

DEFECTS CAN KILL

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I guarantee that anyone reading this, regardless of if you work in the food industry, manufacturing, processing, mining, petrochemical or the like, has more than one defect that has the potential to kill someone, and most of us don't even realize it. It is typically because these defects are laying dormant and haven't occurred yet, or if they have, it's been with a lesser consequence and someone has just been plain lucky because the worst scenario didn't play out that time.

I was about 5 or 6 years into my career when I was asked to join a team to investigate a fire that had destroyed a large diesel hydraulic shovel that is used to move vast amounts of dirt at a mining operation.

The details were as follows.

Shortly after refueling, the shovel operator started up the machine and began to slew (turn the machine on its track frames). Not long after there was a call on the radio by a truck operator saying that there was fire coming from the back of the machine. Within minutes, the fire had engulfed the shovel. The shovel operator activated the fire suppression system and exited the machine. With no time to use the emergency egress system and due to the flames now upon the operators cab, the operator climbed over the handrail and jumped! From the platform where the operators cab is to the rocky ground below it is about 7 meters (23 feet). The operator then, with two broken legs and some burns, tried to crawl away from the burning shovel the best they could with their injuries. The heat radiating from the fire was intense, the height and glow of the flames hid the massive structure of the shovel.

Because of the intensity of the fire and the amount of fuel involved, the fire suppression system was incapable of controlling such a blaze. The emergency response team could only ease the fire from a safe distance with their water cannons. There was no saving this machine. It was only when I visited the site of the fire and the remains of the shovel that I realized that the shovel operator with two broken legs, minor burns, and other cuts and bruises was lucky. Without jumping, the shovel operator would have died.

The following was found during the investigation.

On the shovel there is a service arm which is used to lower the fuel and oil fill points. It lowers when the machine is turned off and raises when the machine is powered back up. There is control logic with a limit switch which prevents the shovel from slewing until the service arm is fully raised.

Shortly after refueling, the shovel was started, and the operator slewed the machine. For some reason the service arm did not raise and the control logic linked to the limit switch did not activate. As a result, the service arm contacted the track frames, ripping the fuel and oil lines open causing a large hydrocarbon spill (+15,000 Liters / 3,960 Gallons).

The ignition source came from a jump start receptacle that was also located on the service arm. This is there to make the process of jump starting the equipment easier if the battery runs flat. This was also damaged when the service arm contacted the track frames and resulted in a significant amount of arcing (and sparks) to occur.

What was found in the investigation was that the system that prevents the shovel from slewing when the service arm is not in the fully raised position was not fail safe. This was a known fact among many people.

It was an event that had happened many times on this shovel and others like it with limited consequence. This time however a series of events lined up perfectly to create the inferno. What I learned during the course of this investigation and have continued to think about for a long time afterwards was that we must take the process of defect elimination seriously. We must take those who identify defects seriously and when defects are identified we must act. This defect was known and acknowledged to be a problem by many, however for whatever reason no action had been taken to eliminate it. Because of this, someone came very close to losing their life and others came very close to losing a spouse, father and brother.

The only conclusion I can make here is that because this had occurred so many times with a lesser consequence, we became desensitized and did not rationalize its true potential. From my personal reflection, this has been something that I have had to make myself aware of. I am not perfect and even since this incident I have found myself becoming complacent with what is going on around me.

With this in mind, it creates an absolute necessity that companies implement a defect elimination program, take it seriously and actively seek to remove the defects from their business. Do not wait for a wake-up call like this to happen.

Before we end the article, let us take a step back and talk about the solutions that were implemented and how they related to the root causes and the hierarchy of controls.

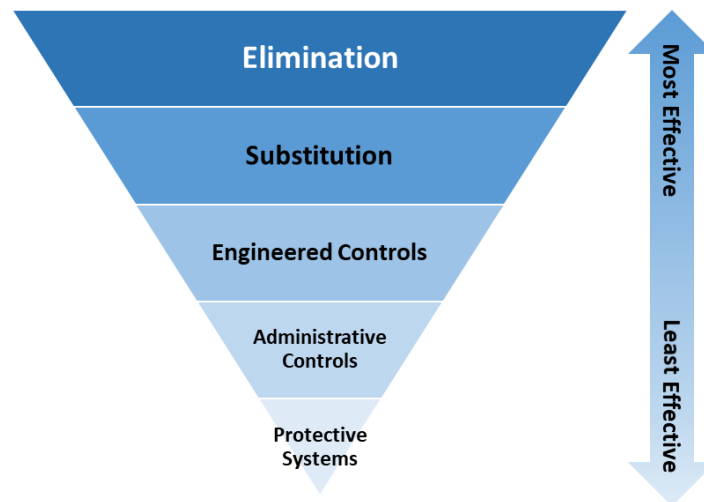
The three primary root causes were:

1. The controls for preventing the service arm from slewing were not fail safe: This allowed the machine to slew while the service arm was in the down position causing the action that resulted in the fuel and ignition source to meet.
2. There is no shut-off mechanism on the fuel tank: The diesel fuel emptied from its tank (fuel source) when the hose was ripped off of the service arm when the machine slewed while the service arm was in the down position.
3. The jump start receptacle was located on the service arm: This was damaged causing arcing (ignition source) when the machine slewed while the service arm was in the down position.

The three actions relating to the primary root causes were:

1. Modify the controls so they are fail safe and will prevent the machine from slewing while the service arm is down.
2. Install a one-way check valve on the fuel inlet pipe to ensure that in the event the pipe fails, diesel fuel does not flow out of the tank.
3. Move the jump start receptacle away from the service arm and areas where it might get damaged, and away from other fuel sources.

These three solutions fall in the upper section of the hierarchy of controls. It would not be acceptable, especially for an incident of this consequence, for the solutions to not be in the upper section of the hierarchy of controls.



You will notice that one of the solutions falls into the substitution category because it replaces components that produce a root cause with ones that do not (i.e. the control system was modified with a different component that now made it fail safe). The other two solutions fall into the engineering category because they isolate the process (i.e. the fuel is now isolated by using a check valve and the jump start receptacle is isolated by relocating it).

Typically, when solutions fall in the upper section of the hierarchy of controls, they are not easy, quick or inexpensive. These solutions however were relatively easy, quick and inexpensive. They were fully implemented across the entire fleet of shovels by coordinating the procurement and installation of the parts by qualified people.

From the investigation, there were also a number of other actions developed that while they did not directly relate to the root causes of the incident, they were identified and found to be of serious nature that must be addressed to prevent incidents of severe consequence occurring. Of note was an action to significantly improve the process for reporting and having faults rectified in a timely fashion. This highlights again the importance of taking the process of defect elimination seriously, taking those who identify defects seriously and when defects are identified act with a sense of urgency.