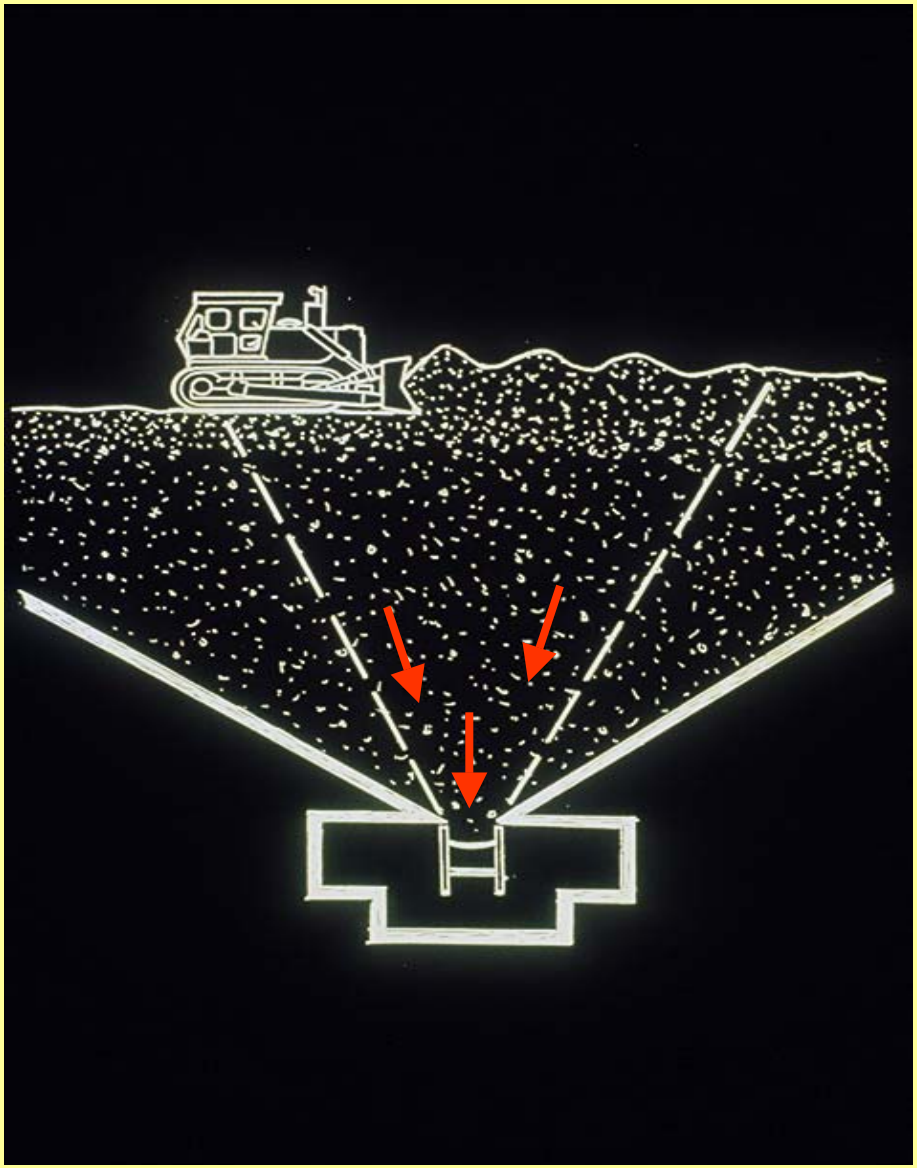
Surge Pile Safety

U.S. Department of Labor
MSHA
Mine Safety & Health Administration

Directorate of Technical Support
Mine Safety and Health Administration

Surge-Pile Hazards...

- **Feeding material acts like "quicksand."**

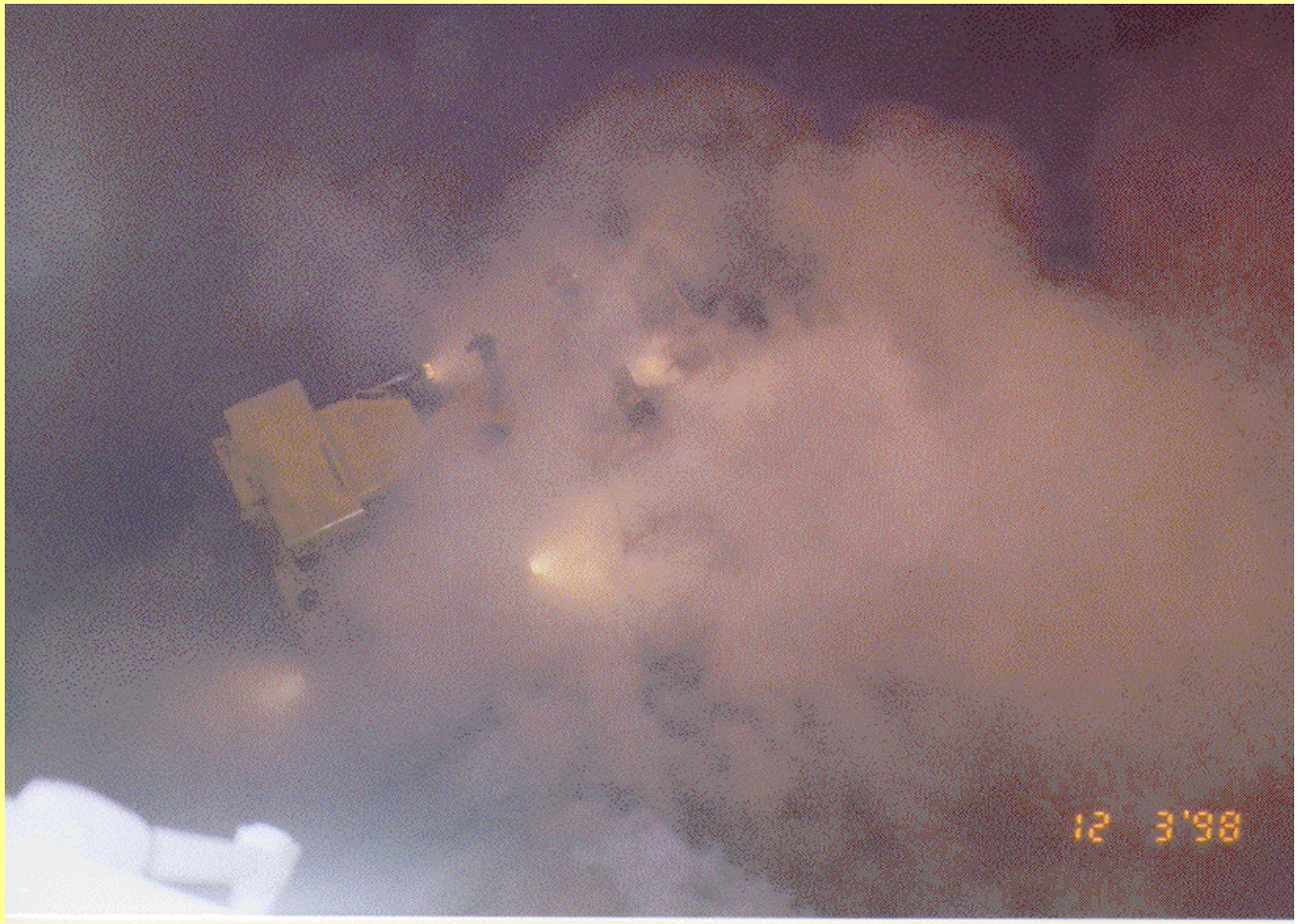


Surge-Pile Hazards...

- **The edge of the drawhole is unstable.**

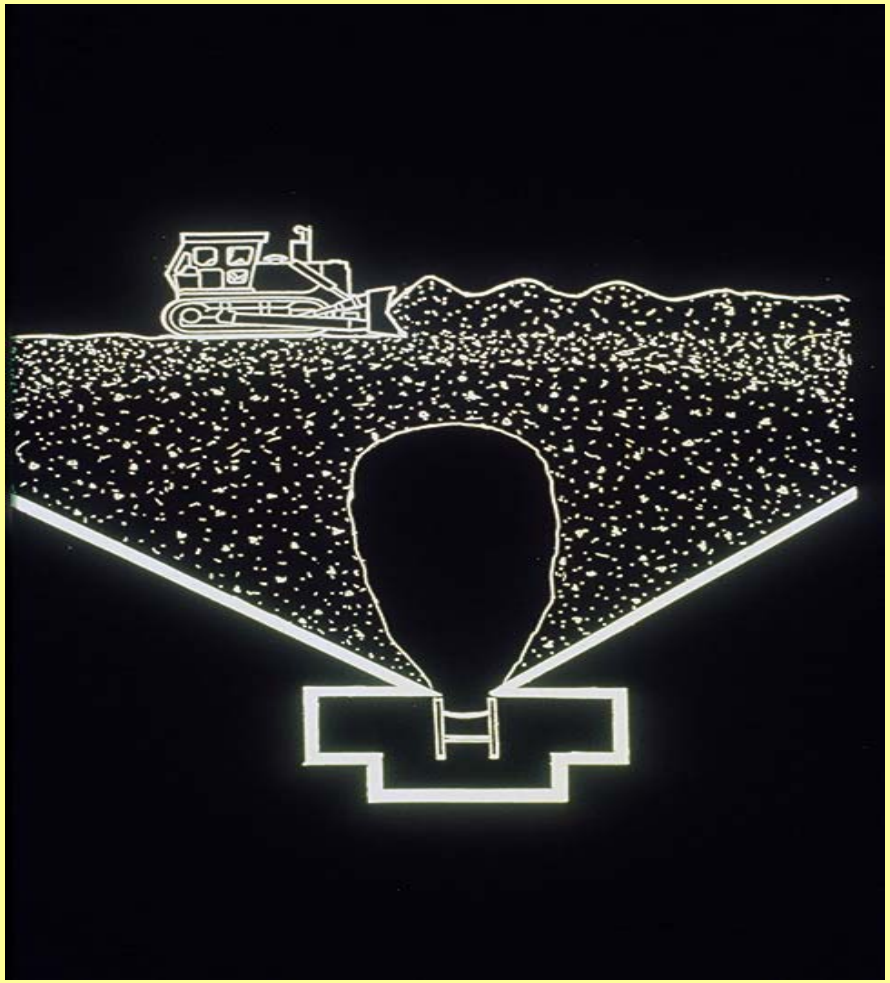
Surge-Pile Hazards...

- **Poor visibility**



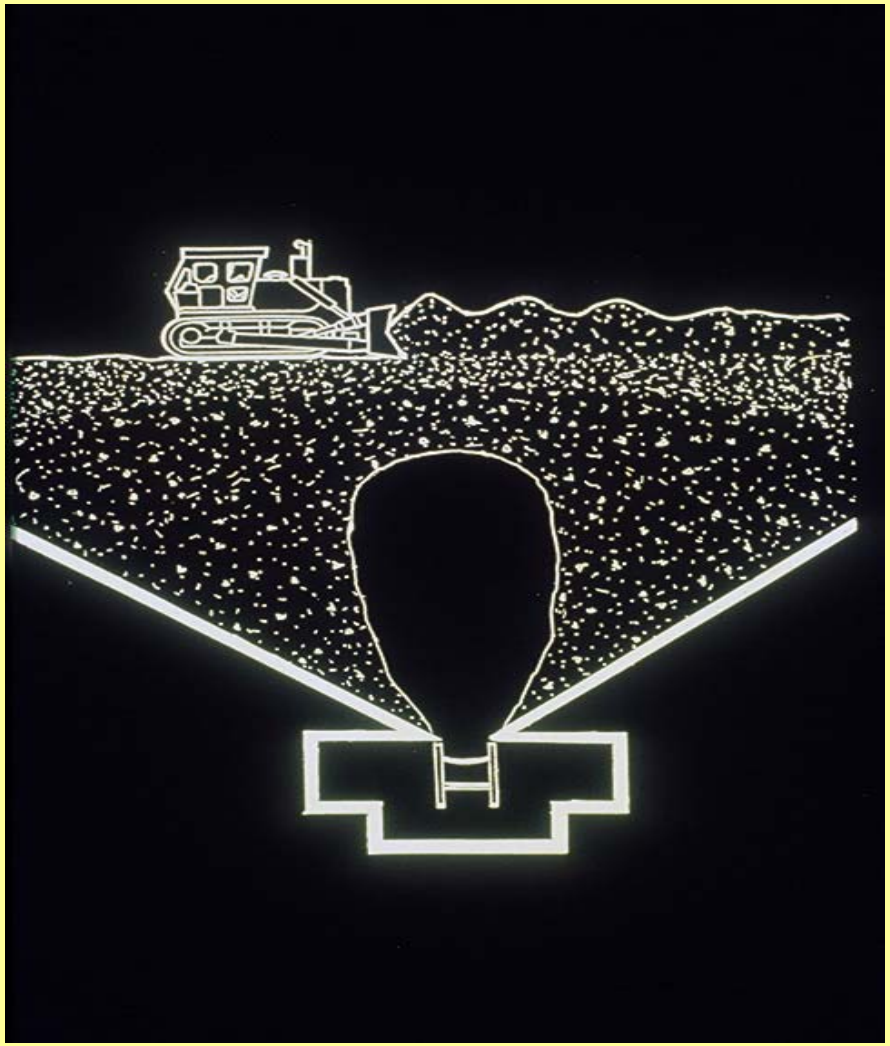
Surge-Pile Hazards…

- **The danger of hidden cavities.**
- **Since 1980, 19 persons have died in surge pile accidents.**
- **Most of the accidents have involved a hidden cavity created when material “bridged” over a feeder.**



Causes of “bridging” over a surge-pile feeder

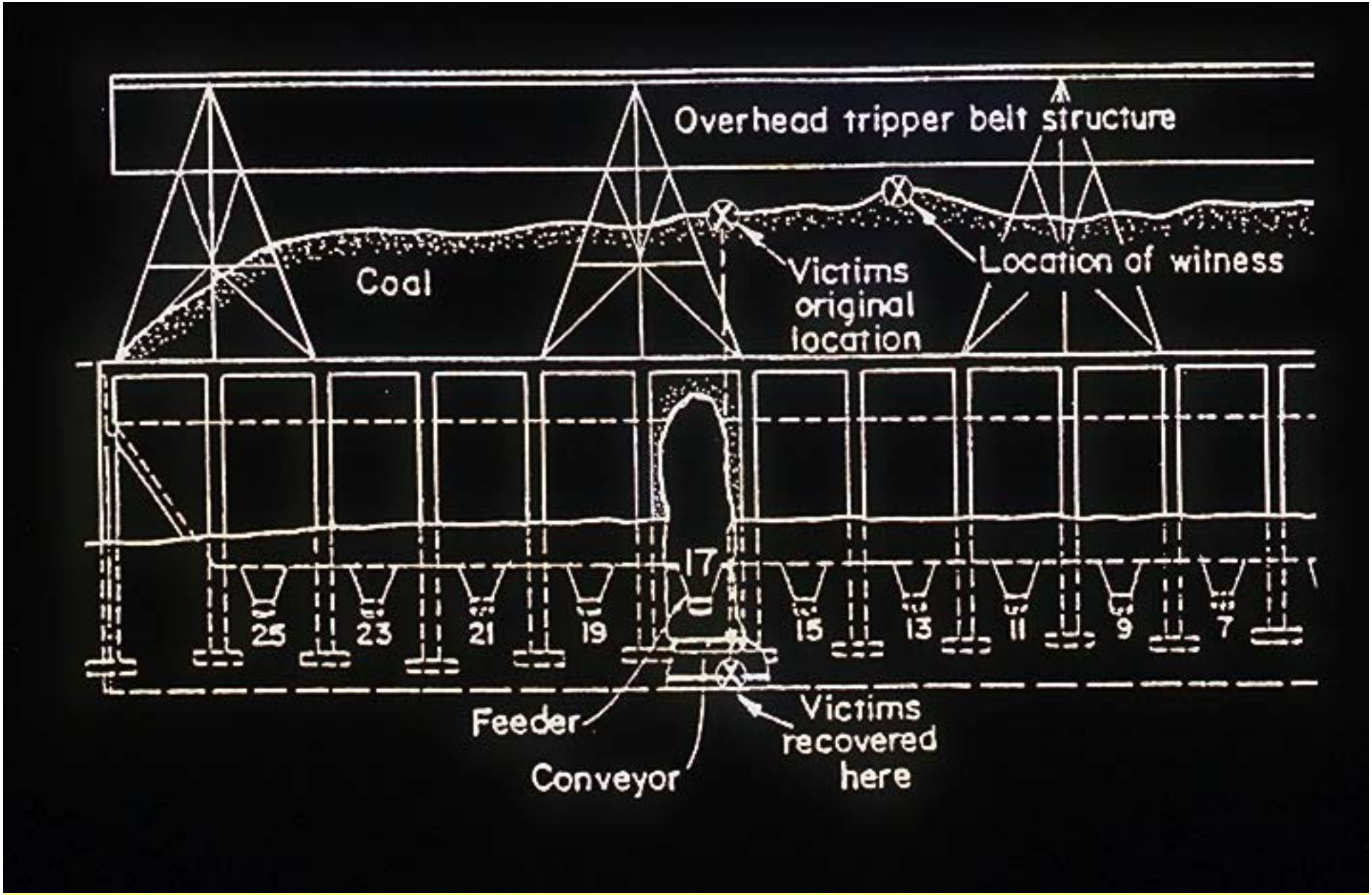
- **Bridging can occur when equipment compacts the material at the surface of the pile.**
- **Bridging can occur if the surface material freezes.**
- **In a pile that has sat idle for a period of time, the pile material tends to “settle in” and become more prone to bridging.**



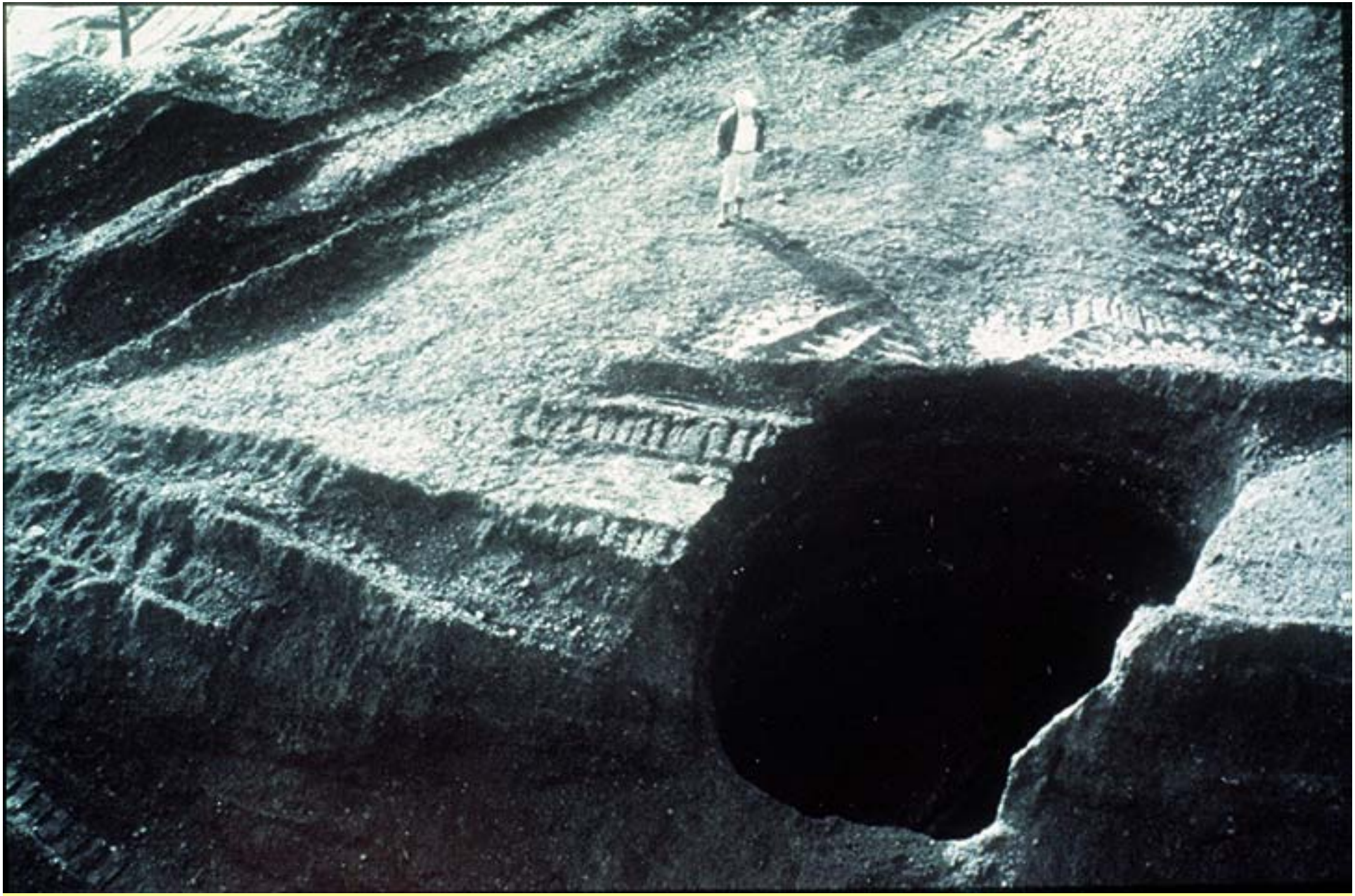
Surge-Pile Accidents

Loveridge Accident - Five Victims

In 1986, five men died when bridged material underneath them collapsed into a hidden cavity on a surge pile in WV. The men had gone onto the pile on-foot to try to determine how best to repair the damaged overhead belt.



Loveridge Accident: This is a section of the surge pile showing the position the hidden cavity, and the location of the five victims and two witnesses.



In this fatal surge pile accident a dozer fell into a hidden cavity. Note the dozer tracks passing over the cavity.

Here's the dozer buried in cavity. Note the thickness of the material that had been bridged over.

Note the partially buried bulldozer in this fatal accident in Pennsylvania. A hidden cavity collapsed under the dozer while it was pushing coal on the pile.

- **In most of the fatal accidents the dozer operator was kill when the dozer cab windows either broke, or were pushed into the cab, allowing coal to fill the cab.**

Close-up of cab filled with coal.

Rescue efforts in a surge pile accident. Unstable material can endanger rescue workers.

More Recent Surge-Pile Accidents

Sidney Coal Accident - March, 1998

Here a buried dozer is being dug out to rescue the operator.

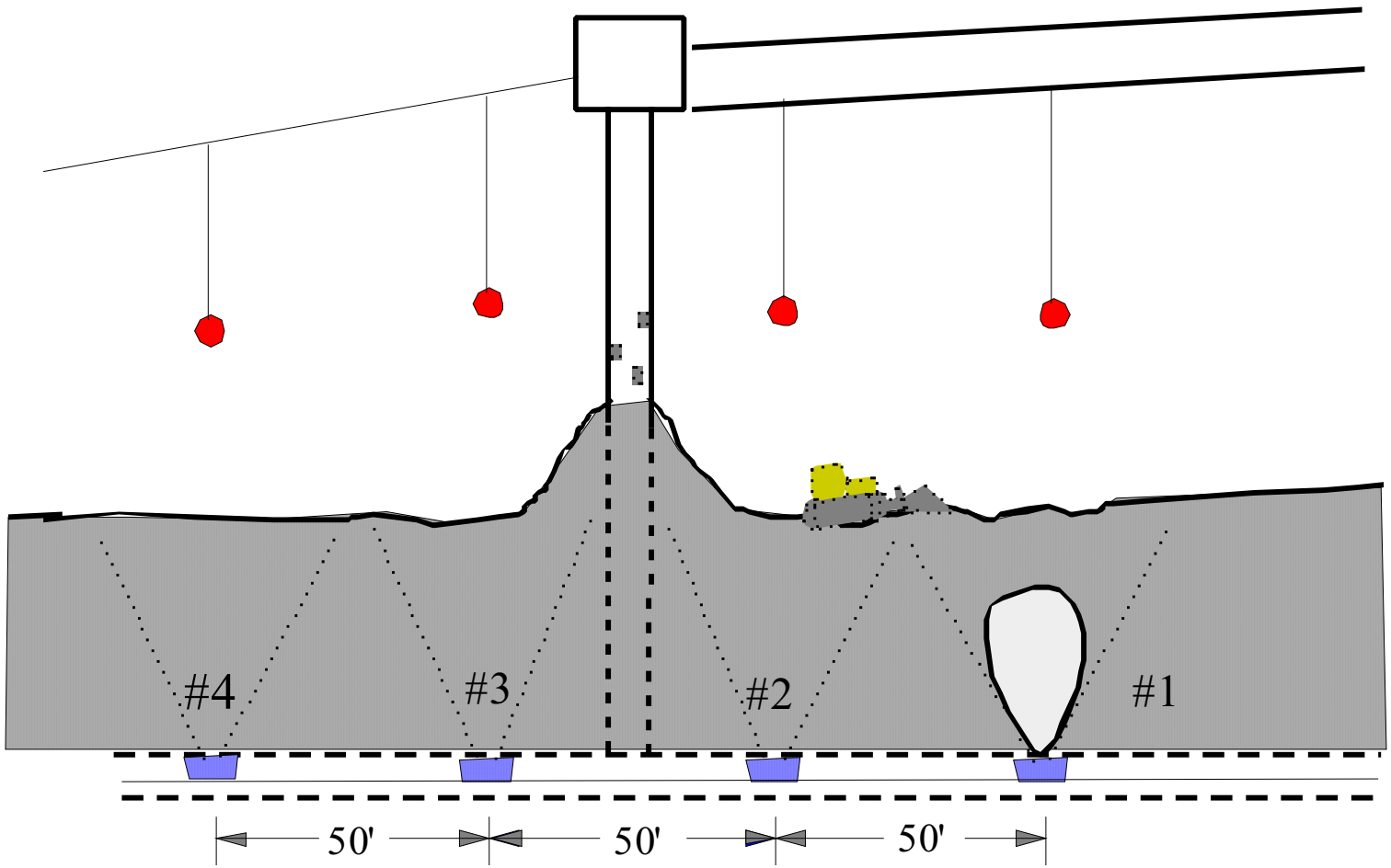
Sidney Coal Accident

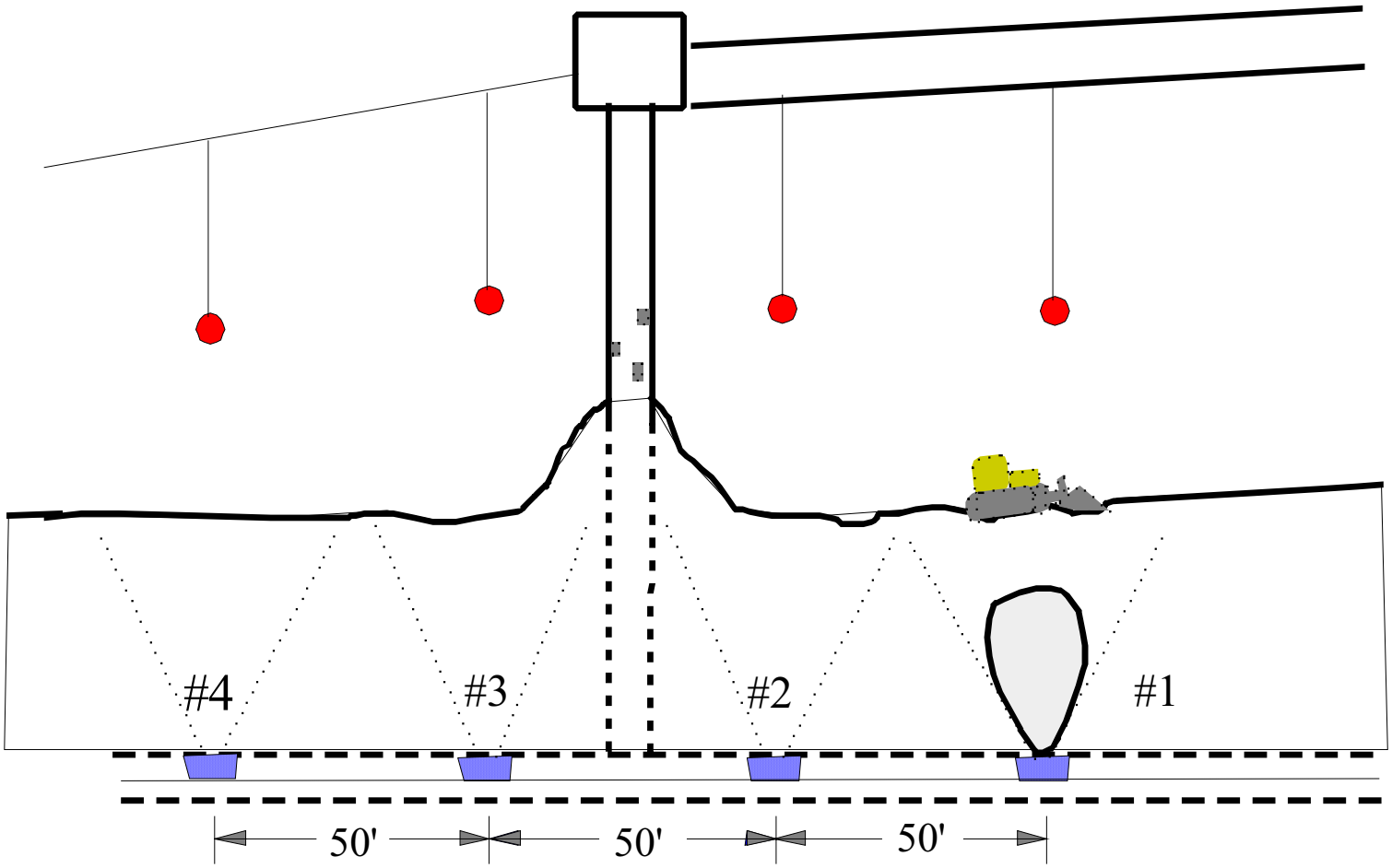
The dozer cab was buried by approximately 12 feet of coal; the cab windows had been upgraded to a degree; the windows held; the operator was rescued.

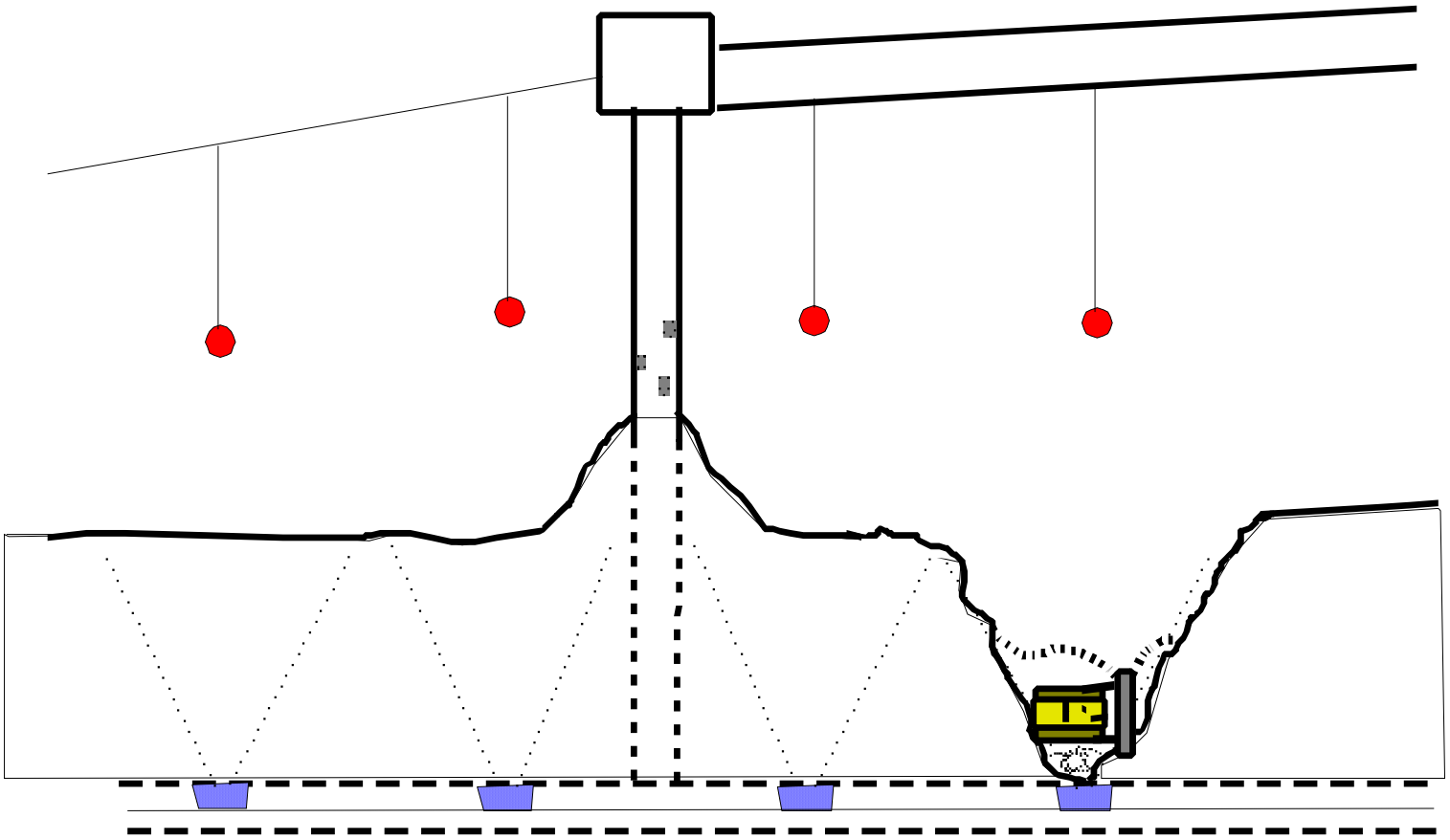
Fatal Accident in Virginia - Nov. 1998

This bulldozer went into a cavity while pushing coal away from the stacker. The orange ball marks the location of a feeder.

Virginia accident - This sketch, and the following two slides, show the surge pile layout and the conditions when the accident occurred.




#4
#3
#2
#1
50'
50'
50'



Virginia Accident: The hidden cavity had been created by gravity discharge through an ungated vibratory feeder.

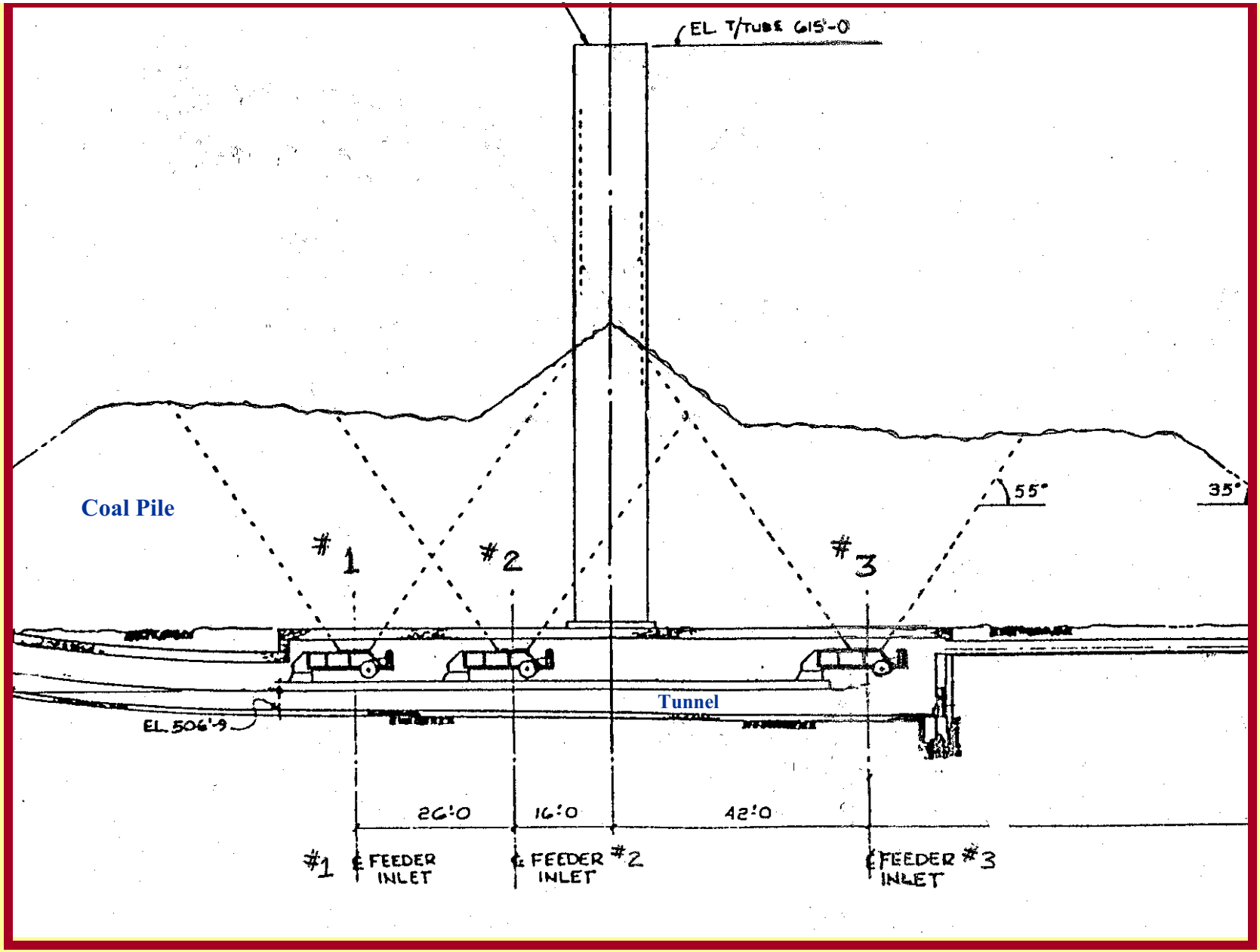
Elk Run Fatality - April, 1999

Elk Run Fatal Accident: Each stacker tube had two feeders. The accident occurred while the dozer operator was pushing clean coal away from a stacker.

Elk Run Fatality

The dozer broke into hidden cavity; coal filled the cab; the windows broke in.

Zeigler Central Cleaning Plant Incident - May, 2000


EL T/TUBE 615'-0
Coal Pile
#1
#2
#3
55°
35°
Tunnel
EL. 506'-9
26'0
16'0
42'0
#1 ℄ FEEDER INLET
℄ FEEDER #2 INLET
℄ FEEDER #3 INLET

Zeigler case: That's the dozer blade. The rest of the dozer is in a cavity over the No. 3 feeder.

Fortunately, the sides of the cavity held up and the operator was able to get out of the cab, climb up on the blade, and narrowly escape injury.

The feeders had been idle for a week while coal was spread on the pile using a D10. There were clayey fines in the coal...

"Pushing coal on a surge pile is the most dangerous job at a prep plant."

Prep Plant Superintendent

- **The job of pushing coal on a surge pile is made difficult by:**

- **changing conditions…**
- **layout of stackers and feeders…**
- **time pressures...**
- **limited visibility…**
- **limited space…**

Best Practices:

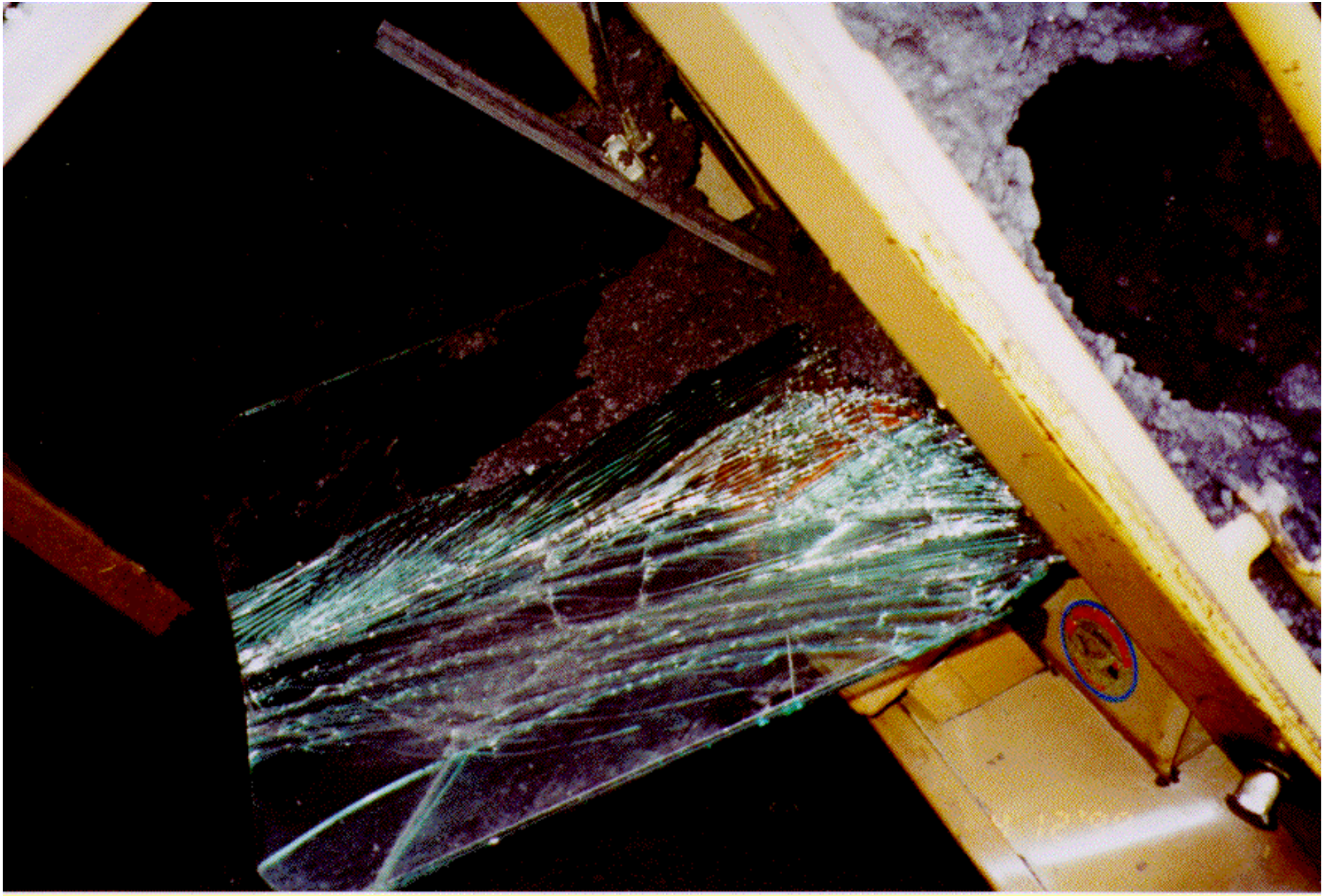
Ways to Improve Surge-Pile Safety

Best Practices: Surge Pile Safety

- **Provide equipment cabs strong enough to resist burial pressures.**

- **Or use remote-control equipment.**

The coal has broken or pushed in the cab windows and filled the cab...



Windshield pushed back into cab. Note: orange object under windshield is an SCSR...

Available Solutions for Stronger Cab Windows...

- **MSHA initiative: use of very high-strength glass…**
- **Massey approach: add supports to the inside of the cab windows - combined with using somewhat stronger glass...**
- **Use of polycarbonate windows... (Adequate strength; support around edges needs to allow for higher deflection; issue of scratch-resistance…)**

Testing of Very High-Strength Glass at PPG Plant

Huntsville, Alabama

Test fixture - size and shape of D9 rear dozer window

Test Results:

D9 rear window held a pressure of 40 psi for over 2 hours - at a glass temperature of 105 degrees - without breaking.

Note that 40 psi is equivalent to the pressure of being buried under about 35 feet of coal. This value was determined based on applying a factor of safety to the conditions observed in surge-pile accidents.

Field Burial Demonstration

Federal No. 2 Mine

near Morgantown, WV

High-strength glass installed using urethane adhesive.

High-strength glass installed in all cab windows of test dozer.

Dozer with high-strength glass being buried in coal pile… (1 or 4)

Dozer burial - 2 of 4

Dozer burial - 3 of 4

Dozer burial - 4 of 4

Buried dozer being dug out...

Checking windows after burial.

High-strength glass intact after burial demonstration.

The Massey Approach

Use somewhat stronger glass and install support bars on the inside of the cab windows.

The supports for the right-side door window are shown here.

Horizontal support bars and additional edge support for the windshield are shown here.

Massey's successful burial demonstration.

The glass cracked but it held the coal out of the cab.

Contrast this scene after the Massey demonstration - where coal was held out of the cab - with...

This scene from an accident, where coal has filled the cab...

New West Virginia Surge Pile Rule

- Title 36, Series 27, Section 5
- Effective January 1, 2001
- "All mobile equipment operated on a surge pile shall be equipped with an enclosed cab fitted with…a window support system or glass certified to withstand 40 psi…"

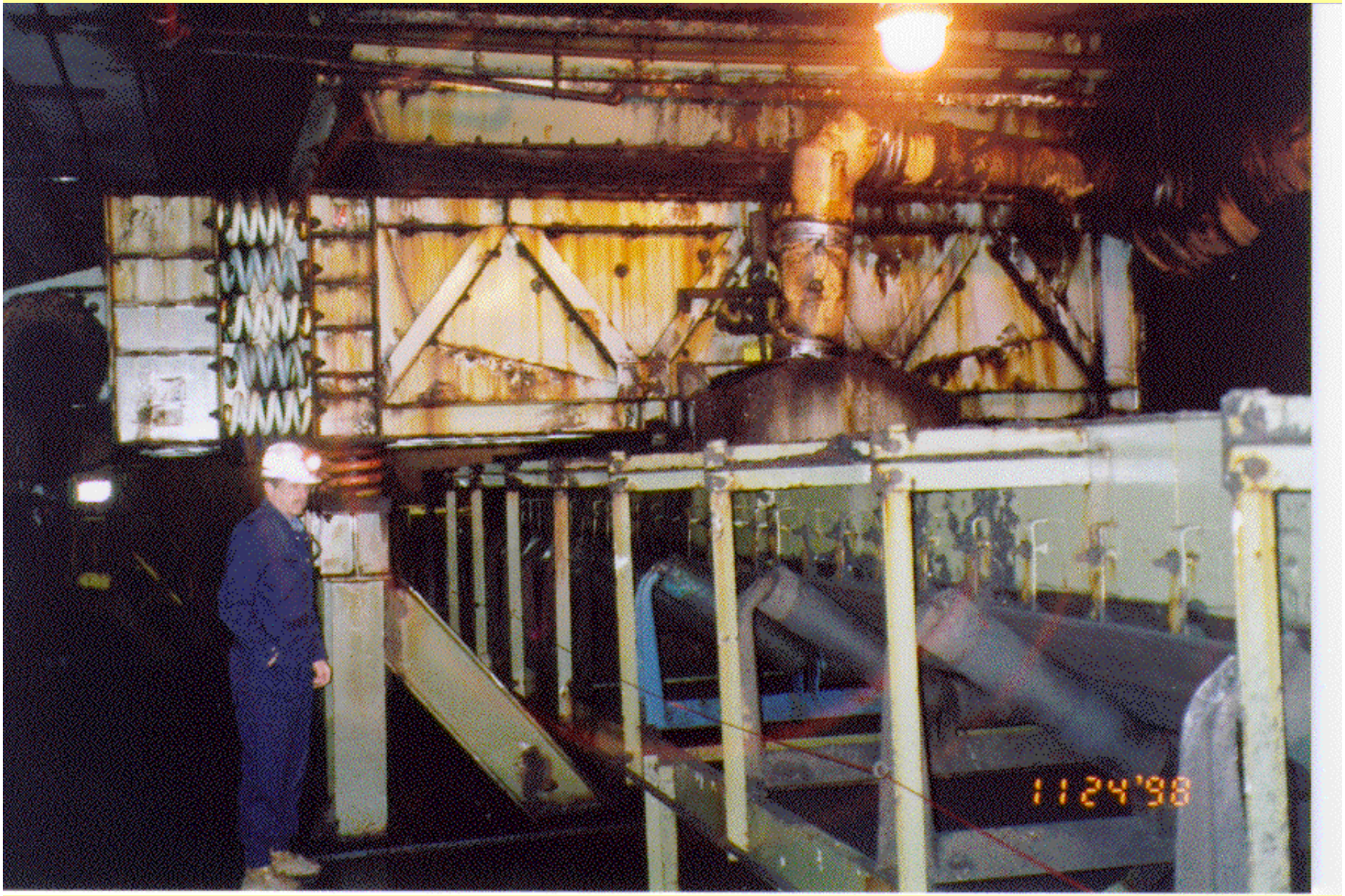
Best Practices: Surge Pile Safety

- **Equip the cab to allow a rescue in the event of an accident.**

- **Provide self-rescuers (shown here mounted above operator's head), radio communications and lighting...**

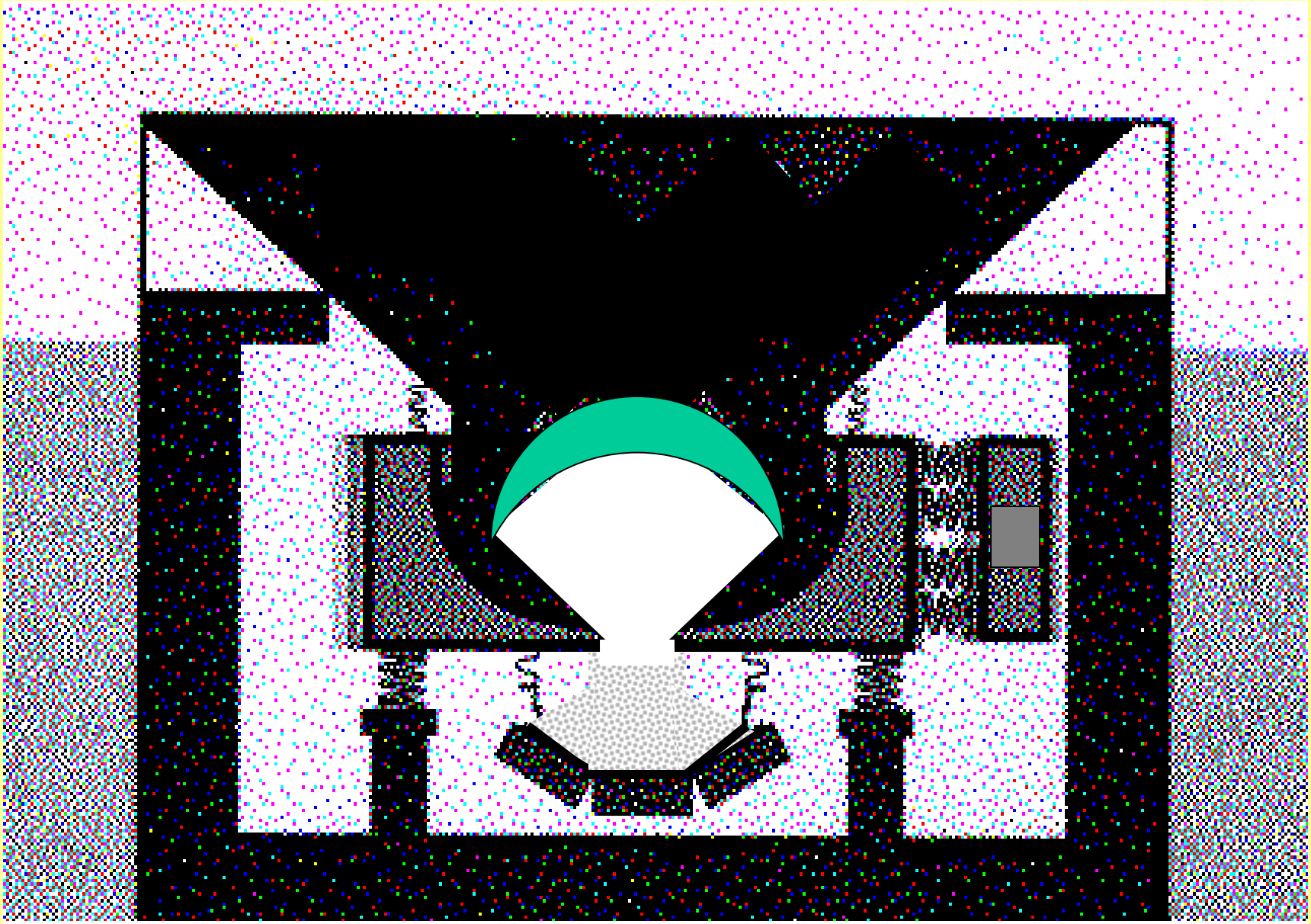
Best Practices: Surge Pile Safety

- **Provide gates on feeders - or otherwise ensure that coal cannot discharge when a feeder is not activated.**



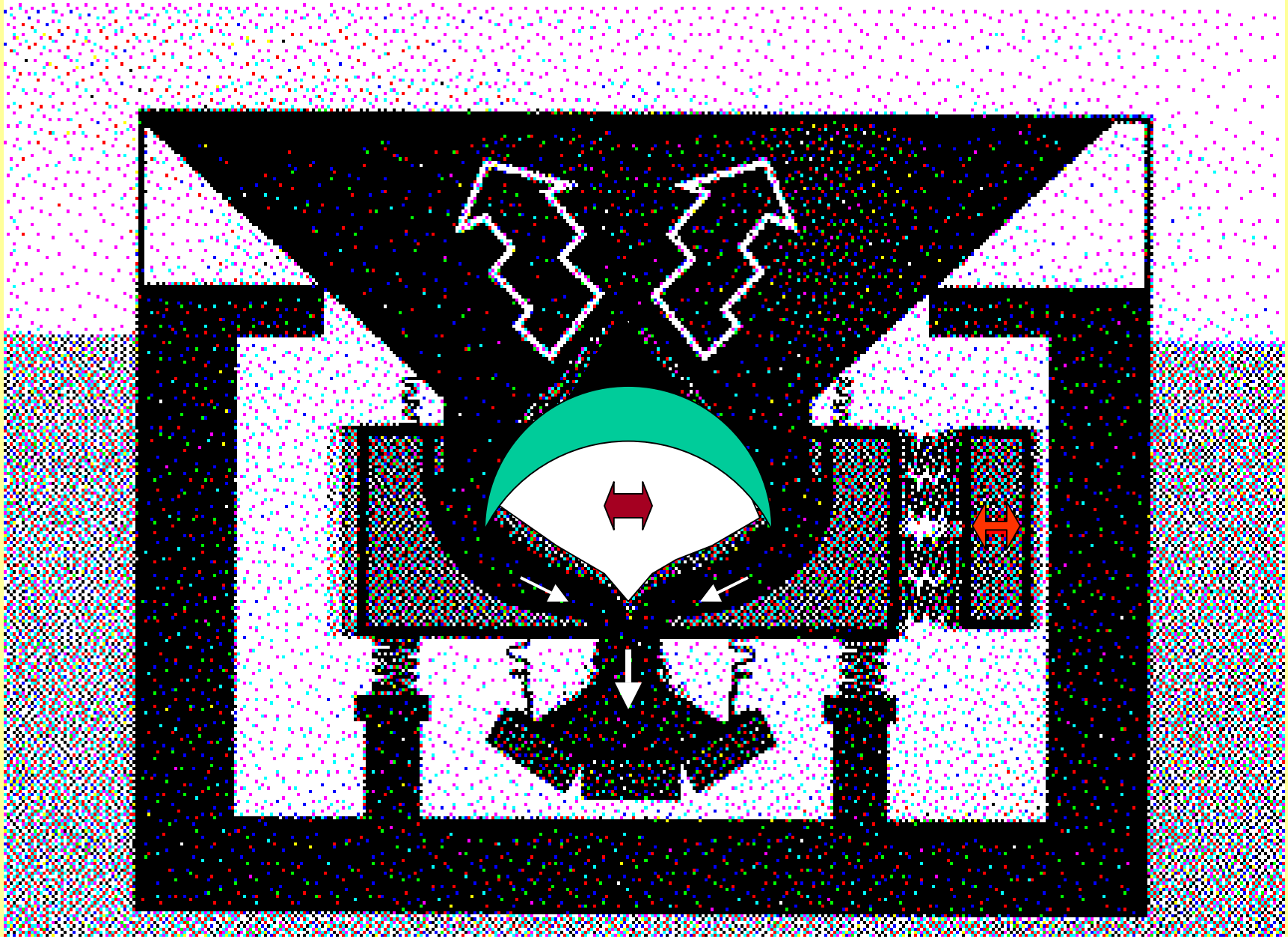
Type of feeder at Virginia accident

WITH VIBRATOR OFF



Cross-section of feeder. With the vibrator off, no coal should discharge on to the belt.

WITH VIBRATOR ON



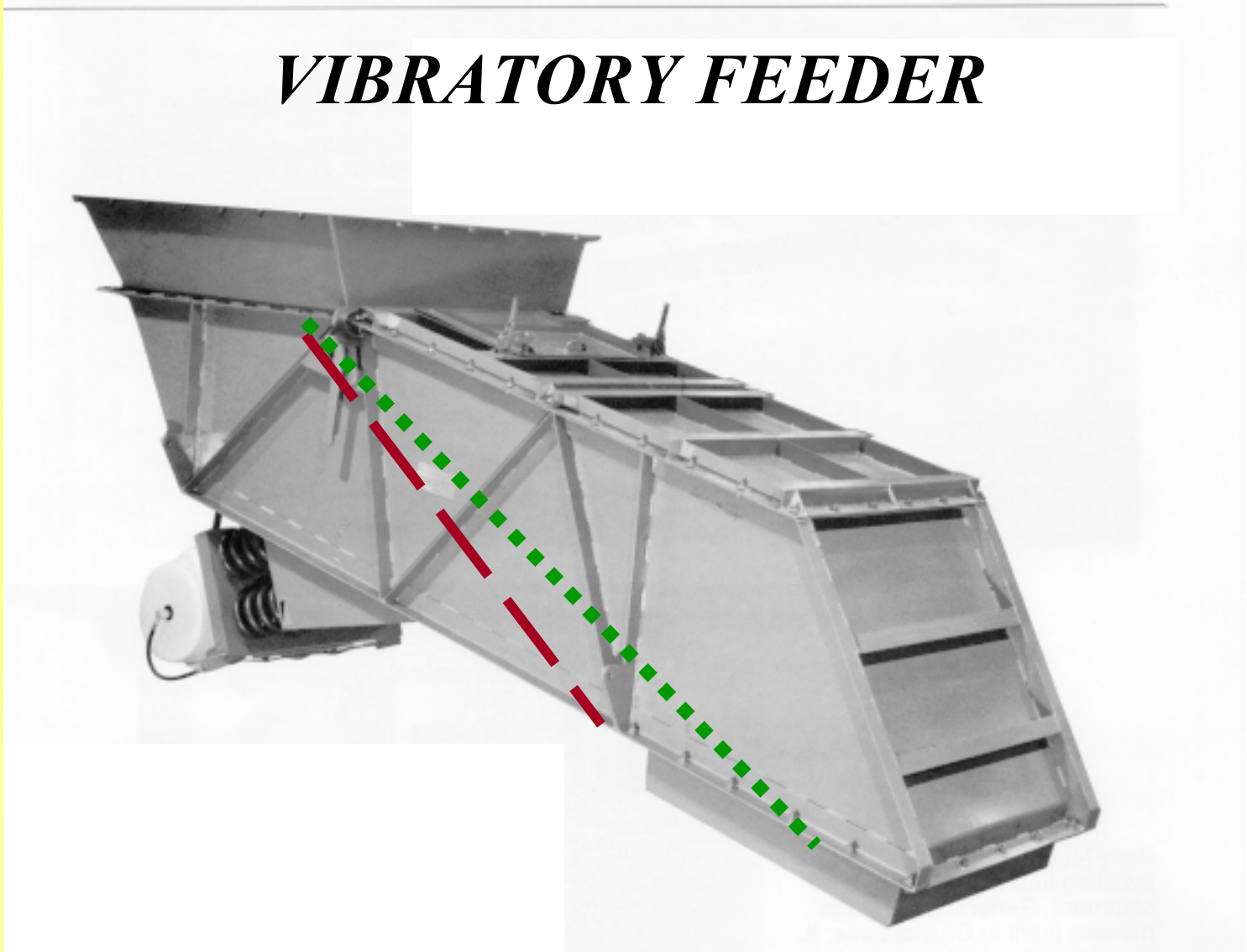
Cross-section of feeder. With the vibrator on, coal should discharge on to the belt.

VIBRATORY FEEDER

This is a different style of feeder, but it works on the same principle.

In this case, when the vibrator unit is turned off, the material comes to rest in the chute at its static angle of repose - represented by the red line.

When the vibrator is started, the material vibrates to its flatter, dynamic angle of repose - and drops through the end of the chute onto the conveyor belt.

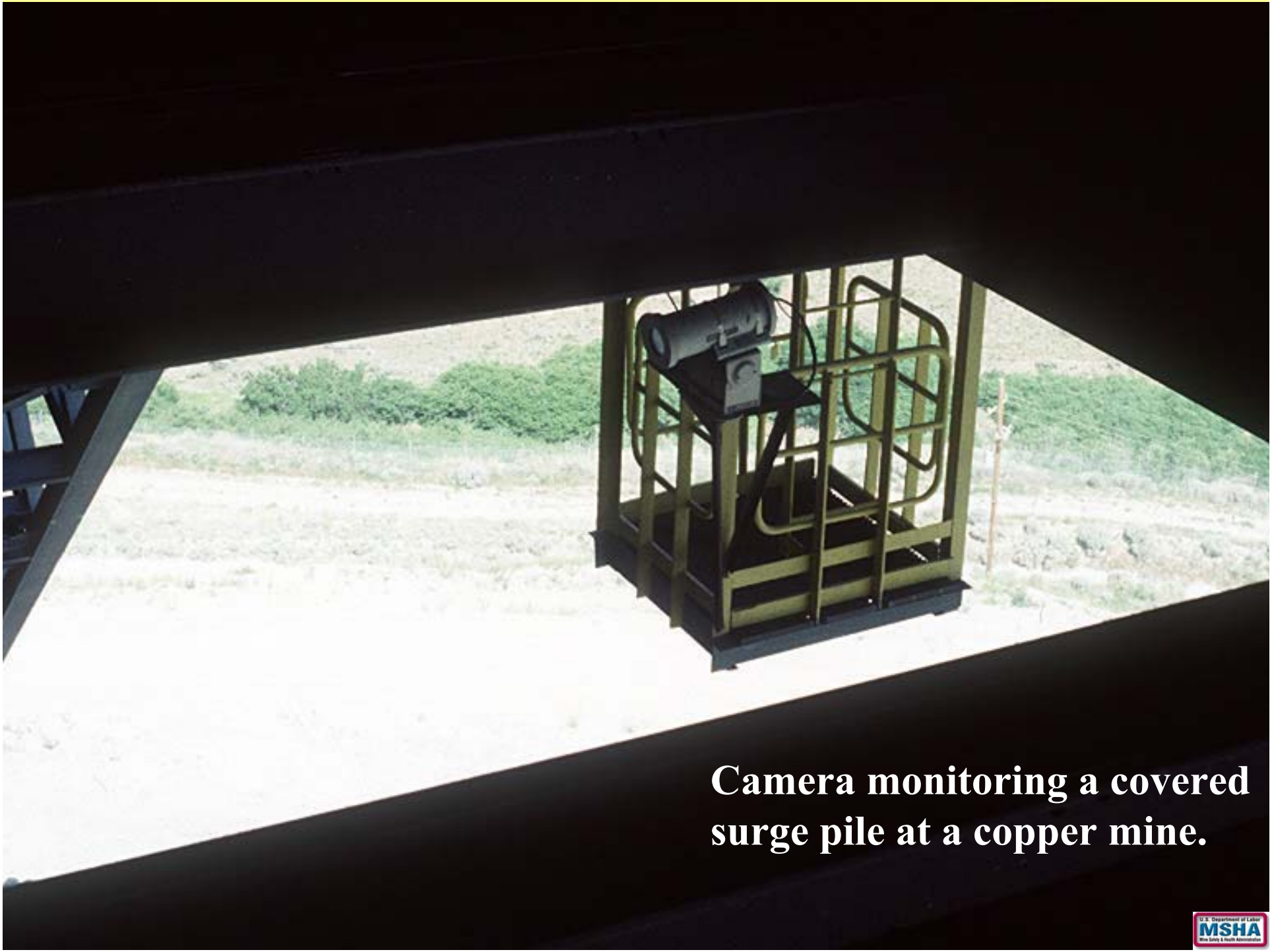


– – – – – – **STATIC ANGLE OF REPOSE - VIBRATOR *OFF***

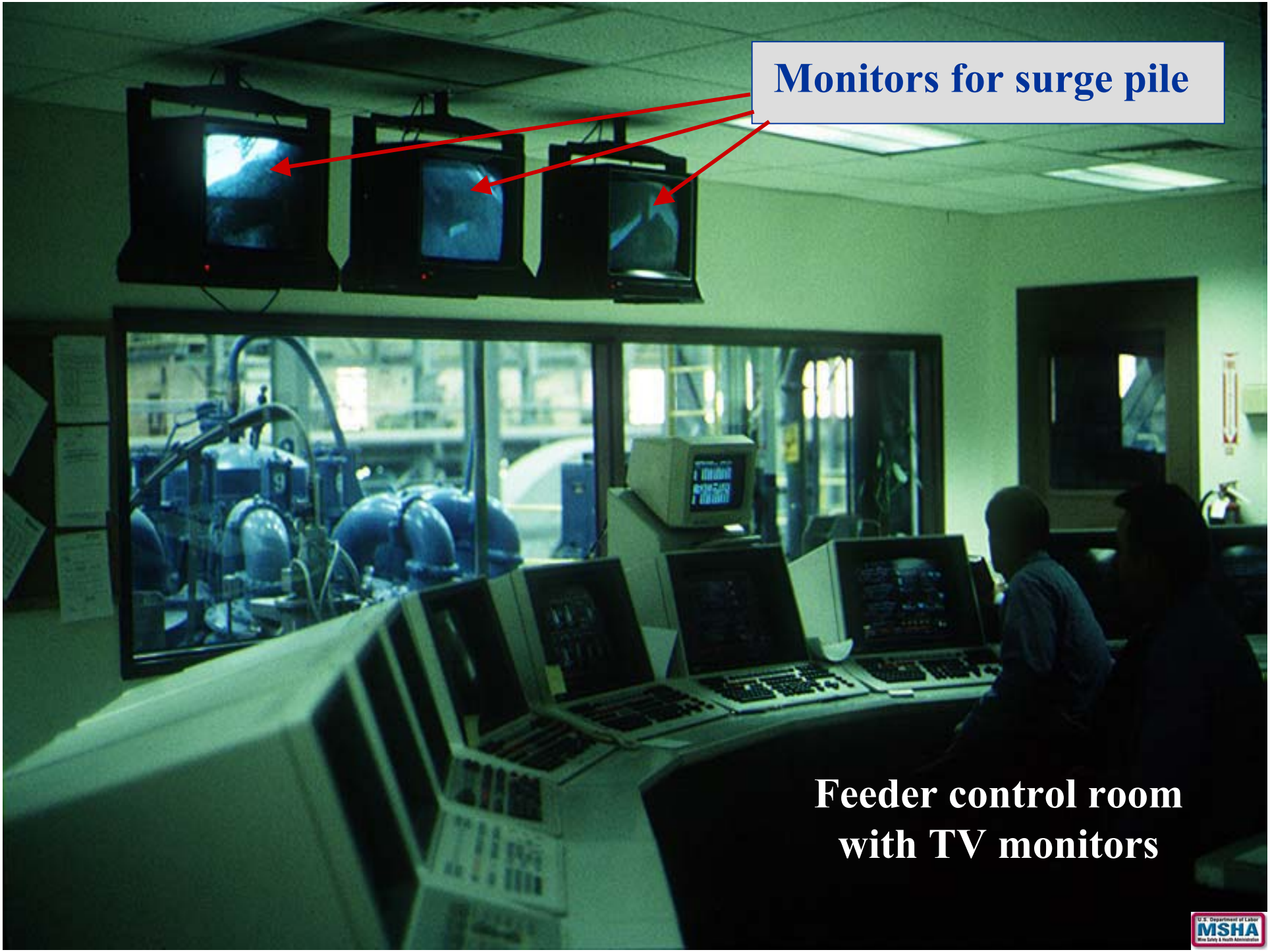
▪▪▪▪▪▪▪▪▪▪▪▪ **DYNAMIC ANGLE OF REPOSE - VIBRATOR *ON***

Best Practices: Surge Pile Safety

- **Provide the feeder operator with the capability to directly observe the conditions and activities on top of the pile.**
  - **Install closed-circuit TV if necessary.**
  - **Use with warning lights over feeders.** **For example, the feeder operator could turn on a flashing red light over the appropriate feeder if he activated a feeder and did not see a drawhole develop. This would warn everyone to stay away from that feeder because a cavity was suspected.**



Camera monitoring a covered surge pile at a copper mine.

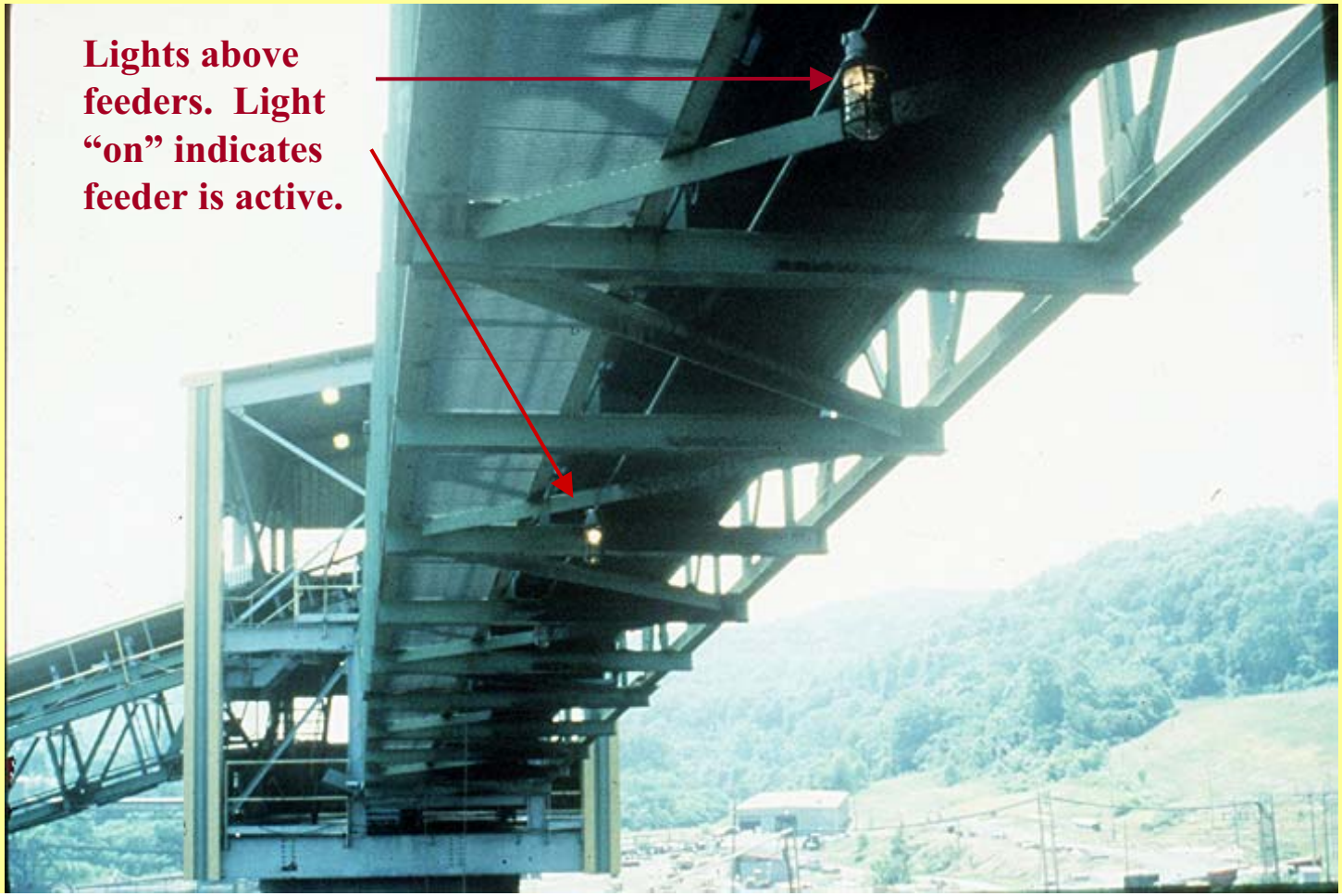

Monitors for surge pile
Feeder control room
with TV monitors

Best Practices: Surge Pile Safety

- ***Mark the locations of the feeders.***

Best Practices: Surge Pile Safety

- ***Provide visual indicators of which feeders are active.***



Best Practices: Surge Pile Safety

- ***Provide the mobile equipment operator with the capability to remotely shut-down the stacker and feeder belts from the equipment cab.***

Example: Transmitter for shutting down stacker and feeder belts at coal mine in WV. Various products are available with this capability.

New WV Surge Pile Rule

- Title 36, Series 27, Section 5.
  Effective January 1, 2001

- "In addition, the cab shall be equipped with... a remote-control device capable of stopping the flow to and from the feeder;…"

Best Practices: Surge Pile Safety

- ***Prevent persons from being on foot on a surge pile - provide warning signs.***

- ***Be especially alert for new miners, and contractor personnel, who may not be familiar with the dangers.***

Best Practices: Surge Pile Safety

- ***When working near a drawhole, always keep the equipment facing the drawhole.***

- ***Keep the drawhole nearly full during loadout.*** ***This prevents getting into a situation where dozers are pushing material into a deep drawhole.***

Best Practices: Surge Pile Safety

- **Dealing with cavities…**

- ***Have a system to detect cavities and warn all affected parties.***
- ***Take measures to ensure that no one is exposed to the hazard.***
- ***Use safe procedures to eliminate a cavity.***
    - *Based on experience, normally the most effective way to eliminate a cavity, or to rescue an operator trapped in a cavity, is to begin to excavate material at a safe distance off to the side of the cavity and work toward the cavity.*

Other Best Practices - Surge Pile Safety

- ***Avoid operating equipment near the feeders.*** **Operating near the feeders packs the material and makes it more prone to bridging.**

- ***Provide adequate training for all surge pile workers.*** **Of special concern are new miners and workers, such as contract personnel, who may only occasionally deal with the surge pile and may not understand the danger.**

- ***Minimize bulldozer safety problems in designing new surge piles and in modifying existing piles.*** **Design surge piles to decrease the dangers of having mobile equipment work near feeders. Close and seal off feeders where possible. On new piles, provide areas around stackers where the dozer can push coal without being near or over a feeder.**

Everyone involved with surge piles should keep this image in mind. By following the "Best Practices," surge pile accidents can be eliminated.

The preceding information is intended solely for the purpose of raising the awareness of surge-pile hazards and of measures that can be taken to prevent surge-pile accidents. The Federal standards for surge-piles are contained in 30 CFR Parts 56, 57, 75, and 77.

The following safety videos are available from the National Mine Health and Safety Academy (304-256-3257).

- "Hazards of Coal Stockpiling Operations," VC-831, 1994.
- "Hazards and Safety Practices on Surge Piles," VC-859, 1997.
- "Hidden Dangers: Safety Improvements for Surge Piles," VC-950, 2000.

Additional surge-pile safety information can be found under the "Accident Reduction Program (ARP)" on MSHA's web page at www.msha.gov.