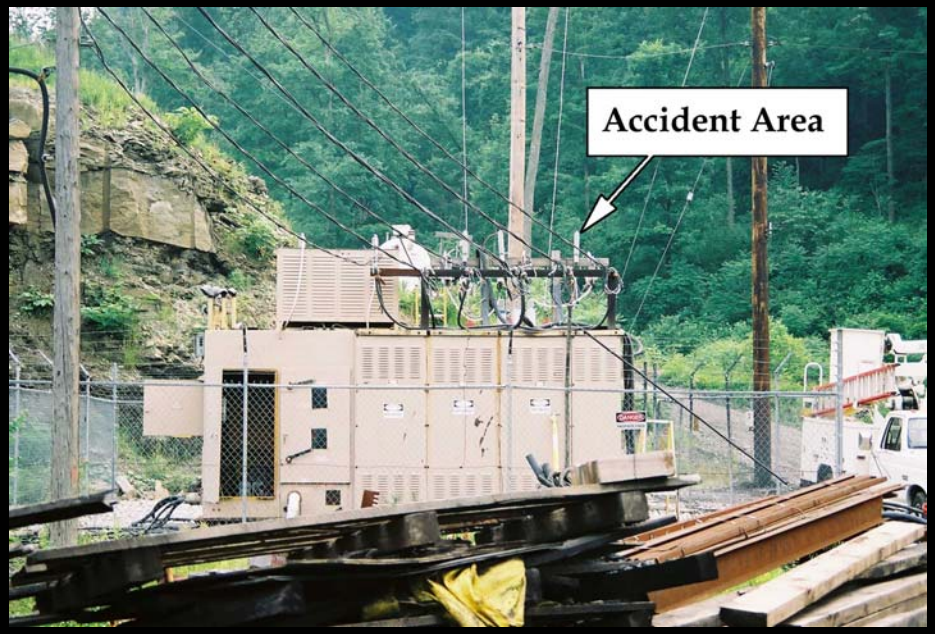
*This presentation is for illustrative and **general** educational purposes only and is not intended to substitute for the official MSHA Investigation Report analysis nor is it intended to provide the sole foundation, if any, for any related citations issued.*

GENERAL INFORMATION

Coal Mine Fatal Accident 2003-16



Operator:	Mountain Spring Coal Company
Mine:	#1 Mine
Accident Date:	June 13, 2003
Classification:	Electrical
Location:	District 2, Beaver Co., Pennsylvania
Mine Type:	Underground
Employment:	32
Production	1,400 tons/day prior to being placed in BA Status on 6/11/03

OVERVIEW

Coal Mine Fatal Accident 2003-16

- The A 41-year old shift maintenance foreman (victim) with 15-years mining experience and two other maintenance foremen were working at a substation to resolve a mine power supply problem.
- The victim had pulled the three disconnects feeding power to a bank of capacitors located on top of the enclosed unit in the substation and had removed a fuse from the center disconnect.
- While kneeling on top of the enclosed unit, closing the fused disconnects, the victim came into contact with an energized 12,470 volt circuit.
- The cause of the accident was failure to de-energize the high voltage circuit prior to performing electrical work. The root cause was management's failure to establish and enforce safe work procedures. Contributing causes included the location of the main disconnects and the installation of the capacitor bank and capacitor bank disconnects.

ACCIDENT DETAILS

Coal Mine Fatal Accident 2003-16

- While working on the section, the victim identified a potential voltage imbalance problem on the miner.
- The mine maintenance foreman assisted the victim in checking voltages at various points along the power system, beginning in the section and working toward the outside.
- Upon reaching the surface, they still had not located the problem.

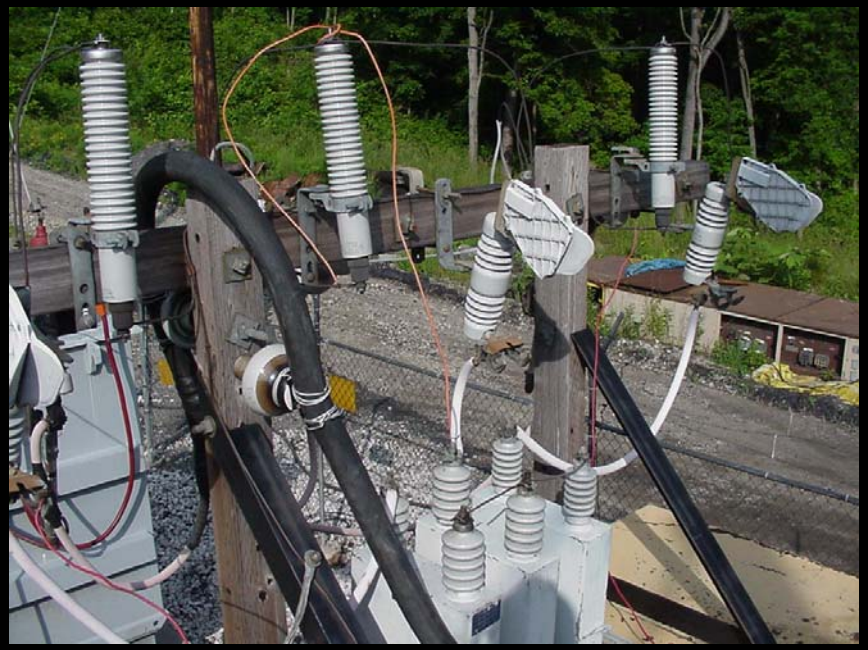
ACCIDENT DETAILS

Coal Mine Fatal Accident 2003-16

- They were joined by the mine electrical foreman as they entered the fenced area of the substation, which included the main transformer and enclosed transformer/switchgear unit.
- They then opened the 480 volt circuit breakers in order to test the circuits.

ACCIDENT DETAILS

Coal Mine Fatal Accident 2003-16



- The victim noticed that the fuse in the center phase disconnect for the capacitor bank appeared to be blown.
- The three fused disconnects were installed above the capacitor bank which was located on the roof of the enclosed unit.
- The victim then donned high voltage gloves and used a hotstick to pull fused disconnects.

ACCIDENT DETAILS

Coal Mine Fatal Accident 2003-16

- They decided that the suspected blown fuse could be performed without opening the main disconnects, which were located 40 feet above ground.
- The victim used a 3-foot stepladder to climb on top of the roof of the enclosed unit and again donned the high voltage gloves.
- He was reminded by the other foremen to be careful because the high voltage capacitor bank circuit was still energized and instructed him to extend the hotstick, one section which would position him further back from the energized circuit.

ACCIDENT DETAILS

Coal Mine Fatal Accident 2003-16

- The victim opened the three disconnects feeding power to the capacitor bank. He tried to remove the suspected blown fuse from the center phase disconnect but could not because the capacitor bank was located below it and prevented the fuse from being rotated far enough to be lifted out.
- He pushed the capacitor bank forward 6 to 8 inches, removed the fuse from the center phase disconnect and handed it down to the mine maintenance foreman, who determined that the fuse was not blown.
- The mine maintenance foreman trimmed the excessive fuse link material from the fuse and then handed it back to the victim to reinstall.

ACCIDENT DETAILS

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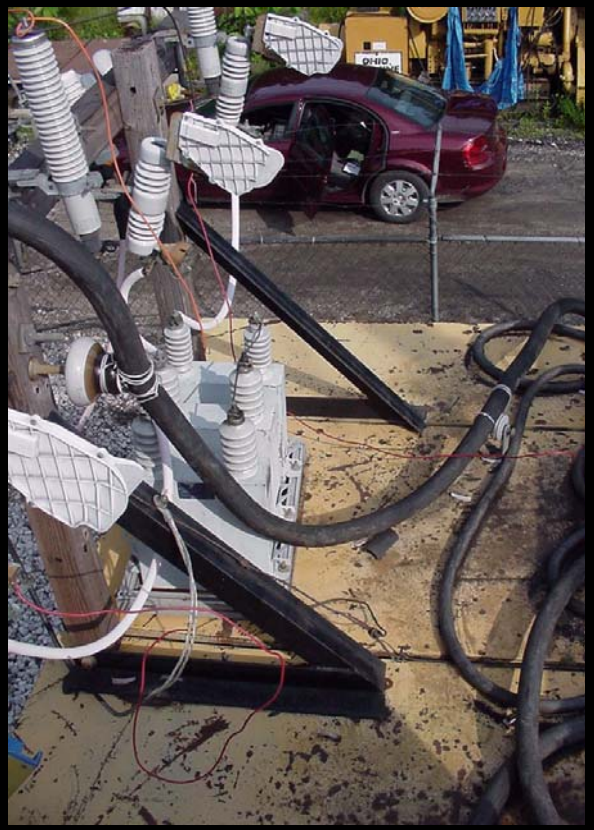
- The victim knelt in front of the capacitor bank as he closed the last of the three disconnects with his gloved hand.
- The electrical maintenance foreman looked away for a moment and heard a “pop.” Looking back, he saw the victim fall onto the capacitor bank and observed a flash around the victim’s head.
- The mine maintenance foreman saw the victim’s right hand jerk backwards and then suddenly come forward toward the capacitor bank. The victim was pronounced dead at the scene.



PHYSICAL FACTORS

Coal Mine Fatal Accident 2003-16

- The electric company required an independent inspection of the site prior to power being placed on-line.
- As a result of this inspection, the main disconnects were raised from approximately 30 feet above the ground to approximately 40 feet above the ground.
- The hotstick used to open and close the main disconnects was 38 feet-10 inches long, making it very difficult to control.
- All three foremen were familiar with the design and installation of the substation. Although the victim was an underground shift maintenance foreman, he and the other maintenance foremen had previously performed work on the substation.

PHYSICAL FACTORS

Coal Mine Fatal Accident 2003-16

- In November of 2001, an independent contractor recommended that a capacitor bank be installed at the substation to improve the mine power factor.
- Mine personnel, including the victim, installed a capacitor bank on the roof of the enclosed unit.
- The capacitor bank was not secured to the roof.
- Because of the location of the capacitor bank disconnects, the capacitor bank had to be pushed forward 6 to 8 inches to allow removal of the fuse from the center disconnect.
- The victim used the hotstick to open the fused disconnects for the capacitor bank, but not to close them. This put him in close proximity to live unguarded parts.

PHYSICAL FACTORS

Coal Mine Fatal Accident 2003-16

- After the accident, the hotstick was found leaning against the substation fence.
- The victim's injuries were consistent with the physical evidence obtained from the terminals on the capacitor bank.
- Following the accident, the high voltage gloves were tested by an independent laboratory according to ASTM F 496 testing procedures and passed.

ROOT CAUSE ANALYSIS

- *Causal Factor:* The main disconnects for the substation were not opened and tagged out prior to electrical work being performed inside the substation.
- *Corrective Action:* A Gang Operated Air Brake Disconnect (GOAB) was installed 40 feet high on the pole, in series with the main disconnects.
  - The GOAB is operated by mechanical linkage located at ground level.
  - The GOAB will serve as the primary disconnect for the substation and is capable of being locked and tagged out.
  - A written safe work procedure requiring opening the main disconnects prior to performing electrical work in the substation was posted at the substation entrance.
  - All qualified electrical personnel will be retrained in safe work procedures in substations.

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ROOT CAUSE ANALYSIS

- *Causal Factor:* The location of the main disconnects, 40 feet above ground, made the main disconnects very difficult to operate from the ground.
- *Corrective Action:* The GOAB was installed and is readily accessible.

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ROOT CAUSE ANALYSIS

- *Causal Factor:* The location of the capacitor bank and capacitor disconnects required the victim to be exposed to unguarded live parts .
- *Corrective Action:* When and if the capacitor bank is reinstalled it will be completed in accordance with the National Electrical Code. The use of hotsticks shall be discussed in the retraining of qualified electrical personnel.

CONCLUSION

- The cause of the accident was failure to de-energize the high voltage circuit prior to performing electrical work.
- The root cause was management's failure to establish and enforce safe work procedures.
- Contributing causes included the location of the main disconnects and the installation of the capacitor bank and capacitor bank disconnects.

ENFORCEMENT ACTIONS

- 104(d) (1) Citation for a violation of 30 CFR 77.501.
  - A maintenance foreman was performing electrical work in the mine substation without opening and tagging out the main disconnects.
  - This work consisted of operating disconnects, removing fuses and moving electrical components while in proximity to exposed energized electrical parts.

- 104(d) (1) Order for a violation of 30 CFR 77.704-9.
  - The disconnection switch on a high voltage surface line was operated without using an insulated stick which was adequately insulated and maintained to protect the operator from the voltage to which he was exposed.
  - The victim was observed closing a fused disconnect for the capacitor bank by hand while wearing high voltage gloves but not using an insulated stick.

ENFORCEMENT ACTIONS

- 104(d) (1) Order for a violation of 30 CFR 77.516.
  - The high voltage disconnects provided for the 23,000 to 12,470 volt transformer located in the surface substation did not comply with the 1968 National Electrical Code in that they were not readily accessible.
  - Article 100 of the NEC defines “Readily Accessible” as capable of being reached quickly for operation, renewal, or inspection, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc.
  - The disconnects were mounted on an electric pole forty feet from the ground. The disconnects could not be reached quickly for operation.

ENFORCEMENT ACTIONS

- 104(d) (1) Order for a violation of 30 CFR 77.516.
  - The high voltage capacitors installed on the roof of the enclosed unit in the surface substation did not comply with the provisions of the 1968 National Electric Code.
  - Article 710-34 (f) of the NEC states "Unguarded live parts above working space shall be maintained at elevations not less than required by the following table: Table 710-34 (f) Voltage between phases 11001 – 22000, Minimum Vertical Clearance of Unguarded Parts 9 foot 3 inches".
  - The high voltage capacitor disconnect switches were mounted 44 inches above the roof of the enclosed unit.
  - The capacitor bank and terminals were located below the disconnects.

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BEST PRACTICES

- De-energize and ground all high voltage phase leads when not necessary to perform work.
- Use properly inspected and maintained safety equipment.
- Perform electrical work on high voltage circuits by properly trained, qualified, and experienced persons.
- Maintain a working area free of extraneous materials.
- Develop a work plan that includes hazard analysis <u>before</u> conducting repair work.

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