

**UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION**

COAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

Surface Coal Mine

**Fatal Powered Haulage Accident
October 1, 2004**

**Jeddo Coal Company
Jeddo No. 8 Preparation Plant
Hazle Township, Luzerne County, PA
ID No. 36-08649**

Accident Investigators

**Thomas J. Yencho
Supervisory Coal Mine Safety and Health Inspector**

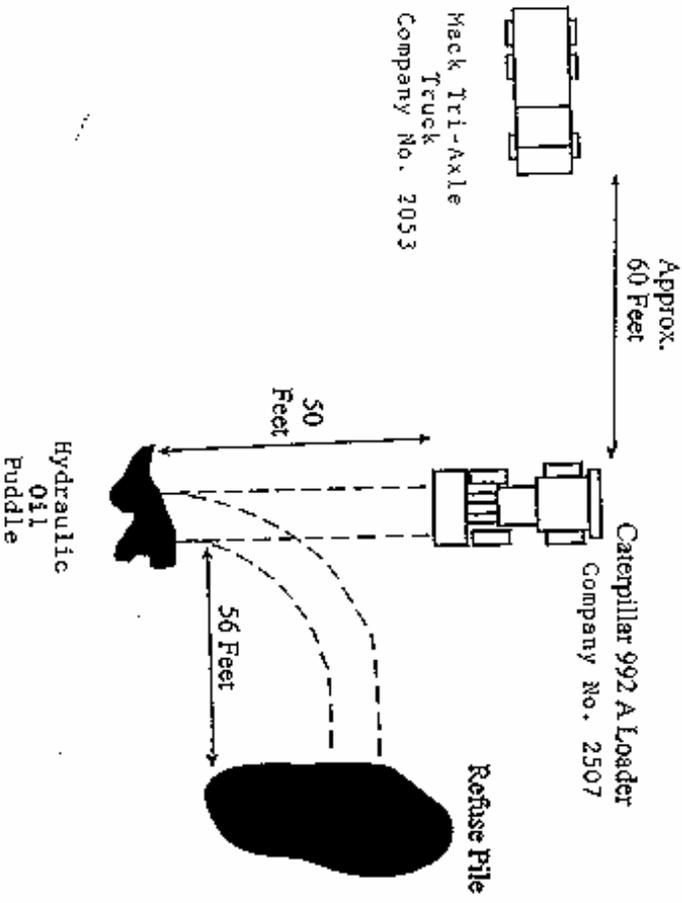
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OVERVIEW OF ACCIDENT SCENE



Not to Scale

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OVERVIEW

On Friday, October 1, 2004, a 51-year old front-end loader operator was fatally injured when a fire ignited between the engine compartment and the cab of a Caterpillar 992A. The accident occurred at a refuse stockpile area where the victim, William Walburn, was loading Co-Gen material into a Mack tri-axle truck, and dumping Co-Gen refuse rock on a refuse pile. Co-workers used seven fire extinguishers to extinguish the fire but the victim was unable to escape the cab.

The direct cause of the fatal accident was the external abrasion of a hydraulic hose that resulted in the failure of its pressure retaining wire braid, and the development of a hole in the hose. This hole allowed hydraulic oil to spray onto the turbocharger/exhaust manifold and ignite. The accident occurred because the front-end loader was not maintained in safe operating condition.

GENERAL INFORMATION

Jeddo No. 8 Preparation Plant is an anthracite coal preparation plant located south of Route 940 in Hazle Township, Luzerne County, PA. The plant began operation in 1997. It is operated by Jeddo Coal Company, a subsidiary of Cordella Corporation, Silver Springs, MD and Brynfan Associated, Naples, FL.

The plant produces various sizes of anthracite coal and operates with one eight hour production shift per day, Monday through Friday; and one eight hour maintenance shift per day, Monday through Saturday. Production shifts start at 7:00 a.m., and the maintenance shifts start at 3:00 p.m., but on Saturday at 7:00 a.m. The plant employs 14 persons and processes 1,400 to 1,600 raw tons of anthracite coal per day.

The last Mine Safety and Health Administration (MSHA) Safety and Health Inspection (AAA) was completed on August 27, 2004. The Non Fatal Days Lost (NFDL) incidence rate for the mine for the calendar year 2003 was 7.56. The 2003 National NFDL rate was 3.07.

The principal mine officials at the time of the accident were:

Louis Pagnotti..... Engineer
Michael Martinelli Superintendent
Carl DeLorenzo Safety Director
Donald Pachucki..... Garage Foreman
Chris Davidson Plant Superintendent

DESCRIPTION OF ACCIDENT

On Friday, October 1, 2004, Walburn started his shift at his normal starting time of 6:30 a.m. He was assigned to operate a Caterpillar, Model 992A front-end loader, Company No. 2507 while his normally assigned machine, also a Caterpillar 992A, was in the mine garage due to an inoperable parking brake. Walburn and Donald Pachucki, Garage Foreman, had a short conversation concerning a plastic knob that was missing from the hoist lever on this loader. Walburn did not indicate that there were any other problems with the loader. Walburn then drove the loader to the Jeddo No. 8 Preparation Plant, his normal work location. Walburn began loading Co-Gen refuse material into a Mack tri-axle truck which was driven by John Bulvin. Walburn was also dumping the material on a refuse stockpile.

At approximately 9:30 a.m., Joseph Belles, a Wabco 120-ton haul truck driver, signaled for Walburn to stop. Walburn stopped the loader, opened the cab door, exited the cab and talked to Belles. Belles asked Walburn to load his truck with breaker rock refuse. After the conversation, Walburn re-entered the operator's cab of his loader, closed the door and loaded the truck with the refuse rock.

Walburn returned to the Co-Gen refuse pile. He loaded the bucket with fine Co-Gen material and dumped it into the Mack tri-axle. Walburn then loaded the bucket with coarse Co-Gen material and asked Bulvin if he wanted this bucket dumped into his truck. Bulvin replied via his radio that the plant foreman said the material wasn't any good and to dump it on the scrap stockpile. Walburn drove the loader toward the scrap stockpile, located south of the Co-Gen stockpile. Bulvin noticed oil spraying between the operator's cab and the engine compartment of Walburn's loader. Bulvin called Walburn on the radio and said, "Billy you got a big oil leak. Shut down." Walburn continued to the refuse stockpile, dumped the material out of the bucket, backed the loader up approximately 56 feet, turned the loader to the left and drove the loader east approximately 50 feet. As Walburn stopped the loader, the oil ignited. The fire was located between the operator's cab and the engine compartment.

John Petusky, operator of another Caterpillar 992A front-end loader, was nearby feeding the plant's raw coal feed hopper. He heard Bulvin call Walburn on the radio and observed the loader on fire. Petusky called the scale house on his radio and said, "Get an ambulance. There's a loader on fire. The operator is trapped." He then drove his loader to the accident scene.

Bulvin rushed to the loader, climbed the ladder toward the operator's cab and started fighting the fire with the portable fire extinguisher from his truck. Charles Grier, Wabco 120 ton haul truck driver, saw the loader on fire. He drove to the accident scene, obtained a portable fire extinguisher from his truck and assisted in fighting the fire. Both Bulvin and Grier stated that after completely discharging two or three extinguishers, the smoke cleared in the operator's cab and they could see the victim, still in the seat. The

two miners used a total of seven fire extinguishers obtained from various locations, including the extinguisher on Walburn's loader to completely extinguish the fire.

The Luzerne County 911 Communication Center received the first call at 10:45 a.m. The caller stated "a man is trapped in a loader that is on fire". A second call was received by the center at 10:49 a.m., stating that there was a fire at the Jeddo Preparation Plant and someone will be at the highway to lead them to the fire site. At 10:51 a.m., the center dispatched Freeland and Foster Township Fire Departments. Freeland Fire Department notified the communication center that the call should have been given to the Hazle Township Fire Department. Hazle Township Fire Department was notified at 10:53 a.m. and arrived on the scene at 10:59 a.m. The fire was extinguished prior to their arrival. The Hazle Township Fire Department, using fire hoses, applied water to cool the cab area.

Paramedics and EMT's from Accident Patient & Transportation Services (APTS) based out of Hazleton, arrived on site at 10:59 a.m. Observing no signs of life, no first aid was administered. At 1:30 p.m., the victim was removed from the cab and pronounced dead by the coroner who had come to the site. The victim was then transported to the Wilkes-Barre General Hospital.

INVESTIGATION OF THE ACCIDENT

Charles Moore, Coal Mine Safety and Health (CMS&H) Field Office Supervisor, was notified of the accident at approximately 11:00 a.m., Friday, October 1, 2004. He advised the company to secure the area and make the area safe. Mr. Moore then initiated MSHA accident investigation procedures. Kenneth G. Hare, CMS&H Conference Litigation Officer and Kathleen A. Radzavicz, CMS&H Inspector arrived at the accident site at approximately 11:40 a.m., October 1, 2004 and issued a 103(k) order to assure the safety of persons at the site until an investigation could be conducted and the site deemed safe.

The investigation was conducted jointly with representatives from the Pennsylvania Department of Environmental Protection, Bureau of Deep Mine Safety. The persons who participated in the investigation are listed in Appendix A. The MSHA accident investigation team arrived at the mine on October 1, 2004 to start the investigation. Interviews were conducted with witnesses and the accident site was examined. The Caterpillar 992A, serial number 25K360, Company Number 2507 was examined.

DISCUSSION

Front-End Loader

The front-end loader was manufactured in 1970. Details of the machine history can be found in Appendix B. Jeddo had obtained the loader approximately two years earlier. Records indicate that preoperational inspections were made for intermittent operation of the loader since April 19, 2004. Although various operators performed these inspections,

no major defects were noted during any of the inspections. The hoses that were removed and tested during this investigation were located under the walkway grating in the upper engine compartment and not visible during a pre-operational check of the machine.

The investigation determined that several hydraulic hoses of improper length, and some improper fittings, were in use on the loader. These hoses were in place when Jeddo purchased the machine and had not been replaced. It was determined through testing that the large section steering pump hose was the source of the oil leak that resulted in the fire. Severe abrasion was found in three areas along the length of this hose. One area of abrasion measuring 1 inch wide x 2 inches long, located approximately 22 inches from the steering pump was found to have all four layers of wire braids broken. The hose was longer than the manufacturer's specification but did have the correct fittings.

Open grating was used on walkways and platforms exterior to the cab. Grating extended to outside the cab door – which was open at the time of the accident. The operator's cab door opened outward above the grating. A leaking hydraulic hose sprayed hydraulic oil upward through the open grate decking located at the rear of the operator's cab. As the fire developed, the flames entered the operator's cab through the open door. A fire extinguisher was located on the outside of the operator's cab. The fire, coming through the grate, blocked the normal path of egress from the operator's cab. The location and placement of grating had not been altered from the original equipment manufacturer's design. As specified in Appendix B, substantial fire damage occurred within the cab and at other points on the loader.

Fuel and Likely Ignition Source

The fuel source was identified as the loader's hydraulic system oil. The auto-ignition temperature for the oil from the hydraulic tank is 671°F. NFPA 921- Guide for Fire and Explosion Investigations states that "Ignition on hot external surfaces may require temperatures of 200°C (360°F) above published ignition temperatures." Since the auto-ignition temperature of the oil from the hydraulic tank was 671°F, a machine surface temperature approaching 1,031°F may have been needed to ignite the fluid. Both the shorted wire and the exhaust manifold/turbocharger could have reached this temperature.

Although a possibly shorted electrical wire could not be eliminated as a potential ignition source, the likely ignition source was determined to be the exhaust manifold/turbocharger. Witness statements that white smoke was seen prior to the fire indicates that leaking hydraulic oil had reached hot surfaces of the engine. The exhaust manifold/turbochargers on diesel engines, under fully loaded engine conditions, can typically reach temperatures of between 900°F to 1,000°F.

Training

A review of records and information provided by the company indicated that the victim had received the required Part 48 training on March 15, 2004. Mr. Walburn had 21 years of experience operating various types of heavy equipment with the Jeddo Coal Company.

ROOT CAUSE ANALYSIS

An analysis was conducted to identify the most basic causes of the accident. During this analysis, causal factors were identified that if eliminated, would have either prevented the accident or mitigated the consequences. The following causal factors were identified:

Causal Factor: A steering hose, whose length was longer than the manufacturer's specifications, came in contact with other components of the loader resulting in abrasion and eventual failure of the hose. Hydraulic oil sprayed from this hose at the point of the abrasion.

Corrective Action: A procedure has been established to assure that when machinery is purchased, a competent person thoroughly inspects, examines and tests the machine to assure that its components and systems conform with the manufacturer's specifications. Any deficiencies will be corrected before the machine is put into operation. The company has incorporated this policy into their safety program and the same policy will be reviewed annually during refresher training.

Causal Factor: The front-end loader remained in operation after a serious oil leak was observed.

Corrective Action: Mine management has instituted a company safety policy requiring machine operators to immediately shut down whenever a significant safety defect is identified. This policy has been incorporated into the company safety program and will be reviewed annually during refresher training.

Causal Factor: Hydraulic oil sprayed onto turbocharger/exhaust manifold and ignited. Grating at the door to the cab did not provide protection to the route of egress.

Corrective Action: An appropriate fire suppression system should be considered. Such systems have proven to be highly effective. The company has replaced the grating with solid flooring in area behind the operator's cab.

CONCLUSION

The direct cause of the accident was the failure of the steering hose (large section) which allowed hydraulic oil to contact the turbocharger/exhaust manifold resulting in a fatal fire on the front-end loader. The hose failed due to external abrasion caused by contact with other components of the loader.

The accident occurred because the front-end loader was not maintained in safe operating condition. The front-end loader remained in operation after a serious oil leak was observed. The lack of a fire suppression system and open grating at the cab entrance contributed to the severity of the accident.

ENFORCEMENT ACTIONS

77.404(a) – 104(a) – Occurred – Fatal – Moderate - The Caterpillar Cat 992A front-end loader, Company Number 2507, was not maintained in safe operating condition, in that, 4 hoses (the right side pump hose, the steering pump hose (small section), the transmission hose and the steering hose (large section) were obviously damaged, frayed, too long according to the manufacturer's specs, etc. The right side pump hose was connected to the implement and brake pump. This was a Gates 24C12 hose with a maximum working pressure of 2,500 psi. Caterpillar specified a hose 30.9 inches long provided with a 60° fitting on one end and one 90° fitting on the other end. The installed hose was approximately 37.5 inch long and was provided with a 45° fitting on one end and one 90° fitting on the other end. The hose was provided with a separate nylon abrasion cover running the length of the hose between the fittings. Severe abrasion exposing the wire was found in one area.

The steering pump hose (small section) was connected to the small section of the steering pump. There were no visible markings on this hose to identify its manufacturer or working pressure. Caterpillar specified a hose 39.2 inches long but did not identify specific angles for the end fittings. The hose removed from the loader was approximately 41 inches long and was provided with 90° fittings on each end. Severe abrasion exposing the wire was found in three areas.

The transmission hose was connected to the transmission. No markings were visible on the hose to identify its manufacturer or working pressure. Caterpillar specified a hose 42.68 inches long, however they did not identify specific angles for the end fittings. The hose removed from the loader was approximately 44 inches long and was provided with a 90° fitting on one end and a straight fitting on the other end. Severe abrasion was found in four areas.

The steering pump hose (large section) was connected to the large section of the steering pump. This was a Gates 24C12 hose with a maximum working pressure of 2500 psi. A Gates date code on the hose indicated it was manufactured on March 4, 2002. Caterpillar specifies a hose 46.8 inches long with a 67.5° fitting on one end and a 90° fitting on the other end. The hose removed from the loader was approximately 50-1/2 inch long and was provided with a one 67.5° fitting on one end and a 90° fitting on the other end. Severe abrasion was found in three areas along the length of this hose. One area of abrasion measuring 1 inch wide x 2 inches long, located approximately 22 inches from the steering pump was found to have all four layers of wire braids broken. The wear marks on the hose cover and its wire braids indicated that abrasion between the hose and a machine component had occurred. One was damaged to the point that a hole was created that allowed oil to spray and ignite. The fire entered the operator's cab and fatally injured the equipment operator. Furthermore, the equipment operator was warned about this unsafe condition and did not remove it from service immediately.

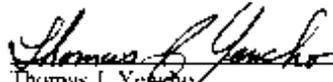
77.1606(c) – 104(a) – Occurred – Fatal – Moderate – On numerous occasions, equipment defects effecting safety were not corrected on the Caterpillar Cat 992A front-end loader, Company Number 2507, before it was used. Four hydraulic hoses were removed from the loader; the right side pump hose, the steering pump hose (small section), the transmission hose and the steering hose (large section) these hoses were obviously damaged, frayed, too long according to the manufacturer's specs, etc. The right side pump hose was connected to the implement and brake pump. This was a Gates 24C12 hose with a maximum working pressure of 2,500 psi. Caterpillar specified a hose 30.9 inches long provided with a 60° fitting on one end and one 90° fitting on the other end. The installed hose was approximately 37.5 inch long and was provided with a 45° fitting on one end and one 90° fitting on the other end. The hose was provided with a separate nylon abrasion cover running the length of the hose between the fittings. Severe abrasion exposing the wire was found in one area.

The steering pump hose (small section) was connected to the small section of the steering pump. There were no visible markings on this hose to identify its manufacturer or working pressure. Caterpillar specified a hose 39.2 inches long but did not identify specific angles for the end fittings. The hose removed from the loader was approximately 41 inches long and was provided with 90° fittings on each end. Severe abrasion exposing the wire was found in three areas.

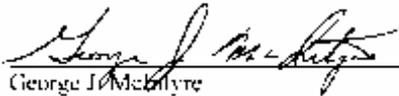
The transmission hose was connected to the transmission. No markings were visible on the hose to identify its manufacturer or working pressure. Caterpillar specified a hose 42.68 inches long, however they did not identify specific angles for the end fittings. The hose removed from the loader was approximately 44 inches long and was provided with a 90° fitting on one end and a straight fitting on the other end. Severe abrasion was found in four areas.

The steering pump hose (large section) was connected to the large section of the steering pump. This was a Gates 24C12 hose with a maximum working pressure of 2500 psi. A Gates date code on the hose indicated it was manufactured on March 4, 2002. Caterpillar specifies a hose 46.8 inches long with a 67.5° fitting on one end and a 90° fitting on the other end. The hose removed from the loader was approximately 50-1/2 inch long and was provided with a one 67.5° fitting on one end and a 90° fitting on the other end. Severe abrasion was found in three areas along the length of this hose. One area of abrasion measuring 1 inch wide x 2 inches long, located approximately 22 inches from the steering pump was found to have all four layers of wire braids broken. The wear marks on the hose cover and its wire braids indicated that abrasion between the hose and a machine component had occurred. One was damaged to the point that a hole was created that allowed oil to spray and ignite. The fire entered the operator's cab and fatally injured the equipment operator.

Submitted by:



Thomas J. Yeeho
Supervisory Coal Mine Safety and Health Inspector

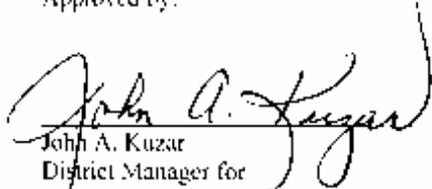


George J. McElhrye
Coal Mine Safety and Health Inspector



Kathleen A. Radzavicz
Coal Mine Safety and Health Inspector

Approved by:



John A. Kuzar
District Manager for
Coal Mine Safety and Health District I

Appendix A

Persons participating in the investigation were:

JEDDO COAL COMPANY OFFICIALS

James Pagnotti.....President
Louis Pagnotti..... Engineer
David Swisher Attorney
Michael Martinelli..... Superintendent
Carl DeLorenzo Safety Director
Donald Pachucki..... Garage Foreman
Chris Davidson Plant Superintendent

JEDDO COAL COMPANY EMPLOYEES

John Bulvin..... Mack Truck Driver
John Petusky Front End Loader Operator
Charles Grier HaulPak Truck Driver
David Formica Front End Loader Operator
Richard Buhl..... Front End Loader Operator
Joseph Belles Water Truck Driver
Daniel Dixon Dragline Operator
Larry GerhardMechanic
Thomas Yanik Front End Loader Operator

UNITED MINE WORKERS OF AMERICA

Timothy J. Baker Deputy Administrator, Dept. of Occupational Health and Safety
Edward YankovichDistrict 2, President

PENNSYLVANIA STATE POLICE

Trooper David Andruzzi Troop "N" Forensic Services Unit
Lt. Stephen J. Barilar Troop "N"
Trooper David P. Cusatis, CFI Troop "N" Fire Marshall

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Paul HummelChief, Deep Mine Safety Program Director
Glenn Bensinger Anthracite Underground Mine Inspector
Troy Wolfgang Anthracite Underground Mine Inspector
Terry Wolfgang Anthracite Underground Mine Inspector

MINE SAFETY AND HEALTH ADMINISTRATION

John A. Kuzar..... Coal Mine Safety and Health District Manager, District 1
William D. Sparvieri Coal Mine Safety and Health Assistant District Manager, District 1
Kenneth G. Hare..... Coal Mine Safety and Health Conference Lit. Officer, District 1
Thomas J. Yencho Coal Mine Safety and Health Field Office Supv., District 1
George J. McIntyre..... Coal Mine Safety and Health Inspector, District 1
Kathleen A. Radzavicz Coal Mine Safety and Health Inspector, District 1
William E. Slusser Supervisor, Educational Field Services
James Angel Mechanical Engineer, Mechanical & Engineering Safety Division

Appendix B

Machine Information

The Caterpillar, Model 992A, Serial Number 25K360 front-end loader was manufactured in 1970. Jeddo Coal Company bought the Caterpillar 992A front end loader from Junior Coal Contracting, Inc., Philipsburg, PA on November 22, 2002. Junior Coal Contracting Inc. bought this loader on June 17, 2001 from the Northern Counties Coal Company, Inc., Philipsburg, PA. Junior Coal did not operate the loader after it was purchased. A review of the Jeddo Coal Company maintenance records indicates repairs to the loader began in May of 2003. These repairs included rebuilding trip jacks, replacing filters and oil for the engine, transmission and hydraulics. On March 16, 2004, the brake tubes were replaced on all wheels, the parking brake was rebuilt, and a new muffler and exhaust elbows were installed. The air conditioner pump was also replaced. The engine was replaced with a used engine on September 7, 2004. The used engine came from the Caterpillar 992A, Company No. 1849. This front end loader was being dismantled and used for parts.

The first operator's preoperation equipment safety check list was completed on April 19, 2004 with no defects noted. From April 19, 2004 through September 30, 2004, the loader was not used on a daily basis. Various operators used this loader as needed and also filled out the required preoperation equipment safety check lists. No major defects were noted by any of these equipment operators.

Operator's Cab

The Caterpillar 992A front end loader was equipped with an updated operator's cab designed for a Caterpillar 992B front end loader. A Caterpillar representative stated that a 992B cab is compatible with a 992A loader. This cab was on the loader when purchased by Jeddo Coal Company.

The operator's cab door opened outward above the grating. A leaking hydraulic hose sprayed hydraulic oil upward through the open grate decking located at the rear of the operator's cab. As the fire developed, the flames entered the operator's cab through the open door. The fire, coming through the grate, blocked the normal path of egress from the operator's cab. A fire extinguisher was located on the outside of the operator's cab. The operating controls in the cab were positioned with the master switch on, the transmission shift lever in neutral, and the parking brake on.

The foot throttle is used to shut the engine off by pulling it back. Although it was found in its normal position, it may have been moved when numerous EMS personnel entered the operator's cab after the fire.

Platforms (Walkways)

Platforms (walkways) around the operator's cab were made of steel grating, a normal component on this model loader. These components were consistent with the design of the original equipment manufacturer. Handrails around the cab were intact.

Door and Walkway Grating into the Operator's Cab

The exterior of the door was oil coated and the paint was intact. There was no sign of heat or flame on the exterior of the door. The interior of the door sustained severe fire damage. The paint was burned and soot was observed on the right rear corner of the walkway.

Operator's Cab Interior

Sound suppression material was burned and in some areas melted. The left side cab windows were dislodged during the fire. The right side windows were removed by the fire department. The front window had smoke and heat damage, but was intact. The plastic indicators on the dashboard and the fuse holders were melted. The glass covering other gauges was cracked and covered with soot. The transmission shifter and plastic knob showed signs of fire damage and soot. The steering wheel showed signs of fire damage. The fuse caps, air conditioner and heater controls were melted. The bucket lift and tilt controls were soot covered. The operator's seat was severely fire damaged. The rear interior portion of the cab was fire damaged. The floor mat was rolled up from the door to directly behind the operator's seat. Burned papers, rags and cans (starting fluid, rust breaker and a can with unknown contents) were found on the cab floor. Also found on the cab floor were a melted plastic water jug, the victim's melted lunch container and broken glass.

Air Cleaner Outlets & Pre-Cleaner

The pre-cleaner was removed and the plastic cones on the bottom of this pre-cleaner were melted and dropped on the air cleaner outer filters.

The left and right air cleaner outlets between the turbo chargers and air cleaner filters.

The left side rubber elbows from the turbo chargers to air cleaner filters were intact. The right side rubber elbows between the turbo chargers and the air cleaner filters showed signs of fire damage. There was no sign of fire damage to the interior of any of these elbows.

Engine Compartment

The left side starter solenoid wires displayed no signs of fire damage. The right side starter solenoid wires were melted. The wiring conduit below the right exhaust manifold was melted.

Hydraulic Hoses

Four hydraulic hoses were removed from the loader; the right side pump hose, the steering pump hose (small section), the transmission hose and the steering hose (large section). These hoses were found to have areas of significant abrasion exposing the wire braid of the hose. All of these hoses were located below the grated walkway between the operator's cab and engine compartment. Three of the hoses were connected to the hydraulic pumps and the fourth was connected to the transmission.

The right side pump hose was connected to the implement and brake pump. This was a Gates 24C12 hose with a maximum working pressure of 2,500 psi. Caterpillar specified a hose 30.9 inches long provided with a 60° fitting on one end and one 90° fitting on the other end. The installed hose was approximately 37.5 inch long and was provided with a 45° fitting on one end and one 90° fitting on the other end. The hose was provided with a separate nylon abrasion cover running the length of the hose between the fittings. Severe abrasion exposing the wire was found in one area.

The steering pump hose (small section) was connected to the small section of the steering pump. There were no visible markings on this hose to identify its manufacturer or working pressure. Caterpillar specified a hose 39.2 inches long but did not identify specific angles for the end fittings. The hose removed from the loader was approximately 41 inches long and was provided with 90° fittings on each end. Severe abrasion exposing the wire was found in three areas.

The transmission hose was connected to the transmission. No markings were visible on the hose to identify its manufacturer or working pressure. Caterpillar specified a hose 42.68 inches long, however they did not identify specific angles for the end fittings. The hose removed from the loader was approximately 44 inches long and was provided with a 90° fitting on one end and a straight fitting on the other end. Severe abrasion was found in four areas.

The steering pump hose (large section) was connected to the large section of the steering pump. This was a Gates 24C12 hose with a maximum working pressure of 2500 psi. A Gates date code on the hose indicated it was manufactured on March 4, 2002. Caterpillar specifies a hose 46.8 inches long with a 67.5° fitting on one end and a 90° fitting on the other end. The hose removed from the loader was approximately 50-1/2 inch long and was provided with a one 67.5° fitting on one end and a 90° fitting on the other end. Severe abrasion was found in three areas along the length of this hose. One area of abrasion measuring 1 inch wide x 2 inches long, located approximately 22 inches from the steering pump was found to have all four layers of wire braids broken. The wear

marks on the hose cover and its wire braids indicated that abrasion between the hose and a machine component had occurred.

The four hoses removed were tested using non-destructive methods at MSHA's Technical Support Division, located in Triadelphia, WV. These hoses were pressurized to locate any holes or defects that could have created the spray of hydraulic oil seen immediately prior to the fire. Three of the hoses showed no defects that would have allowed oil to spray or leak. When the steering pump hose (large section) was pressure tested at approximately 50 psi a significant stream of fluid sprayed from the hose. This fluid originated from the area of the broken wire braids.

These four hoses, removed for testing, were installed prior to Jeddo Coal Company's purchase of the loader.

Fuel Source

The fuel source was identified as the loader's hydraulic system oil. This is supported by statements from the truck driver who witnessed the fire. He stated he saw a spray of hydraulic oil originate from between the operator's cab and the engine. Also, oil samples were taken from the loader's hydraulic system and from the ground. The oil taken from the ground followed the path of the loader immediately prior to the fire. A laboratory analysis indicated that the oil on the ground came from the loader's hydraulic system.

Auto-ignition temperature tests were performed on both samples. The auto-ignition temperature for the oil from the hydraulic tank is 671°F. NFPA 921- Guide for Fire and Explosion Investigations states that "Ignition on hot external surfaces may require temperatures of 200°C (360°F) above published ignition temperatures." Since the auto-ignition temperature of the oil from the hydraulic tank was 671°F, a machine surface temperature approaching 1,031°F may have been needed to ignite the fluid. Both the shorted wire and the exhaust manifold/turbocharger could have reached this temperature.

Ignition Sources

A shorted electrical wire and the engine's right side turbocharger/exhaust manifold were identified as possible ignition sources. A 14 gauge stranded wire supplying 24 volts DC to the air conditioner switch was routed along the steering pump hose. The outer jacket of this wire was damaged, exposing the stranded copper conductor. Five of the wire's strands were fused (broken due to heat from electrical current) and copper was present on the wire braids of the steering hose. These conditions indicated that the energized power wire could have come in contact with metal components or the frame causing a short circuit. The 24 volt DC electrical system was provided with a 30 amp fuse. The fuse for this circuit was intact. Theoretical calculations were performed that indicated that this short circuit could have occurred and melted the five copper strands without blowing the fuse. This information does not conclusively indicate that a short circuit occurred at the time of the leak or that the short circuit ignited the hydraulic oil. Based on available

information, the short circuit can't be ruled out as a possible ignition source. Note that the melting point of copper is approximately 1,984°F.

The more likely ignition source is the exhaust manifold/turbocharger. A truck driver stated that white smoke was seen prior to the fire between the operator's cab and the engine compartment. This indicates that leaking hydraulic oil reached hot surfaces of the engine. The exhaust manifold/turbochargers on diesel engines, under fully loaded engine conditions, can typically reach temperatures of between 900°F to 1,000°F.

Appendix C

Red Circle Indicates Area of Abrasion on the Large Steering Hose



Appendix C

Area of Abrasion Where the Steering Hose Failed

