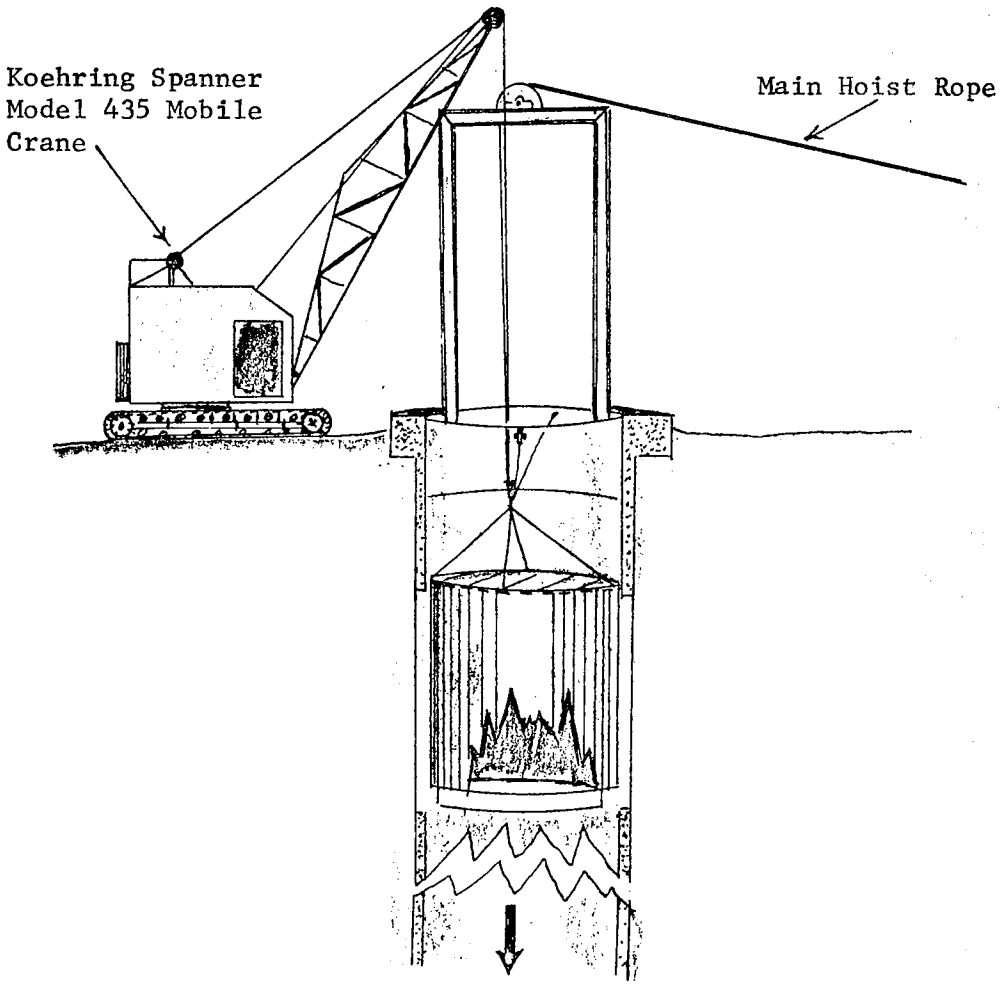
MULTIPLE FATAL (SHAFT SINKING) MACHINERY ACCIDENT

BECKLEY NO. 1 MINE (INTAKE AIR SHAFT)
COWIN AND COMPANY, INCORPORATED
BOLT, RALEIGH COUNTY, WEST VIRGINIA

January 7, 1974



Sketch No. 1

REPORT OF MULTIPLE FATAL (SHAFT SINKING) MACHINERY ACCIDENT

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By

Fred E. Ferguson
Coal-Mine Inspection Supervisor

INTRODUCTION

This report is based on an investigation made pursuant to the provisions of the Federal Coal Mine Health and Safety Act of 1969 (83 Stat. 742).

A machinery-type accident which occurred about 8:45 a.m., Monday, January 7, 1974, at the shaft-sinking operation for the Beckley No. 1 mine, resulted in the deaths of three employees and injuries to three other employees. The three fatally injured employees all classified as miner drillers were: [redacted] Adams, Social Security No. 422-32-2216; C[redacted]owller, Social Security No. 235-64-4990; W[redacted] R. Simpson, Social Security No. 419-72-7230. Adams, age 45, had 8 years experience, including 1 year with this company, is survived by his widow and 1 dependent child; Fowller, age 33, had 1-1/2 years experience, all with this company, and had no dependents; and Simpson, age 23, had 1 year experience, including 9 months with this company, is survived by his widow and 1 dependent child. Injured employees included Gary Clark, clamshell operator, and Leroy Briddle and Eugene Burgess, carpenters.

The Mount Hope office of the Mining Enforcement and Safety Administration was notified of the accident immediately, and an investigation was started shortly thereafter.

The information for this report was obtained from statements of company officials and employees, from an investigation of the accident scene and from the results of tests of the equipment involved in the accident.

GENERAL INFORMATION

The Beckley No. 1 mine intake air shaft construction site is located near Bolt, West Virginia. The construction project consists of excavating an intake air shaft to a purposed depth of 635 feet. At the time of the accident, the shaft had been developed to a depth of about 138 feet. A total of 24 men was employed at the project on 2 shifts a day.

Construction projects for the purposed Beckley No. 1 mine, Ranger Fuel Corporation, consist of air shafts and a slope. The excavation for a return air shaft and slope had been completed. The Cementation Company of America, Incorporated, headquartered in Brampton, Ontario, Canada, had developed the subject intake air shaft to a depth of about 40 feet. Thereafter, the Cowin and Company, Incorporated, headquartered in Birmingham, Alabama, was, in July 1973, awarded the contract to complete the intake air shaft.

The equipment involved in the accident consisted of a working platform used as a form to install cement sidewalls in the shaft, a Sanford-Day Model HKI "Brownie" car-spotting hoist, a Koehring Spanner No. 435 mobile crane, along with the related wire ropes and sheaves used with the hoisting equipment. A description of the applications of the equipment, and the substandard conditions and practices revealed during the investigation are outlined in the Description of Accident section of the report, and in the modification of a 104(a) Closure Order issued during the investigation.

The investigation was conducted by Mining Enforcement and Safety Administration personnel, and those persons present during the investigation were:

Contractor Company Officials

John J. Cowin	President
R. A. Gallentine	Director of Safety
Edward Stamper	General Superintendent
Roy Williamson	Site Superintendent
Blain Sutherland	Shift Foreman

Ranger Fuel Corporation

S. L. Deck	Safety Director

United Mine Workers of America

Charles F. Perrish	Chief Inspector
Jonathan Williams	Representative, International Safety Division
Everett G. Acord	Safety Inspector
Vernon E. Burgess	Carpenter (Eyewitness)
Leroy Briddle	Carpenter (Eyewitness)

West Virginia State Department of Mines

J. A. Philpott	Inspector-at-Large
Charles Browning	District Inspector
Steve C. Colosi	Electrical Inspector
Salem R. Wooten	Safety Instructor

Mining Enforcement and Safety Administration

John E. Weekly	Subdistrict Manager
Fred E. Ferguson	Coal-Mine Inspection Supervisor
John H. Cook	Coal-Mine Technical Specialist (Electrical)
Jesse P. Cole	Federal Coal-Mine Inspector
Billy R. Sloan	Coal-Mine Technical Specialist (Electrical)
Fred T. Casteel	Coal-Mine Safety Specialist
James E. Curtis	Coal-Mine Safety Specialist
George F. Susko	Mechanical Engineer

The management structure for the construction firm consists of a president, general superintendent, site superintendent and a shift foreman. Roy Williamson is the designated official in charge of health and safety for the construction site and R. A. Gallentine is in charge of health and safety for the company. The company had not submitted a training and retraining program for employees to the Mining Enforcement and Safety Administration. Accident rates were not compiled by the company for this operation.

None of the site employees, including some of the first-line supervisors, had received any training other than on-the-job instructions. Roy Williamson, the direct supervisor of the victims, had 13 years construction experience, all with this company, and he had supervised this project from it's initiation. Williamson had received training in safety provisions regarding shaft-sinking operations.

The last Federal inspection of the construction site was completed October 19, 1973.

DESCRIPTION OF ACCIDENT

Normal construction operations were begun on the day shift about 8 a.m., Monday, January 7, 1974. The segment of the shaft-sinking operations in progress on this day consisted of lining the shaft with cement, and these operations had been in progress during the past week. Roy Williamson, superintendent, made an examination of the platform and hoisting equipment and determined that the platform had been raised about one foot too high in the shaft; therefore, six men of the working crew were lowered to the top of the platform, and Williamson gave them instructions to make preparations to lower the platform to the desired location. Thereafter, they were supposed to secure the form in preparation for cementing operations. At the time of the accident, at about 8:45 a.m., the men were distributed as follows: Williamson was situated in the mobile crane with the intent to assist in the lowering of the platform; Gary Clark, clamshell operator, was on the upper deck of the platform with the remote controls for the car-spotting hoist with the intent to assist in the lowering of the platform; Leroy Briddle, Edgar Adams, and Clyde Fowller were also located on the upper deck

of the platform performing miscellaneous duties; and Vernon Burgess and William Simpson were located on the lower deck of the platform with the intent to secure the forms after the platform had been positioned at the desired location.

According to the statement of Williamson, immediately after the two hoisting devices were activated and the platform lowering operations were started, the mobile-crane hoisting rope broke and the crane boom recoiled to a vertical position. Williamson stated that he realized that the hoisting ropes had broken and that the platform had plunged to the bottom of the shaft; therefore, he and other employees on the surface made preparations to lower him (Williamson) in the hoisting bucket to the shaft bottom, as a rescue attempt.

Leroy Briddle, who was on the upper deck, stated that as soon as the platform began to move the hoist ropes snapped and the platform fell. He grabbed the wire-signal rope which was nearby, and thereafter he fell along with the platform to the shaft bottom into the water. Vernon Burgess, who was located on the lower deck of the platform, stated that his view was obstructed and he only knew that the platform was falling. Also, he remembered the impact with the water at the shaft bottom. Burgess, Briddle and Clark survived the fall and they assisted each other in climbing from the water to the top side of the platform, which projected about 2 feet above the water level.

Within minutes, Williamson was lowered to the shaft bottom in the bucket and he helped the three survivors into the bucket. A search was made for the remaining three employees without success. The three men who survived the incident were brought to the surface, and thereafter transported by ambulance to a hospital in Beckley, West Virginia. Their injuries consisted of: Briddle experienced abrasions of his hands (rope burns) and a bruised foot; Burgess experienced two fractured ribs; and Clark experienced multiple bruises and he remained hospitalized, while Briddle and Burgess were released after treatment on the day of the accident.

Recovery operations were begun immediately after the accident; however, the recovery operations were delayed because an air-operated water pump, which was located at the shaft bottom, was rendered inoperative from damage by the fallen platform. Additional air-operated water pumps was acquired from other shaft-sinking projects in the area and installed in the shaft to lower the water level and permit recovery of the accident victims. Fowller was located and removed from the shaft at 2:15 p.m. Adams and Simpson were located at about 2:50 p.m. and removed from the shaft at 3:30 and 3:45 p.m., respectively.

The investigation of the accident revealed that after the shaft-sinking operation had progressed to a depth of about 140 feet, it was decided to stop the earth removing operations at the bottom

of the shaft and to begin installing a concrete liner in the shaft. This action was necessary because an excessive amount of water was draining into the shaft working from the exposed earth walls of the shaft. The concrete lining utilized a water retaining ring and pumping facilities to control the water that entered the shaft. After the decision was made to begin lining the shaft, the platform and hoisting facilities were installed and cementing operations were started about December 26, 1973. Statements of company officials indicated that the installation of the hoisting equipment and the method of repositioning the platform was formulated at the job site by the management at the site. No blueprints or other written design specifications were provided at the site outlining the proper installation procedures for the platform used in the shaft.

The cementing operations for the shaft consisted of a crew on one shift to break the form molds and to reposition the platform to the next desired elevation to be cemented. Thereafter, the day-shift crew would install the concrete, which was delivered to the site by autotruck (premixed) and lowered to the platform in a cement bucket, to the sides of the shaft around the molds. The cement was then permitted to harden during the next shift (idle shift) and the cycle would be repeated the following shift.

The procedure for repositioning the platform consisted of placing a crew of men on the platform to disengage the molds from the shaft walls, to remove the installed platform support bolts and to attach the platform hoisting ropes. One employee would operate the mobile crane and another employee would operate the car-spotting hoist from a control switch located on the platform. After the platform was moved (20-foot segments) the molds were repositioned by using screw-type jacks and the platform resecured for the cementing operations.

On the day of the accident, the 12:01 to 8 a.m. shift crew began the platform repositioning sequence, and because of absenteeism, only the foreman, Blaine Sutherland, and three other employees worked on the platform. At the end of the shift the repositioning cycle had not been completed, and the platform had not been properly positioned nor secured. According to Williams, the platform was about 1 foot higher than the desired location.

Management officials stated that either the car-spotting hoist or the mobile crane, as used, had the capacity to safely hoist and lower the platform device (estimated 20 tons). It was ascertained that neither of the hoisting apparatuses including the ropes, as used, would have complied with accepted standards required for hoisting. (Reference USAS M11.1 - 1960). The car-spotting hoist (Sanford-Day Model HKI "Brownie") was powered by an electric, 30 horsepower motor utilizing 440-volts alternating-current power with a rope pull of 24,000 pounds. The wire rope used on the hoist was a 1-inch, 18 x 7, not-rotating fiber-core preformed-type rope with a breaking strength of 76,600 pounds.

The mobile crane, a Koehring Spanner No. 435 (Model No. C-14944) was using a 50-foot length boom and was being operated at a boom angle of about 70 degrees. A 5/8-inch, 6 x 26, wire-core steel rope was utilized for the hoisting operation. The mobile crane was provided with a 4-block sheave on the end of the boom, and a 4-block sheave was attached to the coupling hook on the platform in the shaft. Two of the sheaves were being used at the time of the accident.

It is relevant to note that neither of the hoisting apparatuses (the car-spotting hoist and the mobile crane) were provided with the safety devices required for hoisting of men or materials. It was the contention of the company officials that such safety devices were not required on this equipment since these hoisting devices were only used to reposition the platform and not used to raise and lower men and materials. It was disclosed that the platform was repositioned once in each 24-hour period prior to the accident, and that the men were required to be on the platform while it was being moved or repositioned. After a reposition maneuver, the platform was secured to the shaft lining by supports and the hoisting equipment was then disconnected and not required for the support of the platform during cementing operations.

The investigation also revealed that the 1-inch rope, used on the car-spotting hoist, was a used rope and company officials indicated that the rope had not been gaged or tested to determine if it was suitable for use at this installation. Also, no rope testing or examination program had been established for the project and all rope examinations that had been performed were visual. The 1-inch rope had also been permitted to rub or contact the concrete shaft collar to the extent that a groove had been worn into the collar. The 5/8-inch wire rope used on the mobile crane had been permitted to rub or contact the metal headframe structure installed over the shaft. The grooves in the 1-1/4-inch headframe metal had been worn to a maximum depth of about 1/2-inch.

Specimens of the 1-inch and the 5/8-inch ropes that failed were sent to the Technical Support Group, a division of the Mining Enforcement and Safety Administration, Denver, Colorado, for performance tests. The results are as follows:

Analysis of 1-inch rope used on the car-spotting hoist:

1. The wires in the broken end of the 1-inch rope were examined and classified by the type of break as follows:

Tension	28 wires	33.3%
Tension and wear	29 wires	34.5%
Fatigue and wear	11 wires	13.2%
Corrosion	16 wires	19.0%
Total No. of crown wires =	84 wires	100.0%

(12 outside strands with 7 wires per strand)

Wire in the six inside strands showed 100% tension.

2. From analysis of the 1-inch rope and hoisting equipment and with it, can be determined:

a. The rope was worn with an average measured diameter of 0.9375 inches.

b. The outside of the rope was rusty and corroded because the reel, the rope was on, was outside under all weather conditions.

c. The rope wear was uniform, however apparent peening was observed. This may have been due to rubbing of the rope against the concrete of the shaft collar.

3. The rope was not properly supported by sheave grooves when under tension. This was obvious since the sheave at the top of the shaft collar had a groove diameter of 1-1/4-inches.

4. The diameter of the sheave at the top of the shaft collar was approximately one half the recommended minimum diameter as specified in M11.1 - 1960 "Wire Ropes for Mines".

Analysis of 5/8-inch rope used on mobile crane:

1. The rope had little or no wear, however rubbing against the bearing block of the head sheave of the main hoist which distorted and weakened the rope. This resulted in the IWRC core of the rope migrating to the exterior of the rope and replacing an outer strand.

2. The lang lay strands were more severely damaged than the regular lay strands.

The results of the testing of the ropes indicated that:

1. The tensile load on the rope due to the angle at the time of the failure was about 15 percent greater than the catalog rated breaking strength for new rope. Because of the wear on the rope, the actual breaking strength was about 7 percent less than this catalog rated strength. For this reason, this tensile load would be 22 percent greater than the actual breaking strength of the rope.

2. At the time of the break, the HKI hoist rope lost most of its mechanical advantage and the crane hoist rope was carrying the whole weight. The HKI hoist rope was running over a sheave which had been grooved for 1-1/4-inch rope. This groove had insufficient support for the 1-inch diameter rope used. The result of oversized grooves is that under normal operating loads sufficient pressure will be exerted to cause the rope to flatten or become distorted from its true circular section. This condition not only weakens the rope but increases fatigue in the individual wires, causing premature failure.

3. The 1-inch rope was rubbing against the concrete on the side of the shaft collar wearing an apparent groove in the concrete. This abrasion between the rope and the concrete contributed to accelerated wear and subsequent loss in rope strength.

4. The 5/8-inch rope was rubbing against the bearing block on the main hoist sheave, distorting the strands and breaking wires in the lang lay strands and seriously weakening the rope.

5. The IWRC core of the 5/8-inch rope migrated to the outside of the rope and replaced an outer strand because of excessive impulse loads. These loads were due to the rope hitting and catching the bearing block. This condition occurred long enough to wear a groove in the bearing block of the main hoist sheave.

6. All broken wires of the 5/8-inch rope evidenced tension and fatigue.

7. The migration of the core to the surface of the 5/8-inch rope was probably due to the weakening of the wire rope when the wires were breaking in the lang lay strands.

A copy of the final report of the Technical Support Group, a division of the Mining Enforcement and Safety Administration is available on file at the Mining Enforcement and Safety Administration office in Washington, D. C., and the District 4 headquarters in Mount Hope, West Virginia.

During the investigation an analysis was made of the mechanical advantage gained by the use of the rope sheaves for the car-spotting hoist. The 1-inch rope, used on the car-spotting hoist, was routed over an 18-inch diameter sheave (13-inch tread diameter) which was installed on the shaft collar, through a sheave (18-inch diameter and 13-inch tread) that was attached to the 1-inch support ropes for the platform (see figure of sketch) and finally, the rope was anchored near the top of the collar on the opposite side of the shaft. At the time of the accident, the platform sheave assembly was about 5-feet below the surface of the collar. Based upon the foregoing conditions, it is the contention of the Mining Enforcement and Safety investigators that any mechanical advantage had been rendered ineffective.

The following is a list of pertinent information revealed during the investigation:

1. The installation of the platform-hoisting apparatus had been done without suitable planning and without engineering specifications.

2. The platform relocation sequence could have been performed without men being on the platform during the time that it was being moved.

3. The examinations of the hoisting equipment, including the main hoist, the car-spotting hoist and the mobile crane, should have revealed the rope damage and persons who conducted the examinations should have realized that the used 1-inch rope was not suited to the hoist installation.

4. The company did not have in effect, at the project, a rope examination and testing program that included gaging and periodic strength testing as outlined in the USAS - Standards for the Use of Wire Ropes for Mines (M11.1 - 1960).

5. The company did not have, at the project site, a safety program or safety inspection personnel to detect the substandard working conditions and procedures.

The investigation further revealed that the six men and the platform fell about 100 feet and into about 14 feet of water (estimated to 47,300 gallons) accumulated at the shaft bottom. The cause of death of two of the victims was listed as drowning; however, it is conjecture to say whether or not the other three employees would have survived the fall had the water not been in the shaft bottom. The accumulation of water at the shaft bottom was not a factor involved in the cause of this accident.

Immediately after the accident occurred, employees of the Monty Brothers Construction Company and the Ranger Fuel Corporation, located nearby, promptly responded to the emergency and these employees and officials provided the necessary manpower, direction and equipment to perform recovery of the victims. This response and assistance in the investigation by these parties was commendable and gratefully acknowledged by the Mining Enforcement and Safety Administration.

CAUSE OF ACCIDENT

This multiple-fatal accident occurred when the support-wire ropes used to move a work platform failed.

Contributing factors to the cause of the accident were:

1. Neither the hoisting apparatus, the mobile crane or the car-spotting hoist was capable of controlling the load (20-tons) under the conditions involved in the accident.

2. The wire ropes, as used, did not provide suitable strength capabilities to safely move the platform.

3. The improper rigging procedures and poor maintenance of the 1-inch hoist rope and the improper hoisting procedure with the 5/8-inch hoist rope which allowed it to wear a groove in the bearing block of the main hoist sheave and other areas of the metal headframe.

4. Improper rigging of the 1-inch rope allowed it to wear on the concrete of the shaft collar. It also introduced excessive loads

as the concrete forms were hoisted to the surface and the angle of pull increased. This rapid change of rope load introduced cyclic tensile changes which further tended to weaken the rope that already evidenced rust and corrosion from improper storage and lubrication. This resulted in the premature rope failure analyzed as tension and fatigue. The rust and corrosion were moderate but contributed to increased stress concentration factors.

5. The company did not provide the necessary engineering and planning in the design of the hoisting apparatus, the installation and maintenance of the equipment, and the procedure for relocating the platform to insure the safe performance of the operation.

6. The exposure of the six men to the hazard of the accident was unnecessary since the platform-moving operation could have been performed without men riding on the platform.

FINDINGS OF FACT

1. Management permitted the hoisting of the platform by hoisting equipment that was not provided with the required safeguards, a violation of Section 77.1905(b).

2. Management utilized hoisting equipment, including the car-spotting hoist and the mobile crane, that was not consistent with the loads (platform), a violation of Section 77.1903(a).

3. The ropes used on the mobile crane and car-spotting hoist were not selected or maintained in accordance with the American National Standards Institute "Specifications For the Use of Wire Ropes for Mines" M11.1 - 1960, a violation of Section 77.1903(b).

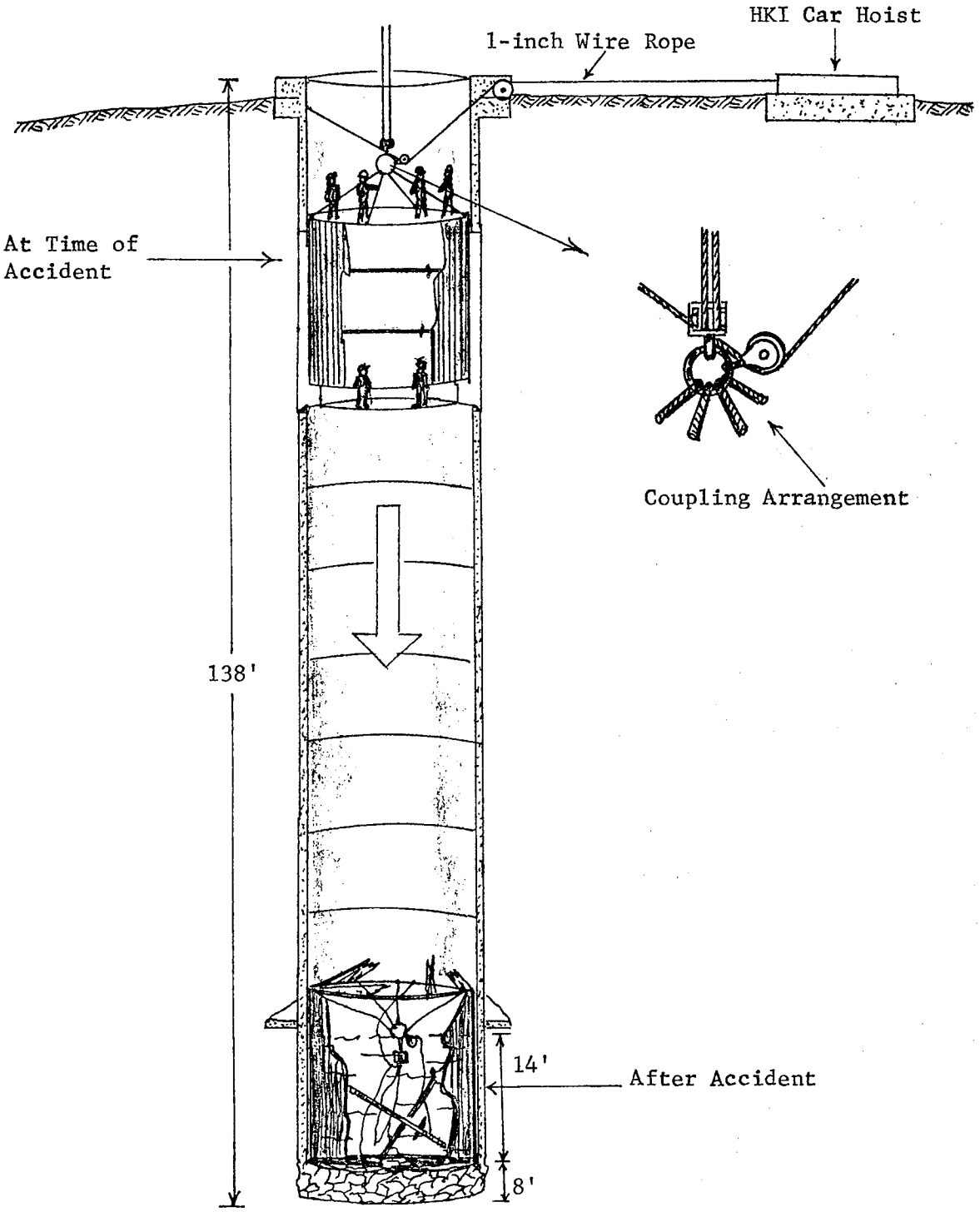
4. Suitable examinations of the hoisting equipment used to transport men and maneuver the platform had not been made, a violation of Section 77.1906.

REQUIREMENTS

1. Management shall not permit the hoisting of any bucket, platform or other device by hoisting equipment that is not provided with required safety devices.

2. Management shall not permit the use of hoisting equipment, including wire ropes, that does not comply with the USAS - Standards for the Use of Wire Ropes for Mines (M11.1 - 1960).

3. Management shall formulate, in written form, an approved method of utilizing the platform while performing shaft-lining operations to minimize the hazards to the employees required to work in the shaft. This program shall be incorporated in the approved plan required under Section 77.1900.



Scale 1" = 20'
Sketch No. 2