REPORT

ON

GROOM MINE MILL BUILDING

Submitted to

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By

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GROOM MINE ABSTRACT

The Groom Mine is a group of mining claims, buildings, structures, and equipment that were operated by Dan and Martha Sheahan during the first half of the 1900's until June 23, 1954 when the Sheahans claim the Mill Building was destroyed by an explosion and fire. I Richard A. Ortiz am an independent fire and explosion, investigating analyst retained by the law firm of Kermitt L. Waters, Esq. to conduct an independent review and analysis of the Groom Mine Mill Building, heretofore known as the Mill Building, and surrounding environment. The goal of this review and analysis is to identify and review physical and circumstantial evidence and to attempt to identify a likely or probable cause of the destruction of the Mill Building.

This report documents the analysis, assessment, and findings of the damage caused to the Groom Mine Mill Building that occurred on June 23, 1954. This analyst examined available documents, photographs, and drawings relating to the condition of the Mill Building before and after destruction and conducted two on-site examinations of the Mill Building and relevant surrounding areas. Said site visits were conducted April 23, 2016 and May 15, 2016.

This report will further identify physical evidence and attributes of the Mill Building in its current post-destruction state that support this analyst's opinion of explosion/fire causation. It will also identify attributes of the Mill Building in its pre-destruction state via information available for review that support the elimination of certain other theories of causation.

The analysis of likely causation of the destruction of the Mill Building focuses on two key destructive forces, explosion and fire. This report will define explosion and demonstrate the expected and observed effects of such forces on this building where exposure to the effects of an explosion is present. This report will further define fire and demonstrate the expected and observed effects of such forces on this building where exposure to the effects of fire is present.

Definitions and terms used in this report are consistent with definitions and terms established by *National Fire Protection Association (NFPA) 921, Guide for Fire and Explosion Investigation, 2014 Edition and Kirk's Fire Investigation, Third Edition, 1991*. Methodology for the conduct of this review and analysis of the destruction inflicted upon the Mill Building is consistent with established Scientific Methodology established by NFPA 921, Guide for Fire and Explosion Investigation, 2014 Edition, Scientific Method.

ARRIVAL AT GROOM MINE

I made two visits to the Groom Mine on two separate dates as listed in the above abstract. Both visits were for the same purpose and both visits rendered information and evidence that is relevant to the cause of the destruction of the Mill Building. The information contained in this report was derived from a combination of the two visits. On arrival during my first visit at the Groom Mine I was introduced to Ben Sheahan, grandson of Dan and Martha Sheahan. I met Ben at the main camp building and was given a brief tour of the house. Ben proceeded to take me through the kitchen of the house and showed me the entrance/exit door on the north side of the house. From that doorway Ben oriented me north by northwest toward where the Mill Building is located. Ben informed me at that time that this house we were in is where Dan and Martha were when the explosion and fire in the Mill Building occurred. Ben demonstrated to me how Dan and Martha could see fire burning at the Mill Building from the camp house immediately after they heard an explosion. The Mill Building lies in a valley between two high rocky ridges that run north and south on either side and is approximately one-quarter mile away from the camp house according to Dan Sheahan (Daniel Sheahan Deposition, Pg. 10). I learned at this time from Ben Sheahan that the Mill Building was destroyed on June 23, 1954.

THE MILL BUILDING

According to an inventory created by Dan Sheahan describing general construction of the building and description of contents therein, the Mill Building is described as approximately 45’x45’ and constructed of 6”x6” vertical wood members on 10’ centers with 2”x4” horizontal wood spreaders on the walls of the building spaced 3’ apart and 2”x6” ceiling rafters spaced 4’ apart. All sides and the roof of the building were sheeted with 24-gauge galvanized corrugated iron panels. The floors were concrete. Retaining walls between terraces were made of reinforced concrete and all principal milling machines were set on reinforced concrete foundations. The engine room measured approximately 24’x30’ and it’s roof was built of 6”x6” trussed members. There was no information available to me that indicated the approximate spacing of the trussed members, which supported the engine room roof system. The floor was concrete and the generator engine and air compressor were set on reinforced concrete foundations. The concentration platform was approximately 18’x 45’ with a concrete floor and 5’ high wood plank sides.

My observations of the Mill Building are as follows:

As I arrived at the Mill Building I observed that it was destroyed. Before approaching the Mill Building I conducted a preliminary 360-degree survey of the Mill Building and general vicinity, which included the adjacent desert area surrounding the building out to a perimeter of 200’ or more from the building in all directions. The Mill Building was built on westerly hillside in order to make use of the force of gravity in milling operations. During that preliminary survey I observed that there was physical evidence of an explosion and fire.

IMPACT AND EXPLOSION

As I conducted my survey I saw several pieces of metal strewn about the property at various distances away from the Mill Building that exhibited evidence of damage consistent with damage that would be inflicted by the force of an explosion. Some of the items I identified were metal cans and corrugated metal panels, heretofore referred to as roof/wall panels, used as siding and roofing materials for the Mill Building and adjacent buildings. Several of these roof/wall panels were found a distance away from the Mill Building especially on the north, west, and south sides of the building. There were fewer roof/wall panels on the adjacent ground east of the building due to the steep up-slope of the hill. While it is possible that some of these panels may have changed location with respect to their original immediate post-incident location due to weather conditions over the years, it is the evidence of crushing damage that some of these panels and cans exhibited that is indicative of having been exposed to the forces of an explosion or suffered damage as a result of exposure to other items within the Mill Building set in motion by an explosive force. It is also possible that some of the roof/wall panels located a distance from the Mill Building may have been deposited there by the force of an explosion, and the lack evidence of crushing damage to those panels may have been a function of their orientation to the area of origin of the explosion.

After examining the condition of the numerous damaged pieces of metal lying in the vicinity of the Mill Building during my preliminary survey, I determined that the damage to these items was likely the result of exposure to a low-order explosion and thus suffered *low-order damage* (Figure 1-5). *High-order damage* to items such as lumber and light weight metals used in the construction of this building, had a high-order explosion occurred, would have caused shattering and fragmenting damage to these building materials and other items within the Mill Building. No evidence exists within the vicinity of the Mill Building that tends to indicate that a high-order explosion occurred (See definitions 3.3.101 and 3.3.119 *low-order damage* and *high-order damage)*. The location of the roof/wall panels and other metal objects found on all four sides of the Mill Building indicates that they were all at one time attached to the Mill Building. Their locations at various distances away from the Mill Building supports their exposure to some explosive force within the building that projected those objects away from the building in all directions.

Figure 1. Corrugated metal roof/wall panels exhibiting low-order explosive damage. These panels are located to the north of the Mill Building and are approximately 50-70’ from the building.

Figure 2. Roof/wall panel exhibiting effects of low-order explosive damage. This panel is located north and approximately 80’ from the Mill Building.

Figure 3. A metal pail exhibiting effects of low-order explosive damage. This pail is located south and approximately 130’ from the building.

Figure 4. A metal can exhibiting effects of low-order explosive damage. This can is located south and approximately 100’ from the Mill Building.

Figure 5. A roof/wall panel exhibiting effects of low-order explosive damage. This panel is located due west and approximately 90' from the Mill Building.

After completing my preliminary survey I approached the Mill Building from the north side. I observed numerous roof/wall panels strewn about and piled upon each other within and outside the boundaries of what were the walls of the Mill Building. Metal piping and conduit for electrical power service, water, and various other metal pipes were distorted and bent but not shattered, fragmented, or projected forcefully outside the walls of the Mill Building (Figure 6.). The low-order damage effects on metal pipes whether electrical conduit, gas, or water pipes is generally less evident than high-order damage effects. This is a function of their shape and surface area. Pipes are round and tend to deflect explosive energy more efficiently than broad horizontal or vertical surfaces.

Figure 6. Damaged piping and conduit.

As I examined the general configuration and construction of the machines inside the Mill Building I determined that all heavy machinery that remained inside the building were made of iron or other similar metals. Most were very large machines such as the concentrating tables, the 6-cell flotation machine, the 3-cell Jig, and the concentrate thickener and presumably are very heavy. According to Dan Sheahan's inventory and my own observations, these heavy machines were either bolted directly to the concrete floor or bolted or secured to heavy timber skids (6x6 or larger), which were bolted to the concrete floor.

Some of the machinery and equipment located on the inside of the Mill Building was displaced from their original locations to varying degrees. The degree of dislocation was greatest starting from the flotation machine near the northeast corner of the lower tier of the building and lessened as distance increased from that point moving outward. As I examined the flotation machine I discovered that immediately adjacent to it to the east was a pile of roof/wall panels lying on an elevated concrete terrace. Through my analysis I discovered that the flotation machine had originally been mounted on that elevated concrete terrace. Evidence indicates that the flotation machine was bolted to heavy wood skids, which were in turn bolted to the concrete floor of the terrace. The flotation machine was dislocated to the greatest degree of all the machines in the Mill Building. See figure 7-10.

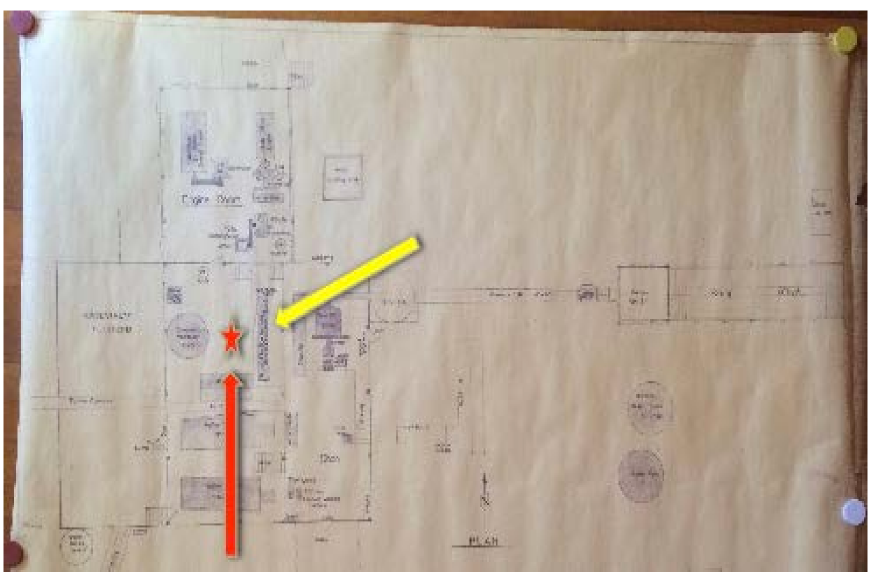

Figure 7. Yellow arrow indicates pre-destruction location of the flotation machine. Red arrow and red star indicate position after dislocation. [Original Mill Building blueprints]. The flotation machine settled in a diagonal aspect on the main floor of the lower tier of the Mill Building with the south end displaced approximately 3 feet to the west and the north end displaced approximately 5 feet to the west.

Figure 8. Red arrow points to an elevated concrete terrace covered by roof/wall panels approximately 3’ off the main milling floor. Yellow arrows represent direction of travel, as flotation machine was dislocated from its normal location.

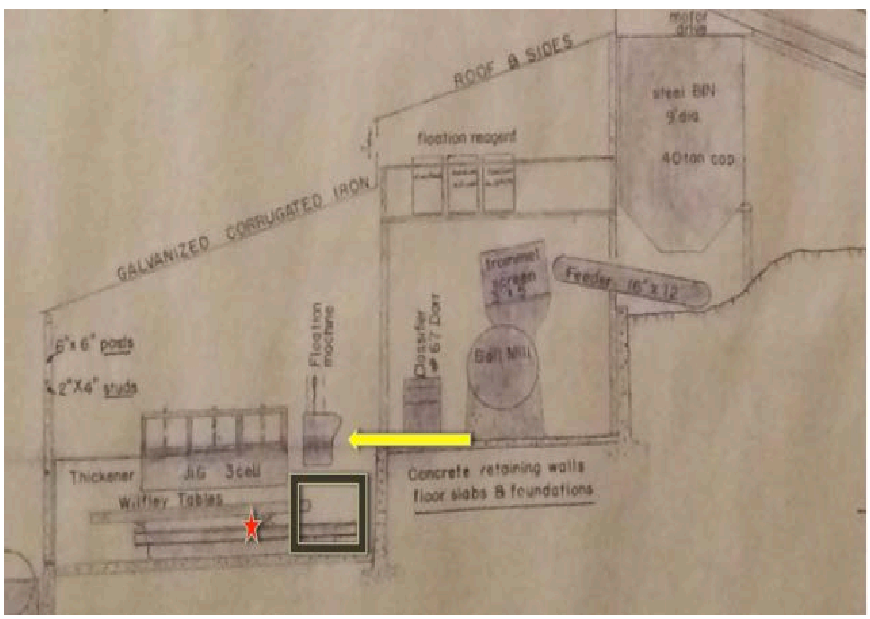

Figure 9. Black box represents the 3’ high concrete terrace where the flotation Machine was mounted. Yellow arrow represents direction of dislocation of the flotation machine. The red star represents post-incident resting place of flotation machine. [Approximation].

Figure 10. Roof/wall panels removed; shows the exposed elevated concrete terrace the flotation machine was originally mounted on. The red arrows indicate the location of the fire-damaged remains of heavy timber skids the machine was mounted on. The blue arrow reveals one concrete lag bolt used to secure the skids to the concrete floor.

On the east side of the flotation machine and toward the bottom are/were three metal straps that secured the floatation machine to the heavy timber skids it was resting on. Two were broken off from where they were welded to the side of the flotation machine. One remained attached but damaged. The one remaining mounting strap still had one of the long, large diameter wood lag bolts used to secure the straps to the heavy timber skids nearest the concrete barrier wall on the east side of the floatation machine terrace (Figure 11-14).

Evidence indicates that the flotation machine was probably pushed or heaved off of the elevated concrete terrace that it was normally mounted on. My estimation of the weight of this machine is approximately 3,000-4,000 pounds.

Evidence supporting the theory that the flotation machine was pushed or heaved from its normal location as an immediate result of an impact and explosive event inside the Mill Building, and did not simply topple off the terrace as a result of fire related mass loss of the wood skids by fire is as follows (See def. 6.2.3.1 Mass Loss):

Figure 11. Top red arrows indicate one remaining strap and large wood lag bolt. Bottom red arrow indicates location of middle strap, which was torn off during dislocation of the flotation machine.

Figure 12. One remaining strap.

Figure 13. Attachment point of middle strap. The weld broke during the dislocation event.

Figure 14.

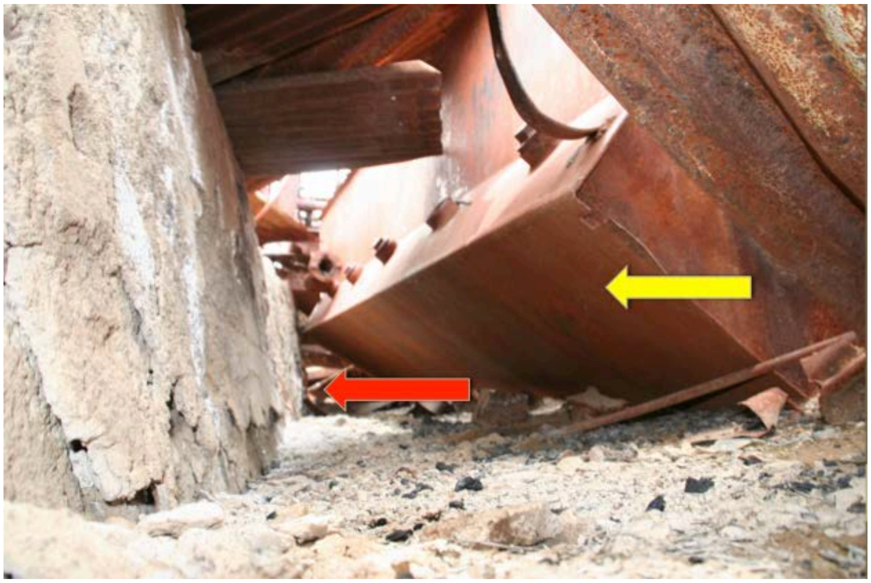

Figure 15. Flotation machine resting on floor below its normal terrace perch. Red arrow indicates 3' high flotation machine terrace wall. Yellow arrow indicates bottom of the flotation machine.

A review of Dan Sheahan's deposition (Dan Sheahan Deposition, Pg. 24) reveals that as Dan and Martha Sheahan approached the burning Mill Building within minutes of the explosion and fire. According to Mr. Sheahan's testimony, he described the building in part as "…leaning to the north". The direction of this lean, and presumably eventual collapse in the same direction, is perpendicular to the direction of force exerted on the flotation machine which caused it to break free of its anchors and to push it from it's elevated terrace to the floor below. According to the description of the roof and wall construction of the Mill Building given in the building inventory according to Dan Sheahan, the wood frame construction of this building and the light weight metal panels used for roof and siding material likely did not impart so much energy upon these heavy machines during building collapse so as to dislocate them to a significant degree from their original positions. In addition, the collapse of the Mill Building being in a northerly direction toward the machine room caused no dislocation to any of the heavier machinery or engines in the machine room to any noticeable degree.

The heavy timber wood skids the floatation machine was secured to showed evidence of severe fire-related mass loss. They were almost completely destroyed as a result of prolonged exposure to fire. In their normal pre-fire configuration the heavy timber skids the flotation machine was secured to were essentially "sandwiched" between the concrete terrace and the bottom of the flotation machine. This normal configuration would have had the effect of limiting the amount of surface area exposed to fire as well as providing protected areas (see def. 6.3.4.2, Protected Areas), between the skids (See def. 5.5.3.1, Heat Transfer by Convection). This reduced surface area would have had the effect of slowing the rate in which the skids could absorb heat thereby slowing their rate of mass loss.

The degree of damage to the heavy timber skids caused by fire was caused by their prolonged exposure to fire burning within the Mill Building. This indicates that the flotation machine was not in its normal position on top of the skids during the prolonged fire event where it would normally have provided insulating or protective properties to the skids. The heavy timber skids experienced no protection from the effects of fire by the flotation machine as an intervening material between the skids and fire burning within the Mill Building. This fact supports the theory of immediate pre-building collapse dislocation of the flotation machine to the floor below its terrace by some competent force and not as a result of gradual mass loss of the skids by fire.

Further support of this theory is the nature of some of the roof/wall panels in relation to the flotation machine. An examination of the flotation machine's final resting spot reveals the presence of roof/wall panels underneath the floatation machine. The flotation machine is resting on several roof-wall panels. Figure 16-17.

Figure 16. Roof/wall panel sandwiched underneath flotation machine. View 1.

Figure 17. Roof/wall panel sandwiched underneath flotation machine. View2.

It is understood that during building collapse roof/wall panels were deposited over the entire span of floor space in the Mill Building. However evidence supports the floatation machine's immediate dislocation from its terrace location to the floor below by some immediate pre-building collapse force such as a low-order explosion, impact by heavy object, or combination of the two. Logic dictates that these roof/wall panels located below the floatation machine were likely thrust to the floor of the mill room immediately prior to dislocation of the floatation machine.

Further evidence supporting the theory that the flotation machine was pushed or heaved from its normal location as an immediate result of an impact and explosive event inside the Mill Building, and did not simply topple off the terrace as a result of mass loss of the wood skids by fire is as follows:

An examination of the entire Mill Building structure revealed that one area and one area only exhibited a particular effect on roof/wall panels. Immediately adjacent to the 6-cell flotation machine terrace on the north side of same area are three roof/wall panels that exhibit a distinct and consistent bend pattern from outside the mill room to inside the mill room. The bends in these panels are greater than 90 degrees from vertical and are graduating from high to low. The high end, or easterly most panel (Panel A) is bent at a higher point than the center panel (Panel B). The center roof/wall panel (Panel B) is bent at a higher point than the bottom panel (Panel C). Figure 18-21.

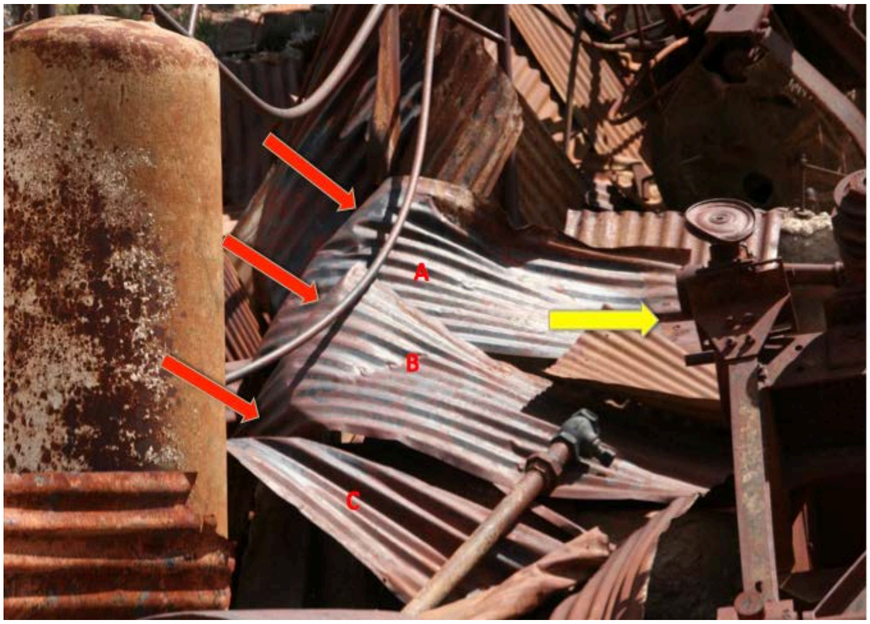

Figure 18. Yellow arrow is the 6-cell flotation machine.

Figure 19. View looking east.

Figure 20. View looking south and east.

Figure 21. Red arrow indicates generally north.

The above photographic evidence supports the theory that some large, heavy, airborne item may have impacted the Mill Building at this point. The shape of which, the configuration, the velocity, and the purpose all are unknown to this analyst.

Referring back to Figures 16-17, roof/wall panels located beneath the flotation machine; it is possible given the direction of travel from north to south of some object having possibly struck the Mill Building, that these roof/wall panels were, as an immediate effect of said impact, instantly deposited to the ground inside the Mill Building in the path of the flotation machine thereby causing the flotation machine to land on top of those panels. The remaining roof/wall panels deposited in the area were a result of an explosion, fire, and subsequent building collapse; and landed on the floatation machine and on the flotation machine terrace.

When combined with evidence that the flotation machine was probably pushed or heaved from its normal position on the terrace in a westerly direction and the point of impact as determined by the location of Panels A, B, and C; it is reasonable to believe that whatever impacted the Mill Building at the point identified may have been responsible for the immediate dislocation of the flotation machine to the floor. In addition, a heavy item impacting the Mill Building at the point indicated may have been causal to the early "leaning" and collapse of the building as a result of impact destruction of the vertical structural members in the area of the north end of the flotation machine terrace. Figure 22.

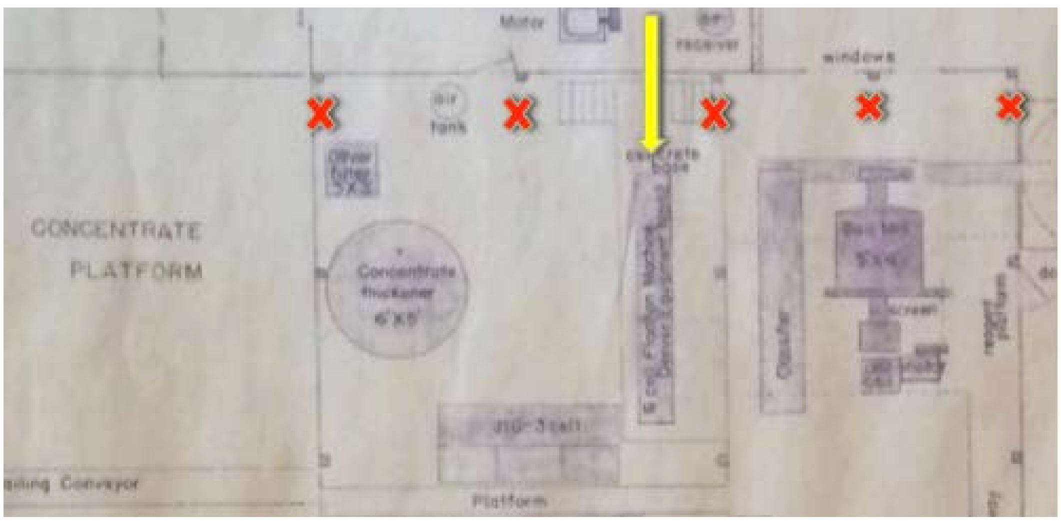

Figure 22. Red X's represent 6x6 vertical structural members, which support the walls. Yellow X represents the suspected path of the impact device or object. It is possible that an impact at this location could have destroyed or severely compromised the vertical structural members promoting early structural failure on the north end of the Mill Building, which could cause the building to lean to the north early in the event as described by Dan Sheahan.

As stated earlier, with the immediate dislocation of the flotation machine, the now exposed heavy timber skids that supported the flotation machine would then present with greater surface area, be unprotected, and therefore would support burning of these timbers to a greater degree than would have occurred in their original pre-dislocation position where they would have been protected by the flotation machine and the concrete floor below from the effects of fire.

Additionally, in the course of my examination of the area of concern near and about the flotation machine, I identified no additional materials, machinery, items, or objects, normally existing within the Mill Building that collided with the flotation machine with energy sufficient enough to move the 3,000-4,000 pound machine causing it's dislocation to the floor from the concrete terrace where it was secured in place by its plate-metal mounting straps and lag bolts.

A careful review of identifiable pressurized and non-pressurized containment vessels within the Mill Building such as the air compressor tank, fuel tanks, or other holding tanks revealed none were compromised, fractured, ruptured or otherwise breached and none contributed to explosion or fire causation. One exception is the oxy-acetylene kit located in the shop. The shop is located on the second tier of the Mill Building and on the south side.

THE SHOP – OXY-ACETYLENE KIT

I observed the shop area from the east side of the Mill Building on the upper portion of the slope the Mill Building was built on. This viewing angle provided me with a view looking down on the shop. As I surveyed the shop area I identified several pieces of equipment including a drill press, a compressor and tank, which was intact and not breached, and various other items including welding rods for an electric welder. I also identified two metal gas cylinders, which were the remains of an oxy-acetylene welding/cutting kit (Figure 23-24). These tanks were located roughly in the center of the shop approximately 18' from the south wall and approximately 50" from the east retaining wall. The oxygen and acetylene cylinders were found together.

Figure 23. Oxy-Acetylene kit tanks located in the upper tier Shop area; photographed as found.

Figure 24. Oxy-acetylene tanks.

The acetylene tank measured approximately 12" in diameter and approximately 40" high. Its size is generally consistent with that of a #5 acetylene bottle, which holds approximately 300 cubic feet of acetylene (Air Products, Safetygram-13). Acetylene is a flammable gas used in acetylene welding and metal cutting. The metered combination of oxygen and acetylene creates a torch flame that can exceed 3,090 degrees Centigrade or 5594 degrees Fahrenheit (Air Products, Safetygram-13). The normal internal pressure of an acetylene storage tank is approximately 275 psi (Air Products, Safetygram-13).

Acetylene cylinders are completely filled with a porous mass filler material containing diatomaceous earth or a ceramic silica lime material. Older cylinders may contain charcoal, asbestos and/or cement. The filler is highly porous, light-weight, and acts like a sponge for the acetone solvent that the acetylene is dissolved into (Air Products, Safetygram-13)

As the tanks lie I noticed only slight bulging to the acetylene tank on the south side of that tank, or the photographer's right in Figure 24. On closer examination I located three separate rupture points on the acetylene tank. Two are displayed in Figure 25. The third rupture is displayed in Figure 26. There was no evidence of rupture on the oxygen tank. Because of the bulging of the acetylene tank at the rupture points, it is evident that the tank failed due to a B.L.E.V.E. or Boiling Liquid Expanding Vapor Explosion (See def. 23.2.2.1 B.L.E.V.E).

Figure 25. Acetylene tank rupture points.

Figure 26. Third acetylene tank rupture point.

Acetylene tanks can fail due to external tank damage or exposure to severe external heating among other reasons. Where a metal gas cylinder is exposed to severe heat for prolonged periods of time, the tank material can fatigue and eventually lose its containment strength. Where a gas cylinder has lost its containment strength, at some point as weakening progresses due to continued exposure to fire, the internal pressure of the tank will exceed the containment strength of the cylinder causing an explosive rupture. The potential energy associated with such a breach depends on the nature of the rupture, the quantity of gas in the tank, the size of the tank itself, and certain environmental factors such as containment (room size). An acetylene tank B.L.E.V.E. can create a low-order explosion with an elevated pressure front (See def. 23.4.1.1 Blast Overpressure and Wave Effect. General). This pressure front can be destructive.

In addition to the imparting of energy into the surrounding area by a ruptured acetylene tank where the rapidly expanding contents have ignited, there will be an immediate contribution to the fire fuel load within the building because of the flammable characteristics of acetylene. The additional fuel load in terms of quantity of fuel is also dependent on the quantity of fuel within the tank. After a review of all available documentation of this incident, it is unknown to me how much acetylene was in the tank at the time of the B.L.E.V.E.

The acetylene bottle was located in the shop on the upper tier of the Mill Building close to the east retaining wall. In a scenario where the acetylene tank ruptured prior to the flotation machine being dislocated, the energy associated with the pressure front from the exploding contents of the ruptured tank would not be known due to lack of information that indicates the quantity of acetylene within the tank at the time of B.L.E.V.E. Such a pressure front would not have impacted the flotation machine with enough force to cause its dislocation. The reasons for this are as follows:

The area of the acetylene tank did not exhibit signs of any significant pressure wave that would be associated with an acetylene fuel/air explosion. Most machines in the shop near the acetylene tank were generally in the their normal places with only minor shifting likely due to building collapse. The oxygen and acetylene tanks were found next to each other in the shop, as is their normal configuration. Often times where an acetylene tank B.L.E.V.E.s the tank becomes a projectile itself and will subsequently be found a distance away from the point of initiation. Also, the heavy timber wall that separated the upper tier from the lower tier would have absorbed and reduced the pressure front wave traveling in the direction of the flotation machine. Lastly the flotation machine, being located on the lower tier and below the grade of the acetylene tank, was protected by the concrete barrier wall, which divided the upper and lower tiers. Any pressure wave from an explosion on the upper tier would have propagated over the flotation machine rather than impacting it directly. By way of demonstration, being in a foxhole is a way to escape the effects of an explosion pressure front wave.

My examination of the entire shop area revealed no other gas cylinders or similar pressurized vessels, or other items that may have caused a fire to occur within the shop or may have caused an explosion that may have affected the acetylene tank and compromised its integrity. Acetylene tanks in their secure and unmolested condition are safe vessels and generally do not spontaneously rupture or auto-destruct.

According to the sworn statements by Dan and Martha Sheahan there was an immediate explosion at the Mill Building preceded by a whistling noise. A whistling noise by their own statements they had heard many times before and had attributed to USAF jet airplanes flying in the area. It is unknown to me what if any sound, a purging safety valve on the acetylene tank makes. It seems implausible however, that the sound, if any, of a single purging safety valve on a gas cylinder could be heard approximately one-quarter mile away (Google Earth) and with intervening structures and earth in the path. Further, in order for an acetylene tank to fail it must suffer some external insult such as a very high impact or exposure to high heat. High heat sufficient enough to cause the acetylene tank to rupture would have to be the result of prolonged direct flame impingement such as having left the torch on the oxy-acetylene kit on and directed at the tank causing a localized weakening and rupture of the tank (not supported by physical evidence), or prolonged exposure to a fire burning within the Mill Building. Such a fire would have had to burn for an extended period of time in order to cause the acetylene tank to rupture. Such a fire would have been noticeable long before the acetylene tank failure.

Evidence revealed by the post-fire condition of the acetylene tank indicates that there were three separate rupture points on the tank, which indicates the entire tank was exposed to fire for a prolonged period of time causing a catastrophic rupture of the tank in three different areas. This rules out a localized torch flame impinging on the acetylene tanks as cause of the rupture. Such a fire causing a B.L.E.V.E. of the acetylene tank was not the result of the acetylene tank rupture but rather the acetylene tank rupture was the result of a fire burning in the Mill Building resulting from an explosion and instant fire, which occurred according to the Sheahan’s.

The acetylene in the tank, once released, certainly contributed an instant high-energy fuel to the already burning fire; it did not cause the fire. No other containment vessels within the shop displayed evidence of rupture or explosive rupture. All items within the shop including the acetylene kit, were ruled out as cause for the primary explosion within the Mill Building.

FIRE

Fire generally burns upward and outward under normal conditions. The vertical growth path of fire as it propagates is slowed only by intervening materials and the reduced availability of fuel and oxygen levels. Given adequate ordinary combustible fuel load and ventilation, the upward and outward spread of fire will grow quickly though not explosively as defined by (See def. 3.3.42, Deflagration). Explosive or deflagration type fire expansion is the result of combustible or flammable diffuse fuels such as chemical vapors or dust vapors. (See def. 3.3.46, Diffuse Fuels).

Buildings and structures generally do not spontaneously combust except for under *flashover* conditions where once all available fuels in a compartment are heated to their ignition temperatures they will ignite at once causing all ignitable or combustible materials within the room to begin to burn more or less spontaneously (See definition 3.3.83, Flashover). Flashover is the very rapid spread of fire within a compartment but is not explosive in nature. There is generally no additional noise or explosive pressure front associated with flashover. As mentioned in the definitions a flashover is a phenomenon that is the result of a fire in progress. There is no evidence that suggests there was a fire in progress in the Mill Building prior to the explosion and fire witnessed by the Sheahans. Given the large open space under the roof of the Mill Building, the ventilations ports (open windows), and the sparseness of ordinary combustible materials, which were limited mostly to the construction members, it is possible that flashover never occurred in this building.

Flashover is ruled out as the source of the explosion that occurred within the Mill Building.

Backdraft is an explosive *deflagration* resulting from the sudden introduction of air into a confined space containing oxygen deficient products of incomplete combustion (See def. 3.3.16, Backdraft). Kirk's Fire Investigation, 3rd Edition, John D. Dehaan, Pg. 363, also defines deflagration as; *A deflagrative explosion of gases and smoke from an established fire which has depleted the oxygen content of a structure, most often initiated by introducing oxygen through ventilation or structural failure.*

According to the sworn statements of Dan and Martha Sheahan there was an explosion and a fire, which resulted in the immediate loss of structural integrity of the Mill Building. Dan Sheahan's statement on page 24 of his sworn deposition states that he and Mrs. Sheahan arrived at the Mill Building within three minutes after hearing a loud explosion and seeing high flames coming from the direction of the building. Mr. Sheahan states that on their arrival, "The roof was caved in" and, "The entire double structure was all leaning to the north, and everything was on fire…" Mr. Sheahan also states that, "Everything was burning when we first got there."

The rapidity by which this fire occurred and the absence of any documented problems with the structure prior to the Sheahans leaving to eat lunch at the camp house, indicates there was no fire burning in the Mill Building as they left. The Sheahans statements that, there was an explosion and large fire, is proven by the presence of physical evidence but was not the result of a backdraft explosion. As mentioned in the definitions, a backdraft is also a phenomenon, which is a result of a fire in progress. In addition, according to Dan Sheahan's statement on pages 16 and 17 of his deposition, he states that some of the windows in the Mill Building were open because it was warm inside the building. The open windows in the Mill Building would have been a source of fresh air/oxygen for a fire burning inside the building. Therefore no oxygen starvation of a fire that would be burning in the Mill Building could occur and therefore no backdraft explosion could occur.

Backdraft is ruled out as the cause of an explosion within the Mill Building.

All fires, whether accidental or as the result of the crime of *arson* (See def. 3.3.13, Arson), have an *Area* and a *Point* of origin (See def. 3.3.11 and 3.3.132 Area of Origin and Point of Origin). The area of origin can refer to a small, localized area such as a particular room within a structure. It can also refer to a general area within a larger room or building. Area of origin is a geographic reference as it relates to the general location of where a fire started. Point of origin is a specific location within the area of origin where a competent ignition source and fuel come together and ignition occurs. Area of origin and point of origin are determined by the identification and the interpretation of the effects of fire, which are commonly referred to a Fire Patterns (See def. 3.3.68, Fire Patterns).

An examination of the Mill Building machine room, the upper level shop room, the engine room, and the concentration platform revealed several potential heat producing machines (electric motors) and gasoline-powered engines. Gas and electrical powered machinery have some potential to render an ignition source under certain circumstances such as a short circuit within an electric motor or a failure or malfunction of a gas or diesel engine. My examination and interpretation of fire patterns within the Mill Building and my examination of these various devices reveals that none was a contributing factor to the cause of this explosion and immediate large fire. Additionally there were no ordinarily present significant sources of flammable or combustible fuels within the Mill Building that contributed to fire causation and explosive fire spread. All tanks and vessels, with the exception of the acetylene tank located in the shop, were in tact with no evidence of breaches or ruptures noted.

Fire patterns within the Mill Building reveal that there was severe fire damage to the entire structure. A review of the building blue prints and inventory reveal that there were few normally existing combustible items within the Mill Building, independent of the wood building materials used in the construction of the building, that contain such fuel potential as to cause the extensive and immediate fire damage that is evident to the building. The majority of items within the building, were made of heavy metal and iron and are generally *noncombustible materials*

(See def. 3.3.121, Noncombustible Material). Additionally there were no normally existing large stores of combustible materials that would contribute to the fuel-load within the Mill Building that would support such immediate severe fire damage (See def. 5.6.1.1, Fuel Load).

Electrical service wiring was secured within metal conduit per Mr. Sheahan's statements. My examination of the Mill Building revealed the presence of electrical conduit, junction boxes, and other electric wiring enclosures. While electrical wiring compromised by damage to a building can cause energized electrical wiring to now be an ignition source for fuels in the area, the electrical service materials themselves contribute little to the fuel load within a the Mill Building.

All or mostly all combustible materials that made up the fuel load within the Mill Building are the wood construction members; the vertical support posts, ceiling beams and rafters, and horizontal spreaders that comprise the frame of the building. The wood members in their ordinary configuration amount to a significant fuel load potential in the walls of the Mill Building but do not constitute a potential explosive fuel load. In plain terms, the wood frame of any structure will not fuel an explosion under normal circumstances.

Available fire patterns indicate a greater level of destruction by fire near the flotation machine terrace and engine room than to the remainder of the building. Figures 27-29 reveal the location of the bottom heavy timber frame base plates of the structural frame of the Mill Building. These pieces of lumber likely had the same 6"x6" dimensions as the vertical support posts. These base plates were completely or almost completely consumed by fire at this point.

Figure 27. Red arrows indicate lag bolts used to secure heavy timber frame base plates to the retaining wall. The yellow arrow points south.

Figure 28. Red arrow indicates one lag bolt used to secure frame base plates to the retaining wall. Base plate is completely consumed by fire.

Figure 29. Small piece of frame base plate remaining on retaining wall bordering flotation machine terrace. Mass loss due to exposure to fire is greater nearer the point of entry of suspected impact object.

Figure 30 below depicts the northwest corner of the milling floor or bottom tier of the Milling Building. This photograph demonstrates the level of destruction to the frame base plates. The base plates were completely consumed by fire.

As the distance from the north end of the flotation machine terrace (identified probable impact point) increases, fire damage to remaining wooden structural members decreases indicating a reduced exposure to fire in terms of fire burn time, fire intensity, or both (Figure 31-33).

Figure 30. Northwest corner of the Mill Building lower tier wall. No remaining base plates due to consumption by fire.

Figure 31. Red arrow points north and indicates increasing destruction to frame base plate from south to north indicating greater exposure to fire on the northerly side (northwest corner of machine room, lower tier of Mill Building).

Figure 32. The remains of the frame base plate near the southwest corner of the Mill Building. This location is essentially diagonal from the flotation machine terrace and identified impact point. This photo demonstrates a reduced level of damage to construction members indicating it is away from the area of origin.

Figure 33. Demonstrates the southwest corner of the Mill Building. Construction members suffered less exposure to fire away from the flotation machine terrace and identified impact point.

Evidence of burning to the remains of heavier construction members identifies a pattern of fire damage (mass loss) that indicates the area of the flotation machine terrace and identified point of impact either burned with more energy due to an increased fuel load in that area or burned for a longer period of time than areas away from that area of the Milling Building. The advanced fire damage or mass loss to the base plates within the area of origin is attributed to either prolonged burning or burning that results in the release of heat energy at higher rates than would be expected from ordinary combustible materials such as wood (See def. 6.2.2.2 Temperature Estimation).

The fuel load in the pre-explosion/fire condition of this building was relatively the same throughout the building with the exception of the potential of the acetylene tank rupture to add some instant additional fuel to the already burning fire, which it ultimately did. A pattern of advanced destruction to the wood frame base plates on the concrete barrier wall on the east side of the shop (upper tier) is inconsistent with the fire patterns in the building at large. The fire damage sustained by these base plates was severe. It is probable that the advanced fire damage present in that area was the result of additional fuel (acetylene) released into the shop area when the acetylene tank ruptured. Such additional fuel would increase the burning temperatures within the shop area so as to cause greater mass loss to all wood construction members in that area.

The lessening of fire damage to the frame base plates as distance from the flotation machine terrace and identified impact point increases and the severe fire damage to those construction members nearer to the impact point indicates the area of origin for this explosion/fire is near the flotation machine terrace.

FUEL/AIR EXPLOSION

Mr. and Mrs. Sheahan's sworn statements indicate that there was a loud explosion and a large fire that occurred within the Mill Building shortly after they left for their lunch break on June 23, 1954. Mr. Sheahan described the flames of the fire as being, "at least one hundred feet high." The creation of an explosion and immediate large fire requires a fuel that is diffusible (See def. 3.3.46, Diffuse Fuel) and capable of igniting readily. Such a fuel must exist in such a quantity so as to cause a large explosion within this 45'x45' Mill Building and to render it mostly destroyed almost immediately in terms of its structural integrity.

The theory that some large and heavy fuel laden object struck the Mill Building causing an explosion and an immediate fire is reasonably probable as it relates to mechanical possibility. Physical evidence at the Mill Building supports this scenario as a possibility:

Fuel/air explosions require some key properties, a diffusible fuel, oxygen from normal atmospheric oxygen levels, the ability of the vapors of such a diffusible fuel to readily mix with normal atmospheric oxygen, and a competent ignition source to ignite such a mixture. The source of a diffuse fuel can be from chemical fuels under pressure contained within pressurized containment vessels such as gas cylinders or non-pressurized *ignitable liquids* (See def. 3.3.103 Ignitable Liquids) that when released into an oxygen rich environment from their canisters will vaporize thereby mixing (diffusion) with available ambient oxygen forming a potentially explosive mixture of fuel and air. These mixtures can vary in the rate at which they will propagate depending on fuel type, fuel to air ratio, and other factors such as containment within a building and the ventilation properties of such buildings. These fuel/air explosions often create a *pressure wave front* as they propagate (See def. 23.4, Effects of Explosions).

The effects of fuel/air explosions are classified as either deflagrations or detonations (See def. 3.3.45, Detonation and def. 3.3.42, Deflagration), depending on the velocity of the flame front propagation through the fuel air mixture or an unreacted explosive. The regimes of propagating flame fronts are more accurately described as a deflagration or a detonation (See def. 23.2.3.1.3, Combustion Explosions).

Evidence within the Mill Building demonstrates the lack of any compressed flammable gas which having released its contents prior to the explosion/fire, contributed directly to the cause of this explosion/fire event. Referring back to the assessment made of the state of the acetylene tank located in the shop area of the Mill Building; the acetylene tank, in the opinion of this analyst, ruptured due to failure of the tank as a result of prolonged exposure to fire as a result of being in the Mill Building as it burned. Physical evidence also demonstrates that no additional normally present large quantity of flammable or combustible liquids or compressed gases that would have acted as the primary fuel of a large explosion were present in the Mill Building prior to the explosion and fire.

CONCLUSIONS

Impact:

As mentioned earlier, the examination of the flotation machine terrace area revealed evidence of a possible impact area against the Mill Building by some large and heavy airborne object. The symmetric bending pattern of the roof/wall panels depicted in Figures 18-21 from outside to inside demonstrates the probable path of travel of whatever object may have impacted this building. Additionally, within the flotation machine terrace area is evidence supporting the immediate dislocation of the flotation machine from its terrace to the floor below. Photographic evidence in Figure 20 demonstrates the probable relationship between the suspected point of entry into the lower tier of the milling room and the flotation machine displacement.

It was noted by this analyst that the engine room, which is part of the Mill Building by way of general construction lies directly to the north and would have been in the path of any object that may have struck the buildings north wall. The remains of the construction materials of the engine room were not specifically identified by me, and none of the remains of the engine room construction materials remain in their original location either due to the explosion and fire or other forces that have affected this building. It is not reasonable to conclude that the machine room structure would have absolutely prevented the large and heavy object from impacting the north wall of the Mill Building milling room. In fact, the point of contact at the flotation machine terrace may have been the result of the deflection of the large and heavy object from some other trajectory. The key point is that the physical evidence supports an impact by a large and heavy object at the point of the flotation machine terrace.

Based on physical evidence near the point of impact against the Mill Building, it is the opinion of this analyst that this building was struck outside to inside by some large and heavy airborne object. The potential for a large and heavy airborne object to strike at some point on or through the engine room and continue its path to strike the north wall of the Mill Building is a function of its design, weight, shape, velocity, trajectory, and construction material. None of the factors listed above are known to me. However, as stated above, the physical evidence of an impact immediately near the flotation machine terrace is present and compelling.

Explosion:

In addition to depositing a greater amount of it's contents near the point of entry, a fuel introduced into the Mill Building by some airborne object would likewise disperse a portion of that fuel into the Mill Building interior space including the engine room causing diffusion of said fuel and mixing with ambient oxygen. Once mixed and within ignitable range, the now competent fuel needs only an ignition source to ignite.

This analyst was unable to identify a specific ignition source. The Mill Building however, was an operating industrial building with electrical service. An impact against this building would likely compromise electrical service equipment or conductors and potentially create a condition where electrical arcing could occur. Such arcing is a reasonably probable ignition source, which could have ignited a diffuse fuel/air mixture causing a low-order fuel/air explosion and an immediate fire. As a liquid fuel is dispersed it mixes with available ambient oxygen (diffusion) and once that mixture reaches its *flammable/explosive range* (See def. 5.2.3.2.1 Flammable/Explosive Range)

Physical and testimonial evidence available to me supports the occurrence of a large explosion and immediate fire within the Mill Building. This analyst found no evidence that indicates there was some normally existing quantity of fuel present in the Mill Building that would have supported such an explosion.

Therefore it is logical to conclude that such a quantity of competent diffusible fuel was probably introduced into the Mill Building by some external source. A careful examination of the area of origin and probable impact reveals evidence that supports an outside to inside impact against the building by some large and heavy object. The coincidence of these two supported events, an impact and immediate explosion, supports the theory that such a large and heavy object which probably struck the Mill Building at the point of the flotation machine was probably laden with some diffusible fuel. Such a fuel, in order to spread through the Mill Building and to mix with available ambient oxygen was probably liquid in form.

Based on the physical evidence identified by this analyst, it is my opinion that the explosion which occurred within the Mill Building was the result of some competent diffusible fuel which was introduced into the building by an airborne containment vessel of some type. Such fuel rapidly spread throughout the interior of the Mill Building, mixed with ambient air (oxygen) until it reached it's flammable range then was ignited by an ignition source within the Mill Building.

Fire:

As discussed in the above Fire section, Pg. 35, such a quantity of fuel introduced into the Mill Building by an outside source, and capable of diffusion and mixture with ambient oxygen, and capable of ignition and explosive propagation would most probably have been liquid in form. An impact against the Mill Building by some vessel containing some ignitable liquid fuel, once contacting the building, would deposit the greater amount of it's contents near the point of impact thus creating a fuel rich area which would sustain burning for a longer period of time relative to areas within the Mill Building that were remote from the point of impact. Supporting evidence for this scenario is the advanced mass loss to the frame base plates near the point of impact and lessening mass loss to the base plates as distance from the point of impact increases (exception: the southeast upper tier shop area due to added acetylene gas fuel as a result of an eventual B.L.E.V.E.).

The fire in the Mill Building was a secondary affect of an impact and explosion within the building. The advanced burning and destruction by fire in this scenario is the probable result of the additional fuel introduced into the building by some large and heavy fuel-laden object. The fuel remaining, which did not readily mix with available ambient oxygen and did not deflagrate, remained in the Mill Building as fuel for the ensuing fire. This additional fuel supported aggressive burning beyond what would have been likely given the normal fuel load within the building. It also supported immediate severe fire conditions per the Sheahan's statements regarding fire conditions minutes after the explosion.

It is the opinion of this analyst based on physical evidence that the most probable scenario of the destructive event which destroyed the Groom Mine Mill Building, is a sudden impact of some large and heavy object against the north side of the building at the point of the north end of the flotation machine terrace. It is further my opinion based on the same physical evidence that such impact device carried with it a quantity of some diffusible liquid fuel, which once striking the building distributed the same fuel throughout the interior of the Mill Building and especially near the entrance point at the flotation machine terrace. This probable impact weakened the Mill Building structure on the north side promoting very early structural compromise (lean), and created a fuel and air mixture within the building that was ignitable by some competent ignition source, most likely electrical arcing from impact damaged electrical service materials and equipment.

GLOSSARY OF TERMS

3.3.11 Area of Origin is defined as a structure, part of a structure, or general geographic location within a fire scene, in which the *point of origin* of a fire or explosion is reasonably believed to be located. The area of origin for a fire is identified by a systematic examination of available fire patterns. Fire under normal circumstances burns upward and outward. The systematic examination of fire patterns starting from least to worst and outside to inside of a compartment will lead an investigator finally to the area of origin of a fire.

3.3.13 Arson is the crime of maliciously and intentionally, or recklessly, starting a fire or causing an explosion.

3.3.42 Deflagration. Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

3.3.45 Detonation. Propagation of a combustion zone at a velocity greater than the speed of sound in the unreacted medium.

3.3.46 Diffuse Fuels. A gas, vapor, dust, particulate, aerosol, mist, fog, or hybrid mixture of these, suspended in the atmosphere, which is capable of being ignited and propagating a flame front.

3.3.62 Fire is defined as a rapid oxidation process, which is a chemical reaction resulting in the evolution of light and heat in varying intensities (NFPA 921). Fire propagation or fire spread is the movement of fire and fire products such as heated gases and smoke within a compartment. Variables within a building such as the shape and size of the compartment, any intervening materials within the compartment, fuel quality (type), fuel load (quantity), fuel configuration, and ventilation attributes control the propagation or spread of a fire burning within a compartment.

3.3.68 Fire Patterns are the visual and measureable physical changes, or identifiable shapes, formed by a fire effect or group of fire effects. The identification of fire patterns demonstrates movement, intensity, and possible duration of a fire within a compartment. Fire patterns can be observed on any material, objects, or building structural members that are combustible or flammable.

3.3.85 Fuel. A material that will maintain combustion under specified environmental conditions.

3.3.99 Heat Release Rate. The rate at which heat energy is generated by burning.

3.3.101 High Order Damage is characterized by shattering of the structure, producing small debris pieces. Walls, roofs, and structural members are broken apart with some members splintered or shattered, and with the building completely demolished. Debris is thrown considerable distances, possibly hundreds of feet. High order damage is the result of relatively high blast loads.

3.3.103 Ignitable Liquids. Any liquid or the liquid phase of any material that is capable of fueling a fire, including a flammable liquid, combustible liquid, or any other material that can be liquefied and burned.

3.3.119 Low Order Damage is characterized by walls bulged out or laid down, virtually intact next to the structure. Roofs may be lifted slightly and returned their approximate original position. Windows may be dislodged, sometimes without glass being broken. Debris produced is generally large and is moved short distances. Low order damage is produced when the blast load is sufficient to fail structural connections of large surfaces such as walls or roof, but insufficient to break up larger surfaces and accelerate debris to significant velocities.

3.3.121 Noncombustible Material. A material that, in the form in which it is used and under the condition anticipated will not ignite, burn support combustion, or release flammable vapors when subjected to fire or heat.

3.3.132 Point of Origin is the exact physical location within the area of origin where a heat source and fuel interact resulting in a fire or explosion. In any fire identifying the point of origin for that fire is the goal of a fire cause investigation. The failure to identify the specific ignition source within the area of origin does not automatically render the cause determination of a fire as undetermined. All facts, circumstances, and the elimination of implausible hypothesis regarding ignition will reasonably infer an ignition source exists and that a fire did occur.

5.2.3.2.1 Flammable/Explosive Range of a fuel is expressed as a percentage of ignitable gas or vapor in air by volume. In this context the words "flammable" and "explosive" are interchangeable. The flammable or explosive range is particular to the fuel involved. Each ignitable gas or vapor has its own range or limits of flammability.

5.5.3.1 Heat Transfer by Convection. Heat is transferred by convection to a solid when hot gasses pass over cooler surfaces. The rate of heat absorbed by the solid is a function of the temperature difference between the hot gas and the surface, the thermal inertia of the material being heated, the surface area exposed to the hot gas, and the velocity of the hot gas…

5.6.1.1 Fuel Load describes the amount of fuel present, usually within a compartment.

6.2.2.2 Temperature Estimation. Wood and gasoline burn at essentially the same flame temperature. The turbulent diffusion flame temperature of all hydrocarbon fuels (plastics and ignitable liquids) and cellulosic fuels are approximately the same, although the fuels release heat at different rates. Burning metals and highly exothermic chemical reactions can produce temperatures significantly higher than those created by hydrocarbon or cellulosic-fueled fires.

6.2.3.1 Mass Loss. Fires convert fuel and oxygen into combustion products, heat, and light. This process results in mass loss of the fuel (consumption of the material). During a fire, combustible and non-combustible materials may also lose mass due to evaporation, calcination, or sublimation.

6.3.4.2 Protected Areas. A protected area results from an object preventing the products of combustion from depositing on the material that the object protects, or prevents the protected material from burning…

7.2.3.7.1 Orientation, Position, and Placement [Many materials burn differently depending upon their orientation, position, or placement within a building. Generally materials burn more rapidly when they are in a vertical rather than horizontal position].

23.2.3.1 Chemical Explosions. In chemical explosions the generation of the overpressure is the result of exothermic reactions wherein the fundamental chemical nature of the fuel is changed. Chemical reactions of the type involved in an explosion usually propagate in a reaction front away from the point of initiation.

23.2.3.1.3 Combustion Explosions are classified as either deflagrations or detonations, depending on the velocity of the flame front propagation through the fuel air mixture… The regimes of propagating flame fronts are more accurately described as a deflagration or a detonation.

23.4 Effect of Explosions. An explosion is a gas dynamic phenomenon that, under ideal theoretical circumstances will manifest itself as an expanding spherical heat and pressure wave front…

23.4.1.1 Blast Overpressure and Wave Effect. General. Certain explosions produce significant volumes of gas. As these gases are generated, the pressure in the confining vessel increases and can significantly damage the confining vessel. In addition, the expanding gases and the displaced air moved by the gases produce a pressure front that is primarily responsible for the damage and injuries associated with explosions.

Kirk's Fire Investigation, 3rd Edition, 1991, Deflagration; A deflagrative explosion of gases and smoke from an established fire which has depleted the oxygen content of a structure, most often initiated by introducing oxygen through ventilation or structural failure.

RESEARCH AND REPORTING RESOURCES

The facts and/or data considered by this author are listed below or are included in the work file, which accompanies this report.

Citations:

- National Fire Protection Association (NFPA) 921, Guide to Fire and explosion Investigation, 2014 Edition
- Kirk's Fire Investigation, John D. DeHaan, Third Edition 1991
- "Air Products: SafetyGram" – 13. Acetylene. *Pdf*. Web. 10 June 2016.

The following research resources are part of the case file and are attached to this report:

- Daniel Sheahan Deposition 1957
- Martha Sheahan Deposition 1957
- 7.30.1955 Letter, Sheahan to Sen. Malone
- 6.23.1954 Mill Inventory
- 1947.5.23 Mill-Mine Inventory
- 1954 Mill Fire Report
- 1954 Mill Site photos
- Google Earth, Build Date 5/20/2015
- Groom Mine Mill Site1950 photos (3)
- Mill Design Plans
- Mill Pictures-Articles

The following documents are attached to this report:

- Ortiz Engagement Letter
- Ortiz CV