

PB 298905



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

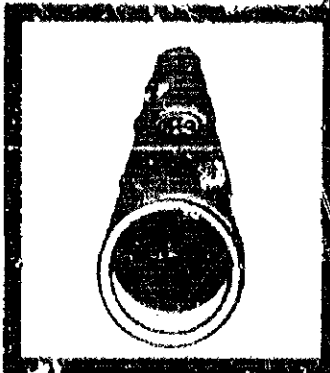
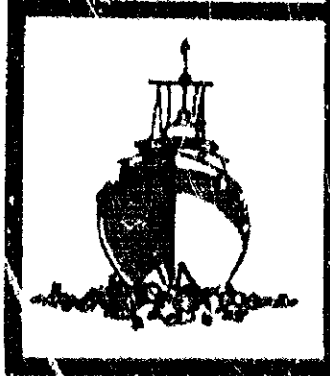
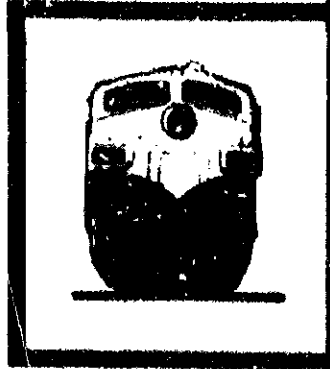
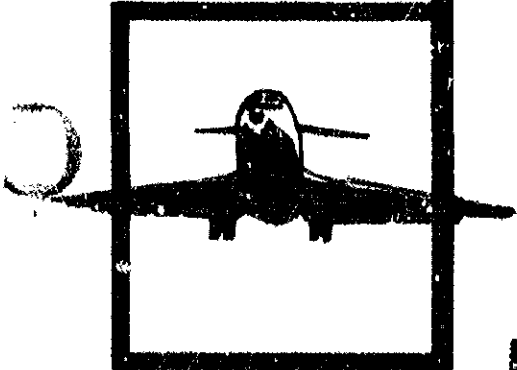
**BAY AREA RAPID TRANSIT DISTRICT FIRE ON
TRAIN NO. 117 AND EVACUATION OF PASSENGERS
WHILE IN THE TRANSBAY TUBE**

**SAN FRANCISCO, CALIFORNIA
JANUARY 17, 1979**

NTSB-RAI-79-5

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16. Abstract <p>About 6:06 p.m., on January 17, 1979, the fifth and sixth cars of the seven-car westbound train No. 117 of the Bay Area Rapid Transit District (BART) caught fire while moving through the tunnel under the San Francisco Bay between Oakland and San Francisco, California. Forty passengers and two BART employees were evacuated from the burning train through emergency doors into a gallery walkway located between the two single track tunnels and then into a waiting train in the adjacent tunnel. One fireman died when the gallery suddenly filled with heavy black toxic smoke. Twenty-four firemen, seventeen passengers, three emergency personnel, and twelve BART employees were treated for smoke inhalation. Property damage was estimated to be \$2,450,000.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the breaking of collector shoe assemblies on Train No. 117, when it struck a line switchbox cover, which had fallen from an earlier train, resulting in a short circuit and fire. Contributing to the severity of the damage was the failure of BART to quickly and properly coordinate the Oakland and San Francisco fire departments' rescue and firefighting efforts, which did not conform with the emergency plan. The cause of the fatality and injuries was inhalation of smoke and toxic fumes emitted from burning plastic materials used in construction of the transit cars.</p>			
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SYNOPSIS

About 6:06 p.m., on January 17, 1979, the fifth and sixth cars of the seven-car westbound train No. 117 of the Bay Area Rapid Transit District (BART) caught fire while moving through the tunnel under the San Francisco Bay between Oakland and San Francisco, California. Forty passengers and two BART employees were evacuated from the burning train through emergency doors into a gallery walkway located between the two single-track tunnels and then into a waiting train in the adjacent tunnel. One fireman died when the gallery suddenly filled with heavy black toxic smoke. Twenty-four firemen, seventeen passengers, three emergency personnel, and twelve BART employees were treated for smoke inhalation. Property damage was estimated to be \$2,450,000.

The National Transportation Safety Board determines that the probable cause of this accident was the breaking of collector shoe assemblies on Train No. 117, when it struck a line switchbox cover, which had fallen from an earlier train, resulting in a short circuit and fire. Contributing to the severity of the damage was the failure of BART to quickly and properly coordinate the Oakland and San Francisco fire departments' rescue and firefighting efforts, which did not conform with the emergency plan. The cause of the fatality and injuries was inhalation of smoke and toxic fumes emitted from burning plastic materials used in construction of the transit cars.

INVESTIGATION

The Accident

About 4:25 p.m., January 17, 1979, Bay Area Rapid Transit District (BART) train No. 363 departed Oakland West Station, and after 1.5 miles entered the tunnel leading to the Embarcadero Station in San Francisco, California. The train consisted of 10 cars with a train operator in the lead car. The tunnel consists of two single-track concrete tunnels about 17-feet in diameter. The westbound tunnel to San Francisco is designated M-1 and the eastbound tunnel from San Francisco is M-2. Six minutes after departure an unexpected emergency brake application stopped the train in the tunnel about 1.5 miles from the entrance. The operator radioed BART central control that there was smoke and possibly fire on his train.

A troubleshooter was immediately dispatched by central to inspect No. 363. He boarded No. 363 without inspecting the exterior of the train or trackway in the immediate area. He and the train operator inspected the electrical circuits located in panel boxes at one end of each car where it was disclosed that the sixth car and eighth car had broken derail bars and that the ninth car had a parking brake engaged. They nullified the derail bar circuits, released the parking brake, and moved the train in road manual 1/ to determine that it was alright to continue. They so advised central and were instructed at 4:47 p.m. to return the train to automatic train operation (ATO) 2/ with permission to continue. Central did not call any fire departments during this incident and when the train reached the end of the line at Daly City about 5:14 p.m. it was taken out of service for inspection.

After train No. 363 had moved to Embarcadero Station, central instructed following train No. 107 to run in road manual from Oakland West into the tunnel. The operator was told to inspect the track because the preceding train had lost two derail bars. The train operator radioed central that he saw a derail bar in the center of the track near where No. 363 had stopped but that the track was clear for normal service. Central dispatched the next train in road manual, but dispatched all following trains in ATO at speeds up to 72 mph.

When seven-car train No. 117 departed Oakland West station at 6:00 p.m., it was the tenth train to enter the tunnel after No. 363. The train was en route from Fremont to Daly City with a train operator in the lead car and a line supervisor in the rear of the sixth car. Forty passengers were scattered throughout the train.

About 6:06 p.m., No. 117's operator radioed central that his train had been stopped by an emergency brake application and that it might be on fire. Although he was not able to tell his exact location because there was too much smoke, he indicated that he was just into the tunnel. (See figure 1.) Central notified all other trains to stop further radio transmissions and told No. 117 that third rail power was being terminated. Immediately, power to the third rail section was turned off as a safety precaution; however, 40 seconds later the power was restored to enable the operator to attempt to uncouple the lead portion of the train from the burning portion.

After the power had been restored, the train operator informed central that he could not move the train in road manual; that he could not see ahead in the tunnel because of the smoke; and that all passengers were being moved into the lead car. Central instructed him to try moving the train in any manner possible and advised that they would begin to ventilate the tunnel. About 6:08 p.m. the Oakland vent fans were activated and exhaust damper No. 11, located about 500 feet in front of the train, was opened.

- 1/ Road manual is an operating mode in which the train responds to the actions of its operator through manipulation of control levers.
- 2/ Automatic train operation is an operating mode in which the train responds to the electronic commands of a computerized train control system.

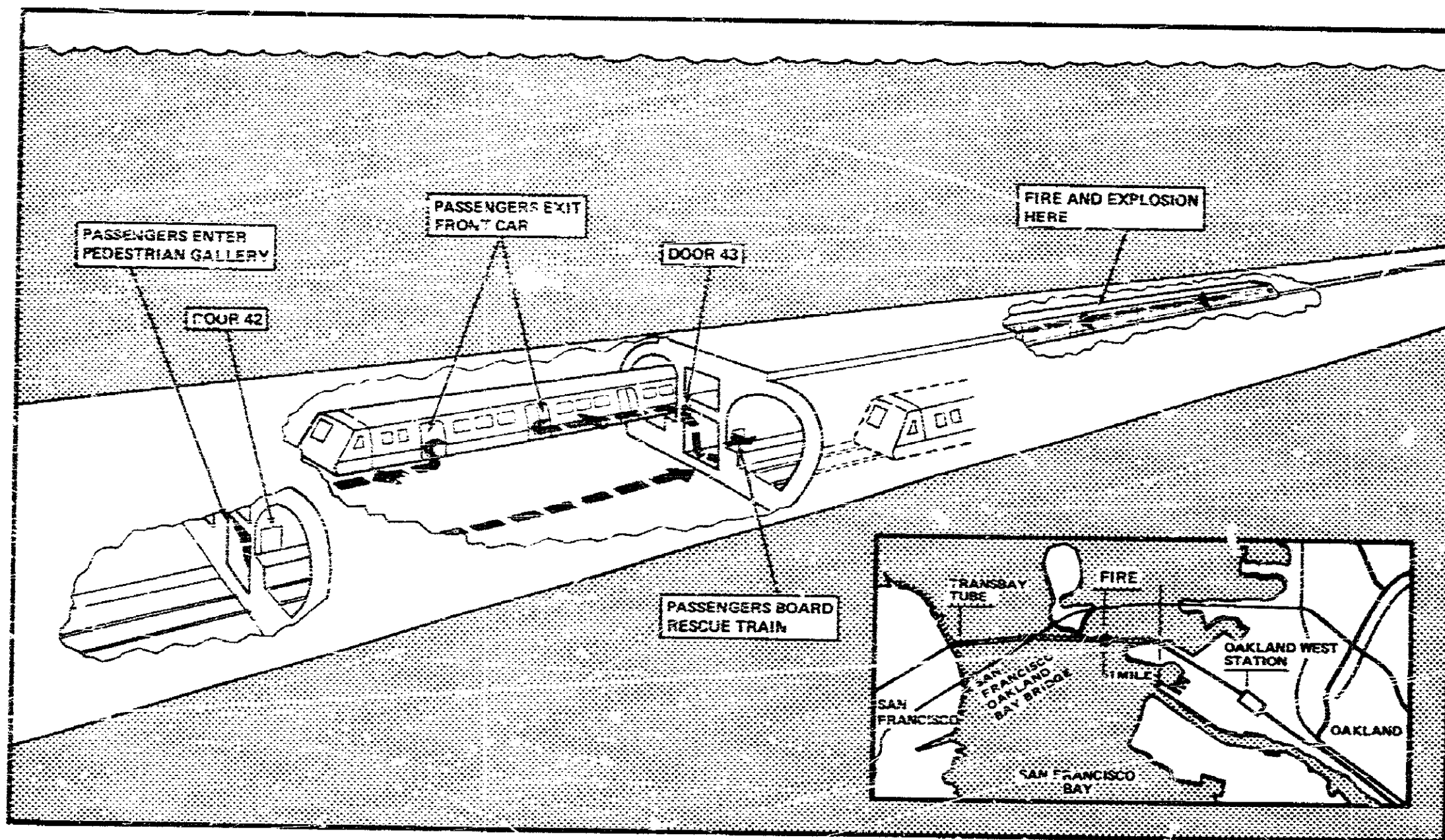


Figure 1. Outaway of Transbay Tube.

The line supervisor informed central that there were explosions and thick smoke in the sixth car and that all passengers had been moved forward. He also advised that he would try to uncouple the lead portion of the train from the sixth car and move out in manual. Central told him that if he was successful to move the train to Embarcadero Station. Central notified the Oakland Fire Department at 6:09 p.m. and 3 minutes later opened damper No. 9. The line supervisor radioed that everytime he tried to uncouple either at the first, second, or third cars the reverser lever would trip preventing the uncoupling. He also advised that the tunnel was full of smoke. At 6:15 p.m., central advised that they would shut off the third rail power and he should evacuate the passengers. During the next minute power was turned off to the tunnel's first two third-rail sections. The supervisor radioed central that the smoke was too thick to evacuate the passengers and that they were trapped in the train.

Central asked No. 117 how many passengers were on board and if the line supervisor could get to a telephone in the gallery walkway. The line supervisor replied that they had 30 to 40 passengers on board and that one of them was blind; he advised that smoke was too thick on the outside of the train to go to the phone. At 6:23 p.m., central opened damper No. 7, located 1,000 feet to the rear of the train, and activated the San Francisco ventilation fans. Damper No. 11 was then closed at 6:25 p.m.

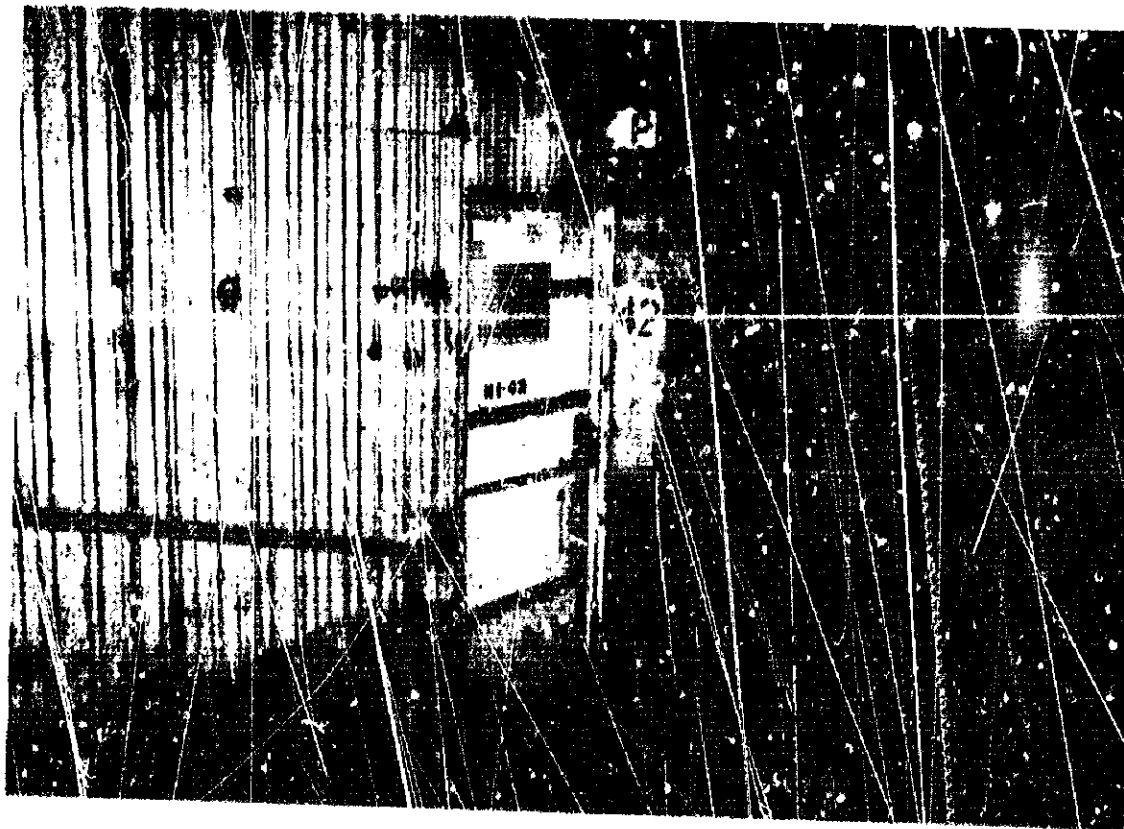
When central first called the Oakland Fire Department, they were instructed to go to the Maintenance of Way access gate close to Oakland West and wait for instructions. At 6:11 p.m. central advised that a train (No. 900) would be at Oakland West to take them into the tunnel behind the train which had smoke difficulties. The fire department responded with nine men to Oakland West but reported that they were unable to locate any fire on the train standing in the station. Since the preplanned response to a tunnel fire did not require firefighters to enter the tunnel by train, the fire department called central for clarification. Firemen subsequently boarded train No. 900 and also initiated their standard tunnel response by calling additional men to the Oakland vent structure.

Train No. 900 was instructed to prepare to run road manual and to take two BART policemen and the firefighters as far as possible into the tunnel. About 1 mile into the tunnel, the train operator stopped the train to remove an auxiliary box cover and a derail bar from the track. He also saw that the third rail cover-board had been torn off and that some of it was on the third rail and some was on the floor against the tunnel wall. He continued to move the train forward stopping about 200 feet from train No. 117, the rear car of which was on fire.

As the firefighters and policemen moved from the train along the walkway to tunnel exit door No. 44, heavy black smoke moved toward train No. 900, causing the group to become separated. The lead policeman and seven firefighters made it into the clear gallery through door No. 44, leaving it open for the others to follow. However, the heavy smoke forced two firefighters and the other policeman to return to train No. 900. The policeman went into the gallery at door No. 45 to set up a maintenance phone to communicate with central. However, as the smoke began to enter the gallery through door No. 45, he abandoned the location and returned to train No. 900, leaving door No. 45 open. (See figure 2.)



Gallery Side of Door



Tunnel Side of Door

Figure 2

At 6:21 p.m., central had instructed train No. 111, with over 1,000 passengers aboard and waiting at Embarcadero Station, to run ATO into the M-2 tunnel to discharge an onboard troubleshooter and to pick up passengers evacuating from train No. 117. The train then immediately moved into the M-2 tunnel and stopped with its rear car at doorway No. 43. Smoke by now had started to filter into the M-2 tunnel. The door to the M-1 tunnel was opened and a heavy concentration of smoke was observed. Central had shut off third rail power for both trains No. 117 and No. 111 in anticipation of the evacuation from No. 117. The firefighters immediately began leading passengers through the black smoke along the tunnel walkway to door No. 43. Eventually the situation became unbearable in the M-1 tunnel and some passengers began yelling for help. Thirty-five passengers, including the blind passenger, were led to door No. 43. Meanwhile, the smoke began to clear from the front of the lead car and the last five passengers climbed through the operator's compartment window and exited through door No. 42. All of the passengers were led from the gallery through door No. 43 on the M-2 side and onto train No. 111. The firefighters then searched train No. 117 for any remaining passengers. After the rescue, the firefighters stated that had they been 3 to 5 minutes later, there would have been numerous fatalities.

While passengers were being evacuated into the gallery some were given oxygen before boarding train No. 111. The train operator and line supervisor from No. 117 were the last to board No. 111, which now had many weary passengers sitting in the aisles. When the firefighters contacted central and advised that the evacuated passengers were all on No. 111, central restored M-2 third rail power. When advised that everyone was clear of the train at 6:59 p.m., central directed No. 111 to immediately move out in ATO in order to quickly move the passengers to Oakland for prompt medical attention. As No. 111 accelerated to about 80 mph, the dense black smoke from M-1 tunnel was drawn into the gallery through doors Nos. 44 and 45 and into the M-2 tunnel at door No. 43. The force of the air knocked down the BART employees and firefighters standing in the gallery near the doors. (See appendix A.) The section of gallery between doors 43 and 45--about 670 feet--was filled with hot, dense black smoke.

As the dense smoke entered the gallery, a fire department lieutenant and 10 firefighters, who had responded through the Oakland vent structure, had reached the area between doors 44 and 45. The firefighters had used their 30-minute oxygen masks after encountering smoke in the gallery while walking to the scene. Their firefighting equipment was being transported to the scene on a BART maintenance department cart because the special fire department cart was still locked at the vent structure; in the confusion, the firefighters had forgotten their keys. After the blast of hot, dense smoke, they formed a single-file line, holding each other's hands to form a chain to get through the dense smoke. At door No. 51, the lieutenant experienced difficulty with his oxygen supply. As others tried to help the lieutenant they too began to run out of oxygen. At 7:09 p.m., another lieutenant with the group eventually found a phone box and called for help. One of the firefighters made it through a door just opened by another firefighter in a smokeless portion of the M-1 tunnel. The other firefighters went into the tunnel and central was advised of the need for assistance. Central immediately instructed train No. 377 at Oakland West to run road manual into M-1 tunnel. The train operator moved No. 377, with an unknown number of passengers scattered throughout the train, because she assumed that whatever had caused the delay was corrected, and that perhaps workmen were still in the area. Central did not know that No. 377 had passengers when the train was moved into the tunnel to pick up the

firefighters. About 7:48 p.m. the train operator requested reverse movement out of the tunnel because injured firefighters had boarded the train. About 8:10 p.m. the firefighters and passengers were unloaded from No. 377 at Oakland West, and the injured were immediately taken to area hospitals. The five department lieutenant, who was the first to exhaust his oxygen supply, died of smoke inhalation and cyanide poisoning.

The tunnel under the San Francisco Bay, called the Transbay Tube, is approximately 3.7 miles long. Access can be obtained at the Oakland and San Francisco ventilation structures, which are located at each end of the tunnel. These structures contain mechanical support facilities, such as exhaust fans, water supply, pumps, and electrification and communication entrance lines. There is an 8-foot-wide gallery between the two track tunnels for access to the tunnel's electrical, mechanical, and communication support facilities. Closed emergency doors which provide access from the gallery to each tunnel are located about every 330 feet. These doors are numbered consecutively from 1 to 56, beginning at the San Francisco ventilation structure. The doors are locked and require a key for opening from the gallery side. They can be opened from the tunnels by pushing on the emergency door hardware. The upper portion of the gallery provides air exhaust and has dampers, 6 feet long by 3 feet high, located above every third doorway. These dampers are numbered consecutively, odd numbers 1 to 37 in the M-1 tunnel, even numbers 2 to 38 in the M-2 tunnel. Each numbering begins at door No. 56 near the Oakland ventilation structure. (See appendix B.) A pressurized water line for firefighting runs the entire length of the tube and has valves with hose connections at each doorway. Each tunnel has a 2 1/2-foot-wide car-floor-height walkway adjacent to the gallery walls and is illuminated by fluorescent lights every 50 feet. Small electrical substations, located in the gallery, furnish electricity to each third rail segment throughout the tunnel. (See figure 3.)

The M-1 track is straight and on a 0.30-percent descending grade for about 4,000 feet beginning 1/2 mile west of the Oakland entrance. It is constructed of 119-pound rail and 5-foot 6-inch gage. The rails are secured to the concrete tunnel floor with bolted insulated steel rail fasteners every 3 feet. The covered 1,000-volt d.c. third rail for train propulsion is located on the the outside of the track and adjacent to the outside tunnel walls. It is constructed of a 4-inch wide by 4-inch high steel I-beam with aluminum bars fused or bolted to each side of its web. The I-beam is clamped to the top of porcelain insulators bolted every 10 feet to the concrete floor. The plastic cover board is clamped to the I-beam every 5 feet by means of special semicircular brackets. (See figure 4.) For isolating purposes, gaps are located in the third rail about every 5,000 feet through the tunnel.

Injuries to Persons

<u>Injuries</u>	<u>Crewmembers</u>	<u>Passengers</u>	<u>Other</u>
Fatal	0	0	1
Nonfatal	2	17	39 ^{3/}
None	0	23	0

^{3/} Twelve BART employees, 24 firefighters, and 3 ambulance company employees.

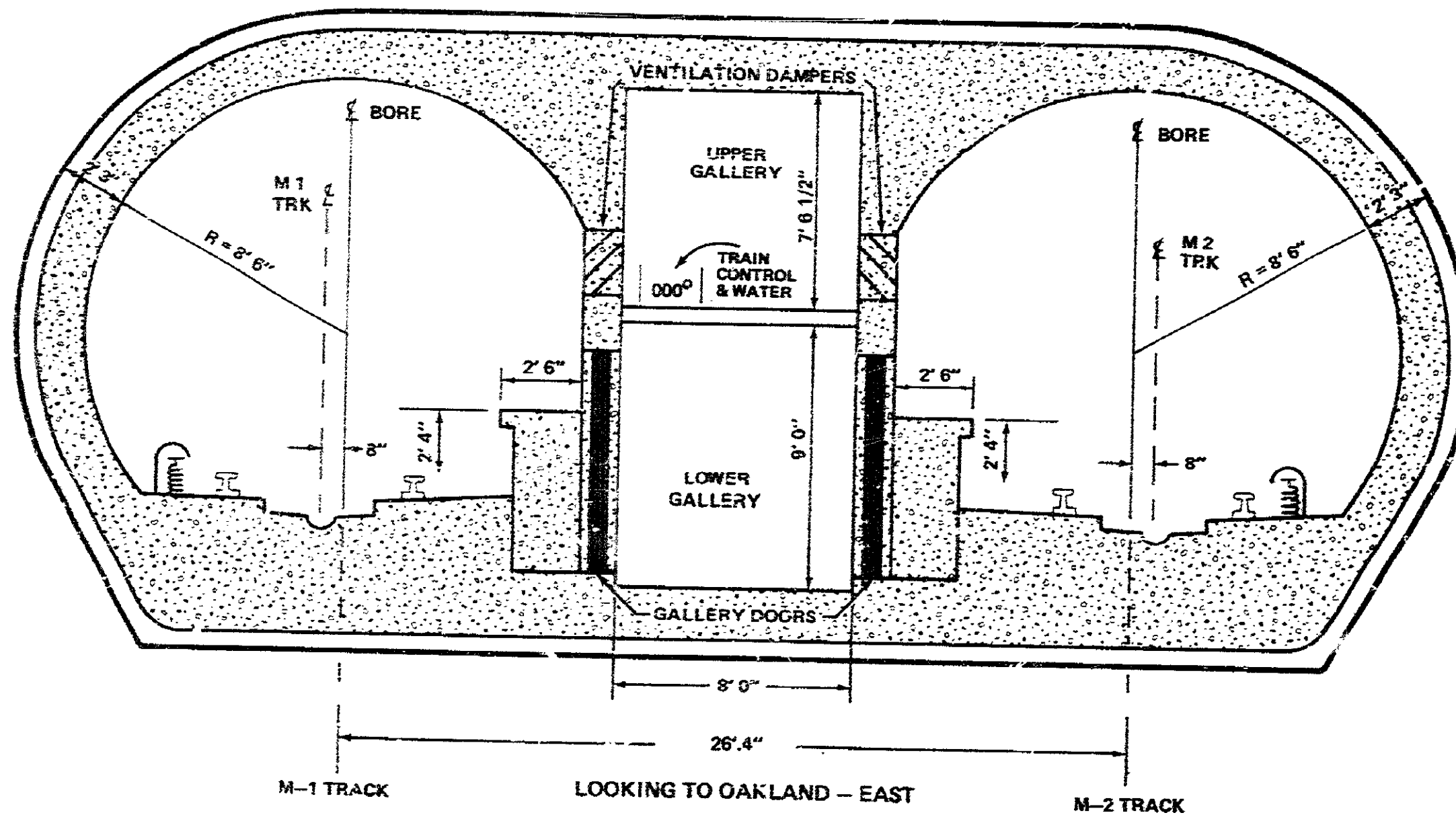


Figure 3. Typical Section of Transbay Tube.

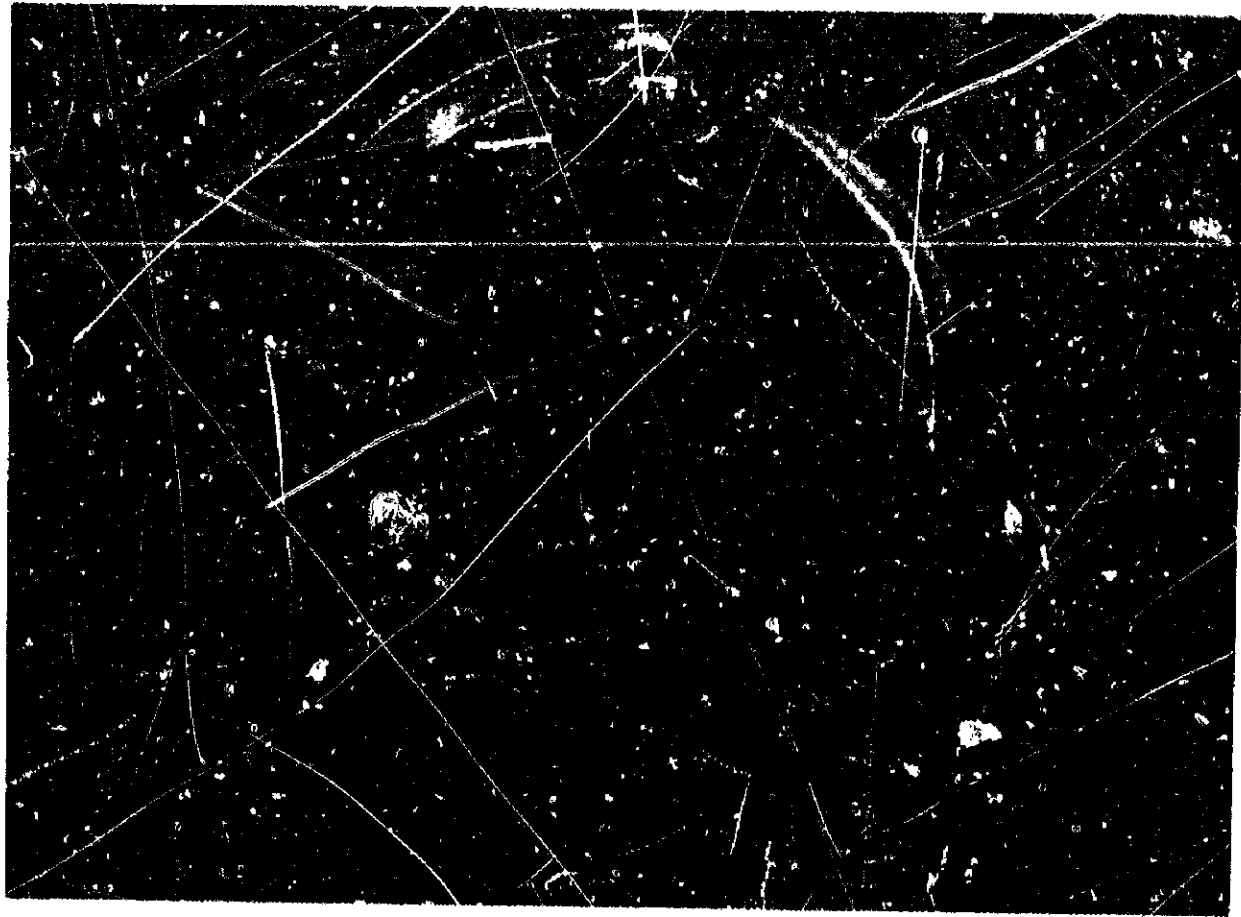


Figure 4. Third Rail and Cover Board.

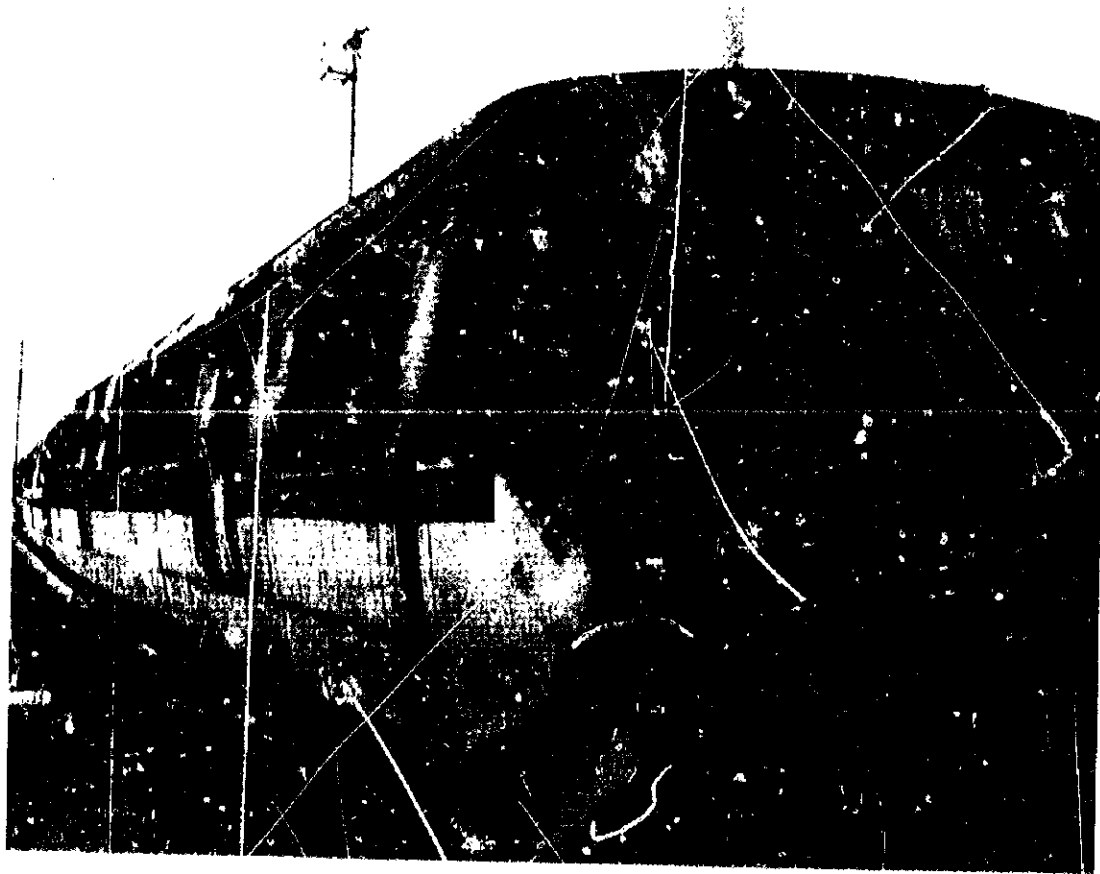


Figure 5. Damaged Train No. 117.

Damage to Trains

Train No. 353's second car had a loose No. 1 traction motor filter assembly. The fifth car had a line switch box cover missing and there was evidence of heavy electrical arcing on the No. 1 wheel and battery box latch. The sixth car had its No. 3 derail bar broken and there was evidence of heavy electrical arcing on its No. 3 collector shoe assembly, on the No. 5 and 7 wheels, air suspension equalizer tank, car body side skirt, dynamic brake grid side shield, brake grid air intake scoop, and the "X" car end auxiliary and evaporator covers. The eighth car had its No. 3 derail bar broken, and the line switch box cover and side skirt damaged from electrical arcing. The ninth car's No. 3 traction motor filter assembly was missing and there was evidence of electrical arcing between the brush shunt and motor housing.

The first three cars of train No. 117 sustained extensive interior smoke damage. (See figure 5.) The fourth car had extensive smoke and fire damage and its No. 1 collector shoe was broken off and a part of its metal shoe bracket was missing. The fifth car was destroyed by extensive fire and smoke, an auxiliary box cover was missing, the No. 4 collector shoe assembly was broken off, and there was evidence of heavy undercar electrical arcing. A hole about 12 inches in diameter had been burned through the floor above the No. 4 collector shoe assembly, and the No. 2 and No. 4 collector shoe fuses were open. The sixth car was destroyed by fire and smoke. (See figure 6.) Its No. 3 collector shoe assembly was broken off with evidence of heavy arcing underneath the car. The air suspension equalization tank was broken and the suspension air bags were destroyed. A hole was burned through the car floor above the No. 3 collector shoe location. The No. 1 and 2 collector shoe fuses and the main fuse were blown. The seventh car was destroyed by extensive fire and smoke. Derailment bars were broken on the third-rail side of the fourth through seventh cars.

Train No. 900 from Oakland West sustained heat damage to its lead operating module and all 10 cars were damaged extensively by smoke.

Other Damage

Near the accident, the third-rail segment sustained two broken insulators and an unintended electric arc flashover of one insulator; a plastic portion from the collector shoe assembly had become imbedded in its web; the aluminum web was scratched and gouged; two coverboard brackets had been struck and moved westerly; and three 10-foot sections of coverboard were torn loose from their brackets.

The concrete ceiling of the M-1 tunnel was covered with black soot and had been damaged by intense heat. The ceiling concrete above the coupled ends of the fifth and sixth cars of train No. 117 had spalled sufficiently to expose the steel reinforcements.

About 20 feet of steel handrail on the M-1 tunnel walkway was warped between doorways No. 43 and No. 44. About 500 feet of overhead radio and train control cables were also destroyed.



Figure 6. Damaged Train No. 117.

Employee Information

The train operator of No. 117 was familiar with the Transbay Tube and BART's operations rules and emergency procedures. He reported to work at 4:00 p.m., on January 17, 1979, and took over operation of train No. 117 at the South Hayward Station about 5:30 p.m. He was advised by the former train operator that the only problem was a friction brake that had cycled out.

The line supervisor on train No. 117 was familiar with the tunnel and BART's emergency procedures. He reported to work at 11:45 a.m. on January 17, 1979; at 5:50 p.m. he had boarded train No. 117 at Lake Merritt Station to return to the Civic Center station headquarters.

The BART central supervisor had a working acquaintance with the functions in the Transbay Tube. He had been involved in previous BART emergencies and emergency drills; however, he had never been involved in a Transbay Tube emergency disaster drill. Before reporting to work at 4:00 p.m. on January 17, he discussed the systems operations with the previous central supervisor and was not advised of any problems.

Train Information

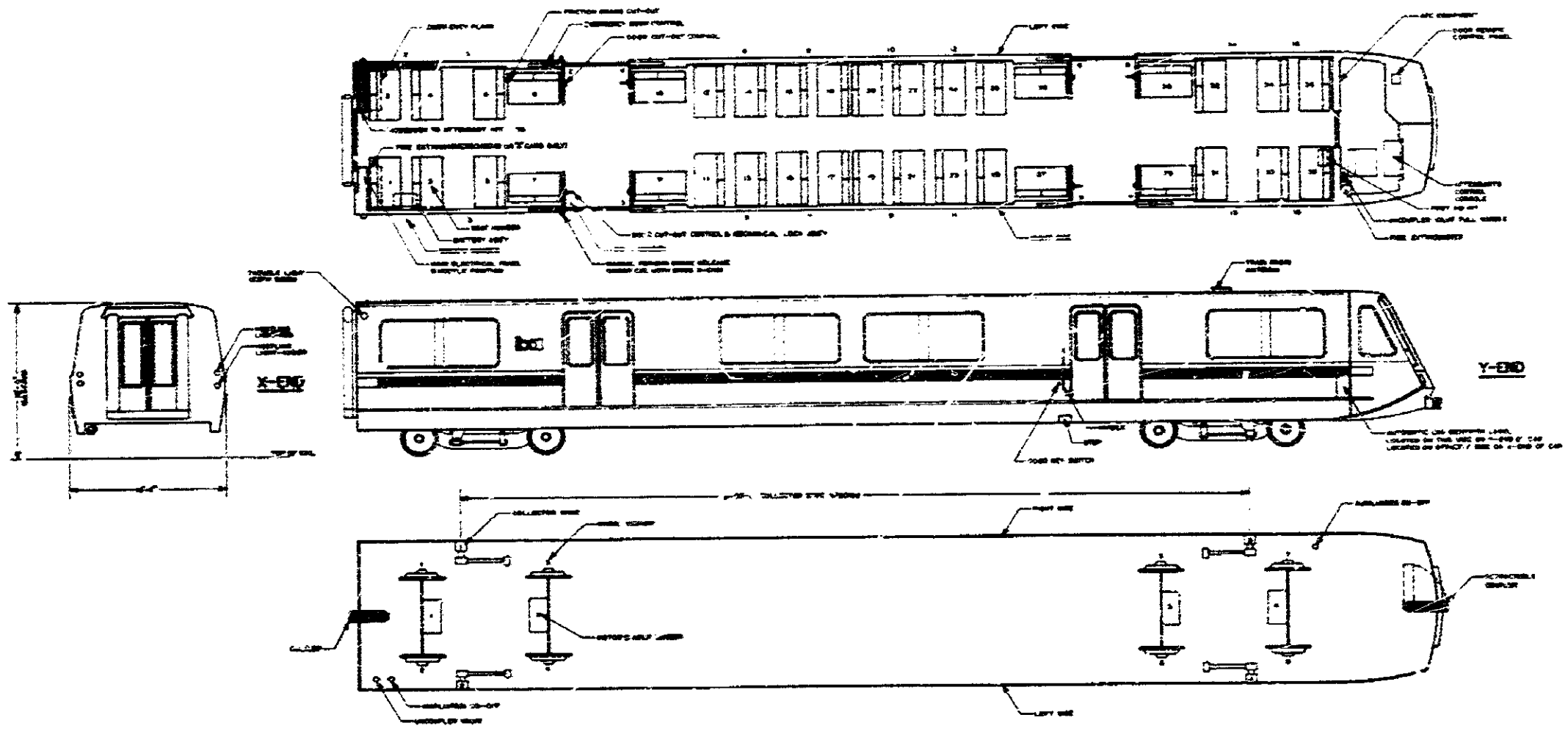
Two of the cars of train No. 117 were end-of-train type cars, called "A" cars, one on each end, and were equipped with 5-foot extension modules containing the train operator's compartment; the other five cars were middle-of-train type called "B" cars which were not equipped with an operator's cab. (See figure 7.)

Train No. 363 was provided with two "A" type cars, one on each end; the remainder were "B" type cars.

The A and B type car bodies were integrated aluminum structures of light-weight semi-monocoque construction. Both the roof and floor were made of outer and inner 0.60-inch aluminum sheets separated at intervals by structural reinforcement. The void between the aluminum sheets was filled with a 2-inch core of polyurethane foam for rigidity and insulation. The interior sidewalls and ceiling were made of molded fiberglass. The seats were made of polyurethane foam encased in vinyl and nylon fabric. The floors were covered with a latex foam pad and wool carpet. Additional sound deadening material which was made of a vinyl-covered polyurethane pad had been installed in the floor over the truck areas.

The 70-foot car bodies were carried on two, four-wheel trucks with pneumatic suspension systems. Each axle was driven by a 150 horsepower, 500-volt d.c. motor. Propulsion current was gathered from the third rail by a sliding collector shoe assembly, on each side of each truck.

Uncoupling is accomplished by depressing a car's uncoupling button and reverse lever to jog the car. This causes unlatching of connected couplers while backing one car away from the other. The uncoupling button, located within the car, is electrically connected to the 37-volt d.c. train control circuit. In the event of a short circuit on any car, the uncoupling system of the train will not function. To isolate the shorted circuit, the train control cable at the rear of the coupler on the damaged car must be disconnected.



-13-

Figure 7. A-car.

T-21

Car braking was provided by a blended dynamic and disc-hydraulic system. Normal braking under ATO was initiated automatically by onboard computerized equipment. Emergency braking can be initiated by the train operator by pressing an emergency stop button on the operating console, or it can occur automatically when a derail bar circuit becomes open or pertinent on-board equipment malfunctions.

Periodic maintenance is performed on all A and B cars every 300 hours of revenue operation. The cars are taken into the shops and visually inspected while performing other programmed equipment testing and servicing. At every 900, 3,600, and 7,200 hours of revenue operation additional preventive maintenance is performed. To perform periodic maintenance, the line switch box cover must be removed from a car in order to wire in simulated 1,000-volt d.c. third rail power. There are no written procedures for securement of the switch box cover nor checklists which require the cover to be replaced. (See figure 8.)

Trains are stored, maintained, and placed in revenue service from three yards located at Hayward, Concord, and Richmond. In the yards train operators perform the required departure test to determine if trains are functioning properly for revenue operations. An outside visual inspection of the train's consist is not required before departure. Upon completion of a satisfactory departure test, the train operator radios BART central and advises that a train is ready.

Method of Operation

BART is a 75-mile double track rail rapid transit system, which serves three counties in the San Francisco Bay area. Trains are operated automatically over these lines and monitored by a computer at BART central in the Lake Merritt station. Central employs two train controllers, two power support controllers, one communications specialist, and the central supervisor. Under central's direction, a train operator can order automatic train operation by inserting train identification number, number of cars in train, and destination number into the operating console. The computerized train control system dispatches the train automatically onto the main tracks. If it is necessary to operate a train on the main tracks manually, a manual control lever is operated which limits train speed to a maximum of 25 mph. Authorization from central is required to change operating key position from ATO to road manual.

BART's Emergency Operating Rules T-605 and A-2 require that passengers shall not be evacuated from a train that is located between stations unless it is absolutely necessary. Efforts should be made to move the train outside of a subway or to a station before evacuation. Rule C-607 (A-6) directs the fan and damper action to be taken in the Transbay Tube when the exact location of a train is not known. It indicates that damper BD-11 should be opened for a train in No. 117's position and that passengers should be evacuated toward Oakland. (See appendix C.) Rule T-609 requires BART central to call the appropriate fire departments when a fire is suspected or known to exist. (See appendix D.)

Fire

At 6:09 p.m. when BART central first attempted to call the Oakland Fire Department, it unintentionally called the San Francisco Fire Department. When advised it was not the Oakland Fire Department, central's reply was to disregard



Line Switch Box Cover



Line Switch Box Cover Removed

Figure 8

the call with no explanation. At 6:19 p.m. San Francisco Fire Department called central asking if there was a fire somewhere. They were advised that a train was stopped in the tunnel on the Oakland side which was producing an excessive amount of smoke, and that Oakland had responded. At 6:32 p.m. the Oakland Fire Department contacted San Francisco Fire Department advising that there was a fire on a EART train in the tunnel, and that they were riding another train to the scene. At 6:36 p.m. San Francisco Fire Department dispatched units to the Embarcadero station entrance of the tunnel to standby.

The San Francisco Fire Department was ready to move to the fire scene on train No. 001 at 7:23 p.m.; however, they were held until 7:52 p.m. because of difficulty getting information from central and Oakland Fire Department. The train proceeded on the M-1 track to where third rail power was off and from there the San Francisco firemen had to walk to the fire; they arrived about 8:15 p.m. Firemen placed hose lines through doors Nos. 43, 44, and 45 from standpipes in the opposite tunnel. Meanwhile, contact with the Oakland Fire Department was made to determine if the third rail in the M-1 tunnel was deenergized. After about 45 minutes, word was received from central that the power was off and the line grounded. Water was put on the fire, however, heat was so intense that the firefighters had to be protected with a second hose line, and it became necessary to relieve the men in the tunnel at 5-minute intervals. The smoke was described as "just like black ink being poured on the men, running off their helmets and coats; a flashlight would not penetrate 2 feet." About 1:31 a.m., on January 18, 1979, the fire was declared under control.

The fire was ignited on train No. 117 in the fifth and sixth cars on the third rail side above the damaged collector shoe assemblies. The broken collector and attached wires carrying 1,000-volt d.c. current struck the 100-psi air suspension equalization tanks, causing arcing and fire. The air bags located above the collector shoes burned and the stainless steel plates between the air bags and car floor melted. Their contact with the aluminum car body caused it to burn and the hole above the plates to develop. The hole exposed the polyurethane core and interior of the car to extreme heat and fire. The interior floor covering pads and carpet over the hole and adjacent area then caught fire. Fire progressed through the interiors of the fifth and sixth cars, burning the carpet, seats, walls, and ceiling liners. Fire continued to the remaining cars via the adjoining car end exit doors.

Tests and Research

Postaccident inspection of the trackway disclosed a line switch box cover, collector shoe assembly, air tank name plate, spring, and gasket material in the track areas where trains No. 117 and No. 363 stopped. Laboratory inspection disclosed that the line switch cover had been struck by the collector shoe assembly. (See Appendix E.) After the accident, the entire fleet of cars was inspected. Inspection revealed that the fifth car in train No. 363 was the only car with a missing line switch box cover. The fifth car in train No. 117 was missing an auxiliary box cover and 41 other cars had various types of loose undercar equipment covers.

Review of BART shop car records disclosed that the fifth car of No. 363 had been inspected on January 1, 1979, and that the fifth car of No. 117 had been inspected at 2:00 a.m. on January 17. These were the cars' last scheduled 300-hour preventive maintenance inspection.

Other Information

Car Interiors. -- At the request of the Urban Mass Transportation Administration (UMTA), during 1977 and 1978 the National Bureau of Standards conducted a limited fire hazard analysis of the BART cars to determine if any aspect of the car's design or materials could result in a hazardous environment in case of fire. In March 1978, a final report was issued which contained five recommendations for decreasing the probability of a hazardous fire situation. One of the recommendations was to change the existing upholstered urethane seat assemblies to a more fire-resistant material and another was to develop a means to improve the floor assembly against fire penetration. (See appendix F.) Currently, there are no regulations concerning the design or use of any materials in transit cars. During 1978 BART's application to UMTA for funds to replace the existing urethane seats was approved; however, the funds have not yet been provided.

BART Emergency Plan. -- The BART Emergency Plan will be automatically implemented when an emergency event occurs which threatens the safety of the public. When the magnitude of the emergency involves 25 or more deaths or injuries, it will automatically be deemed a "disaster" by BART officials, and the local jurisdiction advised so that an official declaration may be made. The General Manager will determine command of central control and the central supervisor will generate the exact plan of action at the time of the occurrence based upon circumstances. Since this accident did not initially involve 25 or more deaths or injuries, no "disaster" was declared.

For fire on a train in the Transbay Tube, the exhaust fans and dampers are to be used to control smoke and the appropriate--San Francisco or Oakland--fire department called. Specific rendezvous points have been predetermined which call for the Oakland Fire Department to respond to the Oakland vent structures and the 7th and Maritime Streets access point for rendezvous with the BART emergency vehicle. The San Francisco Fire Department is to rendezvous at the Embarcadero Station with the emergency vehicle and before entering the tunnel confirm with BART central that third rail power is off. After clearance is given, proceed to the scene of the emergency using the gallery walkway, not the trackways. If the fire commander orders firefighters to ride on the BART emergency vehicle, they shall be equipped with breathing apparatus, each with a spare cylinder. (See appendix G.)

ANALYSIS

It is evident, from the broken air tanks, air bags, and marks of electrical arcing and melting of seal plates on No. 117's fifth and sixth cars, that the explosions heard by the line supervisor was the breaking of these air tanks and bags just before the train stopped. It is also evident that the collector shoe assembly had broken from the truck while 1,000-volt d.c. propulsion current was still provided through each car's other shoes. Since the 1,000-volt d.c. current can generate 3,000 degrees Fahrenheit from arcing, the plastic, rubber, aluminum, and

stainless steel car components, which have ignition temperatures from 500 to 2,200 degrees Fahrenheit, were quickly destroyed. The electrical arcing also caused the seal plates to melt and aluminum car body in the floor area to burn allowing fire to enter into the cars.

Since the line switch box cover hangs freely from two inverted "J" hooks, wind pressure can easily lift it off if the short, single bolt at its bottom works loose and falls off. The cover's location on the side of the car facing the third rail also makes it susceptible to electrical arcing on the side of the car, and it can become lodged between the top of the third rail and coverboard. (See figure 9.) This occurred to the line switch box cover from train No. 363, and the train operator who made the followup track inspection did not see it. With the cover laying on the top of the third rail and partially unsupported in a near horizontal position by the coverboard, the last two cars of No. 363, the nine following trains, and the first three cars of No. 117 passed without incident until the cover became lodged against the coverboard bracket. When struck by the No. 4 collector shoe assembly on the fifth car, both the shoe assembly and bracket broke. As a result, insulators broke and the three sections of coverboard found by train No. 900's operator were torn loose.

Since the troubleshooter and operator on No. 363 did not check the exterior of the train or trackway while stopped in the M-1 tunnel, they were not aware of what caused the broken derail bars. Central, therefore, based resumption of automatic train operation on the limited visual inspection advice of the following train operator. Since BART cars are shop-inspected only once every 300 hours and since no daily exterior inspection is made, the loose line switch box cover was not detected. Since the postaccident inspection revealed 37 loose covers and 8 missing covers, the Safety Board concludes that better cover fastening devices and inspection procedures are needed.

The line supervisor, who was riding in the sixth car of train No. 117, may have prevented some passengers from becoming trapped in the rear cars by the ensuing fire, when he directed all passengers to the lead car. Since the train had only 40 passengers there was no problem in moving these people forward to the first car and to attempt to comply with BART's emergency procedures of not evacuating the train between stations. The attempt to move or uncouple the train, however, precluded the possibility of a quick and successful attempt to evacuate the train in the event moving or uncoupling failed. When central shut off the third rail power for 40 seconds, it may have prevented the train operator from moving forward in road manual. The circuit breaker operating when the reverser lever was depressed indicated an electrical short of the train control circuit apparently caused by the accident or fire damage. Since disconnecting the electrical cable at the rear of the coupler to isolate the shorted car required leaving the train and getting under the car, the operator would have been unable to perform the task because of the tunnel smoke and fire environment. The Safety Board concludes that a positive method of quickly uncoupling the cars from within is essential under emergency conditions. Most importantly, 9 minutes elapsed before the line supervisor informed central that he could not uncouple the train. The first 9 minutes after a fire begins are critical to a successful evacuation. Had the train been loaded with several thousand rush-hour passengers, they could not have been moved forward into the front cars. Also, since BART trains only require a train operator in the lead car, it was a fortunate circumstance in this case that the line

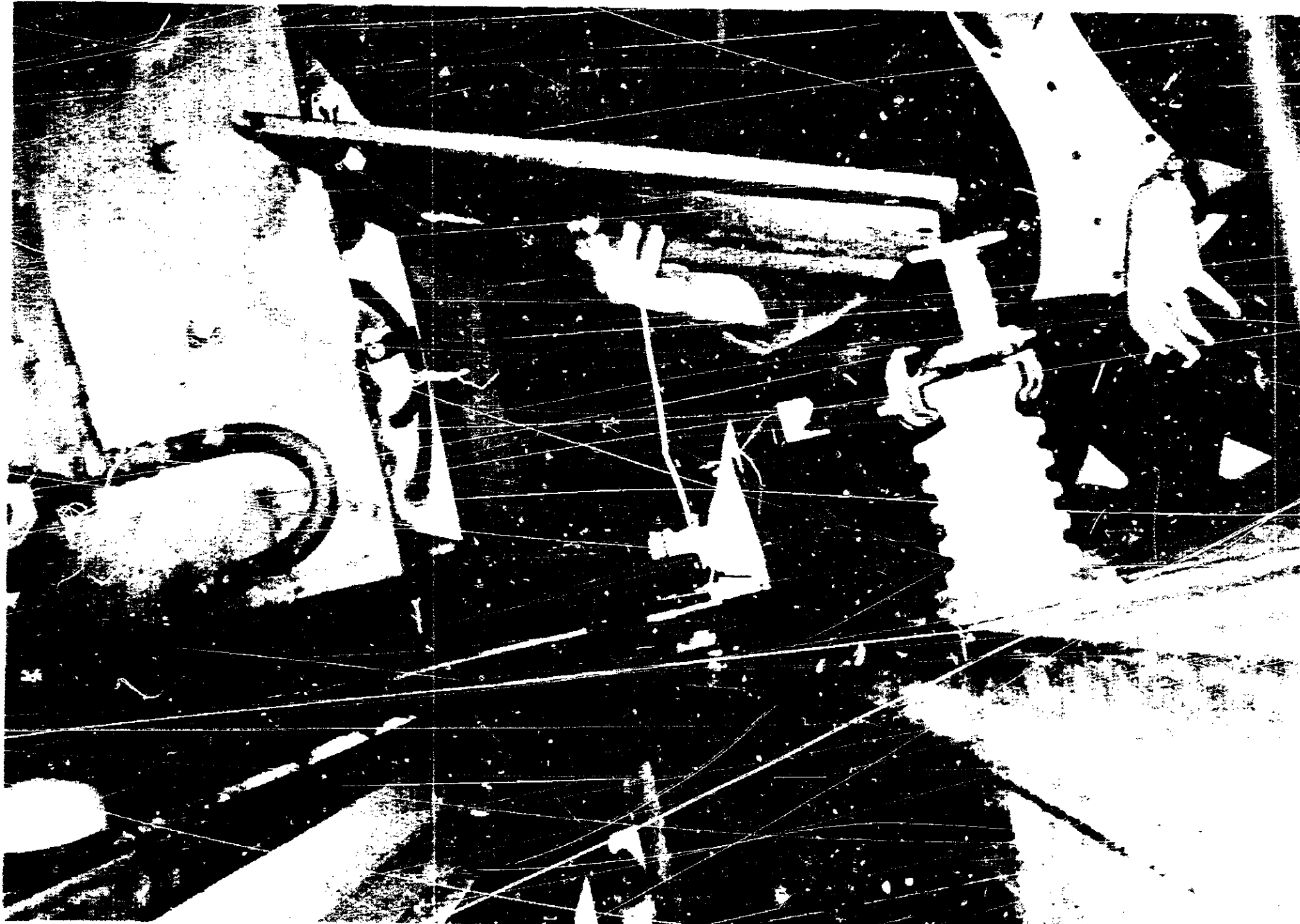


Figure 9. Line Switch Box Cover and Third Rail.

supervisor was in the sixth car. If not, some passengers may have been trapped in the rear cars, which could have contributed to a large number of fatalities. In addition, panicked passengers may attempt to open the train's doors while an effort is being made to move the train, which would further prevent it from moving. The tunnel is almost 4 miles long which makes the prompt arrival of rescue personnel difficult and since the tunnels are provided with a gallery between them into which passengers can escape, it may be better to evacuate passengers immediately and then try to uncouple the train. If successful the passengers could reboard some distance from the smoke or fire.

Since there are no regulations pertaining to transit car design and materials specification, the car body was not designed to specifications which would limit or prevent fire from entering the interior. The fire hazard analysis tests made on the BART car by the National Bureau of Standards indicated the need for better transit car design and better material specifications to make the cars more fire resistant. The quickness by which the smoke built up in the tunnel and the death of the firefighter because of suffocation highlight a need for materials that reduce the hazards of quick smoke buildup and toxic fumes in fires.

Central's requesting the Oakland Fire Department to respond to the Oakland West station to handle the train fire in the tunnel was contrary to the emergency plan to rendezvous with the BART emergency vehicle at the maintenance access point. When central prescribed entering the tunnel on train No. 900 instead of the fire department's requesting such action, the Oakland Fire Department was not the assertive decisionmaker on how the passengers were to be evacuated. When the Oakland Fire Department dispatched firefighters to the Oakland ventilation structure, both central and the fire department remained unaware of each other's plans and decisions. Had the fire department been the primary decisionmaker, No. 900 would have been used both for entry and evacuation of the passengers. Consequently, central's decision to bring in train No. 111 with over 1,000 passengers for rescue, with its potentially calamitous consequences, may not have occurred.

Because central failed to follow the emergency plan, Oakland Fire Department personnel did not realize that there was a train stranded on fire in the tunnel until 10 to 15 minutes after the initial notification. Misunderstanding of what was said is seen in the effort by the Oakland Fire Department to find the fire on train No. 900 standing at Oakland West station because of central's request to respond to that station. This clearly indicates that the Oakland Fire Department believed a train may have been in the tunnel with some kind of smoke problem but was proceeding under its own power to Oakland West where the Oakland Fire Department could extinguish the fire.

The original confusion could also have been a factor in the firefighters' forgetting their keys. This eventually prevented the use of the emergency cart and the ability to unlock the tunnel doors from the gallery side. Since the firefighters arriving at the Oakland vent structure also did not know the exact location of No. 117, they had no way to evaluate the judicious use of their 30-minute oxygen masks. Under these circumstances it is essential to have unlocked door access from the gallery to the tunnels, and a ventilation plan to keep smoke out of the gallery and opposite tunnel.

Central did not know the exact location of No. 117, but they opened damper No. 11 according to rule to pull the smoke from the train toward San Francisco. The intent of this plan was to pull the smoke away from the Oakland end of the tunnel to enable the passengers to walk in the gallery or tunnel free of smoke to the closer Oakland exit. Had the passengers immediately evacuated the train while the smoke was still light in density, the damper plan may have worked. However, the plan is not consistent with the rule not to evacuate passengers from a train until absolutely necessary. When Central was informed by No. 117 that the smoke was thickening in the tunnel, they did not envision the consequences and closed damper No. 11 and opened No. 7 just as No. 900 arrived at the scene. Since the ventilation change was not coordinated with the Oakland Fire Department the firefighters became engulfed in the dense smoke and in their confusion to leave the M-1 tunnel they left door No. 44 open. Since the second BART policeman on the scene was not trained in evacuations and had not been furnished with an oxygen mask, the entry of smoke into the gallery at M-1 door No. 45 caused him to quickly abandon the gallery and return to the train, leaving door No. 45 open.

The potential for a greater disaster developed when central sent train No. 111 into the M-2 tunnel without first unloading its passengers at Embarcadero Station. Central was unaware of the conditions in the M-2 tunnel when No. 111 was sent in, and when the first firefighters went in on No. 900. Also the presence of No. 111 at the fire scene would have hindered connecting of hoses and the use of water if needed during the evacuation of No. 117. The Safety Board concludes that BART central made a gross error by not first unloading the passengers from No. 111 before sending it into the tunnel to evacuate the passengers from No. 117.

If the third rail power failure which occurred in the M-1 tunnel had also occurred in the M-2 tunnel because of subsequent loss of control system wiring, central may not have been able to turn on the power for No. 111 to leave the tunnel which would have stranded an additional 1,000 or more passengers near the fire area.

Because the San Francisco Fire Department encountered other firefighters and BART personnel using the emergency and dedicated fire telephone lines, it was difficult for them to coordinate their firefighting efforts. The 45-minute delay to obtain confirmation that third rail power was off, thus delaying water application to the fire, shows the need for an additional BART emergency radio frequency or need for tunnel antennas enabling both fire departments to use their own radio networks in fighting a tunnel fire.

CONCLUSIONS

Findings

1. The inspection process used to determine what caused train No. 363 to unexpectedly stop was inadequate to preclude damage to train No. 117.
2. The broken derail bars and line switch box cover laying in the tunnel trackway caused extensive damage to critical electrical components underneath train No. 117.

3. Sustained electrical arcing from the 1,000-volt d.c. current caused extreme heat and burning of the aluminum car body and its synthetic appurtenances.
4. The plastic materials were the first to ignite underneath the fifth and sixth cars.
5. The synthetic materials used in the BART car construction give off toxic fumes when burning.
6. The fire entered the trains through the floor over the No. 8 wheel on the fifth car and No. 7 wheel on the sixth car.
7. There are no specifications or regulations concerning limitations on fire entry into the BART cars.
8. Minimal passenger load and fire near the rear of train No. 117 allowed the rear riding BART supervisor to route rear passengers to the lead two cars.
9. Train No. 117 could not be uncoupled because of short circuits caused by 1,000 volts electric arcing and fire when collector shoe wires contacted the under car bodies. When the train operator keyed on at the hostler panel, the hostling circuit breaker would trip.
10. The efforts to escape by uncoupling cars prevented the expedient evacuation of train No. 117 passengers to the gallery before smoke buildup.
11. Opening of exhaust damper No. 11 pulled smoke entirely over train No. 117.
12. BART Transbay Tube emergency exhaust fan and damper procedures do not properly address the location of a fire within a train.
13. The initial calling of only the Oakland Fire Department by BART Central with instruction to rendezvous at Oakland West Station was not in accordance with BART-Oakland-San Francisco emergency procedures for fire response in the Transbay Tube.
14. Closing of exhaust damper No. 11 and opening of damper No. 7 pulled smoke toward the firemen and BART employees arriving on Train No. 900, and cleared smoke from head end of Train No. 117 permitting last five passengers to evacuate through the cab window.
15. BART employees arriving at scene with Oakland firemen were unequipped and untrained to handle a smoke environment.
16. Oakland firemen and BART employees left M-1 track gallery doors 44 and 45 open after entering the gallery.
17. Unknown to BART Central, Oakland firemen entered the gallery walkway at the Oakland Vent structure according to established emergency procedures.
18. BART Central erred in judgment when it improperly dispatched No. 111 from the Embarcadero station to the M-1 tunnel with over 1,000 passengers to rescue passengers from Train No. 117.

19. Communications between the many on-scene rescue parties and between the various rescue parties and BART Central overloaded existing radio and telephone facilities.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the breaking of collector shoe assemblies on Train No. 117 when it struck a line switch box cover, which had fallen from an earlier train, resulting in a short circuit and fire. Contributing to the severity of the damage was the failure of BART to quickly and properly coordinate the Oakland and San Francisco fire departments' rescue and firefighting efforts, which did not conform with the emergency plan. The cause of the fatality and injuries was inhalation of smoke and toxic fumes emitted from burning plastic materials used in construction of the transit cars.

RECOMMENDATIONS

During its investigation of this accident the National Transportation Safety Board made the following recommendations:

— To the Bay Area Rapid Transit District:

"Include in the predispatching procedure an inspection of all undercar equipment covers to assure that such equipment covers are in place and properly secured. (Class I, Urgent Action) (R-79-12)

Provide a fail-safe securement mechanism for all undercar equipment covers on BART rolling stock. (Class II, Priority Action) (R-79-13)"

As a result of its completed investigation of this accident, the National Transportation Safety Board made the following recommendations:

— To the Bay Area Rapid Transit District:

Revise emergency procedures to clarify the necessity of unloading passengers immediately from a stopped burning train in the Transbay Tube and other long tunnel locations. (Class II, Priority Action) (R-79-42)."

"Revise emergency procedures to prevent sending rescue trains with other than emergency personnel into tunnel fire and/or accident areas. (Class II, Priority Action) (R-79-43)"

"Revise Transbay Tube emergency fan and damper procedures to prevent smoke from engulfing an entire train and/or entry into the gallery. (Class II, Priority Action) (R-79-44)"

"Revise emergency procedures to require notification of both the San Francisco and Oakland Fire Departments in the event of smoke and/or fire in the Transbay Tube. (Class II, Priority Action) (R-79-45)"

Determine and designate the most effective department or personnel to act as coordinator of rescue efforts involving train fires and/or emergency evacuations. (Class II, Priority Action) (R-79-46)"

"Provide a means for fire departments to use their own radio equipment in the Transbay Tube and other long tunnel locations. (Class II, Priority Action) (R-79-47)"

"Train and equip employees who may be involved in tunnel rescue efforts to manage a smoke and/or fire environment. (Class II, Priority Action) (R-79-48)"

"Provide an additional Central Train radio frequency for emergency communications. (Class II, Priority Action) (R-79-49)"

"Upgrade the flame resistance of vehicle seat assemblies and other plastic components. (Class II, Priority Action) (R-79-50)"

"Provide means of preventing entry of fire through the vehicle floor in areas susceptible to fire. (Class II, Priority Action) (R-79-51)"

"Redesign and modify car uncoupling circuitry to provide train operators with a positive means of uncoupling from within the cars in the event of an electrical short or malfunction. (Class II, Priority Action) (R-79-52)"

— To the American Public Transit Association:

"Review and revise as necessary vehicle inspection procedures and emergency evacuation guidelines for Association members to correct deficiencies noted in this investigation. (Class II, Priority Action) (R-79-53)"

— To the Urban Mass Transportation Administration:

"Promulgate regulations establishing minimum fire safety standards for the design and construction of Rapid Transit Vehicles. (Class II, Priority Action) (R-79-54)"

"Establish overview of Bay Area Rapid Transit District procedures to ensure that the emergency deficiencies noted in this investigation received appropriate remedial action. (Class I, Urgent Action)" (R-79-55)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

July 19, 1979

Sequence of Events Mile Post 4.0 to Mile Post 4.8

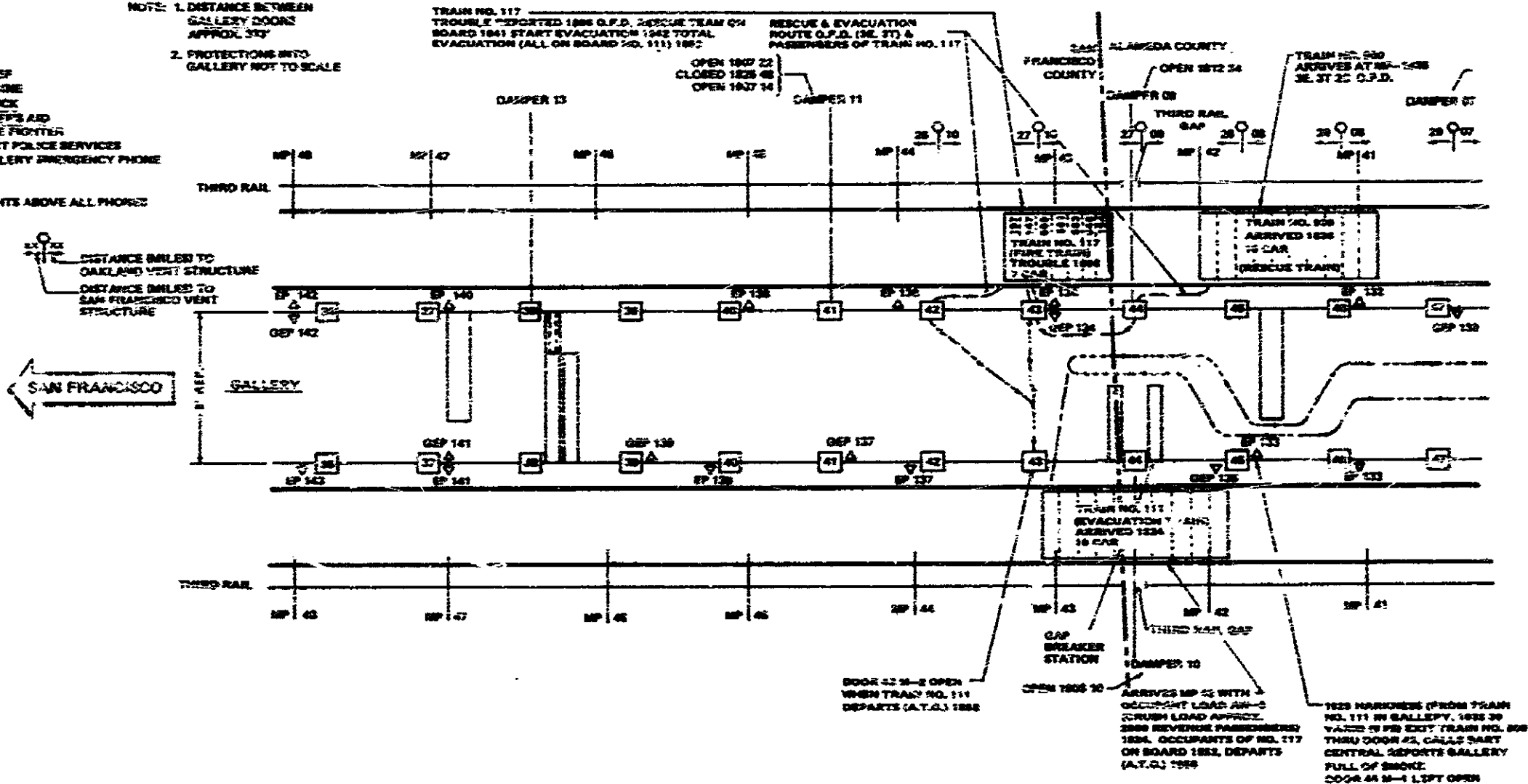
Page 1

NOT TO SCALE

NOTE: 1. DISTANCE BETWEEN GALLERY DOORS APPROX. 33'
2. PROTECTIONS INTO GALLERY NOT TO SCALE

C-CHIEF
E-ENGINE
T-TRUCK
CA-CHIEF'S AID
F-FIRE FRONTIER
S P S-SART POLICE SERVICES
G E P-GALLERY EMERGENCY PHONE

*BLUE LIGHTS ABOVE ALL PHONES



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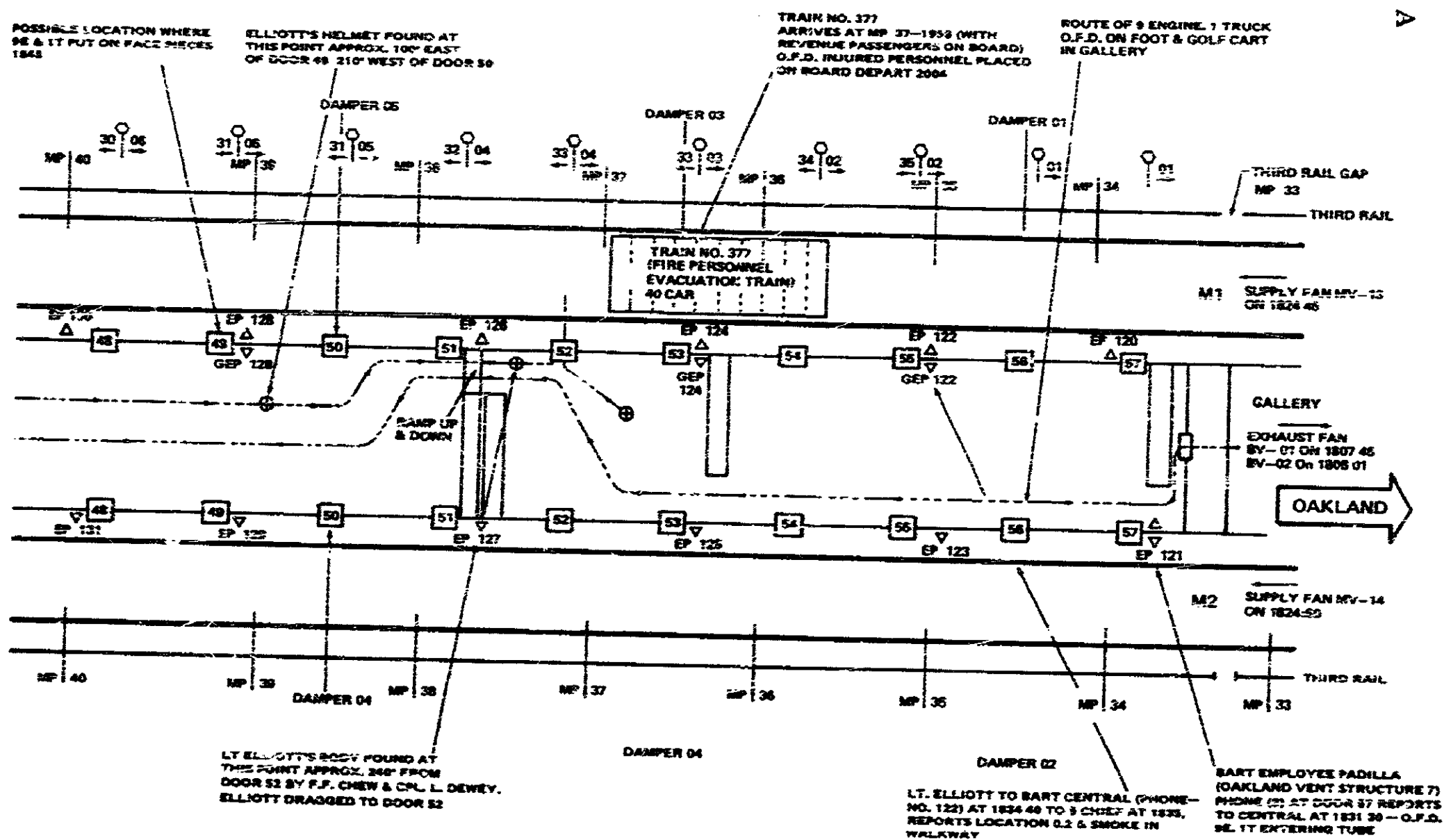
Appendix A

Sequence of Events

Mile Post 3.3 to Mile Post 4.0

Page 2

Appendix A



TRANSBAY TUBE DOOR AND DAMPER LOCATIONS

<u>Mile Post</u>	<u>Door No.</u>	<u>M1 Trackway</u>	<u>M2 Trackway</u>
2.67		Portal	Portal
2.97		MV13	MV14
3.34		Oakland Vent Structure	
3.44	56	BD01	BD02
3.65	53	BD03	BD04
3.85	50	BD05	BD06
4.05	47	BD07	BD08
4.25	44	BD09	BD10
4.45	41	BD11	BD12
4.65	38	BD13	BD14
4.84	35	BD15	BD16
5.03	32	BD17	BD18
5.22	29	BD19	BD20
5.41	26	BD21	BD22
5.59	23	BD23	BD24
5.78	20	BD25	BD26
5.96	17	BD27	BD28
6.14	14	BD29	BD30
6.33	11	BD31	BD32
6.52	8	BD33	BD34
6.70	5	BD35	BD36
6.89	2	BD37	BD38
6.99		S.F. Vent Structure	
7.27		MV19	MV20

Appendix C

Excerpts from
BART Central Operations Manual

C 600 Train Evacuation

When evacuating passengers from a train that is between stations, third rail power shall not be restored until a report that the track is clear is received from the Train Operator or other on-the-scene observer.

C 604 Transbay Tube

A. The following actions shall be taken for fighting fires in the Transbay Tube:

- (1) Remove third rail power from the affected area.
- (2) Refer to the ventilation fan procedure for operation of the fans and dampers.

B. Fire Pump Operation

(1) Fire on the Oakland Side of the Tube:

- a. Open Valve BW01. Do not turn on the fire pumps.
- b. If Valve BW01 fails to open, open Valv. BW02 and BW03 (located at mid-Tube) and turn on Fire Pump BP03. If BP03 fails to operate, or upon instruction from fire fighting personnel, turn on Fire Pump BP04.

(2) Fire on San Francisco Side of Tube:

- a. Open Valve BW02. Do not turn on fire pumps.
- b. If Valve BW02 fails to open, open Valves BW01 and BW03 and turn on Fire Pump BP01. If BP01 fails to operate, or upon instruction from fire fighting personnel, turn on Fire Pump BP02.

C 607

**EMERGENCY FAN OPERATIONS
OAKLAND, BERKELEY, TRANSBAY AND SAN FRANCISCO
SUBWAYS**

General Procedures - All Subways.....A

Emergency Ventilation Flow Chart.....Fig. 1
Train in Subway.....Fig. 2A
Train in Station.....Fig. 2B
Train in Transbay Tube.....Fig. 2C

Downtown Oakland Subway and Stations

Transbay Tube M-2 Track

Transbay Tube M-1 Track

M-Line Stations and Subways (M-16 Through M-50)

M-Line Stations and Subways (M-50 Through M-70)

R-Line Stations and Subways

Berkeley Hills Tunnel

**Appendix: Transbay Tube "Milepost" vs "ED" Dampers Cross Reference.
Schematic Air Flow Diagrams.**

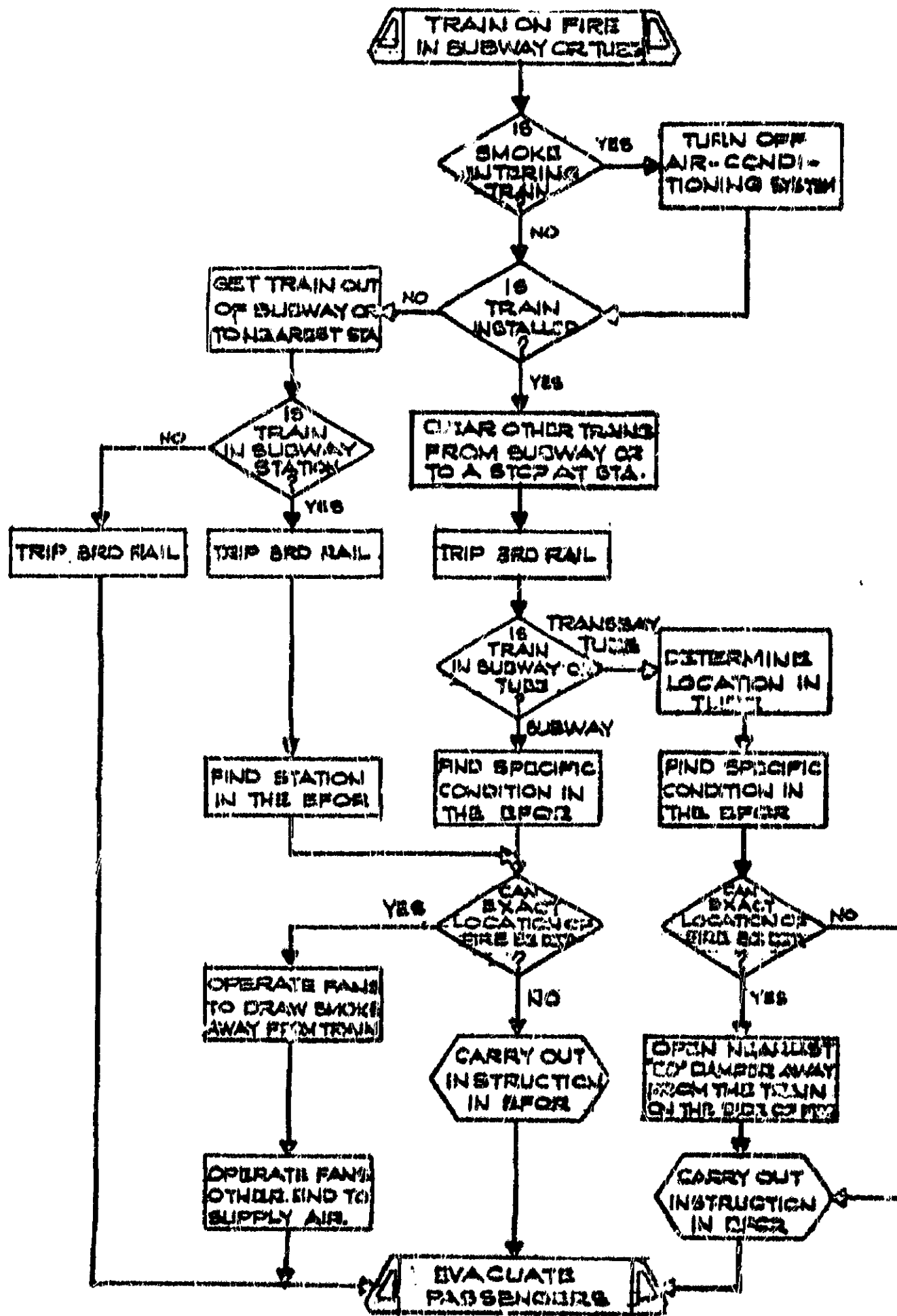
Appendix C

C 607

EMERGENCY FAN OPERATIONS
OAKLAND, BERKELEY, TRANSBAY AND SAN FRANCISCO

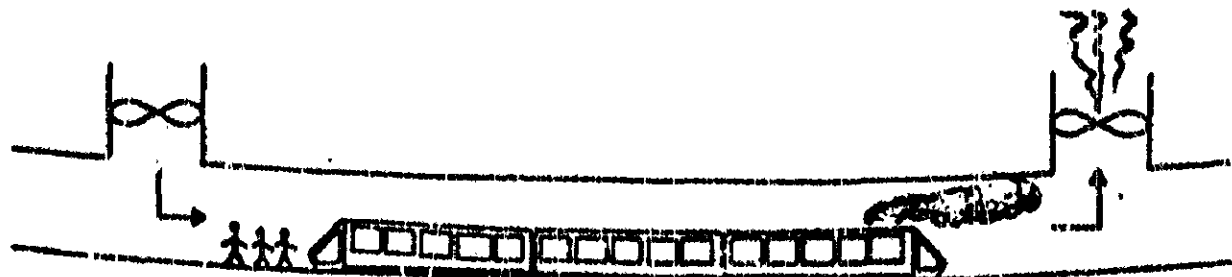
A. GENERAL PROCEDURES - ALL SUBWAYS (Fig. 1, next page)

- (1) If smoke from a fire is entering a train, Train Operators shall be instructed to inform the passengers the lights will go off and to turn off the car air conditioners.
- (2) If at all possible, the train shall be moved outside the subways and evacuated, if necessary, or the train shall be moved to the nearest station and evacuated.
- (3) Emergency fans shall be turned on if there is a possibility of a train being stalled in a subway due to a fire. Fan operation shall be such that smoke is drawn away from the train, without drawing the smoke through the annular area around the train. For example, if the north end of the train is producing smoke, all fans to the north shall be in the exhaust mode and all fans to the south shall be in the supply mode.
- (4) In the event the train is stalled in the subway, trains on the opposite line shall be moved out of the subway or moved to the nearest station and stopped. Fans shall be turned on as soon as the location of the train is determined and shall be operated so that smoke is drawn away from the train. Passengers shall be evacuated in the opposite direction and fans shall be operated to supply air in the faces of the evacuees. (See Fig. 2A). If the exact location of the fire on the train cannot be determined, locate the area in the matrix and carry out the recommended instructions.
- (5) In the event the train is taken to a subway station for passenger evacuation, fans nearest the fire shall be turned on exhaust. Fans on the other end of the station shall be turned on supply. (See Fig. 2B). If the exact location of the fire on the train cannot be determined, locate the station in the matrix and carry out the recommended instructions. Instruct the Station Agent to turn the station fans on exhaust.
- (6) In the event the train is stalled in the Transbay Tube, trip the third rail power to the train. Open the proper BD damper and start the BV fans to exhaust smoke away from the train. (See Fig. 2C). If the exact location of the fire on the train cannot be determined, locate the specific condition in the matrix and carry out the recommended instructions.
- (7) Until the exact location of the fire on the train can be determined, fan operation will provide ventilation to passengers, dilute the smoke and keep the fire cool.
- (8) The orders of fire fighting personnel will take precedence over any of these instructions.



EMERGENCY VENTILATION FLOW CHART

Appendix C

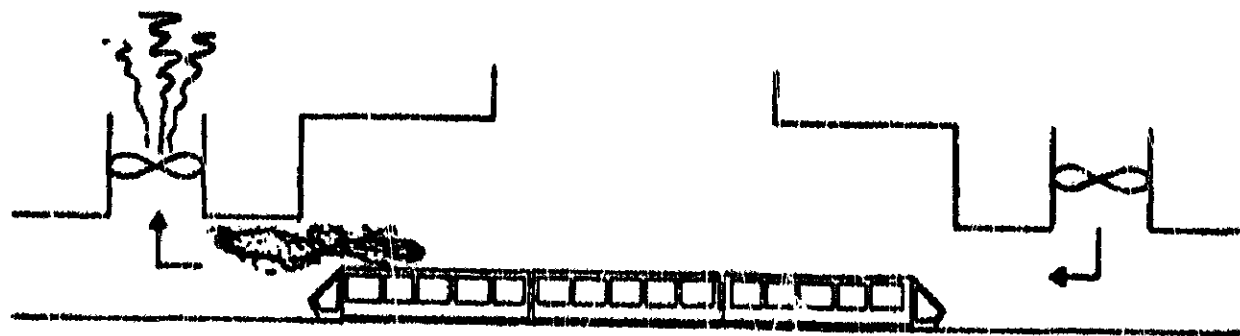


2. TURN FAN AT OTHER END ON SUPPLY AND EVACUATE TOWARDS OTHER END.

1. FIRE AT THIS END, TURN FAN AT THIS END ON EXHAUST

3. FIRE AT MID TRAIN, SEE INSTRUCTION IN EFOR.

FIG. 2A. TRAIN IN SUBWAY

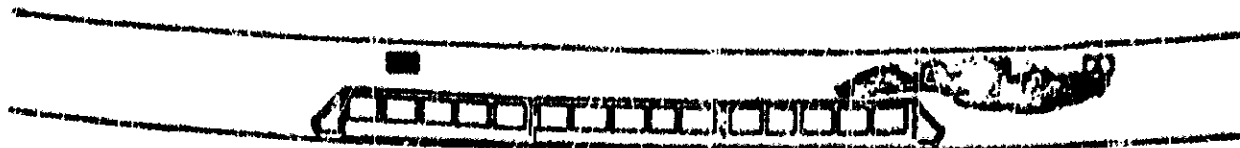


1. FIRE AT THIS END, TURN FANS AT THIS END ON EXHAUST.

2. TURN FANS AT OTHER END ON SUPPLY AND EVACUATE THROUGH STATION

3. FIRE AT MID TRAIN, SEE INSTRUCTION IN EFOR.

FIG. 2B. TRAIN IN STATION



1. FIRE AT THIS END, OPEN DAMPER AT THIS END AWAY FROM TRAIN.

2. FIRE AT MID TRAIN, OPEN CLOSEST DAMPER.

FIG. 2C. TRAIN IN TRANSBAY TUBE

Trains Between	Days of Week																	Normal Evacuation			
	01 02	03 04	05 06	07 08	09 10	11 12	13 14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30	31 01	02 03	04 05	13 14	19 20	NORMAL EVACUATION TOWARDS
Oak. Portal & mp2.9	0																	E	E		Portal
mp & Oak. Vent	0																	E	S		Portal
Oak. Vent & mp3.5 / RD01		0																E	S		Oakland Vent
mp3.5 & 3.7 / RD03			0															E	S		Oakland Vent
mp3.7 & 3.9 / RD05				0														E	S		Oakland Vent
mp3.9 & 4.1 / RD07					0													E	S		Oakland Vent
mp4.1 & 4.3 / RD09						0												E	S		Oakland Vent
mp4.3 & 4.5 / RD11							0											E	S	S	Oakland Vent
mp4.5 & 4.7 / RD13								0										E	S	S	Oakland Vent
mp4.7 & 4.9 / RD15									0									E	S	S	Oakland Vent
mp4.9 & 5.1 / RD17										0								E	S	S	Oakland Vent
mp5.1 & 5.3 / RD19											0							E	S	S	San Francisco Vent
mp5.3 & 5.5 / RD21												0						E	S	S	San Francisco Vent
mp5.5 & 5.7 / RD23													0					E	S	S	San Francisco Vent
mp5.7 & 5.9 / RD25														0				E	S	S	San Francisco Vent
mp5.9 & 6.0 / RD27															0			E	S	S	San Francisco Vent
mp6.0 & 6.2 / RD29																0		E	S	S	San Francisco Vent
mp6.2 & 6.4 / RD31																	0	E	S	S	San Francisco Vent
mp6.4 & 6.6 / RD33																		E	S	S	San Francisco Vent
mp6.6 & 6.8 / RD35																		E	S	S	San Francisco Vent
mp6.8 & S.F. Vent / RD37																	0	E	S	S	San Francisco Vent

0 = Open E = Exhaust S = Supply TRANS-BAY TUBE H-I TRACK

Appendix D

Excerpts from
BART Operations Rules

**PART I: SECTION 6
EMERGENCIES**

- 600 An emergency is any condition which has caused, or could cause, injury to persons or damage to property and/or equipment.
- 601 The primary consideration in any emergency shall be the safety of the public and employees.
- 602 Employees shall report any emergency condition immediately to Central, Yard Control, or BART Police Services, as appropriate, providing as much information as possible.
- 603 Employees reporting emergencies, if at the scene, shall remain there until released by a supervisor or the control center having jurisdiction.
- 604 The responsible control center shall implement necessary protective measures and dispatch available resources.
- 605 Responsibility for notifying and insuring proper coordination with Public Service Agencies shall rest with Central, Yard Control, and BART Police.
 - A. Central shall be responsible for notifying and coordinating with public transportation, utility, and disaster preparedness agencies and other services as required.
 - B. Central and Yard Controls shall be responsible for notification and coordination with fire departments.
 - C. The BART Police Dispatcher shall be responsible for dispatching required police, ambulances and coroner services.
- 606 Emergency situations shall command first priority in the employment of resources available to or within the District.
- 607 Employees dispatched to the scene of an emergency shall respond immediately.
- 608 The first employee at the scene of an emergency shall, within his/her capabilities, take action to prevent further injury or damage, and notify the appropriate control center of the status at the scene.
- 609 Employees at the scene of an emergency shall render all assistance possible.
- 610 Patrons shall be removed from the scene of an emergency as soon as it is safe to do so, with all available employees assisting in this effort.

Appendix D

Emergencies

- 611** Employees shall refer inquiries from the press and the public to the Office of Public Information; and from any regulatory agency to the Director of Safety. Employees shall not express personal opinions or communicate information of a speculative nature to anyone, pending the outcome of the investigation process.
- 612** In any emergency situation where the coordination between more than one department, or between outside agencies and BART is necessary, an on-scene communications coordinator shall be required to provide on-site status to the appropriate control center and to coordinate the necessary on-scene activities during each phase of the emergency:

PHASE I (Notification/Response) Begins when a BART employee becomes aware of an emergency condition and makes the necessary notification. The first employee at the scene shall establish communications with the responsible control center and will act as on-scene communications coordinator until a senior transportation employee or BART Police Services officer assumes that responsibility.

NOTE: Personnel from outside agencies must be closely supervised and protected from operational hazards.

PHASE II (Rescue/Evacuation/Stabilization) BART Police Services shall direct rescue and evacuation efforts at the scene and coordinate the actions of outside agencies responding to the scene. All necessary steps shall be taken to stabilize the scene to prevent further injury or damage.

NOTE: Any evacuation of passengers from trains shall require Central approval, if communications exist.

The senior BART Police Services officer or transportation employee shall continue to act as on-scene communications coordinator until relieved by a transportation supervisor.

PHASE III (Scene Protection/Investigation) The area involved in the emergency condition shall be protected by BART Police Services pending an on-scene joint investigation by BART Police Services and the Safety Department. Upon completion of the on-scene investigation, BART Police Services shall release the area to the on-scene communications coordinator for restoration of services or site clearance/repair by system maintenance.

Appendix D

Emergencies

PHASE IV (Site Clearance/Repair) The Maintenance Department shall make repairs as necessary, and, when safe, release the scene to the transportation supervisor (on-scene communications coordinator) for restoration of service, as applicable.

PHASE V (Service Restoration) The transportation supervisor (on-scene communications coordinator) shall coordinate the restoration of service with the control center insuring that all personnel are clear of the area and the equipment involved is safe to operate.

Further investigation, if required, shall be conducted by the Safety Department and the Police Services Department, utilizing all necessary District resources.

- 613 In the event of conflict during phase transition, the responsibility for resolution of such conflict rests with the control center having jurisdiction.

**PART II: SECTION 6
EMERGENCIES**

- T-600** To alleviate confusion at the scene, the Control Center having jurisdiction shall designate a specific employee to act as the on-scene Communications Coordinator, and control the phase transition and change of Communications Coordinators as specified in Part I, Section 6.
- T-601** Employees designated as on-scene Communications Coordinators shall establish and maintain communication with the Control Center having jurisdiction, providing accurate and current site status.
- T-602** Employees designated as on-scene Communications Coordinators shall advise the Control Center having jurisdiction of any change of coordinators. The relieving coordinator shall be thoroughly briefed on the status at the scene.
- T-603** Employees using any emergency equipment shall report such use to their supervisor who shall assure necessary replacement.
- T-604** Employees reporting emergencies or requesting assistance shall be specific about the location. Maps in the System Description Section of this Manual may be used to identify the area.
- T-605** Passengers shall not be evacuated from a train that is between stations unless it is absolutely necessary to do so; and then only after authorization from Central Control, if communications exist.
- T-606** Third Rail power shall be removed from all third rails in the area prior to evacuating passengers from a train that is between stations, if possible.
- T-607** If possible, trains with reported fire or smoke aboard shall not be allowed to enter the Trans-Bay Tube or any underground structure.
- T-608** **GENERAL EMERGENCY PROCEDURE (TYPICAL)**

RESPONSIBILITY	ACTION
Employee-At-Scene	A. Act to minimize hazards. (1) Operate third rail trips installed in yards, test track, subways and on station platforms, if immediately available.

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Emergencios

RESPONSIBILITY

ACTION

Employee-At-Scene

(2) Warn persons in the area to remain clear.

(3) Signal approaching trains to stop.

B. If a report has not been made, report the emergency to Central Control/Yard Control or BART Police Services by the nearest means of communications. Provide name, location and a concise description of the situation. NOTE: For fire or smoke, activate a pull box when one is available. In all cases, make a verbal report to the Control Center having jurisdiction.

C. Comply with instructions received. If first to arrive at the scene, act as on-scene Communications Coordinator until the emergency situation is corrected, or until relieved by a BART Police Services Officer or senior Transportation employee/supervisor.

Central/Yard Control

D. Protect the area from conflicting train movements and electrification hazards, as required.

E. Dispatch, or cause to be dispatched a Transportation Supervisor, BART Police Services, and Maintenance Crews, as required.

F. Notify Public Service agencies, as required.

G. Alert services that may later be needed.

H. Implement emergency notification list.

Appendix D

Emergencies

RESPONSIBILITY	ACTION
Central/Yard Control	I. Advise patrons affected. J. Provide instructions for evacuation, or transfer, as required.
Employee-At-Scene (On-Scene Communications Coordinator)	K. Attend to passenger safety. L. Coordinate the activities of the District and Public emergency services. M. Provide the Control Center with current reports as the situation progresses. N. Inspect the area for hazards. O. Authorize resumption of normal operation after release of area by BART Police Services, or Maintenance Department, as applicable. P. Submit applicable reports, i.e., Unusual Occurrence Report, Accident/Injury Report, etc.

T-609 CONTROL CENTER COORDINATION WITH FIRE DEPARTMENT

- A. The Control Center having jurisdiction shall notify the appropriate Fire Department upon receipt of a fire alarm or verbal report of fire, unless maintenance or testing is in progress at the location specified and positive assurance can be obtained that no fire exists. If in doubt, the Fire Department shall be notified.
- B. The Control Center employee alerting the Fire Department shall:
 - (1) Identify himself.
 - (2) Identify the Control Center.
 - (3) Specify the type alarm or fire, if known; i.e., electrical, structural, etc.
 - (4) Specify "How Received"; i.e., verbal, computer, etc.
 - (5) Give location of the alarm/fire.

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Emergencies

(6) Advise of best access to the area. (BART Maintenance, Police Services, or Supervisory personnel shall be dispatched to the scene to provide access, if necessary.)

(7) Verify status of third rail power, if applicable.

C. The Control Center having jurisdiction shall:

(1) Establish and maintain communication with either the on-scene Communications Coordinator or the Fire Department employee in charge at the scene, depending on who arrives first.

(2) Brief personnel at the scene on the status of third rail power, if applicable. Attempt to comply with all requests for changes in the third rail power status unless the change would cause an unsafe condition. Third rail power should always be removed unless it is necessary to move a train to safety.

(3) Provide the necessary assistance to the on-scene Communications Coordinator to insure effective rescue and evacuation efforts. Brief personnel at the scene on the status of trains, and protective measures implemented.

(4) Coordinate site clearance/repair/restoration as applicable. The on-scene Communications Coordinator shall be required to confirm that all personnel are clear and that the area or equipment involved has been inspected and reported safe to operate.

(5) Maintain a written record of the event to include: times, actions taken, and the names of all Communications Coordinators and Fire Department personnel contacted.

T-610 EMERGENCY REMOVAL OF THIRD RAIL POWER

A. When necessary to remove third rail power in an emergency:

(1) Proceed to the nearest emergency third rail trip button and activate, or

(2) Contact the Control Center having jurisdiction and request third rail power removal at the emergency location.

Emergencies

- B. In either case, notify the Control Center having jurisdiction and provide the Power Controller/Tower Supervisor with the following information:
- (1) Name of employee requesting/reporting power removal.
 - (2) Location (specify track(s)), and if known the contact rail identifying number.
 - (3) Reason for power removal.
- C. Typical locations and functions of emergency third rail trips:
- (1) Mainline:
 - a. Platform: These trips are located on each side of a passenger station platform. When activated, the third rail power is removed from the contact rail immediately adjacent to the platform side where the trip is located. Third rail power on the opposite side is not removed. The trip is initiated by breaking the glass allowing the depressed button to extend and complete the function.
 - b. Underground: These trips are housed in boxes spaced no more than 1000 feet apart within line of sight in all underground structures. Blue lights are affixed immediately above the box which houses an emergency telephone, third rail trip button, maintenance telephone outlet and a 110 volt auxiliary power outlet. When the third rail trip button is depressed, the power is removed from the contact rail immediately adjacent to the location of the box. Third rail power on the opposite side is not removed.
 - (2) Yards: There are two types of trips located throughout each yard, mounted on orange fluorescent-painted posts. Depressing any of these buttons removes third rail power from the entire yard, including transfer tracks. The Hayward Test Track is de-energized when third rail power is removed from Hayward Yard.
 - Types:
 - a. Box with trip button only.

Appendix E

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Technology
Washington, D. C. 20594

March 7, 1979

Metallurgical Laboratory
Report No. 79-41

METALLURGIST'S FACTUAL REPORT

A. ACCIDENT

Location : San Francisco, California
Date : January 17, 1979
Vehicle : Bart Transit train No. 117
NTSB No. : DCA-79-A-R026

B. COMPONENTS EXAMINED

- 1) Piece of collector shoe
- 2) Line switch box cover

C. DETAILS OF THE EXAMINATION

A detailed visual examination of the two components was made to determine if there was any physical evidence of the collector shoe striking the line switch box cover. By matching up imprint marks, it appears that piece of collector shoe struck the line switch box cover at the relative position, shown in Figure 1. Although several imprint marks on the two components appeared to match-up, the most conclusive evidence is the imprint of a nut and bolt in the switch box cover. A close-up view of the imprint is shown in Figure 2. The size and shape of the imprint appeared to be almost identical to the nut bolt on the collector shoe (see arrow "B", Figure 3).

Failure of the strands in the copper cable on the collector shoe appeared to have been caused by abrasion. No evidence of any melted strands was found.

Jerry A. Houck
Jerry A. Houck
Metallurgist



Figure 1. The line switch box cover, "A" and the collector shoe, "B" shows the relative positions when the two components made contact.

NOTE:

The collector shoe assembly is symmetrical. Therefore, the matching marks would be the same for both sides. Due to damage to the plastic insulation it was more difficult to match the marks to the side in the lower half of the picture. The photo on the following page correctly shows the part of the collector shoe assembly which contacted the line switch box cover. Car direction makes it impossible that the two pieces could have contacted as shown.

Appendix E



Figure 2. Close-up of nut and bolt imprint in the line switch box cover (see arrow "A")

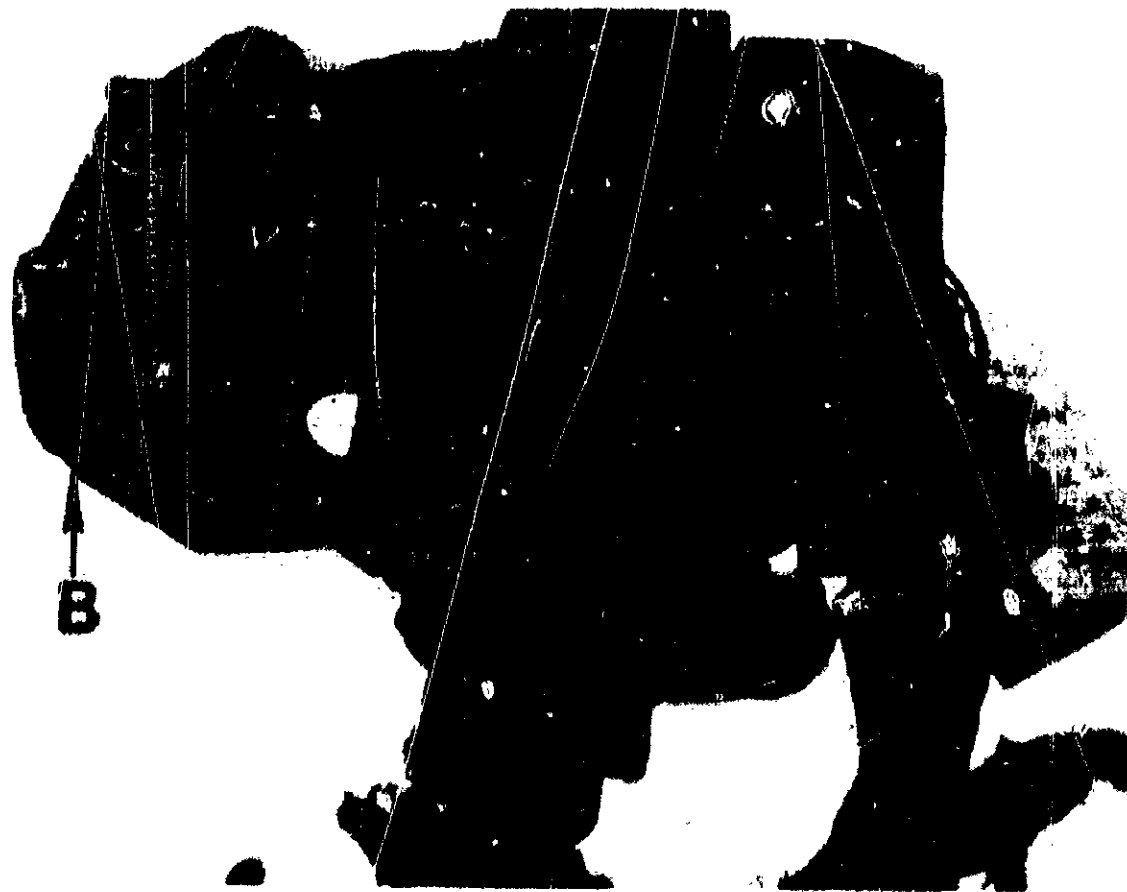


Figure 3. Close-up view of the piece of collector shoe. The nut and bolt denoted by arrow "B" appears to have made the imprint in the switch cover box (see arrow "A" Figure 1)

Excerpts from
National Bureau of Standards Report

NBSIR 78-1421

**FIRE HAZARD EVALUATION OF BART
VEHICLES**

Ernl Braun

Center for Fire Research
Institute for Applied Technology
National Bureau of Standards
Washington, D.C. 20234

March 1978

Final Report

Prepared for
Urban Mass Transportation Administration
Department of Transportation
Washington, D.C. 20590



U.S. DEPARTMENT OF COMMERCE, Juanita M. Kropp, Secretary

Dr. Sidney Harman, Under Secretary

Jordan J. Baruch, Assistant Secretary for Science and Technology

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

Appendix F

FIRE HAZARD EVALUATION OF BART VEHICLES

Neil Braun

Abstract

A fire hazard evaluation of the subway cars used on the San Francisco Bay Area Rapid Transit District was performed. After analyzing the cars' interior and exterior design, five recommendations were made that, if implemented, would improve passenger safety by decreasing the probability of developing a hazardous fire situation. Among these recommendations were the upgrading of current upholstered urethane seat assemblies and the need for the development of a fire detection system appropriate for rapid rail transit vehicles. These system improvements would not only provide passengers a safer traveling environment but would also provide a modest level of protection for the heavy investment in rail vehicles.

Key words: BART; fire accidents; fire hazards; fire safety; fire scenarios; mass transportation; material fire performance; rail vehicles; subway car design; UMTA.

8. RECOMMENDATIONS

Based upon a review of the design and materials used in the BART subway cars, and analysis of potential fire situations, it is recommended that:

1. BART upgrade the flame resistance of the seat assemblies, e.g., by introducing all vinyl upholstery. In order to further increase evacuation time, serious consideration should be given to incorporating neoprene cushions with the vinyl upholstery.
2. BART investigate the technological and economic feasibility of using an intumescent coating on the wall and ceiling liner.
3. BART develop a means for hardening the floor assembly against sub-car fire penetration at least in those areas most vulnerable to fire exposure.
4. BART, after additional study of detector types and locations, install a fire detection system to indicate the presence of a fire on board a train.
5. BART, in the interim, provide walk-through inspection after passing the terminal stations and/or prior to entering storage facilities.

9. REFERENCES

- [1] BART Operations and Maintenance Manual, Car Body and Interior Components Manual, Vol. 12 (December 1974).
- [2] BART Operations and Maintenance Manual, Transit Vehicle Manual, Vol. 1 (March 1972).
- [3] BART Operations, Rules and Procedures Manual.
- [4] BART Train Safety File (Flammable Materials).

Excerpts from
Bay Area Rapid Transit District Emergency Basic Plan

BAY AREA
RAPID TRANSIT DISTRICT
EMERGENCY PLAN

BASIC PLAN

I. AUTHORITY

- A. (BART management directive requiring the preparation of this plan.)
- B. Contra Costa County authority for massive full-scale response:
 - 1. Title 4, Division 42, Chapter 42-2 of the County Ordinance Code.
 - 2. Contra Costa County Emergency Plan (March 1973).
- C. Alameda County authority for massive full-scale response:
 - 1. County of Alameda Administrative Code - Chapter VI.
 - 2. Alameda County Emergency Operations Plan (Rev. 11-73).
- D. San Francisco authority for massive full-scale response:
 - 1. City and County of San Francisco Disaster Corps Ordinance (Ord. No. 4045-9-16-46). (Plan 11-69 Emergency Operations Plan).
 - 2. San Francisco City and County Emergency Operations Plan.

II. PURPOSE

- A. To provide for the mobilization and direction of BART resources and a coordinated and effective response to any emergency situation.
- B. To establish an understanding of the authority, responsibilities, and emergency functions and operations of all elements of BART.

III. IMPLEMENTATION OF THE PLAN

- A. The BART Emergency Plan will be automatically implemented when an emergency event occurs which threatens the safety of the public (patrons).

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BASIC PLAN

BAY AREA RAPID TRANSIT DISTRICT EMERGENCY PLAN

- B. For planning and training purposes the plan is effective immediately as of the date of issuance.

IV. PLANNING FACTORS

- A. EMERGENCY POTENTIAL (Hazards). The following conditions have been considered in the formulation of the responses outlined in this plan.

1. Earthquake
2. Earth/Mud Slide
3. Collisions
4. Derailment
5. Fire on Train
6. Fire in Station.
7. Emergency in Bay Tube

B. BART RESPONSE (General)

1. It is understood that BART is responsible for and will respond to all emergency situations. Some situations will not involve outside agencies. When the magnitude of the emergency involves 25 or more deaths or injuries, it will automatically be deemed a "DISASTER" by BART officials, and the appropriate local jurisdiction advised so that an official declaration may be made.
2. It is also understood that in a major disaster affecting the entire Bay Area and all of the jurisdictions therein (i.e., major earthquake) outside help may be delayed or unavailable for an extended period of time.

C. BART RESPONSE (Specific) - See Annexes attached.

V. DIRECTION AND CONTROL

- A. General Manager will determine command of Central Control.

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E. Fire on Train. Supervisor will:

1. Acknowledge and copy all facts.
2. Evaluate overall situation. Determine actions to be taken over and above checklist.
3. Contact supervisor at scene for assessment.
4. Call local bus agencies if required.
5. Coordinate movement of maintenance vehicle.
6. Inform management of progress.
7. Impound mag and audio tapes.
8. Insure all checklists complete.

F. Fire in Station. Supervisor will:

1. Acknowledge and copy facts.
2. Evaluate overall situation. Determine actions to be taken over and above checklists.
3. Establish contact with supervisor at scene.
4. Re-establish power at scene after inspection of area.
5. Coordinate with Rolling Stock and Shop Foreman for maintenance vehicle movement.
6. Coordinate bus service, if applicable.
7. Inform management of progress.
8. Impound mag tape and audio tape, if applicable.
9. Insure all checklists complete.

G. Emergency in Bay Tube. An emergency in the Transbay Tube could be of several types, each calling for a different strategy. The exact plan of action would be generated by the Supervisor at the time of occurrence - based upon the circumstances!

1. Train Stalled for a Prolonged Period.

A. train stalled for a prolonged period in the tube causes great

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inconvenience to passengers and risks panic. Every effort should be made to get the passengers to the nearest station without allowing passengers to leave the train. Supervisory assistance should be dispatched to the train if possible, and a field control designate shall maintain communication with this person. Assuming there is power, the train could be pushed or pulled to the nearest station. If this is not possible, uncoupling some of the cars and shuttling the passengers to the nearest station may be feasible. Failing this, evacuation of the train should be considered. The power must be off on both tracks prior to initiating this action and additional supervisory and BPS assistance must be on the scene. Evacuation may be to a waiting train (preferred if a long distance involved) or to the gallery where the passengers would walk to the nearest station^(SAFE EXIT) under guidance.

2. Train Derailed.

Follow the procedure for "Derailment". If necessary to unload passengers, proceed as in 1. above.

3. Train on Fire.

Follow the procedure for "Fire on Train". Use exhaust fans and louvers to control smoke. If necessary to detrain passengers, proceed as in 1. above and move them in a direction opposite to the direction of smoke travel, if possible.

4. Train Collision.

Follow the procedure for "Collisions". Proceed as in 1. above if necessary to detrain passengers.

5. Earthquake.

Follow the procedure outlined in paragraph 1. above. In particular, insure that all trains are cleared from the tube as soon as possible.

ANNEX NO. 2 - BART POLICE SERVICES

- A. Earthquake.
- B. Earth/Mud Slide.
- C. Collisions.
- D. Derailment.
- E. Fire On Train.
- F. Fire in Station.
- G. Emergency in Bay Tube.

The primary responsibility of the BPS relating to above conditions is the protection of BART patrons and employees. The following elements are essential to insure effective operation under emergency or disaster conditions:

1. Immediate response to the scene to determine extent of damage and/or injury and what resources and manpower will be necessary to meet the circumstances. Establish command post.
2. Secure the scene to minimize further danger or injury.
3. Render necessary first aid to the injured and establish an emergency first aid area.
4. Coordinate necessary ambulance transportation and arrange for medical assistance at scene if desirable.
5. Rescue trapped or endangered persons and remove to safety.
6. Evacuate and control access to scene.
7. Arrange for vehicle towing if necessary.
8. Investigate to determine if any criminal acts involved.
9. Maintain complete and accurate chronological reports of all events involving BPS.

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Excerpts from
Oakland Fire Department BART Emergency Plan

OAKLAND FIRE DEPARTMENT

COMMUNICATION NO. 18-76
FILE: EMERGENCY PROCED-
URES MANUAL - at
rear of BART SECTION
JANUARY 28, 1976

TO: . STANDARD DISTRIBUTION
FROM: BART COORDINATOR
SUBJECT: BART MASTER KEYS (revised list)

This Communication replaces Communication #10-75 filed at rear of
Emergency Procedures Manual - BART Section.

Two additional BART Master Keys have been received by the OFD. They
have been placed in Street Box 2236 at 6th and Broadway, and Street
Box 2294 at 9th and Harrison Streets. They are included in the
attached list.

For any emergency response to the BART underground, the first company
on the scene will dispatch a man to obtain the key from the proper
street box (list attached), and open up the facility. For a BART Sta-
tion, the entrance nearest the standpipe inlets should be opened first.
Other entrances may then be opened to accomodate the responding com-
panies. When all necessary entrances have been opened, the key should
be handed to the Chief in charge at the incident scene. The one excep-
tion to the above procedure is the 12th Street (City Center) Station.
At this facility it is impossible to use the key to open the entrance
nearest the standpipes from the outside. The entrance on the West
side of Broadway (across the street from the standpipe inlets) can be
opened from the outside and we should use this entrance if time permits.
The alternative is to use Forcible Entry on the entrance at the stand-
pipe location.

The entrance on 9th Street between Webster and Harrison is a flush-
type (sidewalk elevator type) sidewalk door that leads to an under-
ground stairway emergency exit. This door has a unique locking device
that may be opened with a screw-driver. The Master Key is necessary
to open the fire doors located within the underground stairway that
lead to both track levels.

It is very important that all companies enter the attached information
on their BART phantom box cards and on the BART diagrams in the
Emergency Procedures Manual that is carried on all apparatus.

JAMES F. SANDY
BART COORDINATOR

BARTD TUNNELS
7TH ST. FROM MARITIME PORTAL TO VENT STRUCTURE AND TRANS-BAY TUBE

3E	Vent Structure	Standby to connect to Fire Dept. Inlets.
9E	Access Point	Rendezvous with BART Emergency Vehicle.
32E	Access Point	Rendezvous with BART Emergency Vehicle.
3Tr	Vent Structure	Proceed to incident.
1Tr	Access Point	Rendezvous with BART Emergency Vehicle.
2Ch	Vent Structure	Establish Command Post.
5Ch	Access Point	Rendezvous with BART Emergency Vehicle - Take charge at incident scene.
BARTD TUNNELS MARITIME ST. PORTAL TO VENT STRUCTURE AND TRANS-BAY TUBE (PHANTOM BOX)		
PERT INFO 2162		

SPECIAL INFORMATION

HORIZONTAL ACCESS- MARITIME ST. PORTAL

VERTICAL ACCESS- VENT STRUCTURE (STAIRWAY)

STANDPIPE INLETS- S/S 7TH, W/END CARNATION CO.
S/S 7TH, E/END CARNATION CO.
S/S 7TH, E/O TERMINAL ST.
S/S 7TH, AT FERRY ST.
S/S 7TH, E/O FERRY ST.
VENT STRUCTURE (FOR TB TUBE)

POWER SUBSTATION KIE- VENT STRUCTURE (OUTSIDE)

LINE FANS- MV 13 & MV 14
TUNNELS @ TERMINAL ST.

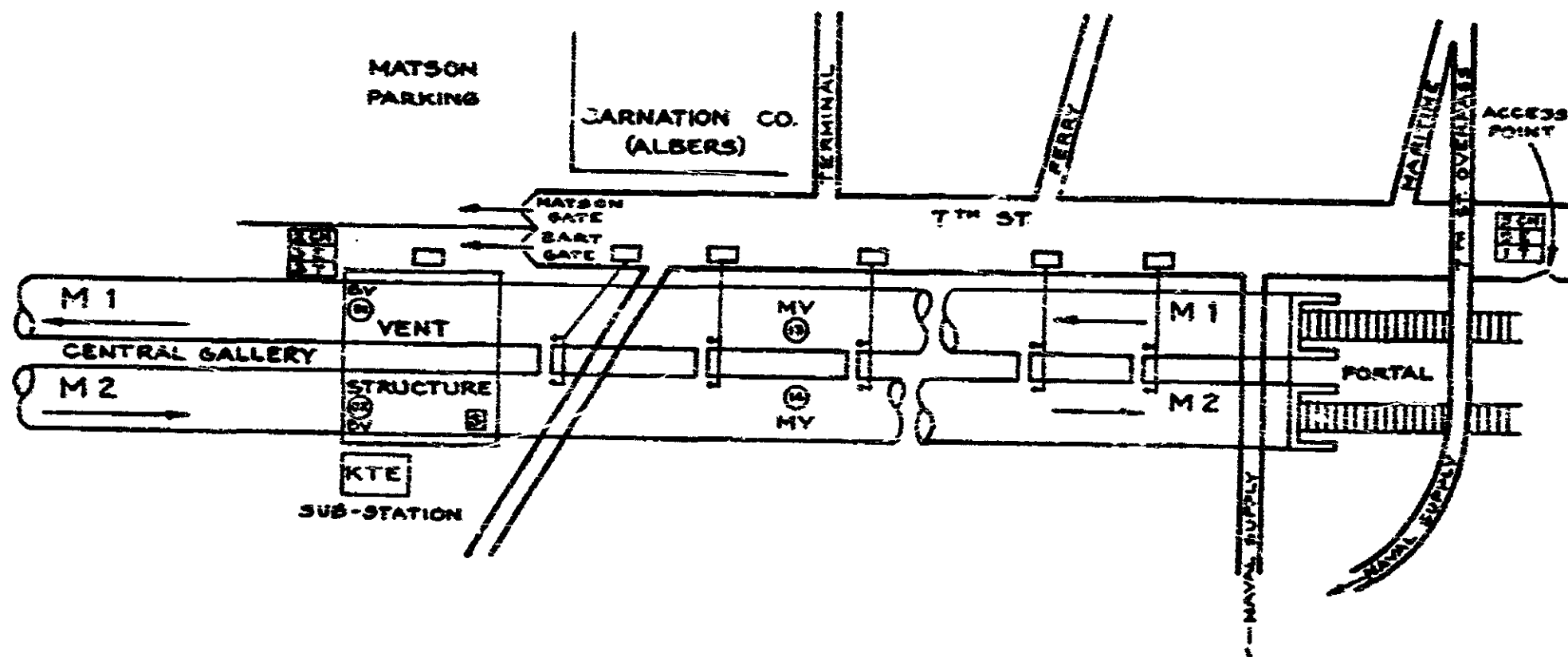
BV 01 & BV 02
TB TUBE @ VENT STRUCTURE

-55-

DIAGRAM 8

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**BARTD TUNNELS
7TH ST FROM MARITIME PORTAL TO VENT STRUCTURE
& TRANS-BAY TUBE**



Appendix G

9-74
DIAGRAM 8

Excerpts from
San Francisco Fire Department BART Emergency Plan

II

SUGGESTED EMERGENCY PROCEDURES FOR BART

These procedures are flexible and will be improved upon as time goes on, but it must be emphasized that certain procedures are necessary to insure that power is off and that communications are reliable.

1. SFFD Communications Center shall notify BART of alarm, if the alarm was not received from them.
2. The first alarm assignment shall rendezvous at the station entrance on the surface.
3. The ~~Division~~ chief establishes Surface Command.
4. Surface Command sends a number to the fire alarm box to get the BART Master Key.
5. The first two engine crews on the scene (except drivers) together with the Battalion Chief and the ~~Division~~ Chief's operator enter the station for investigation.
 - a. Each engine crew brings one bundle of 1½ inch hose and one small line "Wye."
 - b. Battalion Chief and ~~Division~~ Chief's operator each bring the SFFD portable radio and the two maintenance telephones from the ~~Division~~ Chief's vehicle.
6. The truck crews and the third engine crew stand-by at Surface Command to bring necessary equipment.
7. The investigating team stops at the station agent's booth on the mezzanine level (designated as Station Control) and checks the annunciator panel for possible location and obtains the red box containing two maintenance telephones which have been placed there for exclusive SFFD use. Two maintenance phones are necessary for initial communication. These two additional phones can be plugged into the circuit as needed.
8. The operator remains at the station agent's booth (Station Control) and plugs in one maintenance telephone.

There are several means of communicating with the incident commander at Surface Command.

- a. By use of SFFD portable radios.

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II

- b. By use of telephone in station agent's booth to telephone or speaker at elevator entrance on surface.
 - c. By use of maintenance telephone system, through BART Central to SFFD Communication Center to Surface Command.
 - d. By use of public telephone system through SFFD Communication Center.
9. All communications should be through Station Control; if necessary, the firefighters operating at the scene of the incident can communicate directly with Bart Central.
 10. The remainder of the investigating team takes a maintenance telephone and proceeds to the platform level. The maintenance phone is plugged into a convenient maintenance phone jack and the situation is reported to Station Control for relay to Surface Command. A white courtesy phone can also be used to report to Station Control.
 11. If there is an actual incident in either the tube or station trackway - BREAK GLASS IN PLATFORM TRIP. This de-energizes the third rail on that side ONLY. Each trackway has its own trip.
 - a. Use maintenance phone to notify Station Control of situation.
 - (1) Station Control shall confirm with BART Central that the power is off (POWER OFF).
 12. If the emergency is in the BART tube, it is recommended that a battalion chief accompany the investigating team.
 13. Before entering the tube, use the maintenance phone circuit through Station Control to confirm with BART Central that the power is off in that tube. This may have been done, but always verify that the power is off before entering. Clearance must be given from BART Central before SFFD personnel enter tubes or electrical enclosures.
 14. After clearance is given, proceed to the scene of the emergency in the tube. Use the walkway, not the trackway.

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15. The forward command officer evaluates the situation. The officer orders the contact rail trip to be depressed at the nearest blue light station, confirms with BART Central that the power is off in this section, and notifies them that the contact rail trip has been depressed. The emergency phone at the blue light station can be used for this purpose. The officer orders the maintenance phone to be plugged into the jack at the blue light station, or at a multi-plex (MUX) box for communications with Station Control. This position will be known as the Forward Command Post. As needed, request the emergency vehicle, additional personnel, activation of ventilation fans, etc..
16. If the emergency involves fire, engine crews hook up to standpipe outlet as directed. The forward command officer orders the standpipe charged on the surface using the maintenance phone circuit through Station Control. (Relay information found on standpipe identification plate at standpipe outlet as this gives the location of the standpipe inlet on the surface). A 20-pound ABC extinguisher will be found near each blue light station.
17. Department order requires that no operation be conducted below the car floor level until "SAFE CLEARANCE" has been given.
18. Should the incident commander order a truck crew to ride on the BART EMERGENCY VEHICLE, they shall be equipped with breathing apparatus. Should Scott-Air-Paks be used, each member shall bring a spare cylinder.
19. Depending on the distance of the emergency from the standpipe outlet, it may be necessary to have firefighters carry large line into the tube while awaiting the arrival of the BART EMERGENCY VEHICLE. One method to accomplish this is to roll fifty-foot lengths.
20. The Station Control may be relocated depending upon the evaluation of the situation. The station agent's booth is used initially as it is readily located and adequate communication is available at this point. If possible, a second firefighter should assist the operator at this post.
21. Should a 2nd alarm be necessary, it is suggested that the first battalion chief on the second alarm take over the Surface Command and the ~~DIVISION~~ chief move to the Station Control.
22. The emergency evacuation of the tubes will be made in a horizontal direction, using either the walkway in the bore being evacuated or the cross passages to the adjacent bore. There, patrons may be transported to the station area by train or led down the walkway in that bore. It is considered that the combination of cross passages, doors and ventilation control make the adjacent bore a place of safety for passengers.

Train bores are connected by cross passages at intervals not exceeding seven hundred and fifty feet (750') in the tubes beneath Mission and Market Streets. The distance is up to one thousand feet (1000') in the tubes beneath Chenery Street.