MAI–2015-15

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Surface Nonmetal Mine
Crushed, Broken Granite

Fatal Falling Material Accident
August 3, 2015

Luck Stone Corp - Leesburg
Leesburg Plant
Ashburn, Loudoun County, Virginia
MSHA I.D. No. 44-02964

Investigators

Gary C. Merwine
Mine Safety and Health Inspector

Brett M. Smith
Mine Safety and Health Inspector

Darren J. Blank, P.E.
Supervisory Civil Engineer

Anthony J. Argirakis
Civil Engineer

Gregory J. Mehalchick
Mine Safety and Health Specialist (Training)

Originating Office

Mine Safety and Health Administration
Northeastern District
Thorn Hill Industrial Park
178 Thorn Hill Road, Suite 100
Warrendale, Pennsylvania 15086-7573
Peter J. Montali, District Manager

OVERVIEW

On August 3, 2015, Daniel C. Potter, truck driver / seasonal associate, age 18, was fatality injured at the Leesburg Plant. Potter had parked his truck alongside the "sand plant fines" silo under a conveyor belt to load his truck. Potter exited the truck and entered a door leading underneath the silo. Soon after entering the silo, the hopper portion of the structure collapsed, burying Potter beneath the falling material.

The accident occurred due to management's failure to ensure that adequate inspections were conducted to properly evaluate the structural integrity of the "sand plant fines" silo. In addition, management failed to take necessary follow-up actions to repair or replace components in order to maintain the stability of the structure.

GENERAL INFORMATION

The Leesburg Plant, a surface stone mine owned and operated by Luck Stone Corp-Leesburg, is located in Ashburn, Loudoun County, Virginia. The principle operating officials are John Legore, President, and Charlie Windle, Vice President, Northern Region. The mine operates two, 9-hour shifts, five to six days per week. Total employment is 45 persons.

Granite is drilled and blasted from a multiple-bench quarry. A front-end loader is used to load haul trucks, which transport the broken granite to the onsite plant for processing. The material is then crushed, sized, and sold as construction aggregates to a wide variety of commercial users.

The Mine Safety and Health Administration (MSHA) completed the last regular inspection at this operation on March 3, 2015.

DESCRIPTION OF ACCIDENT

On the day of the accident, Daniel C. Potter (victim) reported for work at 6:00 a.m., his normal start time. Potter attended the regularly scheduled morning meeting and was assigned by Steve Schneider, Lead Man, to remove material from the "sand plant fines" silo and dump it at the onsite fines storage area. Potter conducted a pre-operational examination of his haul truck and then drove it to the silo.

When Potter arrived at the silo, Terry B. Leon Guerrero, Utility Man, and Stephen H. Iuliano, Plant Operator, were standing nearby. Leon Guerrero and Iuliano spotted for Potter as he backed his truck underneath the outside SP4 conveyor belt to load. As Potter was exiting the truck cab, Iuliano stated that he would start the conveyor belt and observed Potter getting back into the truck. Using the SP4 control switch mounted on the outside of the silo, Iuliano started the conveyor belt and proceeded to walk eastward toward the Pug Mill. Iuliano stopped to talk to Dale R. Silvers, Plant Operator, who was driving past in a pick-up truck.

Leon Guerrero heard the conveyor startup alarm sound and proceeded to walk through the "sand plant fines" silo, exiting the silo at the West door. As Leon Guerrero was walking through the silo, Potter exited his haul truck and entered the silo. Leon Guerrero was approximately 10 feet outside of the West door when the silo partially collapsed. Leon Guerrero, Silvers, Iuliano, and Adam G. Beissner, Intern Engineer, were all in the area when the collapse occurred. They immediately checked with each other to see if anyone was hurt. When Leon Guerrero noticed that Potter was not in his truck, he started calling his name, but there was no response. Leon Guerrero contacted Rusty M. Minix, Foreman, to report the collapse and that Potter could not be located. Minix called 9-1-1 for emergency assistance. He then instructed all employees to search for Potter in the garage, bathrooms, break room and other buildings, but Potter could not be located. Afterward, every available person attempted to remove material, by hand, around the outside of the silo. Due to the amount of material that had flowed from the silo and the unstable condition of the structure, the rescue attempt was halted.

At 6:39 a.m., emergency response teams from Fairfax County and Loudoun County, as well as personnel from the Ashburn Fire Department arrived on site. The unstable condition of the silo prevented immediate rescue. A 450-ton capacity crane was brought to the site and wire-rope cables were attached to the structure in order to secure and stabilize it. At approximately 7:30 p.m., the emergency responders started removing material and cutting away the fallen metal structure. The victim was recovered from the wreckage at 11:50 a.m. on the following day. The cause of death was attributed to mechanical asphyxia.

INVESTIGATION OF ACCIDENT

Troy Austin, Safety Coordinator, notified MSHA of the accident at 7:01 a.m. on August 3, 2015, by a telephone call to the Department of Labor's National Contact Center (DOLNCC). The DOLNCC notified Kevin Abel, Acting District Manager, and an investigation began the same day. In order to ensure the safety of all persons, MSHA issued a 103(j) order and later modified it to section 103(k) of the Mine Act when the first Authorized Representative arrived at the mine.

MSHA's accident investigation team traveled to the mine, conducted a physical inspection of the accident site, interviewed employees, and reviewed conditions and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, mine employees, and the Virginia Department of Mines, Minerals, and Energy.

DISCUSSION

Accident Location and Overview

The accident occurred at the "sand plant fines" silo. The operator conveyed fine material (very fine sand to clay sized particles) generated from processing sands to the silo from bins 2 and 3 via conveyor belt SP1. The material from the SP1 belt fed into a Buell© aggregate classifier located near the roof at the south end of the silo. The coarse fraction of the material (larger than 150 microns) passed through the classifier and was deposited onto the SP2 conveyor belt where it was then taken to the sand stockpile. A portion of the material, finer than 150 microns, was deposited into the silo. Fine material withdrawn from the silo was deposited onto the SP4 conveyor belt. The SP4 belt was reversible and material could either be directed to the east and deposited into a haul truck for placement in a storage area or directed to the west where it was taken back to the sand plant. The fines material within the silo was used as mineral filler in the production of asphalt.

Description of the Silo

The "sand plant fines" silo was designed by Peabody TecTank, Incorporated, and was erected in April 1993 by J & L National Construction Corporation. According to design data presented on the construction details drawing, the estimated capacity of the silo was 734 tons. The silo was 21 feet 6.5 inches in diameter and 56 feet 7 inches in height (not including the bag house structure on the roof), and designed to operate under a negative pressure. The silo contained an internally suspended, 60-degree hopper, with an outlet positioned 16 feet 1 inch above the 24-foot-square concrete foundation slab. The 17-foot-8-inch-deep hopper was bolted to the cylinder wall 33 feet 9 inches above the foundation. The hopper had a 16-inch-diameter outlet, and a rotary vane feeder deposited the material onto the SP4 conveyor belt. The cylinder portion had a height of 22 feet 10 inches above the hopper connection (see Figure 1).

The hopper and cylinder portions of the silo structure were constructed of ¼-inch-thick steel plate and the inter-plate hopper and cylinder connections were bolted using ½-inch-diameter grade 5 galvanized carriage bolts placed through 5/8-inch-diameter holes that were drilled on 2-inch centers. The plates used in the cylinder wall were approximately 8 feet high by 4 feet 6 inches wide. The interior and exterior of the silo was coated with copoxy primer, but the exterior was provided with a finish coat of Boscobel acrylic. The silo was design without wear plates. Also, the operator did not install wear plates inside the interior of the silo after the silo was placed into service. The operator did install a flow induction system into the silo to promote continuous feeding of the fine material. According to the investigation interviews, the flow induction system was automated and sent pulses of compressed air into the hopper at regular intervals (reported to be approximately every 5 minutes).

The 60-degree hopper was constructed in three concentric rings. The lower section was approximately 8 feet high and 7 plates were used for its construction. The outlet opening was 16 inches in diameter and a rotary vane feeder was bolted to the outlet. The central ring was also approximately 8 feet high and 14 plates were used for its construction. The top of the lower ring was bolted along the entire circumference to the bottom of the central ring. The upper ring was approximately 1 foot 8 inches high and also consisted of 14 plates. The upper ring was secured to the silo wall and the top of the central ring was bolted to the bottom of the upper ring along the entire circumference. A 1-inch-wide nitrile rubber gasket was placed on the inside of the connection ring for air-tightness.

The structural apron of the silo around the hopper area was stiffened by the addition of fourteen, 6-inch-deep (W6x9), steel columns evenly spaced around the internal circumference of the structure. The columns were bolted directly to the cylinder wall through the lower right flange and also secured to the wall with the use of right and leftsided lateral support brackets. The top of the columns abutted the hopper just below the connection to the cylinder wall and the bottom of the columns rested on a shim plate on the concrete slab. The apron contained a conveyor opening and a man door opening on both the east and west sides. The conveyor openings were 3 feet 6 inches wide and approximately 3 feet high. The 24-inch-wide SP4 conveyor belt ran through these openings. The man door opening on the east side of the silo was approximately 3 feet wide and 7 feet high, and the controls to operate the SP4 conveyor belt were mounted to the outside of the silo wall on the south side of this opening. The man door opening on the west side was 2 feet wide by 5 feet high. The man door openings were offset approximately 6 feet in the counterclockwise direction from the conveyor openings.

The roof of the silo was also constructed of ¼-inch-thick steel plate. Two separate horizontal frames were positioned just beneath the roof. The northern rectangular-shaped frame consisted of W16x26 steel members and the southern rectangular-shaped frame consisted of W8x18 members. According to the design drawings, the northern frame was designed to carry a maximum load of 21,000 pounds. The frame supported a model 315 expandable capacity reverse pulse dust collector manufactured by Tri-Fab, Incorporated, which weighed an estimated 20,000 pounds. The southern frame was designed to carry a maximum load of 4,000 pounds and appeared to provide direct support for the drop-out boxes associated with the classifier.

Two additional structures were separate from the "sand plant fines" silo, but located in close proximity to it. The "C-Box" pump house building consisted of a small trailer located at the north end of the silo and it housed instrumentation for the dust control system. A four-level structure at the south end of the silo provided support for portions of the classifier, transfer chutes, and dust control equipment. It had a flight of stairs that led to the roof of the silo, but the structure was otherwise independent of the silo.

Previous Silo Repairs and Inspections

In 2007, Luck Stone retained the services of Tank Connection to replace the lowest ring of the hopper structure. Tank Connection's design included was a 24-inch-diameter flush-style manway opening with a cover. They installed a new rotary vane feeder was also installed as part of this repair work. Persons interviewed during the investigation did not know the reason for replacing the ring.

On January 17 and 18, 2012, Cliff Powell, Construction Superintendent for Luck Stone, and several plant associates performed an inspection of the "sand plant fines" silo. This was the only inspection of the silo that was conducted prior to the accident. Plate thickness measurements were taken at 34 locations in the cylinder wall above the hopper and at 13 locations in the hopper. The measurements were taken from the outside of the cylinder and the hopper using an electronic ultrasonic thickness gauge. When discussed during interviews, company representatives were not aware of inspections ever being conducted inside of the cylinder or hopper.

The plate thickness measurements taken in the cylinder wall were well distributed over the height and circumference of the section. The section comprised three rings of plates, and a pattern of wear was evident based on the measurements. Starting at the north side and progressing to the east and west, the loss of cross-sectional area was minimal over the height of the wall. The minimum thickness measured was 0.23 inches, which is only slightly less than the original thickness of 0.25 inches. As the readings progressed beyond the east and west sides toward the south side of the wall, the thickness of the plates significantly diminished. From the east side progressing to the south end, the thickness measurements tapered down from approximately 0.24 (east) to 0.21 (southeast) to 0.16 inches (south). At a couple of locations at the south end, the thickness of the plate measured 0.13 inches, which represents nearly 50 percent section loss. From the west side progressing to the south end, the thickness measurements tapered down from approximately 0.24 (west) to 0.20 (southwest) to 0.16 inches (south). The drop-out boxes from the roof-top material classifier were positioned above the south end of the silo where the reduced plate thicknesses were observed.

Luck Stone concentrated the hopper plate thickness measurements in the central and lower rings. While the elevations of the readings were clearly marked on the referenced drawing, the positions of the readings relative to direction were not. A reading taken on the top of the central ring indicated a thickness of 0.25 inches, and four readings taken in the lower portion of the central cone showed a range of thicknesses of 0.18 to 0.21 inches. A total of eight thickness measurements were taken near the bottom of the lower ring and at the top of the cone outlet. The measurements ranged in thickness from 0.22 to 0.24 inches. It is expected that the thickness measurements in the lower ring would be relatively high since the section was replaced in 2007.

Powell's 2012 inspection report indicated that "the area of concern is near the drop-out boxes." Recommendations were made to change wear characteristics, and that wear locations should be checked yearly or every other year. This recommendation was never acted upon by the operator.

MSHA Inspection of the Silo following Failure

When the hopper failure occurred on the morning of August 3, 2015, the silo was reportedly full of fine material. While an exact level was not known, the computer control room received a "high level fault" or a full bin alarm on August 2, 2015, from the Bindicator© located at the top of the silo. The fault caused the bins and conveyors feeding the silo to shut down. MSHA obtained a sample of the stored fine material and determined that the material had a unit weight of 98 pounds per cubic foot (pcf). Based on a calculated storage volume of 10,650 cubic feet, the estimated weight of the material in the silo at the time of the accident was 522 tons. Luck Stone later weighed uncompacted and compacted, known-volume samples of the material and determined densities of 85.2 and 104.2 pcf, respectively. Using these densities, the estimated material stored in the silo would have ranged between 454 tons and 555 tons.

The failure reportedly occurred just minutes after the SP4 belt was started and only a small amount of material was withdrawn from the silo. The failure of the hopper structure occurred along the connection of the central ring to the upper ring. This connection was not part of the work in 2007 when the lower hopper ring was replaced.

As indicated above, 14 plates were used for the construction of the conically shaped central ring. The upper circumferential ring connection to the bottom of the upper ring contained 5/8-inch-diameter bolt holes drilled on 2-inch centers (each plate contained 25 holes in the upper ring connection). The inter-plate seams of the central hopper ring possessed the same specifications. The bolts used for the ring connection and inter-plate seams had an original head diameter of 1.0 inches.

Based on observations of the final position of the hopper, it appears that the initial separation occurred at the south side (see Figure 1). This resulted in the hopper swinging to the north before completely detaching. When observed on the concrete pad, the south side of the hopper was lower than the north. When the hopper impacted the ground and the north silo wall, it resulted in a tear in the cylinder wall that measured 17 feet wide (at the base) by 27 feet high. The hopper tore open through the full height of 16 feet and the width of the tear was 14 feet at the base. A large section along the northeast side of the hopper was cut out during the recovery process.

During the investigation, the investigation team made observations and measurements of the cylinder, hopper structure, and connecting hardware. While the central ring of the hopper contained 14 seams, for clarity of reporting the findings, this report uses a conventional north-south direction system and divides the circular structure into quadrants. The diameter of the five uppermost bolt heads was measured with a micrometer to determine the representative amount of section loss due to corrosion and abrasion at each of the 14 seams. The range of diameters found at each seam was narrow; however, to reduce the volume of data presented, only the average value of the five measurements will be reported. Additionally, while elongations were measured in many of the bolt holes along the central ring connection (particularly on the north side), it was clear that the connection did not tear on either the central or upper ring.

<u>North to West Quadrant</u>

- The investigation team observed heavy delamination of the hopper plates and bolt heads. They used a chipping hammer to remove the delaminations.
- The average diameter of the bolt heads tapered from 0.95 inches at the north side of the hopper down to 0.80 inches at the west side of the hopper. The heads became considerably thinner toward the west side.
- Many of the bolts still remaining in the connection ring had very thin bolt heads that pulled through the connection to the upper hopper ring.
- Many of the bolt holes on the connection ring exhibited elongation in this quadrant. Starting at the north end, elongations measured approximately 0.81 inches (0.625 inches was the original diameter). Progressing to the west side, the elongations tapered down to 0.69 inches.

West to South Quadrant

- The investigation team observed corrosion of the hopper plates, but the steel was not delaminated. It is likely that material flowing against the hopper continually removed the delaminations.
- The average diameter of the bolt heads abruptly tapered from 0.80 inches at the west side of the hopper to missing at the south side of the hopper. Of the four seams measured in this quadrant, only the first seam on the west side had measurable bolt heads.
- Many of the bolts still remaining in the connection ring had heads that were completely worn and corroded off. Mainly the bolt shafts remained and corrosion was observed on the top of the shaft. An example of the worn/corroded bolts found at the south side interior of the silo is included in Appendix C (see Figure 2).
- Most of the bolt holes on the connection ring exhibited no appreciable elongation.

South to East Quadrant

- The investigation team observed, corrosion of the hopper plates, but the steel was not delaminated.
- The bolt heads were missing at the south side of the hopper. Of the three seams measured in this quadrant, only the last seam on the east side had measurable bolt heads. The average bolt head diameter on the west side measured 0.75 inches, but the heads were very thin.
- Many of the bolts still remaining in the connection ring had heads that were completely worn and corroded off. Mainly the bolt shafts remained and corrosion was evident on the top of the bolt shaft. Some of the bolts still remaining on the connection ring near the east side had very thin bolt heads that pulled through the connection to the upper hopper ring.
- Most of the bolt holes on the connection ring exhibited no appreciable elongation.

East to North Quadrant

- The investigation team observed moderate delamination of the hopper plates and bolt heads. A chipping hammer was used to remove the delaminations.
- The average diameter of the bolt heads in this quadrant ranged from 0.98 inches at the east side to a full 1.0 inches toward the north side.
- Many of the bolts still remaining on the connection ring had deformed significantly and failed through the shaft. The surfaces appeared to be fresh breaks and no corrosion was observed.
- Many of the bolt holes on the connection ring exhibited elongation in this quadrant. Starting at the east side, elongations measured approximately 0.73 inches. Progressing to the north side, the elongations remained mostly consistent at 0.74 inches.

Visually, the outside of the silo structure and the area inside of the apron appeared to be in good condition. The protective paint was intact, and the investigation team did not observe signs of significant corrosion.

Weather

The weather conditions on the day of the accident were clear with a temperature of 64 degrees Fahrenheit and light winds from the southwest. Weather was not considered to be a factor in the accident.

Summary

The investigators concluded that the failure of the hopper initiated at the south side along the connection of the central hopper ring to the upper hopper ring. As the hopper began to drop, the connections around the east and west sides became overstressed and the failure progressed to the north side. As the stress shifted to the north side of the cylinder, the cylinder wall and columns became overstressed and buckled. As the contents in the silo began to drop due to the failing hopper, the associated negative pressures within the silo caused the unreinforced walls in the cylinder section to pull inward. The force of the falling material and the impact with the concrete foundation pad caused the hopper to tear open, contact the north cylinder wall, and cause it to tear as well.

The failure of the hopper occurred due to a combination of critical factors. The bolt heads connecting the central hopper ring to the upper ring were completely abraded/corroded off over an arc angle of approximately 64 degrees on either side of the south end of the hopper. This corresponds to an arc length of approximately 24 feet (of the total 67.5-foot silo circumference), which would have been completely unrestrained against movement. Additionally, sections of the connection ring adjacent to this area had bolt heads that were significantly damaged due to corrosion and abrasion. The measured elongations of the holes in the connection ring revealed that the south side of the of the central hopper ring transferred little stress before disconnecting. The elongations of the holes progressively increased (reflecting an increasingly higher stress transfer) along the east and west sides of the structure with the highest elongations at the north side.

It was reported that the silo was full of sand fines material at the time of the failure. The day before the failure, the automated feed was shut down when a high-level fault occurred. It was estimated that approximately 522 tons of material was in the silo at the time of the accident. This resulted in a significant load on the cylinder and hopper structure. Additionally, the hopper's central ring connection to the upper ring was substantially compromised due to the damaged bolts, particularly along the south side of the structure. The concentrated damage to the south side of the cylinder (in both the cylinder wall and hopper bolts) appears to be the result of progressive abrasion and corrosion.

The silo was designed for off-center filling with a center discharge and a funnel flow pattern. Under funnel flow conditions, the material along the cylinder walls essentially is static and flow is concentrated down to the hopper outlet through a central channel. As the material level continues to drop, the stagnant material along the wall gradually falls into the central flowing channel. The abrasion to the cylinder walls and hopper are minimized under this flow regime. However, it is believed that a more asymmetric off-center emptying condition developed which ultimately contributed to the damage to the south side of the structure. The evidence to support this theory includes the company's inspection data that revealed significant loss of cross-sectional area of the cylinder's south walls, the wear patterns of the bolt heads measured along the perimeter of the connection ring, and the degree of delamination of the hopper plates and bolt heads along the north side of hopper. Since the delaminations associated with the hopper plates and bolt heads on the north side of the hopper were still on the members and not abraded off, it suggests that the north side of the silo could have been a dead storage area that led to the asymmetric flow condition.

It appears that the failure of the hopper was triggered when the SP4 conveyor was started and material began to withdraw from the silo. Material flowing adds additional load to the wall of a storage structure due to frictional drag. Due to the dead storage of material along the north side of the silo and the asymmetrical flow, unsymmetrical loads were applied to the cylinder and hopper as material began to flow, which resulted in the structure becoming more oval in shape. As the ovality of the hopper increased in the east-west direction, the north-south dimension of the hopper diameter decreased. On the south side, the central ring connection separated due to the lack of bolt heads along the connection. The separation continued until the central ring completely pulled from the bolt shaft and support for the central ring was lost. This separation did not occur along the north side due to the bolt heads still being intact.

TRAINING AND EXPERIENCE

Daniel C. Potter (victim) had 9 weeks of mining experience as a Truck Driver / Seasonal Associate, all at this mine. A representative of MSHA's Educational Field and Small Mines Services reviewed the mine operator's Part 46 training records for Potter. Potter had completed his 24-hour new miner training on June 23, 2015. He also received task training for his assigned haul truck on July 13 and 17, 2015.

ROOT CAUSE ANALYSIS

The investigators conducted a root cause analysis and identified the following root causes:

Root Cause: Management failed to ensure that adequate inspection procedures were in place to properly evaluate the structural integrity of the "sand plant fines" silo. In addition, management failed to take necessary corrective actions in order to maintain the stability of the structure.

Corrective Action: Management contracted an independent engineering firm to evaluate the existing structure to ensure that prompt corrective actions were taken to restore or replace the "sand plant fines" silo.

CONCLUSION

The accident occurred due to management's failure to ensure that adequate inspections were conducted to properly evaluate the structural integrity of the "sand plant fines" silo. In addition, management failed to take necessary follow-up actions to repair or replace components in order to maintain the stability of the structure.

ENFORCEMENT ACTIONS

Issued to Luck Stone Corp-Leesburg

Order No. 8919404 - Issued on August 3, 2015, under the provisions of Section 103(j) of the Mine Act. An Authorized Representative modified this order to Section 103(k) of the Mine Act upon arrival at the mine site:

> *A 200 ton bin collapsed at the sand plant at 0620 hours. A verbal 'J' order was issued over the phone to prevent destruction of evidence. All persons are prohibited from entering the sand plant with the exception of recovery personnel.*
>
> *A fatal accident occurred at this operation on August 3, 2015, when a miner was trapped under a collapsed bin. This order is issued to assure the safety of all persons at this operation. It prohibits all activity at the sand plant until MSHA has determined that it is safe to resume recovery operations. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore activity in the affected area.*

This order was terminated on August 10, 2015, after conditions that contributed to the accident no longer existed. Note: At the time of the initial accident response, the investigators were informed that the silo had a 200-ton capacity (as reflected in Order No. 8919404 above). As outlined in the "Discussion" section of this report, the investigators later determined that the estimated weight of the material contained in the "sand plant fines" silo was 522 tons.

Citation No. 8922124 - Issued under the provisions of 104(a) of the Mine Act for violation of 30 CFR § 56.14100(c):

> *A fatal accident occurred at this operation on August 3, 2015, when a truck driver exited his truck, entered the "sand plant fines" silo, and a structural failure occurred causing the silo hopper to collapse and engulfing the truck driver in the falling material. The silo was constructed of steel panels bolted together with carriage bolts, the rounded head of the bolts were located on the inside of the silo. The bolt heads were diminished by material wear and corrosion allowing them to pull through the bolt holes of the hopper ring causing the failure. In 2012, an inspection was conducted of the silo. At that time, recommendations were made to change the wear characteristics of the silo and to recheck the wear locations yearly or every other year. The mine operator did not follow these recommendations nor take necessary actions to ensure the structural integrity of the "sand plant fines" silo.*

Approved: Peter J. Montali (signature)
Peter J. Montali
District Manager

Date: 12/28/2015

LIST OF APPENDICES

APPENDIX A

PERSONS PARTICIPATING IN THE INVESTIGATION

Leesburg Plant

Troy Austin	Safety Coordinator
Abel Parker	Risk and Regulatory Affairs Manager
Lewis Murphy	Plant Manager
Fred Morgan	Assistant Plant Manager

Loudoun County Sherriff Department

Michael Grimsley	Detective

Mine Safety and Health Administration

Gary C. Merwine	Mine Safety and Health Inspector
Brett M. Smith	Mine Safety and Health Inspector
Darren J. Blank, P.E.	Supervisory Civil Engineer
Anthony J. Argirakis	Civil Engineer
Gregory J. Mehalchick	Mine Safety and Health Specialist (Training)

Virginia Department of Mines Minerals and Energy, Division of Mines

Paul E. Saunders	Supervisor
John J. Guth	Inspector
William B. Hutcheson	Inspector

APPENDIX B

VICTIM INFORMATION

Accident Investigation Data - Victim Information

Event Number: 6 6 8 8 5 8 9

U.S. Department of Labor

Mine Safety and Health Administration

Victim Information: 1

1. Name of Injured/Ill Employee: *Daniel C. Potter* | 2. Sex: *M* | 3. Victim's Age: *18* | 4. Degree of Injury: *01 Fatal*

5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: a. Date: *08/03/2015* b. Time: *6:28*

6. Date and Time Started: a. Date: *08/03/2015* b. Time: *6:28*

7. Regular Job Title: *116 Laborer/Utility*

8. Work Activity when Injured: *037 Entering silo*

9. Was this work activity part of regular job? Yes | No X

10. Experience

	Years	Weeks	Days
a. This Work Activity	0	9	0
b. Regular Job Title	0	9	0
c. This Mine	0	9	0
d. Total Mining	0	9	0

11. What Directly Inflicted Injury or Illness? *013 Fine Sand Silo*

12. Nature of Injury or Illness: *170 Crushed by silo collapse*

13. Training Deficiencies: Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

14. Company of Employment: (If different from production operator) *Operator*

Independent Contractor ID: (if applicable)

15. On-site Emergency Medical Treatment: Not Applicable: X | First-Aid: | CPR: | EMT: | Medical Professional: | None:

16. Part 50 Document Control Number: (form 7000-1)

17. Union Affiliation of Victim: *9999 None (No Union Affiliation)*

APPENDIX C

"SAND PLANT FINES" SILO – SCHEMATIC AND PHOTO

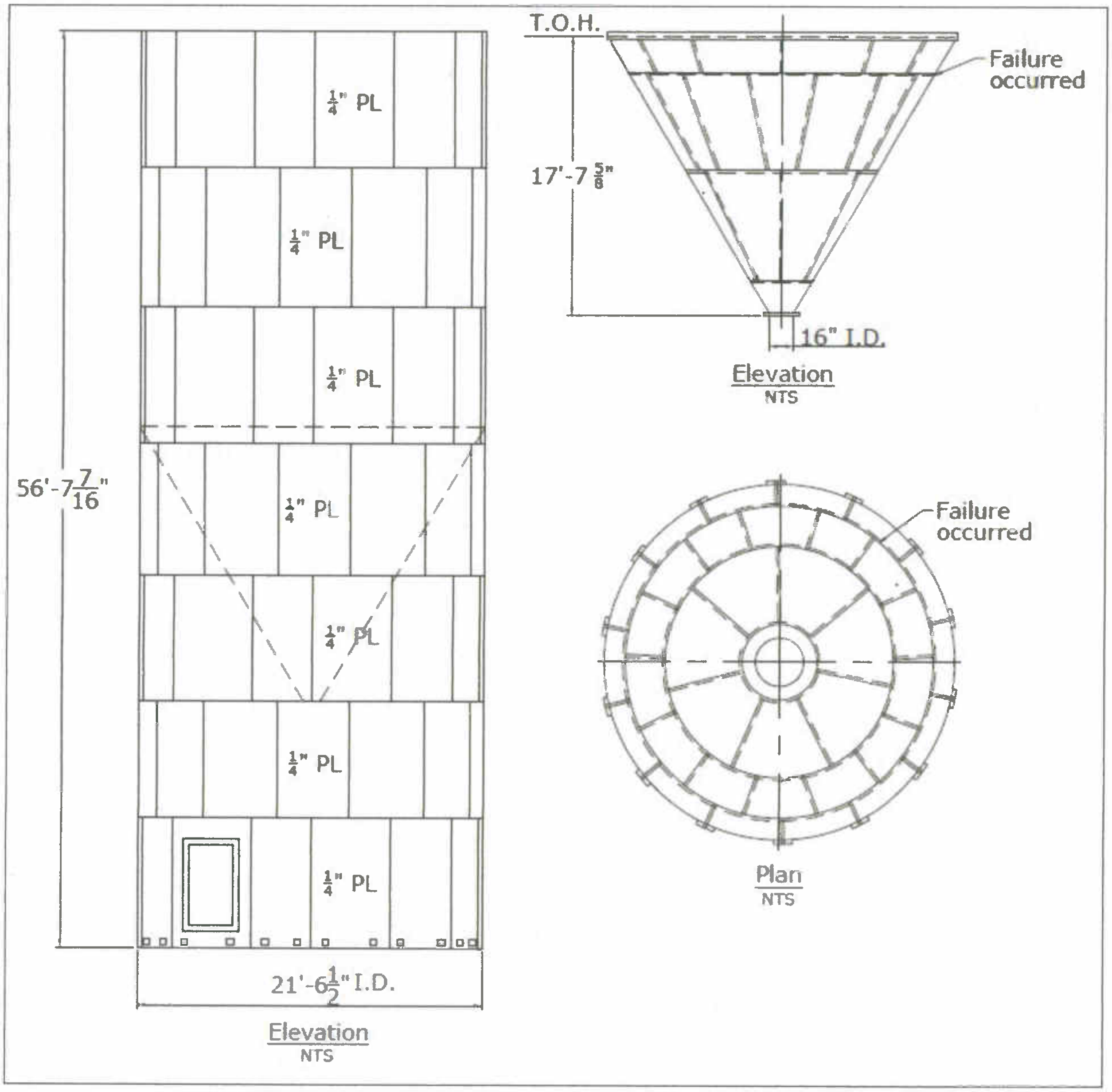

Figure 1 - ""Sand Plant Fines"" Silo

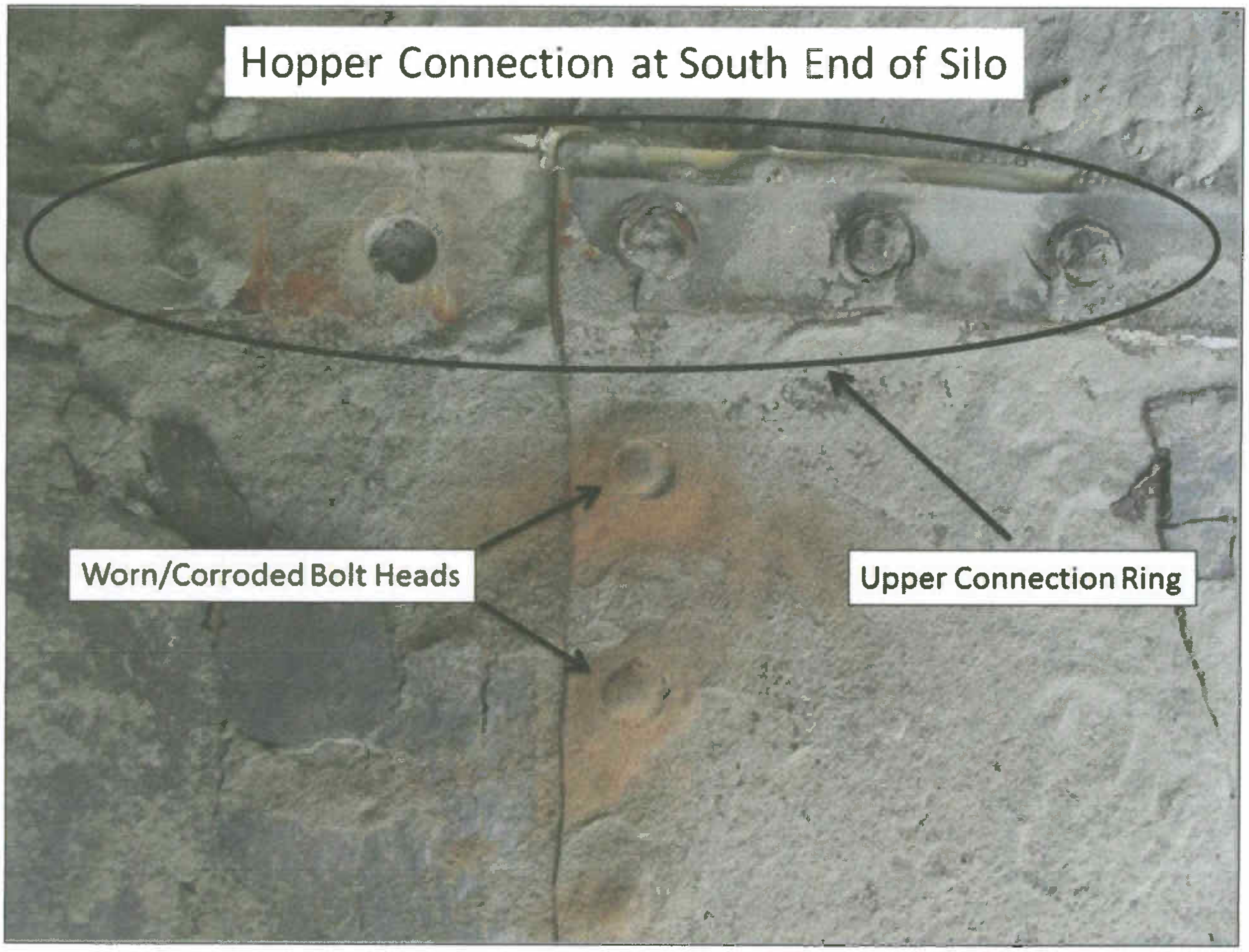

Figure 2 – Photo showing interior of "Sand Plant Fines" Silo