about potential dam failure.

This dam failed partly because the engineer was not willing to challenge the Owner's poor decisions! As an API inspector or engineer, are you more concerned about fulfilling code-ordained responsibilities or pleasing the Owner-User? Most of the time, we please the Owner-User by fulfilling our code-ordained responsibilities. But when there is a conflict between the Code's requirements and the Owner's desires, always stand with the Code, because ***Our Decisions Do Matter.***

This was the town of Woodvale. It's gone!