NATIONAL TRANSPORTATION SAFETY BOARD

RAILROAD ACCIDENT REPORT

PENN CENTRAL COMPANY
Electrocution of Juvenile Trespasser
On Penn Central Tracks
at Washington, D.C.

May 14, 1971

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-RAR-72-3

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15.Supplementary Notes

16.Abstract

On May 14, 1971, a male juvenile climbed on top of a draft of freight cars which had been left temporarily adjacent to the Penn Central Sixth Street Yard, Washington, D. C., and was electrocuted when he contacted the electrified catenary system. Within minutes thereafter, a police officer was seriously burned and knocked from the top of an adjacent car when he attempted to reach the stricken youth. The youth was apparently killed outright, but the police officer survived.

There are few effective warning indicators in and around the accident area and no barriers that would discourage trespassers. Compounding the hazard in the area is a parking lot on which children congregate to play. There are no positive separation barriers between the railroad and the parking lot. Also prominent in causal factors to the injury of the policeman is the practice of Penn Central of immediately restoring an actuated circuit breaker when the cause of actuation is not known.

Recommendations evolving from the investigation are for more and better signs, fencing, and a general improved way of keeping trespassers off railroad property. There is also recommended action to change the manner of power restoral in cases of outages, and expedite the removal of side-end ladders to keep people off the top of box cars.

17.Key Words	18.Distribution Statement
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ELECTROCUTION OF JUVENILE TRESPASSER
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I. SYNOPSIS

At approximately 6:45 p.m., Friday, May 14, 1971, a 14-year-old youth was electrocuted while he was moving on the top of a railroad boxcar, of a standing 26-car complement, when he contacted the catenary propulsion system of the Penn Central Railroad. The 26-car draft was standing on Penn Central (PC) secondary track, designated No. 4 track by timetable, in the vicinity of Seventh Street and Virginia Avenue, S W., Washington, D.C. No locomotive was coupled to the cars at the time of the incident

A passer-by and the U S Coast Guard duty officer observed the accident from the time following the initial flash at contact The Coast Guard duty officer has an office in the Nassif Building, 400 Seventh Street, S W., and from his location he could see the scene of the accident Both the passer-by and the duty officer notified the Metropolitan Police Department, which in turn notified the District Fire Department.

Police department personnel arrived at the scene first and a sergeant from the first precinct mounted a freight car adjacent to the car on which the body of the youth was lying, in an attempt to reach him After the officer reached the top of the car, he suddenly became surrounded by flames and immediately fell to the ground The sergeant had made contact with the trolley wire of the catenary propulsion system and had sustained severe injuries.

Immediately after the police sergeant fell, fire department personnel arrived, and administered first aid to him. The boy appeared to be dead and, because of the great risk, no further attempt was made to reach him until the power was turned off. The police sergeant was revived and subsequently was taken to the George Washington University Hospital. After the catenary system had been de-energized and grounded, the body of the boy was taken down from the top of the car and removed to the Washington Hospital Center. He was pronounced dead on arrival

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was contact by the trespassing youth with the trolley wire of the 12,000-volt, 25-hertz catenary system while he was moving on top of railroad freight cars

Contributing factors were:

a. The absence of fencing to prevent access by persons to the hazards of railroad

operations, including the high voltage catenary propulsion system.

b. Inadequacy of signs to convey an understandable warning of the specific hazards present.

The cause of the injuries to the police officer was his contact with the trolley wire while he was moving on top of the freight car in an effort to reach the electrocuted youth.

Contributing factors were:

a. The prevailing practice of the Penn Central to restore failed circuitry experimentally without a physical inspection to determine the absence of hazard to persons.
b. Lack of training of the police officer relative to the hazards in the area.
c. Lack of contact and communications between the police and the Penn Central.

II. FACTS

A. Location of Accident

The accident occurred on the Penn Central Railroad's freight line which runs from Landover, Maryland to Potomac Yard, Virginia, via Anacostia, D.C., Virginia Avenue tunnel, Long Bridge, and the Penn Central Sixth Street S W. Yard, Washington, D.C. The railroad runs east and west geographically at the immediate scene of the accident, but north and south by timetable direction. Timetable direction will be the reference in this report.

At the scene of the accident, which is approximately 250 feet north of the Seventh Street bridge, there are five tracks. (See Figure 1.) From west to east there is a side track (Barber Siding) which serves several industries in the vicinity, a secondary running track designated No. 4 track, a southbound main track designated No. 3 track, a northbound main track designated No. 2 track, and a secondary running track designated No. 1 track. Track Nos. 1, 2, 3, and 4 are electrified; that is, over each track is a trolley wire, part of an electrical catenary propulsion system by which the Penn Central powers its electric locomotive units. The side track has no overhead catenary system. Figures 2 and 3 are sketches of the parking lot area with some pertinent details and approximate distances shown. These will be further referenced in the analysis. Figure 4 shows the position of the last three cars in the draft of cars standing on No. 4 track, the cars on the adjacent siding, and affords an overall view of the area.

B. Method of Operation

1. Interlocking

Virginia Interlocking is located principally in the vicinity of Second Street and Virginia Avenue, S.W., Washington, D.C.; however, the interlocking limits extend from the south end of 14th Street, N.W., to the south portals of the First Street and the Virginia Avenue Tunnels. The interlocking facilities are controlled by an Interlocking Operator at Virginia Interlocking Tower, located at Virginia Avenue and Second Street, S.W.

Trains operate in the area by signal indication and by timetable. Tracks 1 and 4 are secondary running tracks designated by timetable as north and south respectively, but their use is controlled by indication of signals located at Virginia Interlocking Tower for southward moves and at 14th Street for northward moves. Tracks 2 and 3 are used for northward and southward trains respectively, both passenger and freight. Direction on these two tracks is by timetable designation.

2. Washington Yard Engine

The Washington yard engine assigned to Benning Yard, Anacostia, D.C., operates between Benning Yard and Potomac Yard, Virginia. It moves drafts of cars from Benning Yard

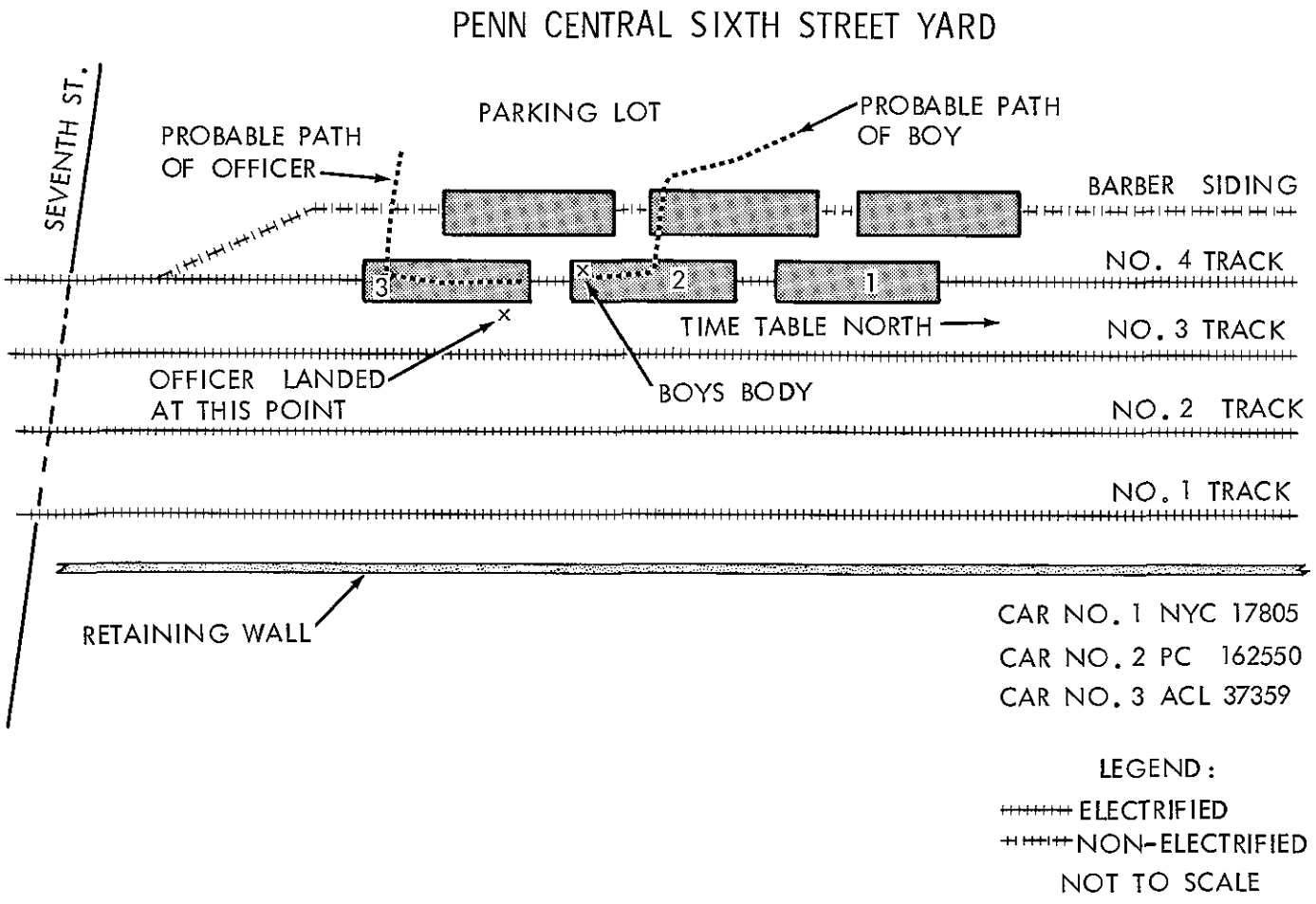

Figure 1.—Plan view of accident area showing location of cars

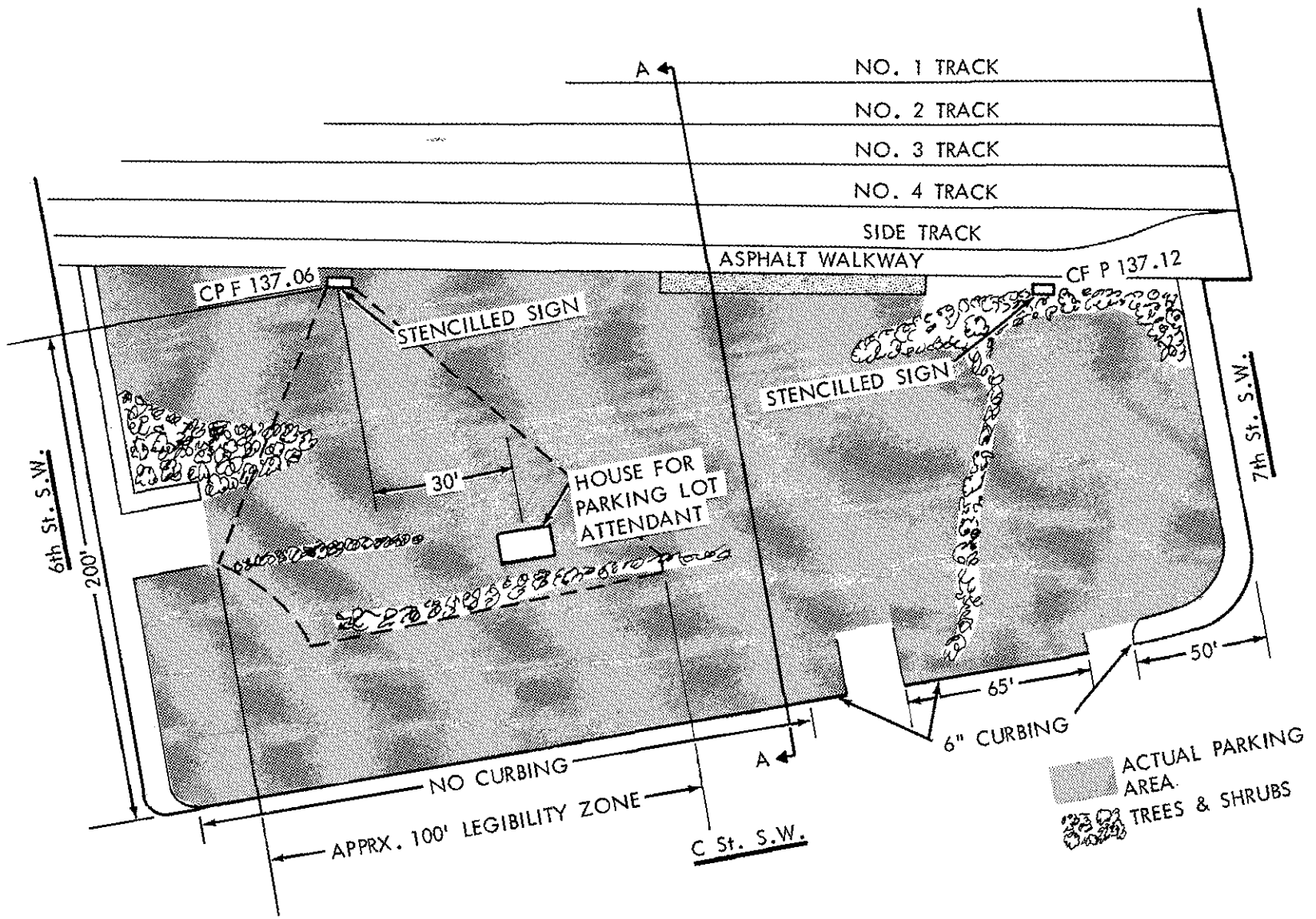

Figure 2.—Plan view of parking lot area—no scale

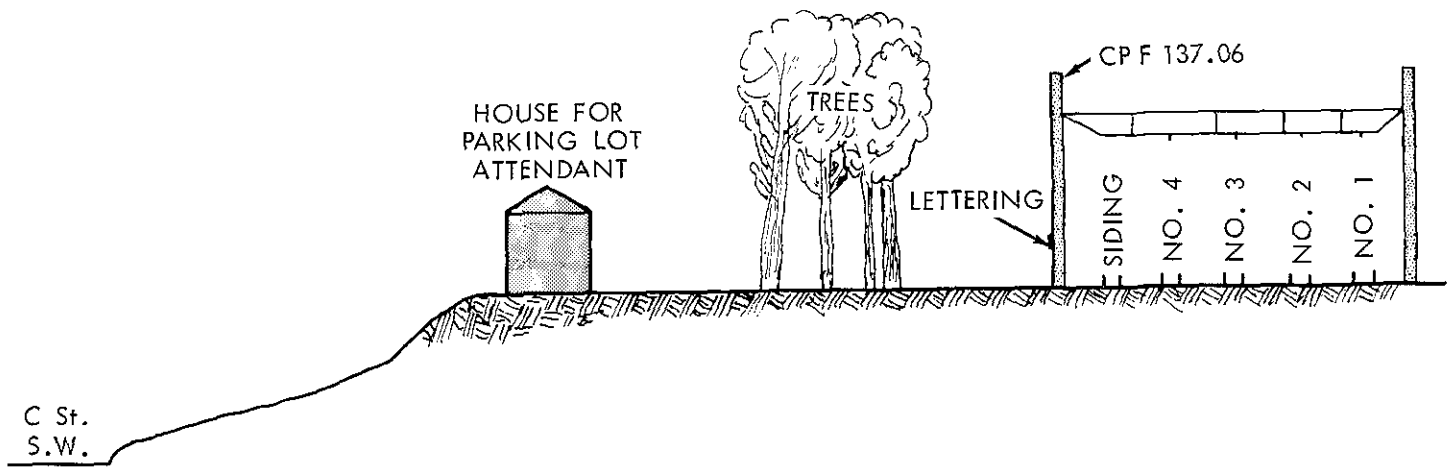

Figure 3.—Profile of section A-A of parking lot area—not to scale

to Jersey Yard in Washington; Jersey Yard to Potomac Yard and vice versa. It also switches cars in intermediate yards such as Sixth Street Yard, 14th Street Yard, and to and from industrial sidings.

The yard crew takes its instructions from the yardmaster at Benning Yard and operates on signal indication between Benning Yard and Potomac Yard. During switching operations at intermediate points, it is customary to leave the main draft of cars clear of the main track on either a yard track or one of the secondary tracks.

12,000 volts alternating current, 25 hertz single phase with ground return. The catenary system is sectionalized for control purposes, and each section is identified by an assigned Plate Number. The control switches for the various sections are located at interlocking towers, yard offices, or other conveniently accessible points. The control switches for the catenary sections in the vicinity of the accident are located in the Virginia Interlocking Tower. These switches are under the direct control of the interlocking operator on duty, but they can only be operated by authority of the power director located at

Figure 4.—Rear of Yard Draft on No. 4 track and cars on Barber Siding at time of accident.

The yard engine is equipped with a mobile radio with which the operator at Virginia Interlocking Tower, or the yardmaster at Jersey Yard, can be reached as an alternative to telephone communication.

C. The Electrical Catenary Propulsion System

The electrical catenary propulsion system is an overhead electrified network from which power is derived for the propulsion of the Penn Central electric locomotives. The system carries

Baltimore, Maryland. The power director maintains a daily log of all operations pertaining to the catenary system, including undesired outages. Penn Central has a comprehensive set of rules in effect for guidance in handling the power for routine maintenance, or for emergencies. A general safety rule for guidance of all employees is that they are not to approach closer than three feet to an energized catenary wire. In the event of any problem associated with the power system, the power director is contacted. He is the sole authority for any operation involving the catenary system.

Through the Jersey Yard and Potomac Yard areas, power is supplied simultaneously to the catenary system through circuit breakers from the feeder station at Potomac Yard and the Capitol Substation at Jersey Yard The circuit breakers at each of these stations were actuated when the contact was made with the trolley wire by the youth and the police officer at the Sixth Street Yard

The trolley wire is the lowest point of the catenary system and is the actual feed wire through which power is transmitted to the locomotive via the locomotive pantagraph The pantagraph maintains contact with the trolley wire during locomotive operation. The catenary network varies in height above the top of the rails depending on location. At the point of the accident the height of the trolley wire above the top of the rails is 20 feet 1½ inches At underpasses and through tunnels, the height decreases to approximately 16 or 17 feet The reduced height between the rails and the trolley wire often creates problems when it becomes necessary to run an unusually high car or high load through the tunnels. However, the Penn Central frequently runs trains through its tunnels with a clearance, trolley to train, of 6 inches without turning off the power It is noteworthy that the 6-inch clearance in tunnels is primarily specified in consideration of freight car clearance of the catenary support system.

D. Description of the Accident

1. Train and Movement

On Friday, May 14, 1971, the day of the accident, the Washington yard crew went on duty at 3:05 p m , at Benning Yard. The crew was composed of four men and they were assigned diesel electric switcher No. 8195 on job 2-B. The draft of cars assigned yard crew 2-B consisted of 33 cars. The last three cars in the draft from the north end were:

NYC	17805	Steel Box
PC	162550	Steel Box
ACL	37359	Steel Box

PC 162550 had the running board and the side and end ladders removed Ladders and running boards were intact on the other cars [1] The distance from the trolley wire down to the top of the car at the accident site was 5 feet 5½ inches; the top of the car was 14 feet 8 inches above the top of the rail (ATR) Clearance from the top of the running board on ACL 37359 to the trolley wire was 5 feet ¼ inch. The top of the running board measured 15 feet ¼ inch ATR. The distance between cars at the top on adjacent tracks, Barber Siding and No. 4 track, was approximately 30 to 36 inches.

The yard engine and crew left Benning Yard at 4 p m., headed south to Jersey Yard They switched some cars at Jersey Yard and entered No 4 track at Virginia Interlocking. The train stopped in the clear on No. 4 track at the north end so the engine could switch cars at the Sixth Street Yard.

After the switching at this point, the crew left three cars on Barber Siding, coupled the engine to the other cars on No. 4 track, and moved south toward 14th Street. When they stopped clear of the spur track at 14th Street, the engine, with a few cars, went to work at the 14th Street Yard. The rear of the train was at Sixth Street Yard and remained in that position until the accident occurred. The last three cars of the draft were parallel to the three cars on Barber Siding The train stopped at this point at about 6:42 p m

[1] Federal Railroad Administration Docket No 34468 (Issued by the Interstate Commerce Commission) Part 231 Chapter I of Title 49 Code of Federal Regulations amends paragraph 231 1 to direct that on or before April 1, 1974, Box or other House Cars (not including cars with roofs 16 feet 10 inches or more above top of rail) shall be equipped as nearly as possible with the same complement of safety appliances as specified in Sections 231 27 or 231 28 for cars with or without roof hatches respectively, which means that roof running boards, roof hand holds, and side and end ladders shall be removed and hand brakes and platforms adjusted accordingly

When the yard crew had finished the work at the 14th Street Yard, they recoupled the engine to the draft of cars previously left on No. 4 track. After the brake system had been recharged with air and the brakes released, the conductor, who had made the coupling, returned to the engine and radioed to the operator at Virginia Interlocking Tower that he was ready to depart for Potomac Yard. The operator told him not to move the train because there was trouble at the north end, near the Sixth Street Yard, and that he ought to determine what had happened.

The conductor walked back to the rear of the train and found the activity resulting from the accident. He noted one man on the top of the cars on the rear and requested a police officer standing nearby to ask the man to come down. When he got no response from the officer he personally asked the man to come down. The man ignored him for a short time, but finally responded and came down. He was identified later as a plainclothes officer. The conductor also noted that there were numerous people milling around the scene.

2. Track Facilities and Access

The Penn Central track structure is built on fill or a viaduct from just south of Seventh Street, S.W. to the Virginia Avenue Tunnel. Access to the track facilities on the east side of the track, north of the Seventh Street bridge, is restricted because of the retaining wall paralleling Virginia Avenue, S.W. The wall is about 15 feet high and has a pipe rail fence atop it. The fence includes a 15-inch high wire mesh in the bottom portion of the two rail fence. (See Figure 5.)

Crushed stone ballast is used on tracks 2 and 3. Washed gravel, cinders, and dirt are used under the side track and under tracks 1 and 4. Access to the track facilities at the scene of the accident is through a parking lot on the west side of the track, with a grade sloping down to

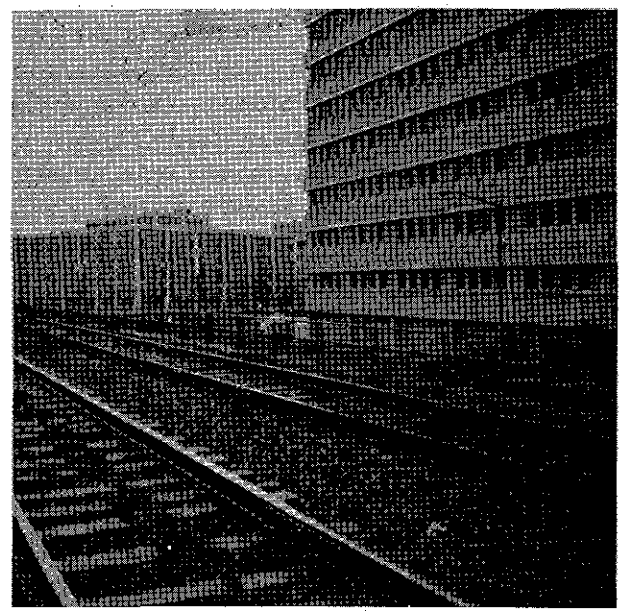

Figure 5.—Track structure and retaining wall on east side at the scene of the accident.

Figure 6.—Parking lot area adjacent to Sixth Street Yard and point of accident.

"C" Street, S.W. and Sixth Street, S.W. The parking lot can be entered from either "C" Street or Sixth Street. The lot is unfenced at the street and there is no fence between the lot and the railroad tracks. Figure 6 shows the parking

lot area There are no barriers nor impediment to ready access Neither are there any prominent warning signs indicating a hazardous area because of train traffic and/or high voltage Small stencilled "NO TRESPASSING" lettering 2½ inches high was found on two catenary poles designated CP-F 137.06, and CP-F 137.12 The stencilling is about 5½ feet above ground level. (See Figures 7 and 8.)

Figure 7 —Catenary Pole CP-F-137 06, 171 feet north of scene of accident Lettering is 5½ feet above top of ground

Catenary pole CP-F 137.06 is located approximately 171 feet north, and CP-F 137 12 approximately 146 feet south of the point of the accident They are approximately 317 feet apart.

The stencilling on catenary pole CP-F 137.12 cannot be seen from the parking lot area. (See Figure 2) Dense vegetation blocks the view and one would have to go to the base of the pole to see the sign During the growing season, the sign cannot be seen from the parking area because of tree foliage. Access to the pole is impeded because of undergrowth and an embankment.

The approximate range of visibility and zone of sign legibility for the stencilled sign on CP-F 137-06 are shown by the dotted line in Figure No. 2

Figure 8.—Catenary Pole CP-F-137.12, 146 feet south of scene of accident.

An approach to the parking lot area from any other direction or location outside of the dotted line area would be made in a zone of totally unwarned access to the track. Neither sign would be visible and no other indicators warn of hazards presented by the catenary high voltage system, or by rail traffic

3 The Incident

a. The Youth

The youth and his friends gained access to the railroad and freight cars through the parking lot on "C" Street The parking lot closes at 6 p m., and the attendant departs; therefore, he was not present at the time of the accident

Information from a parking lot attendant indicates it is not uncommon for children to congregate, to ride bicycles, and to engage in other games on the parking lot after working hours when the lot is cleared of cars He added that frequently children are seen grabbing onto slow-moving freight trains in the immediate area, and riding for short distances.

At the time the Washington yard engine stopped the draft of cars on the No 4 track, the youth and several playmates were playing in the vicinity of the parking lot When

the train stopped, the youths ran toward it. The youth who was electrocuted climbed the ladder of a boxcar on Barber Siding, moved across the car roof, and jumped onto the roof of PC 162550, the second car from the north end of the draft of cars standing on No. 4 track. (See Figure No. 9.) He continued to move along the top of PC 162550 toward ACL 37359, the third car from the north end. While thus moving from PC 162550 to ACL 37359, his head contacted the catenary trolley wire. An arc was established which set the youth's clothing on fire, seared and burned his body and knocked him to the roof of PC 162550. His body landed on the west side of the car in a position 3 feet 5 inches from the south end of the car. His body was prevented from falling to the ground by a stub of the roof handhold which remained when the handhold was removed in compliance with FRA Docket No. 34468.

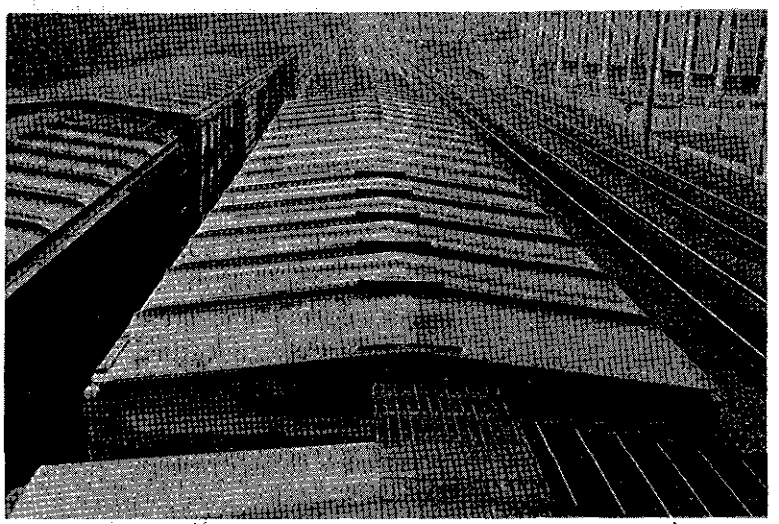

Figure 9.—Cars on Barber Siding from which the youth jumped to cars on No. 4 track.

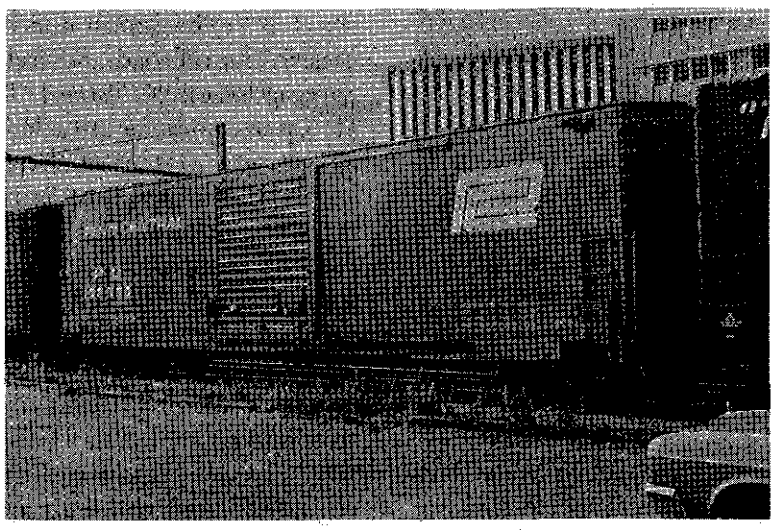

Figure 10.—Foreshortened ladder on PC 162550 as required by FRA Docket 34468

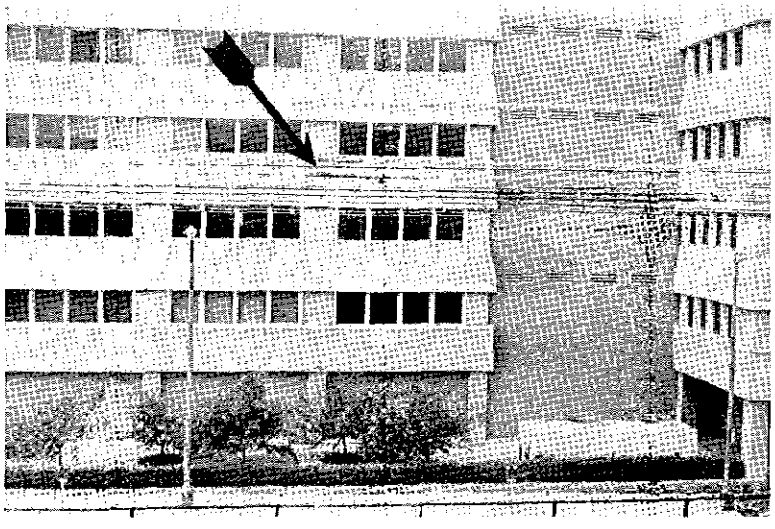

Figure 11 —Burn marks on catenary trolley where the youth contacted the wire

A burn mark was evident on the trolley wire 1 foot 9½ inches from the south end of the car. The burn marks on the car spread from the center of the car westerly to the edge of the roof indicating where the youth was at the instant of contact, and where his body landed Figure 11 shows the burn marks on the trolley wire, and Figure 12 shows burn marks on the car

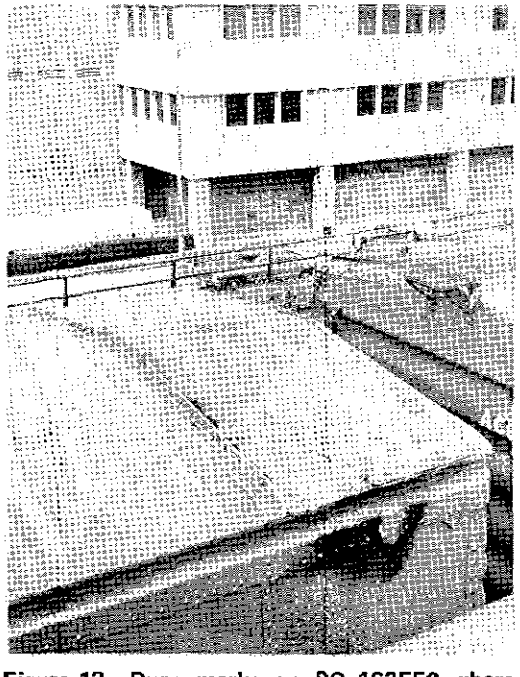

Figure 12 —Burn marks on PC 162550 where the body of the youth landed.

The report of the autopsy by the Acting Medical Examiner for the District of Columbia indicated there were extensive third degree burns over 90 percent of the body, and that there was a place about 2 inches wide by 1 inch long slightly to the left of the middle of his head that was devoid of hair, with charred hair and coagulation surrounding the area Cause of death was listed as "third degree burns involving 90 percent of body surface due to high voltage wire contact (Electric Wire) "[2]

At 6:45 p.m , the operator at Virginia Interlocking Tower notified the power director at Baltimore, Md. that catenary circuit 2602 between substations 25 and 26 had been actuated

At the same time, the U.S Coast Guard duty officer and his relief saw a dull blue flash from the direction of the railroad, and heard an explosive noise.

When the flash drew the duty officer's attention to the railroad, he saw an object flying through the air over the top of some

[2] From the Coroner's Report, District of Columbia

boxcars. The object was traveling from south to north and was enveloped in flames. It landed on top of what he described as the second car from the rear of the line of cars.

The duty officer called the Metropolitan Police Department and reported a fire atop the boxcars near Seventh Street and Virginia Avenue, S.W.

b. The Police Sergeant

As the Coast Guard officers continued to monitor the scene, they saw a police officer come across the top of ACL 37359 in a direction from south to north. As he approached PC 162550, the second car, they saw another flash and heard an explosion. The police officer slowly sank to the car roof, rolled off, and fell to the ground below.

The duty officer telephoned the police department again and reported the incident. The two officers also noted that there were several boxcars on Barber Siding. They noticed at least one other youth on top of one of these cars, and one on the ground standing on No. 3 track to the northeast of the car on which the electrocuted youth was lying.

The police sergeant responded to the reported fire. Upon his arrival at the scene, the sergeant found a police officer in the act of climbing a ladder to the top of the car. The sergeant ordered the officer down from the ladder and ascended the ladder himself, intending to help the youth. From the best information available, the sergeant climbed the west side ladder on the south end of ACL 37359 and proceeded over the top of the car northward toward PC 162550 and the injured youth. At the north end of the car the sergeant apparently came in contact with the catenary trolley wire. (However, witnesses reported that he drew a 3-foot arc). He immediately became enveloped in flames, was knocked to the top of the car and rolled over the side to the ground on the east side of the car. His clothing was afire and he was badly burned.

Burn marks were found on the trolley wire 2 feet 8 inches from the north end of ACL 37359. Burn marks were also found on the running board of ACL 37359 immediately under the burn marks on the catenary trolley. This particular burn mark does not show in Figure 11 but it would have been the position of the sergeant when he made electrical contact. Figure

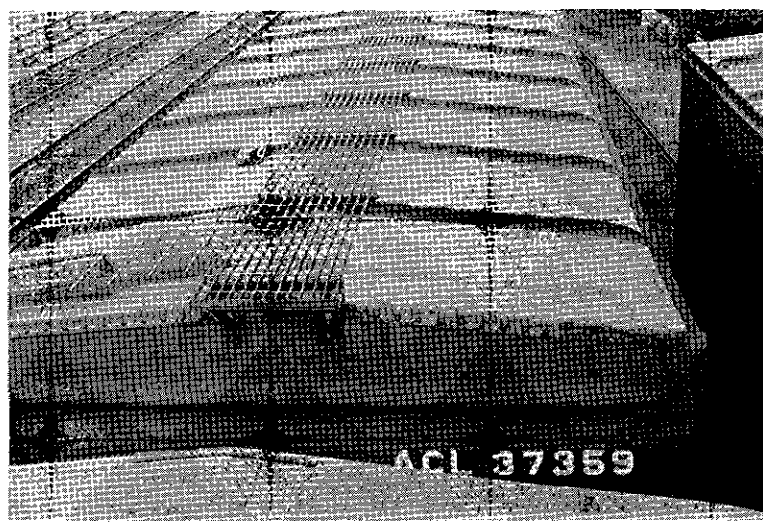

Figure 13.—Burn marks on ACL 37359 caused by the police officer at the time of contact with trolley wire. Note his cap.

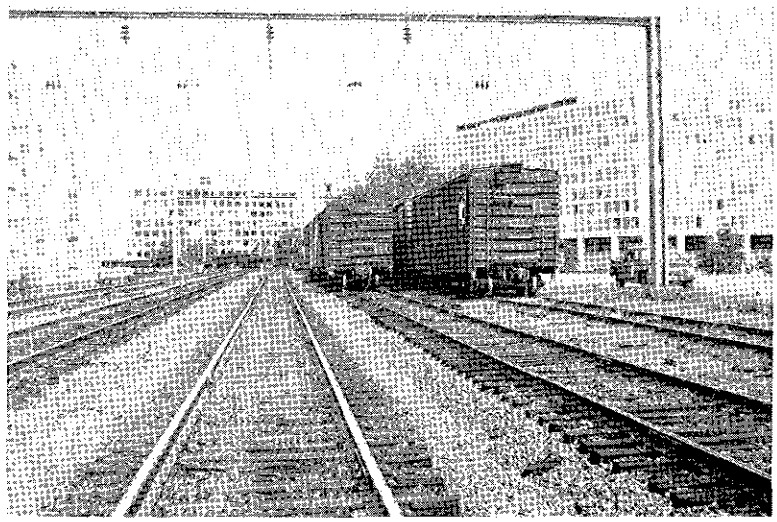

Figure 14 —General view of the accident area and the catenary propulsion system. CP-F-137 06 is in the right foreground.

13 shows burn marks on ACL 37359 made by the police officer Figure 14 is an overall general view of the accident area.

4. Action of Police and Fire Department

a. Police Department

Metropolitan Police Department First District Headquarters, located at 415 Fourth Street, S.W., dispatched personnel to the scene immediately when the alarm was received, and at the same time, sent the police sergeant, who was in a patrol car, to cover the accident. The involvement of the sergeant has been described

b Fire Department

Engine Company No 13, located at 450 Sixth Street, S.W., responded to the fire alarm. Truck Company No 10, platoon No 1, rushed down Sixth Street, S W , to the scene of the accident. En route they saw smoke coming from the trouble area and stopped their equipment on Virginia Avenue, adjacent to the retaining wall. By using a ladder two of the firemen reached the top of the wall and crossed tracks 1, 2, and 3 to the accident scene. One of the firemen saw that the sergeant's clothing was on fire He removed his own running coat as he crossed the tracks, threw the coat over the sergeant and smothered the flame. He could not detect pulse or heartbeat, but he prepared the sergeant for first aid and began administering mouth-to-mouth resuscitation. At the same time he began closed-chest cardiac massage In a brief period, the sergeant responded, began shallow breathing on his own, and was removed to the emergency room of the George Washington University Hospital

Other elements of Engine Company No 13, platoon No 1 also responded to the alarm According to the officer in charge, he saw a police officer climbing the ladder on the side of a box car where the smoke was originating. As the officer reached the roof and began to straighten up, he was suddenly surrounded by flames and pitched off the roof to the ground. The officer in charge noted the personnel of Truck Company No. 10 going over the track retaining wall, so he continued to the west side of the tracks at the parking lot, via Sixth Street and "C" Street. In the meantime, having seen the police officer encounter the catenary trolley, he radioed for oxygen and extra emergency assistance

When he arrived at the scene of the accident, the officer in charge observed the body of the youth in the supine position, with the head outward over the edge of PC 162550, and arms extended downward. The body showed burns and some of the clothing was burned away. There were no signs of life. Because of the hazard of attempting to handle the body in the immediate vicinity of the 12,000-volt catenary, no further attempt was made to recover it until the firemen were informed that the catenary power was off. At 8:16 p m. the body of the youth was recovered and immediately taken to Washington Hospital Center

5. Weather

The weather at Washington National Airport on May 14, 1971, at 5:55 p m. was clear, temperature 78°F. and the relative humidity 31 percent. The tops of the railroad cars were dry.

6. Catenary Operation

The power director recorded in his log that at 6:45 p.m. there was a power outage and that breakers feeding circuit 2602 from feeder station 25 and substation 26 had been actuated or "kicked". This was caused by the boy coming in contact with the catenary trolley wire. The log record also indicates that after breaker restorations at 6:48 p.m. and 6:49 p.m. for feeder station 25 and substation 26, respectively, the same breakers associated with circuit 2602 were actuated at 6:51 p m. and restored at 6:55 p.m. The second actuation of the breakers was caused by the contact with the catenary trolley by the police officer.

The breakers associated with circuit 2602 at feeder station 25 and substation 26 had not been "kicked" by a fault in the 30-day period immediately preceeding the accident. However, the "kicking" of breakers is not an infrequent occurrence in the Penn Central's expansive catenary system. During the year 1968, the Penn Central recorded 68 propulsion system power outages attributed to large birds, squirrels, snakes etc., on their Chesapeake Region, which extends from Wilmington, Delaware, to the District of Columbia, including The Washington Terminal Company and Potomac Yard, Virginia. Consequently, the first indication of circuit failure generated no cause for alarm among the cognizant Penn Central employees on duty.

The procedure followed by the power director when a circuit breaker is actuated is to determine from the train dispatcher or other railroad official or employee, whether there are any trains moving in the vicinity of the circuit served by the actuated breaker. The entry on his record indicates this determination was made, and it showed that no trains were moving.

Standard procedure was that when the power director determines that there are no trains moving, he closes the breaker to see if it will hold (remain in the circuit). If the breaker holds once it is restored, no further action is taken. If the breaker "kicks" a second time, it may be restored a second time to determine if it will hold If it does, again no action is taken If the breaker "kicks" the third time, the power director begins to sectionalize the line to determine the faulty section, through a process of elimination.

The log maintained by the power director shows that after each interruption, (the boy at 6:45 p m., the police officer at 6:51 p m.) the breakers were restored and in each instance they held. Therefore, no further action was taken until a request was made to remove the power for the rescue operations at the scene of the accident.

7. Applicable Laws and Regulations

Title 49 Code of Federal Regulations 231.13(e)(1) states "Transfer train and yard train movements not exceeding 20 miles, must have the air brake hose coupled between all cars, and after the brake system is charged to not less than 60 pounds, a 15 pound service brake pipe reduction must be made to determine that the brakes are applied on each car before releasing

and proceeding." In this case it was the intent of the crew to move the cars without making a brake test.

8. Training and Instruction for Policemen and Firemen Involving Railroad Hazards

The Metropolitan Police Department of the District of Columbia had no effective program for training, or for issuing guidance to personnel, to keep them abreast of measures to take in emergencies involving the Penn Central catenary system. They did not know where the power director was located, nor did they know where railroad telephones were located that would enable them to reach the control officer Some railroad telephones operate on a "push-to-talk" system If a person had not had specific instructions to cover this, it would be unlikely that he could use them successfully. In addition, most railroad telephones have a line selector switch which must be used to gain access to the party desired This information was not freely disseminated to police personnel, or in its entirety to fire department personnel It was not common knowledge to the police that the power director can be reached through the telephone switchboard operator at Union Station There was little information provided to police personnel relating to the hazards of high voltage. It is extremely important that police officers and fire department personnel, through whose patrol jurisdiction the Penn Central catenary system or high voltage power lines pass, be trained to cope with high voltage distribution or power systems under emergency circumstances such as this one.

The District of Columbia Fire Department had issued instructions to its personnel regarding the catenary systems, prior to the accident These instructions were issued in 1960 and gave a general code of conduct for emergencies in and around the catenary system. They describe whom to contact, where the telephones are located, tunnel areas, and general procedures to follow. They do not cover the peculiarity of the push-to-talk button on the telephones with which the telephone set may be provided

III ANALYSIS

A Lack of Method of Preventing Injury to Juveniles and Others

The operational procedures for Penn Central trains through the area involved are comparable to similar operations throughout the industry. Train operation presents a number of potential hazards to railroad personnel, who are familiar with operational procedures, and to trespassers, irrespective of their reason for being on railroad property.

Much of the trackage or right-of-way for the Penn Central freight line in the southwest Washington area is through densely populated residential districts, and the track structure is accessible along most of the right-of-way. The high level of ambient noise caused by automotive traffic, airplanes, etc , makes it highly improbable that one would hear a train approaching. In addition, there is the hazard from the electrification, and the remotely controlled track switch facilities which give no warning of movement There is a significant hazard to trespassers climbing on or into standing freight cars. Often these cars are moved with no advance warning, and trespassers or employees place their lives in jeopardy when moving in, on, or under this equipment

B. Effectiveness of "NO TRESPASSING" Signs

The most readily apparent attempt by the railroad to discourage trespassers was the placement of "NO TRESPASSING" signs. The railroad police and train crew employees make an effort to keep juveniles and other trespassers off the right-of-way, but coverage of railroad property by railroad personnel is inadequate to reduce or eliminate them. In many instances, persons regularly use the railroad right-of-way as a short cut to their destinations.

The posted "NO TRESPASSING" signs on the catenary poles at the Sixth Street Yard area are inconspicuous The sign on the south pole,

CP-F 137 12, is not visible from any approach through the parking lot. The boldness of the letters and the contrast of the background have deteriorated substantially, making the sign less conspicuous. In the immediate foreground of the sign is a prolific growth of trees and bushes, and the foliage effectively blocks the sign to view from any point in the area. In order to see the sign one must deliberately and with some effort climb the embankment so he is immediately in front of the pole where the sign is stencilled It is totally ineffective and serves no purpose in warning would-be trespassers.

The sign on the north pole, CP-F 137.06, has lost most of its conspicuousness due to deterioration. It has a limited zone of legibility as can be seen in Figure 2. The contour of the parking lot contributes to the limited zone of legibility. One cannot see the sign from "C" Street until he approaches within approximately 100 feet, and this is dependent upon his path of approach. If an approach is made from "C" Street via the driveway entrance, the sign would not be seen unless one were going into the lot consciously looking for that particular warning sign. These signs were inadequate as a method of warning against trespass because they could easily be passed without being seen.

The question arises as to the effectiveness of the signs, even if they were seen by both the juveniles and the rescuers. The rescue personnel, by the nature and demands of their job were required to be there, but the signs gave no warning as to the nature of the hazards. It is doubtful whether all juveniles have a clear understanding of what constitutes "trespassing." The word trespass does not necessarily imply a hazard, and a person who finds a "NO TRESPASSING" sign has no way of knowing the reason for the posted zone or area In this incident the "NO TRESPASSING" signs gave no indication of the hazard involved

The signs failed to inhibit the juvenile trespassers, and did not warn the police sergeant or other members of the police and fire departments Despite the two casualties as the result of contacting the catenary wire, the conductor found a plain clothes officer on top of a box car at the scene of the accident This incident also points up the fact that the hazards from high voltages and danger of electrocution are not appreciated by many people. Even if the power had been cut off the catenary system over the car on which the plain clothes officer was standing, he still could have received a substantial shock or burn as a result of inductive coupling to that line from nearby energized circuits, or from surges due to lightning flashes. Another aspect of the posting of "NO TRESPASSING" signs is that even though the no-trespassing edict is not enforced adequately, the hazard is just as real and ever present.

C. Security of Right-of-Way Against Trespassing

The parking lot constitutes one of the few open parcels of ground in the immediate area where bicycles, wagons, scooters, etc , could be ridden. It is partially paved, it has paths or tracks for use as roads, it has a hilly approach and it is an attractive recreational facility to children, especially since it has a ready and free access after the parking lot attendant leaves at about 6 p m. Entry to the parking lot can be made from either "C" Street or 6th Street via semi-paved entranceways. In addition to the appeal of the parking lot area, railroads are a never-ending fascination to most people regardless of age.

The easy access to the parking lot provides easy access to the railroad There are no barriers to keep anyone from moving off the parking lot onto the track structure Children have a natural bent for climbing trees, hills, and box cars The boy who was electrocuted apparently yielded to this temptation. With no fencing nor other barrier, it was a simple matter to cross the undefined line between the parking lot and the railroad track structure.

D Length of Electric Arc

Statements by witnesses to the two accidents indicate that arcs were established by flashover at distances up to three feet.

It is highly improbable, for the voltages involved, that a flashover would occur, and an arc be established at a distance greater than approximately two inches Flashover distance will vary depending on path to ground, resistance of path, weather, humidity, etc. The weather at the time of the accident was clear with a low relative humidity of 31 percent. The length of the insulators in the catenary network and the proximity of metal to earth ground at other points refutes the susceptibility of arcing to ground. Air pollutants and inclement weather would cause incessant flashovers if the system were so prone to arc to ground. An arc will be sustained 12 to 18 inches once it is initiated, but it will not be drawn that distance without first having a path to ground established by a physical contact with the conductor. Thus it is possible for a witness to see a long arc and even to conclude that it might be repeated

E. Effect of Circuit Breaker Handling

There are practical advantages to keeping power on the catenary system at all times. Therefore, when a circuit breaker is actuated for some unknown reason, the practice has been to restore the breaker to see whether it would stay on line Experience has shown that most of these outages are caused by a non-hazardous temporary condition, such as electrocution of an animal or a bird, and once the breaker is restored, the circuit is again normal, with the object creating the short circuit having been burned away When the boy contacted the catenary trolley wire and caused the breaker to be actuated, a restoration was made according to custom and the breaker remained on line

The fallacy of this action is in the assumption that the source of the short circuit was non-human when it is not known what caused the actuation. It would seem far more realistic to insure that there was no human involved before restoring a breaker Information made available from Penn Central, covering the Chesapeake Region, indicates that for the year 1968, there was an average outage of catenary power of 1.13 per week The effort to investigate one event per week is not a heavy workload. The breakers to circuit 2602 had not been operated by a fault for over 30 days. At the time, there were no electric trains moving in the area. This meant that the outage did not involve a train, so the power was restored immediately. The three attempts to restore an actuated breaker are, in effect, an effort to burn off the source of the short circuit. However, if a human is involved, the effort adds immeasurably to the hazard of rescue operations in progress by anyone, and could further jeopardize the life of the person who had come in contact with the high voltage There is the danger of ignition if the outage was the result of a hazardous materials accident.[3] A more prudent method of handling an interruption of power, caused by an unknown actuation of breakers, would be to investigate the cause prior to restoration of power With the communication systems available to both the police department and railroad personnel, it should be possible to have the railroad contact the police for a quick check to see whether there were any related calamities in the area of the affected circuit The Board believes that more caution is required in a situation such as this than evidenced by a practice of automatically restoring the breakers.

Those in charge of restoring the power should understand that a rescue effort will probably involve personnel working in close proximity to the high voltage system. In the case of the police sergeant, the immediate restoration of the breaker very nearly cost him his life If the cause of the actuation had been investigated,

[3]The check of moving trains does not account for standing cars which may be carrying hazardous materials

the police officer would have escaped injury. The outcome of the youth's encounter with the catenary would not have been any different, in this case; nevertheless, such a procedure could save lives in the future. In order for it to be known that the power will remain off until the problem is cleared, positive communications between the principals concerned are mandatory.

F Police and Fire Department Knowledge of Precautions and Actions

The police sergeant arrived at the accident scene in an atmosphere of excitement. His attention was undoubtedly focused on the boxcars and the police officer already on the scene who was mounting the side of a boxcar. The inadequate warning signs would not have given him a warning of the high voltage hazard present. From his action, it is evident that he either did not know of the electrical hazard, or that he was selflessly exposing himself to danger in an effort to reach the youth. Action by the fire department indicates they radioed the station house for auxiliary equipment and additional help, but they did not ask for action to have the catenary power cutoff. The procedure for this is covered in their current emergency procedures involving the catenary system. The failure to do so gives indication that these instructions had not been reviewed recently. It is also significant that there was no warning issued by either the local police or fire supervisors to alert the men to the danger of high voltage. The nature of the progression of rescue operations immediately following the accidents points out a lack of ready communications with the Penn Central Railroad.

G. Hazard to Rescuers from Train Operations

If the train crew had moved the draft of cars without testing the brakes, as they intended to do before their conversation with the operator at Virginia Interlocking Tower, they would have violated the requirements of the Power Brake Law. It is evident that if an inspection of the brakes had been made, the difficulty at the rear of the train would have been discovered If the conductor had not called the operator at Virginia Interlocking Tower before the draft was moved, there is a good possibility someone else may have been injured seriously or killed. A walking inspection would have revealed the activity even if there had been no radio contact.

H. Removal of Roof Running Boards and Side Ladders

Full compliance with the directive to remove ladders from boxcars which afford access to the roof and roof running boards, would have in all probability prevented the accidents. The shortened ladders are of no value in gaining access to the roof. This is evidenced by the fact that the youth reached the roof by use of a full length ladder on another car and jumped to the PC 162550, and the police sergeant used a full length ladder on the ACL 37359 to reach the roof.

I. Practicality of Security Fencing and Signs in Populated Areas

The extensive right-of-way of the Penn Central makes it economically unrealistic to expect complete fencing at this time Irrespective of the cost of fencing an entire right-of-way, there is an urgent need for it in the more easily accessible zones in densely populated areas. In addition, readily discernible signs, warning of danger from high voltage and from rail traffic, could be placed conspicuously. Both of these measures are technically feasible. Fences are, in fact, used in third rail areas. It is noted that fencing against animals and pedestrians is a significant part of the construction of most of the new interstate

highways. In many instances, fencing is apparent along highways in remote rural areas In most cases, fencing is provided in densely settled areas As an adjunct to the fencing, it might be observed that there are numerous signs prohibiting hitch-hiking A traveler can also note that the signs are continually ignored The same is true in many instances of signs reading, "NO STOPPING EXCEPT FOR EMERGENCIES " All of the above lead to the conclusion that signs alone can be ineffective as barriers to access to hazardous areas, even where their message is clear.

IV. CONCLUSIONS

1 The electrocuted youth and the burned police sergeant contacted the electrically energized trolley wire

2 The stencilled "NO TRESPASSING" signs on the catenary poles in the immediate vicinity of the accident were inconspicuous and marginally legible, did not contain specific warnings of the types of hazards present, and therefore had no hazard warning effect.

3 The railroad right-of-way at the scene of the accident was easily accessible to the general public, and was immediately adjacent to a place where juveniles played from time to time.

4 The procedure employed by the Penn Central railroad to restore power to circuits opened by automatic circuit breakers is hazardous. Automatic circuit breaker opening is an indication that a potential hazard exists The restoration of power renews the hazard without the assurance that it is cleared Repeated attempts to restore power are essentially blind efforts to burn away any obstruction with the assumption that human life is not at risk

5. The procedure of blind restoration of power did not contribute to the death of the youth, however, it was an essential element in the burning of the police sergeant.

6 Power, blindly restored, may inhibit the rescue of persons and may enlarge potential accidents involving hazardous materials

7. The continued presence of ladders leading to roofs of train cars constitutes a hazard.

8 This accident shows clearly the results of the lack of necessary communications between the railroad company and local fire and police authorities Inadequate training of rescue personnel against the hazards inherent in railroad operations was demonstrated.

9. The Power Brake Law specifically covers procedures for tests and inspections of transfer trains for which movements do not exceed 20 miles. The action of the crew of Washington Yard Engine 8195 indicates that they were not planning to comply with the Federal regulations which apply to the testing and inspection of the train brakes of their train.

V PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was contact by the trespassing youth with the trolley wire of the 12,000-volt, 25-hertz catenary system while he was moving on top of railroad freight cars

Contributing factors were:

a The absence of fencing to prevent access by persons to the hazards of railroad operations including the high voltage catenary propulsion system

b Inadequacy of signs to convey an understandable warning of the specific hazards present.

The cause of the injuries to the police officer was his contact with the trolley wire while he

was moving on top of the freight car in an effort to reach the electrocuted youth.

Contributing factors were:

a The prevailing practice of the Penn Central to restore failed circuitry experimentally without a physical inspection to determine the absence of hazard to persons

b Lack of training of the police officer relative to the hazards in the area.

c Lack of contact and communications between the police and the Penn Central.

VI. RECOMMENDATIONS

The Safety Board recommends that:

1. The Federal Railroad Administration, under authority of the Federal Railroad Safety Act of 1970, promulgate regulations to cover the operation of catenary and third rail electric power supply systems when power is interrupted unintentionally or when circuit breakers are actuated by an unknown cause.
2. The Federal Railroad Administration investigate the procedures on the Penn Central as they relate to brake tests of trains used as combination industrial switchers and main line transfer trains, and take action where appropriate
3. The Federal Railroad Administration expedite the application of Docket No 34468 and its requirements for the removal of side and end ladders and running boards from box cars
4. The Federal Railroad Administration promulgate regulations requiring fences or other means to discourage trespassing on railroad tracks and right-of-way A study should be made to determine the actual effectiveness of "NO TRESPASSING" signs as a means of preventing trespass.
5. The Penn Central Company and the Metropolitan Police and Fire Departments of the District of Columbia jointly develop training programs to teach emergency personnel safe and efficient methods to be used when responding to emergencies in areas exposed to an electrified catenary.
6. The Penn Central Company require employees to determine that the cars and tracks are free of obstructions and trespassers before moving a draft of cars which has been stopped in an urban area.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H REED
Chairman

/s/ OSCAR M LAUREL
Member

/s/ FRANCIS H McADAMS
Member

/s/ LOUIS M THAYER
Member

/s/ ISABEL A BURGESS
Member

March 29, 1972