

Decision No. 90144 APR 4 - 1979

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Investigation on the Commission's )  
own motion into the safety )  
appliances and procedures of the )  
San Francisco Bay Area Rapid )  
Transit District. )

Case No. 9867  
(Filed February 4, 1975)

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Advocacy and Referral Agency; interested parties.  
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ELEVENTH INTERIM OPINION  
(Tunnel Phase)

SUMMARY

With this order, the Commission lifts its prohibition on operation of the San Francisco Bay Area Rapid Transit District's (BART) trains within the transbay tube between Oakland and San Francisco. The only immediate condition imposed on resumption of service is that BART provide on each train operating in the transbay tube, in addition to the train operator, an employee trained in lifesaving, evacuation and other emergency procedures. The order also sets time schedules for implementation by BART of additional measures which will further reduce the likelihood of fire on BART trains and improve BART's ability to protect passengers in the event that fires occur.

Since the fire of January 17, BART has greatly enhanced the safety of transbay tube operations. BART has demonstrated its compliance with the six conditions imposed by Decision No. 89902, issued January 19, 1979. The measures taken include development of a detailed evacuation plan, improvement of communications, provision of an extensive public information program on evacuation procedures, modification of exit doors within the tube to allow rapid egress, drilling of employees, testing of emergency procedures, and physical modifications to hatch covers and the gallery structure to reduce fire risk and improve ventilation capability. A complete list of actions taken since January 17 is attached as Appendix B. Taken together with provision of a second BART employee on transbay tube trains, we believe that BART has achieved an acceptable level of safety for transbay tube service.

At the same time, additional measures are required on an expedited schedule to enhance further BART safety in the transbay tube and elsewhere. We will therefore order that:

(1) Within 90 days, BART should submit to this Commission a schedule for speedy elimination of polyurethane materials from the passenger seats in BART cars. That schedule should provide for full implementation within 270 days;

(2) Within 180 days, BART should submit to this Commission recommended actions and a proposed timetable for reducing the fire risks associated with the fiberglass reinforced plastic materials used in the floors, ceilings, and side wall linings of BART cars. The timetable should provide for the reduction of fire hazard from these sources in at least 20% of the BART cars operating in the transbay tube and Berkeley Hills Tunnel by not later than one year from the date of this order so that each such train offer a relatively safer section for possible removal of passengers in the event of emergency;

(3) The Commission has concluded that the major reduction of safety personnel adopted in July, 1978 by BART jeopardizes public safety. Within 90 days of this order, BART shall submit to this Commission a detailed report approved by its Board of Directors on the organizational form and levels and types of manpower which BART will commit for the forthcoming year to overseeing public safety in its operations. Thereafter, BART shall, on an appropriate date to be determined by staff, make such a report annually to the Commission.

(4) BART shall within 90 days of this order submit to this Commission a detailed plan for the training, drilling, and repeat

training of its train operators and safety personnel in appropriate safety and emergency procedures. Thereafter, BART shall annually submit a report to the Commission on the implementation of these procedures and on the adequacy of any necessary modifications in such training procedures.

(5) Within 180 days of this date, BART shall submit to this Commission a report on its implementation, or decision not to implement and the reasons therefor, of the following significant proposals made during the three days of hearings just completed:

(a) Provision of improved communications capability for emergency situations within the transbay tube among BART employees on the incident train, BART Central, Fire Department command stations, and BART patrons on the incident train;

(b) Development and provision of a tape-recorded message or messages for instruction of BART passengers in emergency procedures in advance of a crisis;

(c) Development of additional appropriate passenger education measures, including car-card placards, instructional pamphlets, etc.;

(d) Provision of directional signs within the transbay tube indicating not only the nearest gallery door but also the distance to the nearest alternative door which may be reached by proceeding in the opposite direction;

(e) Provision of back-up emergency manpower capability at BART Central;

(f) Provision for walk-through track inspections in the event of unexplained in-service train stoppages;

(g) Provision of airpacks, megaphones, and/or portable train radios for attendants on transbay tube trains to facilitate their ability to function outside the train in emergency conditions.

The principal focus of BART and the Commission staff since January 17 has been safety measures which would allow resumption of service within the transbay tube. Much less attention has been given, as a

matter of ordering priorities, to other elements of the BART system. The Commission staff is hereby directed to work with BART to develop a more complete expedited schedule for consideration of BART safety issues outside the transbay tube. Such a schedule should be completed and presented to the Commission for approval within 60 days. However, the Berkeley Hills Tunnel stands out as of immediate critical importance, presenting many of the problems found in our investigation of the transbay tube. We therefore direct with respect to the Berkeley Hills Tunnel that BART:

1. Within 60 days complete development of a detailed evacuation plan and within 120 days complete initial training of its train employees operating through that tunnel in such evacuation procedures; and

2. Within 90 days, report to the Commission its conclusion and the reasons therefor as to the desirability of providing a second BART employee in addition to the train operator on all trains through that tunnel.

We commend BART for the many positive steps taken since January 17 to improve the safety of train operations through the transbay tube. Safety on the system cannot be assured without the full commitment as a top priority of BART's Board of Directors, senior management and employees. The California Legislature has determined that the Commission should act in an oversight capacity with respect to BART safety, but the Commission should not and does not wish to substitute its judgment in the day-to-day work and management decisions of BART directors and employees. We believe that today's order exercises properly the Commission's oversight responsibilities for public safety while at the same time leaving to BART substantial discretion for operation and management decisions as to how these directives should be carried out. By proceeding as herein proposed, we believe that BART will be able to assure its passengers that major public safety advances have been made and that they may ride the trains without unreasonable risk.

I. INTRODUCTION

Pursuant to Section 29047 of the Public Utilities Code, the Commission is charged with the duty to adopt regulations respecting BART's "safety appliances and procedures" for the purpose of affording reasonable safety to BART's employees and the general public. The Legislature intended that BART's safety appliances and procedures be subject to review by a regulatory agency as a means of providing a check and balance to BART.

This investigatory proceeding was instituted on February 4, 1975, and serves as an ongoing forum for the Commission to investigate BART's safety appliances and procedures and to issue appropriate and necessary orders pursuant to the Commission's statutory duty.

On the evening of January 17, 1979, a fire occurred on a BART train within the transbay tube which resulted in the loss of one firefighter's life.

After telephone notice to the parties to this proceeding and other parties with an interest in BART's safety appliances and procedures, a hearing was held in San Francisco on January 19, 1979 before Commissioners Richard D. Gravelle and Claire T. Dedrick. At the conclusion of that hearing, the Commission issued an oral order, later ratified by Decision No. 89902, which closed the transbay tube until further order.

The six conditions we imposed in Decision No. 89902 that BART must meet as a minimum prior to reinstatement of transbay revenue service are summarized as follows:

1. BART must show that the transbay tube's structural and operational integrity is intact.
2. BART must explain the cause of the severe smoke condition that existed in the transbay tube's lower utility gallery on the night of the fire and present its plan to eliminate that situation in the future.
3. The Chiefs of the Oakland and San Francisco Fire Departments must concur that BART's explanation and plans outlined above in Condition No. 2 are adequate.
4. BART must demonstrate to the satisfaction of the respective Fire Departments that it has adequately provided for the availability of emergency vehicles, golf carts, communication facilities, and emergency breathing equipment in the transbay tube.
5. BART must supply, in conjunction with the respective Fire Department Chiefs, a plan whereby the fire incident commander will be the Fire Chief of the jurisdiction in which the incident occurs.
6. BART must show that the gallery door problem, which blocked individual exit the night of January 17, has been solved.

In order to facilitate <sup>that</sup> expeditious treatment of this important matter, we provided BART the opportunity on 24-hour

notice to present evidence at a public hearing regarding the progress of their efforts to meet the conditions imposed. On February 8, 1979, BART requested a public hearing on Sunday, February 11, 1979. Given time constraints, we provided telephone notice to all parties of the February 11 hearing on February 8, 1979; public necessity required a hearing on less than 10 days notice as provided by our Rule 52.

A public hearing was held on February 11, 1979 before the Commission, en banc, with this proceeding's assigned Commissioner, Richard D. Gravelle, presiding. President John E. Bryson and Commissioners Vernon L. Sturgeon and Claire T. Dedrick, along with Administrative Law Judges Alderson and Doran, were in attendance.

After the testimony of two public witnesses, who were aboard the fire train on January 17, 1979, BART presented three witnesses who testified regarding the structural integrity of the transbay tube. Following the lunch recess, BART asked that the hearing be terminated until such time as it notified the Commission that it was better prepared to demonstrate the safety of transbay tube operations. BART was again provided the opportunity, at its discretion and on 48-hour notice to the Commission, to demonstrate compliance with Decision No. 89902.

On March 23, 1979 BART requested that hearings be held commencing March 29. Given the need for expeditious consideration, notice was again provided by telephone on less than 10 days notice. Public hearings were held in San Francisco on March 29, 30, and April 2, 1979.

#### Cause of January 17, 1979 Fire in the Tube

Shortly following the fire, BART's General Manager convened a Board of Inquiry (Board) to investigate the probable cause of the incident and to recommend remedial measures to prevent recurrence. The Board's comprehensive report was received as Exhibit No. 96 in this proceeding. We attached the first 17 pages of that exhibit hereto as Appendix A to serve as an explanation of the cause of the

fire.\* We adopt the Board's conclusions contained in Appendix A as findings of fact for purposes of this opinion. Public witness testimony presented on January 19 and February 11, 1979 substantially corroborates the Board's description of the incident.

The principal conclusion to be drawn from the Board's report is that at the time of the January 17 fire BART was grossly deficient in emergency response capability.

## II. BART'S PRESENTATION RESPECTING THE SIX CONDITIONS FOR REOPENING THE TRANSBAY TUBE

### 1. Structural Integrity of the Transbay Tube

One of the conditions imposed on BART requires our satisfaction that the transbay tube is structurally and operationally safe, with independent verification from the Division of Industrial Safety or the Department of Transportation (Caltrans).

BART's manager of design and construction and a consulting engineer with Testing Engineers, Inc. both testified about fire damage to the tube. The Chief of Caltrans' Division of Construction, J. J. Kozak, further testified that BART's damage-testing procedures, primarily undertaken by Testing Engineers, Inc., were comprehensive.

The fire damage occurred to the top and upper sides of Tube M-1, extending approximately 350 feet, with the deepest point of concrete spalling penetrating about 3-1/2 inches. After thorough surface cleaning, BART applied pressure-sprayed cement to the damaged area. The repairs accomplished by BART do not fully restore the tube to its prior structural strength; however, the effect of the fire on the tube's structural soundness is "negligible". The transbay tube's structural soundness has been attested to by Caltrans' highly experienced and qualified J. J. Kozak. Accordingly, we find that the structural and operational integrity of the transbay tube has not been jeopardized as a result of the fire.

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\* BART presented extensive evidence outlining subsequent measures taken to prevent fires similar to the January 17 incident (Exhibit 91, Part IV).



## 2. The Cause of the Smoke Condition In the Tube's Lower Gallery

BART presented testimony, verified by appropriate testing, indicating the cause of the smoke condition in the gallery. Sworn testimony demonstrated that the movement of trains within the transbay tube on both tracks created conditions that resulted in pressure differentials between the upper and lower gallery. Also, several doors were left open from the trackway to gallery during the fire which, combined with train movement, allowed large amounts of smoke to enter the gallery. Once smoke had entered the gallery, it tended to travel in the gallery toward Oakland. The lack of integrity between the upper and lower galleries as well as loose-fitting hatch covers, in addition to the limited exhaust fan operation on the night of January 17 created pressure differentials which caused the smoke to move in the direction of Oakland. (Exhibit 91, Part I, RSW-6.)

BART further presented its plan to eliminate, to the degree feasible, the problem of smoke in the gallery (Exhibit 91, Part I, RSW-7). Appropriate preventive measures include: (1) limitation of train movement and speed during transbay tube emergency situations; (2) sealing all openings affecting the integrity between the upper and lower galleries; (3) closure of gallery doors; and (4) modification of the transbay tube's ventilation system.

Gage-Babcock & Associates, Inc., an independent engineering and consulting service retained to provide fire protection expertise for the BART Board, testified that all recommendations it provided to BART for improvement of the transbay tube ventilation system have either been or are in the process of being implemented. They further concluded that the present transbay tube's ventilation system, if properly operated, has the ability to remove large volumes of smoke from the incident tube and minimize smoke movement into the lower gallery and non-incident tube (Exhibit 91, Part I, PDS-6). With respect to the operation of the ventilation system, the Board of Inquiry amply described the necessity of insuring proper operation of the system. Mistakes made in damper opening and ventilation sequence may serve not only to render the system ineffective but can seriously compound the smoke problem, as they did on January 17. We

will closely monitor BART's ability to respond correctly in this area and will require periodic demonstration of this ability.

Based upon the uncontroverted evidence, we are sufficiently satisfied with BART's explanation of the cause of smoke in the gallery; and we accept, as reasonable, its plan to limit gallery smoke-intrusion in the future.

3. The Concurrence of the Oakland and San Francisco Fire Department Chiefs that BART has Explained the Cause of the Gallery Smoke and has an Adequate Plan to Prevent its Recurrence

William L. Moore, Chief of the Oakland Fire Department, testified that BART has adequately met the conditions imposed by the Commission.

Chief Moore testified in general:

"Based upon the information given to the Oakland Fire Department by BART, as well as the activities we have observed, the department feels that BART has met the six original requirements imposed by the Public Utilities Commission on January 19, 1979.

"Because transit systems such as BART are excluded from fire prevention regulations imposed by municipal fire departments, the department has no authority to enforce fire and life saving standards within BART's system. Therefore, the department's finding that BART has complied with the original six requirements of the Public Utilities Commission is not to be interpreted as an unqualified guarantee of public safety by the City of Oakland." (Exhibit No. 100.)

Andrew C. Casper, Chief of the San Francisco Fire Department, also testified concerning BART's compliance with the Commission's conditions. He also made specific recommendations beyond the scope of the six conditions that will be described and discussed in a subsequent portion of this opinion.

With respect to the condition under discussion, Chief Casper indicated:

"The San Francisco Fire Department and the Oakland Fire Department monitored a series of tests conducted by B.A.R.T. to determine the cause of smoke in the gallery. Highest importance was placed on the test findings due to the extreme hazard that must be reduced to a minimal level of safety for passengers, firefighters, and B.A.R.T. employees.

"I concur that the cause of smoke in the gallery can be attributed to the following: openings into and within the gallery; train movements; air flow between the upper and lower gallery; and air flow into the lower gallery from the bores of the tube.

"I concur that while the lower gallery cannot be maintained in a smoke free condition, the tests show that a number of steps can be taken to minimize the amount of smoke entering the gallery in the event of a fire and to maintain a relatively safe condition for passenger evacuation and firefighting efforts. The steps are summarized as follows:

- "1. Seal leaks and improve latching of hatches between the upper and lower galleries.
- "2. Reduce train speed in the transbay tube following notification of a smoke condition.
- "3. Limit further train operations to the opposite bore.
- "4. Review and revise fan operating procedures to ensure effective operation of the ventilation system.
- "5. Ensure that gallery doors are kept closed as much as possible.

"I understand that B.A.R.T. has closed the openings that previously existed between the upper and lower galleries and has improved latching mechanisms on all hatches between the upper and lower galleries in an effort to ensure a tight seal. Further, I understand that B.A.R.T. has instituted procedural matters of reduction of train speed; restricting necessary train operations to the opposite bore; revised ventilation operating procedures; and procedures requiring gallery doors to be closed, all included in B.A.R.T.'s Transbay Tube Emergency Plan. With all of this, in the final analysis the ultimate success of all procedures will depend upon the skill and effectiveness of B.A.R.T. personnel and the training they receive. Attention should also focus on the tagging and inspection of hatches and doors during the interim period before remote annunciation of openings can be achieved."

BART has satisfied Condition No. 3 presently under discussion.

The thrust of the testimony by both Fire Chiefs was that BART has met minimum requisites for public safety in the event of fire

incidents within the tube. However, considerable long-range study, coordination between BART and fire protection jurisdictions, and training and disaster drilling are necessary. We concur with the point both Fire Chiefs expressed with respect to long-range study, evaluation, and disaster training and drilling. We will order appropriate long-term efforts along the lines recommended by the Fire Chiefs.

4. The Satisfaction of Fire Departments that BART has Adequately Provided Emergency Vehicles, Golf Carts, Communications, and Emergency Breathing Equipment for Tube Fire Incidents

Chief Moore indicated, as discussed above, that BART has taken adequate measures in compliance with this condition.

Chief Casper addressed the points in this condition as follows:

"A. Emergency Vehicles.

"B.A.R.T. has designed modifications which have increased the current personnel carrying capacity of the emergency vehicles. These modifications have been completed on two of the vehicles I have seen. One is on the Oakland side, and one is on the San Francisco side. Availability has been made swifter by the extending of the planking for the set-on platforms at the Embarcadero Station. These two platforms are in the M-1 and M-2 bores.

"B. Golf Carts.

"Both the Oakland and the San Francisco Fire Departments are in agreement that the use of electric carts should be discontinued as a primary means of access in the Transbay Tube. However, B.A.R.T. is currently requesting bids for an improved electrically powered vehicle that will provide greater capacity and improved reliability should such use later be determined appropriate.

"C. Communications Facilities.

"B.A.R.T. installed a comprehensive communications system which ties in the appropriate fire department facilities with B.A.R.T. facilities. The functional requirements of this system were agreed upon by both fire departments. B.A.R.T. has further provided dedicated command post space for both fire departments by erecting a separate

building at the Oakland Vent Structure and designating a room at the Embarcadero Station. The communications system was reviewed by a consultant acceptable to the fire departments and PUC staff.

"While the consultant's report concludes that the communications system is adequate as to voice transmission and equipment employed as presently configured, it also states the consultant was not engaged to make a determination as to reliability. This point must be mentioned along with acceptability being considered as an interim measure pending installation of a modern emergency radio network. With these facts in mind, concurrence on this item is given with the understanding that B.A.R.T. will maintain necessary provisions to ensure constant reliability of the communications system.

"D. Breathing Equipment

"B.A.R.T. has currently obtained eighteen 4-hour oxygen regenerating breathing masks and distributed nine each to the Oakland and San Francisco Fire Departments. B.A.R.T. has further placed purchase orders for a sufficient number of such masks to provide a total of twenty to each fire department. Delivery of these masks is scheduled for mid-April. It is hoped that if a more efficient, reliable mask becomes available, that B.A.R.T. will purchase a satisfactory number as replacements." (Exhibit No. 101.)

Chief Casper indicated BART has taken steps to insure minimal levels of safety. It is apparent that he expects continuing efforts from BART to improve facilities in the tube necessary for effectively coping with fire incidents. We will continue to monitor BART's efforts in this area and make specific orders as appropriate and necessary for the safety of the public and firefighters.

At this time BART has demonstrated that necessary modifications have been made and equipment acquired or modified to provide a level of safety above that which existed on January 17, 1979. With the concurrence of the Fire Departments, BART has satisfied this condition; however, considerably more effort and evaluation must be devoted to these issues in subsequent phases of this investigation.

5. Plan Recognizing that the Incident Commander at any Fire within the Transbay Tube will be the Fire Chief within the Jurisdiction in which the Incident Occurs

Although such a plan has not been reduced to a formal agreement, both Chief Casper and Chief Moore testified that it is the clear agreement between the fire chiefs and BART that the fire chief within the jurisdiction in which the incident occurs assumes responsibility as incident commander.

Chief Moore testified, in general, that the above-mentioned condition has been met. (Exhibit No. 100.) Chief Casper's testimony respecting the plan was more specific in nature:

"Both fire departments and B.A.R.T. are jointly reviewing examples of such agreements which are utilized in eastern transit properties. It is expected that development of formal agreements may take several weeks or more. Until formal agreement is completed, B.A.R.T. is in clear agreement that command of any fire incident occurring within the system is under complete control of the appropriate fire department. This includes the immediate notification of any specific fire condition within the Transbay Tube to both the San Francisco and Oakland Fire Departments. Qualified B.A.R.T. supervisory level personnel will be assigned to each fire department command post as well as B.A.R.T. Central Headquarters to facilitate the coordination of the fire department requests. B.A.R.T. personnel under these conditions will report to the command post and will assist fire personnel in coordinating activities between B.A.R.T. and the fire departments. B.A.R.T. personnel will assist with men and equipment under the direction of these fire departments. The removal and restoration of third rail power within the fire area will be done at the direction of the fire department. Train movement, emergency vehicle movement and other on-rail equipment movement will be accomplished at the direction of the fire departments.

"Concurrence with this item is with the understanding that on-going drilling and training will take place with participating agencies being B.A.R.T., the Oakland Fire Department and the San Francisco Fire Department. Drills and training sessions will be not only to insure B.A.R.T.'s performance standards, but those of the fire departments as well. In this regard, expertise of all three agencies will be exchanged." (Exhibit No. 101.)

Accordingly, we find that BART has substantially complied with the above-referenced condition.

6. BART's Demonstration of Solutions to the Gallery Door Problem

Mr. Mahon's prepared testimony (Exhibit No. 91, Part III, p. VPM-16 et seq.) describes modifications that have been made to gallery doors:

- "1. All locks were removed from doors throughout the gallery in the tube.
- "2. All doors were painted a bright chrome yellow.
- "3. On the upper right hand side of the door identification has been stenciled in four inch materials.
- "4. Door number identification is located in the center of the door at door handle level. Numbers are stenciled in black and are six inches in height.
- "5. A pull down handle lever was attached to the latching device on the gallery side of the door.
- "6. Two stripes of anti-skid tape were applied on either side of the door handle running the length of the door on the gallery side.
- "7. Three strips of fluorescent tape and three strips of reflective tape have been added to the lower portion of the door.
- "8. On the trackway side of the door, push bar door opening devices have been installed for ease in exiting to the gallery. Signs stating "Exit to Gallery" consisting of a blue background with black lettering have also been added."

These modifications will render the gallery more useful as a cross-passage between a fire-incident tube and the safe tube, as well as facilitating firefighting and rescue operations.

With respect to BART's modifications, Chief Casper commented:

"Locks which inhibited movement from the gallery to the trackway have been removed. A barrier has been installed to minimize track hazards upon entering the trackway from the gallery. Both fire departments have recommended a number of marking changes on the doors to facilitate movement and precise locations. These markings are now in place. Further, improvements to latching mechanisms have also been completed." (Exhibit No. 101.)

Both Fire Chiefs concur that BART has satisfied this condition.

### III. ANALYSIS OF THE ACCEPTABLE LEVEL OF SAFETY FOR TRANSBAY TUBE SERVICE

#### 1. Description of Transbay Tube Fire Hazard

Consultants for the Commission staff presented testimony which concluded that both the seats and the fiberglass reinforced plastic wall and ceiling materials in BART cars are extremely flammable and represent a very grave fire danger. (Exhibit No. 103, p. 22.) Their full-scale tests demonstrated that in the event that the car floor is breached by fire near a seat, there would be flames at the ceiling within three to four minutes and full involvement (flashover) would occur within no more than a further two minutes. It would be imperative to evacuate people on the incident car and adjacent cars before flashover occurred. Such a fire would also produce enormous quantities of black toxic smoke.

The expert testimony further stated that the time to burn-through of the floor is a highly variable quantity, ranging from a breach in as short a time as two or three minutes to as long as half an hour or not at all. In view of evidence that the seats and interior finish are so combustible, the witness concluded that it would be unwise to assume that the floor cannot be breached in a short period of time. (Exhibit No. 103, p. 22.)

Limited testimony was presented regarding the toxicity of gases generated by polyurethane combustion. Further study will be required to determine the nature of such combustion products and their effects upon individuals within confined spaces.

Given the highly combustible nature of materials within BART cars and the toxic smoke that such combustion will generate, the nature of the hazard becomes apparent when considered within the confines of the transbay tube with its limited ventilation and means of egress. As passenger loading on BART cars increases, the danger posed by a fire condition in the tube correspondingly increases. Irrespective of the issue whether such occurrences are sufficiently remote or not, the magnitude of this hazard, which includes the possibility of 1,800 patrons stranded on a burning train within the tube, requires our strictest scrutiny.



## 2. BART's Plan to Mitigate Transbay Tube Hazards

BART's presentation to the Commission consisted of a dual approach to meeting its burden to demonstrate that transbay service can be immediately reinstated at an acceptable level of safety. On one level, BART sought through presentation of a statistical analysis to demonstrate that the probability of a worst-case situation occurring (i.e., fire in the tube on a heavily loaded train) is low; and further that if such a remote event does occur, there is a reasonably high probability of survival. (Exhibits Nos. 91, Part V, KB-8, 97.) On the second level, BART proffered evidence delineating modifications and changes of BART equipment and procedures which have occurred subsequent to January 17 and which have served to measurably improve levels of safety within the tube. (Exhibits Nos. 92 and 99.) Exhibit 99, which outlines such developments, will be included in this order as Appendix B.

Since January 17, though its effort has been somewhat fragmented, BART has demonstrated a good-faith effort to substantially improve safety within the transbay tube. BART has implemented significant improvements to evacuation procedures and firefighting and emergency facilities in the tube. (Appendix B, Exhibit No. 92, Part K.) BART's transbay tube emergency plan, including its preferred evacuation method, represents a significant improvement when compared to the nebulous, unrefined emergency procedures that existed prior to January 17, 1979.

However, BART's emergency preparedness and fire safety program for the tube is not completed. We find that BART's transbay tube emergency plan, as presently constituted, sufficiently improves levels of transbay tube safety and is adequate for purposes of reinstating transbay service. Yet, it must be noted that BART's plans are far from perfect and must be further refined and modified where appropriate. The process of enhancing the safety of the transbay segment must continue; and future investigation should, among other things, address modifications that will serve to make BART's emergency plans, including its evacuation method, more flexible and responsive to various fire and emergency scenarios.

It is apparent that much investigation and analysis must be undertaken by BART and our staff in this proceeding's continuing review of BART's operations. Pursuant to Section 29047 of the Public Utilities Code, BART will be directed to reimburse the Commission for the expense of consultants, who are retained by the Executive Director, to aid in the Commission's independent assessment and investigation. BART will be afforded the opportunity to comment on proposed consulting contracts before consultants are retained by the Executive Director.

3. Hazard Mitigation Measures  
Recommended by Interested Parties

Communications. Chief Moore concurred that BART had met the six conditions imposed by the Commission. However, he indicated that eventually provision should be made for the use of portable hand-held radios in the event of subsequent tube fires as a means of communicating between BART Central, the incident commander, and firefighters. BART has undertaken study of this recommendation as part of a re-evaluation of its entire communications system and expects a resolution on this recommendation in approximately one year. (Exhibit No. 92, part K.) BART's present communications system within the tube is adequate for purposes of reinstating transbay service. However, we will monitor closely BART's efforts to upgrade the system and improve its reliability.

Second Train Attendant. Chief Casper made several recommendations. Before opening the tube for revenue service, he strongly recommends that BART trains operating through the tube have a second train attendant stationed in the rear of the train and equipped with a portable radio to enable communication with the train operator. He indicated the second train attendant could be either a train operator or a BART employee fully trained in public safety measures and emergency procedures. Chief Casper's recommendation was supported with testimony from many other witnesses, including various experts retained by the Commission staff.

Christina Baxter, an experienced flight attendant employed by United Air Lines, testified regarding airliner evacuation procedures

and the ratio of flight attendants to passengers. She observed two of BART's evacuation drills, and based on her experience and observations, recommends that a second uniformed train attendant be positioned at the rear of tube trains.

Robert Law, the BART train operator who was on the fire train of January 17, testified that a second train attendant should be aboard tube trains and that it is his opinion the Kaiser-developed Preferred Evacuation Plan could not have been followed on the night of the fire with just one train operator.

There was considerable questioning during the hearing regarding the advisability of a second train attendant. BART's witnesses conceded that a second employee on tube trains could have certain advantages in certain cases; e.g., in situations where a train operator were disabled, in cases where fire occurred in the middle of the train and evacuation had to proceed in different directions, and in circumstances where an attendant's presence would deter vandalism and arson. However, BART's witnesses all indicated that they believed a second attendant was not essential for public safety and that the Commission should not order second attendants in the tube until further cost-benefit analysis is made.

We have carefully considered the evidence and conclude that until further study or evidence convinces us a second train attendant is not necessary for tube operations, there should be a uniformed second train attendant on the train. We will leave location and deployment of this second individual to the reasoned discretion of BART management. We are convinced that such an attendant, in addition to providing additional security and passenger assistance, could serve to provide: (1) reduced incidence of arson fire; (2) first response fire suppression; (3) first aid to stricken passengers; (4) walk-through inspections and police services; (5) assistance and instructions in emergencies; and (6) potential limited train operation and decoupling. However, at this juncture, this measure is necessary. BART's general manager testified that if the Commission ordered a second train attendant in the tube that the employee should be a person primarily trained in security and public safety, not a second train operator.

We will direct that all revenue trains in the tube be operated with a second uniformed BART employee who is trained in public safety and disaster procedures. It would be desirable for the second train attendant to be able to operate the train under emergency conditions.

We also will direct BART to study on a cost-benefit basis the advisability of a second train attendant for other portions of its system.

Taped Emergency Procedure Information. Chief Casper, among others, recommended that a cassette-taped message explaining evacuation procedures be employed rather than having train operators take time away from other necessary and simultaneous functions during an emergency (e.g., location of fire and critical communication with BART Central) to explain procedures. Also, he recommended use of taped messages in trains continually as a means of familiarizing passengers with emergency procedures on the various segments of BART's routes. BART should analyze these two suggestions and report its conclusions during future hearings. Likewise, BART should study the Chief's recommendation that a second or backup person should be on duty in BART Central at all times who is competent to handle emergency situations.

Further Toxicity Study. Chief Casper and other witnesses indicated that a toxicity study should be undertaken so there is an awareness of exactly what the danger is from tube fire fumes under different fire scenarios. The testimony indicates that much more needs to be known about the toxicity resulting from combustion of existing materials in BART cars. Without such information the disaster situation decision of when and whether to evacuate passengers given various fire, smoke, and toxic gas scenarios cannot be made with full knowledge of the risk. Accordingly, we recommend that BART undertake toxicity analyses which indicate how long passengers or evacuees could reasonably endure smoke and fumes under different fire scenarios. Developing this toxicity data is vital if BART and fire departments are to know how to assess and devise evacuation strategies.

Handicapped Passenger Facilities. Ms. Jane Jackson, who is confined to a wheelchair, attended BART's evacuation drills and recommended that provision for stretchers would be desirable as a means of moving the disabled up the 30" catwalk to gallery doors in an evacuation. BART should study this recommendation.

Measures for Deaf Passengers. The thrust of participation by the Deaf Counseling Advocacy and Referral Agency was that BART has not adequately provided for insuring that deaf patrons are apprised of fire disaster and evacuation procedures. It was suggested that a system of flashing lights would warn the deaf and that BART's employees should know basic survival deaf sign language. The cross-examination of BART's witnesses shows that further specific study of the deaf population's handicap in developing disaster plans and facility modification should be undertaken.

Reduced Train Loading. Mrs. Baxter, Edward Bennett III and Professor Williamson testified that reduced train loading, to avoid crush loads with standees, would be of great benefit where evacuation must be undertaken. Apparently anticipating that this suggestion would be made, BART witnesses testified regarding the extensive operational problems load-limit requirements would pose. Primarily, BART points out there could be extensive enforcement problems, since it currently is not staffed to monitor loading at its various stations. Any reduced loading program would be difficult and extremely expensive to enforce. Also, only about 0.5 percent of BART's tube trains have a load factor in excess of 2.0 (or a standee for every seat). We are of the opinion that load limitation is not a measure we should direct at this time.

Emergency Response Planning. We will closely monitor BART's efforts to train employees to deal with disaster situations, including BART Central personnel, train operators, security or station employees. In view of the chaos and disarray surrounding the January 17 fire, much must be done in this area. Employees must be trained, drilled, tested, and periodically retrained and tested until their response is almost second nature given different emergency scenarios.

The State Fire Marshall presented testimony on evacuation from the tube and related training and certification of BART personnel. He recommended that the Commission make an evaluation of the safety functions of BART and require annual certification and testing of train operators to assure that the operators meet the performance standards. Further, he recommended that tube train operators be able to communicate with the passengers in clear English. The Fire Marshall recommended monthly hands-on drills of train operators to assure that they are adequately prepared to respond to an emergency. These requirements for training, annual certification, and monthly hands-on drills appear reasonable. The hands-on monthly drills may be performed on off-track equipment that is not in revenue service. It is also reasonable to expand the monthly drills to all BART personnel with assignments in the Transbay Tube Emergency Plan.

BART's Safety Staffing. The record reflects that the staff of BART's Director of Safety was reduced almost in half over the past year. The Safety Director is responsible "for the development of safety programs, safety related studies and investigations ... technical audit of proposed modifications to system operations and coordination of district actions related to regulatory agencies". (Exhibit No. 91, Part I, RSW-1.) BART has recently streamlined its organization so the Safety Director now reports directly to the General Manager. However, he now has a staff of five safety professionals, with some additional personnel "on loan". In view of the substantial efforts BART must undertake in the future to improve systemwide safety, we believe that it is prudent for BART to carefully review appropriate staffing of the Safety Department.

Reducing Combustibility Risk. The Commission staff presented testimony and recommendations by two witnesses with respect to the serious threat posed by the combustibility and toxicity of BART's rolling stock in the event of fire.

Dr. Robert Brady Williamson sponsored Exhibit No. 103 and presented films (Exhibits Nos. 104, 105, and 106) that portray the

sobering fire hazard caused by the materials now used in BART's cars. Fire tests show the existing polyurethane-based materials used in the seats, floor, walls, and ceilings of cars are too combustible. BART has undertaken preliminary steps to replace seat cushions, but the neoprene replacements originally contemplated also pose significant combustibility problems. Also, the seats are only part of the problem. Most arson fires can theoretically be extinguished by on-board firefighting equipment. However, it is most critical that undercar fires do not reach the car interior and seats. The combustibility of the car floor material poses the greatest threat of another under-car fire such as occurred on January 17.

Richard Rappolt, M.D., a toxicology expert, testified that burning polyurethane produces hydrogen cyanide gas, which is extremely lethal and can quickly disable those who breathe it.

In the long range BART must, as it replaces rolling stock, have materials used which are far less combustible and will be far less toxic in the event of fire. BART should, as quickly as feasible, present the Commission with its long-term proposal, including appropriate time schedules, for ultimately replacing its rolling stock fleet. The short term presents more difficult choices. Dr. Williamson recommends: (1) that the seats be replaced as soon as possible; (2) that the floor be hardened to increase its fire resistance and that use of a more fire resistant carpet underlay be considered; (3) that the ceiling liner should be replaced with that of a less combustible fiberglass material; and (4) that full-scale fire tests be undertaken on alternative materials before new cars are ordered. He stressed that reducing combustibility and toxicity would buy time should evacuation be required and could equate to lives saved.

BART must act to replace the seats (a federal grant has been obtained for this purpose) with an acceptable cushion material. We will order BART to submit a plan as a compliance filing in this proceeding within 90 days which outlines its plan to replace seat assembly cushions and which further addresses the feasibility and need for a fire resistant barrier layer on the lower side of the

seat cushions. BART should be ordered to complete replacement of the seat assemblies within 270 days.

BART must expeditiously explore alternatives to slow the floor burn-through time and take corrective action. We will order BART to file a plan within 180 days that outlines its proposal. Results of thorough analysis and fire testing of the materials BART proposed to use for seat assemblies and floor sections shall accompany its required filings.

With respect to other sections of the cars that present combustibility hazards, BART should continue its review of alternatives and corrective action as set out in Exhibit No. 92, Part K.

#### Findings of Fact

1. BART has complied with the six conditions precedent to authorizing reopening of the tube as listed in Decision No. 89902.
2. The conclusions contained in the Board's report (Appendix A hereto) are adopted as findings for this opinion.
3. A second attendant in BART tube trains would aid in the reporting of fire locations, explaining emergency procedures to passengers, evacuating patrons and communicating with BART Central in the event of the train operator's disability.
4. BART has not thoroughly explored possible means of providing adequate measures for dealing with the deaf and non-English-speaking in the event of a fire incident.
5. The seats, wall, ceiling, and floor materials in existing BART cars are highly flammable.
6. Large amounts of toxic black smoke is produced when the existing materials used in BART cars are burned.
7. Evidence concerning the time evacuees could safely endure various smoke concentrations, in view of their toxic composition, has not been produced.



8. Repeated and continued drills, training, and proficiency testing is essential to insure BART's employees are thoroughly familiar with emergency response plans and can react appropriately.

9. The following order should be effective the date of signature given the substantial public interest affected.

#### Conclusions

1. BART should be authorized to reopen the transbay tube for revenue service subject to the conditions set forth in the following order.

2. The following order should be issued at a public conference not regularly scheduled and noticed because the situation constitutes an emergency and the public interest requires expeditious action.

3. Public safety requires that BART should be ordered to operate revenue trains in the transbay tube with a uniformed second attendant on each train who is trained in emergency response procedures and public safety.

4. BART should submit to this Commission within 90 days a schedule for the speedy elimination of polyurethane materials from the passenger seats in BART cars. That schedule should provide for full implementation within 270 days.

5. BART should be ordered to submit to this Commission within 180 days recommended actions and a proposed timetable for reducing the fire risks associated with the fiberglass reinforced plastic materials used in the floors, ceilings, and side wall linings of BART cars. That timetable should provide for the reduction of fire hazard from these sources in at least 20% of the BART cars operating in the transbay tube and Berkeley Hills Tunnel within one year of this date in order that each such train offers a relatively safer section for possible removal of passengers in the event of emergency.

6. BART should be ordered to submit to this Commission within 90 days a detailed report approved by its Board of Directors on the organizational form and levels and types of manpower which BART will

commit for the forthcoming year to overseeing public safety in its operations. Thereafter, BART should, on an appropriate date to be determined by staff, make such a report annually to the Commission.

7. BART should be ordered to submit to this Commission within 90 days a detailed plan for the training, drilling, and repeat training of its train operators and safety personnel in appropriate safety and emergency procedures. Also, BART should be required to annually submit a report to the Commission on the implementation of these procedures and on the adequacy of any necessary modifications in such training procedures.

8. BART should be directed to submit to this Commission within 180 days a report on its implementation, or decision not to implement and the reasons therefor, of significant proposals set forth in the following order, which were made during the hearings since the January 17 fire.

9. BART should be directed to submit to the Commission and/or institute the following with respect to its Berkeley Hills Tunnel operations:

a) Within 60 days a complete and detailed evacuation plan and within 120 days complete initial training of its train employees operating through that Tunnel in such evacuation procedures; and

b) Within 90 days submit its conclusion and the reasons therefor as to the desirability of providing a second BART employee in addition to the train operator on all trains operating through that tunnel.

10. BART should be directed to undertake a study of the toxic effects of car combustion in underground portions of its system under different fire scenarios and file it with the Commission.

11. BART should be directed to reimburse the Commission for expenses for consultants who are retained by the Executive Director to aid in the Commission's independent assessment and investigation.

IT IS ORDERED that:

1. The San Francisco Bay Area Rapid Transit District (BART) is authorized to resume revenue service through the transbay tube on or after the effective date of this order on the condition that trains operating through the tube have a second uniformed attendant on each train who is trained in emergency response procedures.

2. Within 90 days of the effective date of this order, BART shall submit to this Commission a schedule for speedy elimination of polyurethane materials from the seat assemblies in BART cars; such schedule shall provide for full implementation within 270 days.

3. Within 180 days of the effective date of this order, BART shall submit to this Commission recommended actions and a proposed timetable for reducing the fire risks associated with fiberglass reinforced plastic materials used in the floors, ceilings and side-wall linings of BART cars; such timetable shall provide for the reduction of fire hazard from these sources in at least 20% of the BART cars operating in the transbay tube and Berkeley Hills Tunnel not later than one year from the effective date of this order.

4. Within 90 days of the effective date of this order, BART shall submit to this Commission a detailed report approved by its Board of Directors on the organizational form and levels and types of manpower which BART will commit for the forthcoming year to overseeing public safety in its operations. Thereafter, BART shall, on an appropriate date to be determined by staff, make such a report annually to the Commission.

5. Within 90 days of the effective date of this order, BART shall submit to this Commission a detailed plan for the training, drilling, and repeat training of its train operators and safety personnel in appropriate safety and emergency procedures; thereafter, BART shall annually submit a report to the Commission on the implementation of these procedures and on the adequacy of any necessary modifications in such training procedures.

6. Within 180 days of the effective date of this order, BART shall submit to this Commission a report on its implementation, or

rationale for non-implementation, of the following proposals:

(a) Provision of improved communications capability for emergency situations within the transbay tube among BART employees on the incident train, BART Central, Fire Department command stations, and BART patrons on the incident train;

(b) Development and provision of a tape-recorded message or messages for instruction of BART passengers in emergency procedures, in advance of a crisis;

(c) Development of additional and ongoing passenger safety educational programs, including car-card placards, instructional pamphlets, and provisions for non-English speaking and handicapped persons.

(d) Provision of directional signs within the transbay tube indicating not only the nearest gallery door but also the distance to the nearest alternative door which may be reached by proceeding in the opposite direction;

(e) Provision of back-up emergency manpower capability at BART Central;

(f) Provision for walk-through track inspections in the event of unexplained in-service train stoppages;

(g) Provision for airpicks, megaphones, portable train radios and such other devices for attendants on transbay tube trains to facilitate the ability of train attendants to function safely and efficiently outside the train in emergency conditions.

7. Within 60 days of the effective date of this order, the Commission staff after consultation with BART shall develop and submit to this Commission a schedule for consideration of BART safety issues not fully explored in the analyses and hearings leading to this order.

8. Within 60 days of the effective date of this order, BART shall submit to this Commission complete development of a detailed evacuation plan for the Berkeley Hills Tunnel and within 120 days complete initial training of its train employees operating through that Tunnel in such evacuation procedures.

9. Within 90 days of the effective date of this order, BART shall report to this Commission its conclusion and the reasons therefor as to the desirability of providing a second BART employee in addition to the train operator on all trains through the Berkeley Hills Tunnel.

10. Within 30 days from the effective date of this order, BART, in consultation with the Commission staff shall submit a proposal, with appropriate scoping, for a study of the toxic effects of car combustion and their impact on evacuation procedures.

11. BART shall reimburse the Commission for cost for consultants retained by the Executive Director to aid in the Commission's independent assessment and investigation, and such other unbudgeted costs to the Commission.

Further hearings will be held in this proceeding to expeditiously investigate the adequacy of BART's measures to insure safety to passengers and employees.

The effective date of this order is the date hereof.

Dated at San Francisco, California, this 4<sup>th</sup> day of APRIL, 1979.

John E. Bryson  
President

Thomas L. Sturgeon

Richard E. Wood

William T. ...

Donald ...  
Commissioners

APPENDIX A

REPORT OF THE BOARD OF INQUIRY  
on the  
FIRE IN THE TRANSBAY TUBE  
of the  
SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT  
on  
January 17, 1979

William L. Moore, Chairman  
Emmet D. Condon  
Robert S. Korach  
Thomas Pope  
James D. Squeri  
Ralph S. Weule  
George W. Gray (Alternate)

March 5, 1979

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## I. P R E F A C E

This Board of Inquiry was appointed by C. K. Bernard, General Manager of the San Francisco Bay Area Rapid Transit District, subsequent to the January 17, 1979 Transbay Tube fire.

This Board consists of William L. Moore, Chairman, Chief of the Oakland Fire Department; Emmet D. Condon, Deputy Chief of the San Francisco Fire Department; Robert S. Korach, Assistant General Manager of the Port Authority Transit Corporation of Camden, New Jersey; Thomas Pope, Superintendent of Equipment of the New York City Transit Authority; James D. Squeri, Supervisor, Rapid Transit Systems Section, Public Utilities Commission of the State of California; Ralph S. Weule, Director of Safety Department, San Francisco Bay Area Rapid Transit District; and George W. Gray (Alternate for Chief Moore) Battalion Chief of the Oakland Fire Department.

This Board was charged with determining to the fullest extent possible all related facts and probable causes of the event, to determine and recommend remedial measures to prevent recurrence where appropriate, and to fully document the investigative process.

The inquiry by this Board involved inspection of the site of the event; the equipment involved, the maintenance shops; the Central control; and the use of a test train in the tube to better understand the event. It also involved the use of interviews with BART employees, BART passengers, and Oakland and San Francisco Fire Department personnel. A major study was made of the taped transcripts of all communications into and out of BART Central Control, and the power console and fan regimes reports of BART Central. For special expertise, the Board engaged the services of Gage-Babcock Associates, Fire Protection Engineering Specialists. Finally, the Board used all necessary available records and procedures of BART and the two fire departments.

In addition, the Board was assisted in its deliberations by E. J. Boyle, Safety Program Manager, Urban Mass Transit Administration, United States Department of Transportation; Arthur Crognale, Jr., Assistant Safety Specialist, Bureau Surface Transportation Safety, National Transportation Safety Board; and G. H. Dunn, Senior Transportation Supervisor, Public Utilities Commission of the State of California. Certain joint investigations were held with representatives of the National Transportation Safety Board of Washington, D. C.



## II. EXECUTIVE SUMMARY

On Wednesday, January 17, 1979, at 4:30 p.m., Train 363 proceeding westbound in the Transbay Tube (TBT), came to an emergency stop and reported a possible fire onboard and smoke at Milepost (MP) 4.8 on the M-1 track. The emergency stop resulted from a derail bar being broken when struck by a metal line switch box cover which was improperly secured and had fallen from the train. With a technician onboard Train 363, the problems were apparently corrected; and the train exited the TBT, eventually completing its trip to Daly City.

Due to the incident, the two following trains were instructed to proceed through the TBT at a slow speed and make a visual inspection of the M-1 track. Except for locating the broken derail bar, these "sweep" trains found no reason for the problem on Train 363. Normal service was then resumed on the M-1 track, and seven additional trains proceeded through the TBT on the M-1 track without incident.

At approximately 6:00 p.m., Train 117 (Fire Train) departed the Oakland West Station with forty (40) passengers, and proceeded through the TBT toward the Embarcadero Station - San Francisco. At 6:06 p.m., train operator Robert Law reported to BART Central (Central) from the TBT that he had a bad overload, possible fire, and smoke coming through the train.

Misalignment of the third rail and/or third rail protection board brackets occasioned by impact of the line switch box cover from Car 537 - Train 363 caused the breaking of contact shoe assemblies on Train 117, resulting in short circuits and fire.

The forty (40) passengers aboard Train 117 immediately moved toward the lead end (S.F.) of the train, away from the rear of Train 117 where the fire had occurred. Paul Gravelle, a BART Line Supervisor, was fortunately onboard and able to assist the passengers during the emergency.

Smoke immediately enveloped the train and prevented the train operator from reporting his location to Central. As a result of the fire and explosion, the train had made an automatic emergency stop at a point later determined to be approximately one mile west of the Oakland Vent Structure. Central, in an effort to alleviate the smoke conditions and vent the M-1 bore, and without the knowledge of the train's precise location, incorrectly opened the damper located directly west and in front of the train, drawing more smoke through and around Train 117.

At 6:09 p.m., Central notified the Oakland Fire Alarm, requesting Oakland Fire Department (O.F.D.) response to Maintenance Way 04 near the Oakland West Station, stating that there was a train

with a smoke problem in the TBT on the Daly City side. Confusion about fire location ensued between Central and Oakland Fire Alarm, resulting in the incorrect dispatch of O.F.D. responding units to Oakland West Station. Previous to this call, Central had contacted the San Francisco Fire Department (S.F.F.D.), thinking it was the O.F.D. S.F.F.D. was instructed by Central to disregard the call. Central's emergency operations procedure did not specifically require notification of both fire departments in the event of an incident in the TBT.

The O.F.D. responded to the Oakland West Station, believing that the involved train was at that location. When they discovered that the fire train was in the TBT, nine (9) firemen were sent into the tube on Train 900 (Rescue Train) to assist in evacuating the passengers. It was then necessary to dispatch additional fire units to the Oakland Vent Structure as required by O.F.D.'s regularly established response plan for incidents in the TBT. Central was unaware of the proper Oakland response. Ten (10) firemen, including Lieutenants Elliott and Schuette, entered the Oakland Vent Structure and proceeded toward the scene of the fire to assist in rescue and fire suppression. All men were equipped with one-half hour MSA oxygen breathing apparatus, and all were walking except two men who rode a golf cart loaded with equipment.

At approximately the same time, Central dispatched Train #111 (Evacuation Train) loaded with 1000 to 2000 passengers into the M-2 tube from Embarcadero Station to evacuate the forty passengers on the fire train.

On the fire train Gravelle and Law had unsuccessfully attempted to uncouple the burning cars in an effort to remove the remainder of the train with the passengers to Embarcadero Station. Central had started the ventilation exhaust system as soon as an approximate location of the train was determined from the Central Control board; unfortunately, the wrong blast damper was opened in front of the train. The resulting envelope of smoke prevented passenger evacuation from the train. Gravelle tried to leave the train and reach an emergency door to the gallery, but he had to re-enter the train and report to Central that he could not breathe outside of the train.

When Central became aware of the fact that the ventilation system was not clearing the train properly, other blast dampers at the rear of the train were opened. However, the passengers were to remain trapped on the train by the dense smoke until Gravelle reported to Central at 6:44 p.m. that they were getting some "clear sky." Simultaneously, the O.F.D. rescue team arrived, disembarked from Train 900 and commenced evacuation of the passengers through the central gallery to the evacuation Train 111 standing by on the adjacent M-2 track.

The passengers on Train 117 had been trapped for forty minutes in the heavy smoke, and the evacuation train had been positioned

in the opposite trackway for approximately thirty (30) minutes with over one thousand (1000) passengers onboard. Smoke had also entered the evacuation train and was distressing the onboard passengers. In response, Central opened several blast dampers in the M-2 trackway to try to clear the evacuation train.

When all passengers were safely onboard, Train 111 was released on automatic train operation and proceeded to Oakland West Station for evacuation and medical treatment of injured passengers and employees. The train acceleration of approximately three miles per hour per second caused a strong suction action in the gallery and trackway -- strong enough to knock several firefighters to the ground and tumble them about. The train action also sucked a large amount of smoke from the fire bore through the gallery and into the M-2 trackway.

When the Oakland firefighters recovered from this "shellacking", they closed the door between the gallery and the M-2 trackway. After assessing their position and the available firefighting equipment, they made the decision to walk out to the San Francisco side of the TBT.

During the passenger rescue operation, Lieutenants Elliott and Schuette, with their crews, had almost reached the location of the fire train when they began to encounter smoke that was dense enough to require them to don their breathing equipment. It was 6:45 p.m. by Lieutenant Schuette's watch, approximately the same time as Gravelle's report from the fire train that the smoke was clearing.

A combination of several things caused the heavy smoke to travel toward Oakland which engulfed the firefighters in the gallery. A door to the gallery from the fire bore had been inadvertently left open. The exhaust fans in the San Francisco Vent Structure had been turned off, and Central could not reactivate them. Several blast dampers had been opened indiscriminately. Additionally, train operation in the TBT had a significant effect on the movement of the smoke. These events, in combination with loose-fitting gallery doors and hatch covers, resulted in movement of smoke into areas of the ventilation system, ultimately trapping the Oakland firefighters in the gallery -- an area which they had been trained to believe was a safe refuge.

The smoke in the gallery area became so dense that there was no visibility; Lieutenants Elliott and Schuette, aware that their breathing apparatus were almost expended, made a decision to retreat. Shortly after they began retracing their steps, Lieutenant Elliott experienced breathing difficulties which became so severe that he removed his mask and almost immediately began to collapse. His fellow firefighters supported him and struggled down the gallery, alternately falling down and bumping into utility installations. Several members of the O.F.D. gallery unit

responded heroically in a futile effort to save Lieutenant Elliott.

All of the trapped firemen, except Firefighter Heath and Lieutenant Elliott, were eventually able to find their way out of the gallery, either by exiting through a gallery door opened by a BART employee and an Oakland firefighter, or by walking back to the Oakland Vent Structure. The performance of BART employee Padilla in assisting rescue efforts in the gallery can only be deemed heroic. Lieutenant Elliott and Firefighter Heath were finally removed from the gallery by an O.F.D. rescue team, and CPR was immediately initiated.

At 7:55 p.m., Train 377 was sent into the TBT from Oakland West Station in the M-1 fire bore to evacuate the injured firefighters. This train contained approximately 55 passengers, and neither they nor the train operator were informed by Central that they were proceeding into an emergency fire area. Central assumed that there were no passengers on the train since it had been delayed at the station for approximately one hour. However, Central did not verify this fact, nor did they inform the train operator that she was in anything other than regular revenue service.

Train 377 returned to Oakland West Station and the injured firemen, as well as several employees, were transported to various hospitals for medical attention. It was confirmed that Lieutenant Elliott had expired and that firefighter Heath was in serious condition.

The participation of the S.F.F.D. in the emergency was seriously delayed because Central failed to notify them to respond to the train fire. In fact, Central's response to S.F.F.D. requests for information referred simply to a train with a smoke condition. There appeared to be a reluctance on their part to acknowledge that a fire was in progress in the TBT. Finally, at 6:32 p.m., the Oakland Fire Alarm contacted the S.F.F.D. and asked them to respond to the TBT and standby, stating that there was a BART train on fire in the TBT approximately one mile from the Oakland West Station.

The S.F.F.D. dispatched fire department units to the Embarcadero Station and to the S.F. Vent Structure. The established S.F.F.D. plan called for one group to proceed to the fire in the gallery with a second group transported to the fire on a BART train, carrying the bulk of the necessary equipment.

The S.F.F.D. was unable to locate the portable phones stored in the Embarcadero Station, so most of their communications were conducted over the BART maintenance telephone line which was experiencing considerable difficulty.

At 6:45 p.m., the San Francisco Command Post ordered an emergency vehicle to be brought to the Embarcadero Station, and further

requested a BART train be brought to the M-2 trackway to move men and equipment to the fire. However, it was not until 7:10 p.m. that Train 901 arrived at the Embarcadero Station, and it arrived on the M-1 track rather than the M-2 track as requested. Central later stated that the reason for not complying with the Fire Department's request was their hope that they could couple the 901 train to the fire train and tow it to the Embarcadero Station. However, they did not communicate this information to the Fire Department.

Train 901 was loaded with men and equipment while the Command Post attempted to contact the O.F.D. to get a progress report. Communications were very poor on all telephone lines, particularly on the telephone lines between the S.F.F.D. and Central, as well as on the maintenance telephone.

At 7:52 p.m., Train 901 proceeded toward the fire until encountering loss of traction power at Milepost 5.4. At this point, the men on the train were joined by S.F.F.D. personnel walking in from the San Francisco Vent Structure. All equipment was off-loaded from Train 901, and the firefighters proceeded toward the fire. Shortly thereafter the combined S.F.F.D. unit met the Oakland firemen who were walking out from the fire scene toward San Francisco. S.F.F.D. personnel continued and carried their equipment approximately one mile before reaching the fire scene.

Fire suppression activities were initiated from the M-2 bore, through the gallery and then into the fire bore. Heat was so intense that firefighters had to be relieved at five-minute intervals, and it was necessary to keep them covered with secondary hose streams while they were operating in the fire bore.

Firefighting activity continued until sometime after 10:00 p.m. when control had been sufficiently established to permit a survey of the fire train. Fire had penetrated the floor in the second and third cars from the rear of Train 117 and then progressed throughout the interior of five of the seven cars, totally destroying them.

At 1:30 a.m., January 18, the TBT fire was finally declared under control by the San Francisco Command Post, and the arduous task of preparing and removing damaged and destroyed train cars commenced.

### III. CONCLUSIONS

#### A. ROLLING STOCK

1. The line switch cover off Car #537 (Train 363) was involved in the failure of Train 363.
2. The Auxiliary box cover off Car #683 (Train 117) was not directly involved in the short circuit problem on Train 117.
3. Misalignment of third rail and/or third rail protection board brackets caused by impact of line switch box cover of Car 537 (Train 363) caused breaking in contact shoe assemblies of Train 117 resulting in short circuits and fire.
4. Both missing box covers from these two trains were not properly secured prior to entering the tunnel.
5. The broken collector shoe assemblies contacted the 5000 cubic inch air suspension reservoir tanks on Car 683 (Train 117) above #8 wheel and 646 (Train 117) above #7 wheel. The resulting arc caused the tanks to burst and provide a conductive path for arcing to the stainless steel sliding seal plate at top of the air spring assemblies. This caused the air suspension system to collapse and catch fire providing entry of fire into cars.
6. The fire entered the train through the floor over the #8 wheel on Car 683 (Train 117) and #7 wheel on Car 646 (Train 117).
7. The Kydex air ducts were the first ignited materials underneath the cars (approximately 500° flash point).
8. Train could not be uncoupled because of direct battery voltage short circuits caused by the 1000V electric arcing and fire when collector shoes contacted the undercar bodies of Cars 683 and 646 (Train 117). When Operator keyed on at hostler station the hostling circuit breaker would trip.
9. A portion of the roof on Car 581 (Train 117) was still intact because it had been rebuilt with heavier metal due to previous accident and repair.
10. Dynamic brake problem reported by train operator of Train 363 prior to incident in Tube was caused by loop control contacts on Car 521 (Train 363) having poor contact surface area due to normal contaminate build-up.

## B. EMERGENCY PROCEDURES

1. The response of the Oakland Fire Department (O.F.D.) was significantly hampered by BART Central's (Central) delay in notification and subsequent inadequate communication of information to O.F.D. responding units concerning the nature and location of the emergency incident of January 17. Both Central and Oakland Fire Alarm are equally culpable for the failure to accurately transmit such critical information to the proper O.F.D. units -- a failure which necessitated a departure by the O.F.D. from the preplanned response to a Transbay Tube (TBT) incident. Once on the scene, communications between responding O.F.D. units were almost impossible. The physical layout and confusing identification markings within the gallery limited the rescue effort. Finally, the thirty minute limitation of the oxygen masks doomed the gallery rescue attempt to failure.
2. The response of the San Francisco Fire Department (S.F.F.D.) was tragically delayed due to lack of any notification by BART Central. Later communication attempts between the S.F.F.D. and Central were characterized by delayed and/or conflicting responses from both parties. The eventual approach of the S.F.F.D. to the fire scene on BART Train 901 resulted in still more problems, since this train encountered a dead section of third rail well short of its destination. This situation necessitated the laborious transportation of various types of firefighting equipment by hand and a time-consuming approach by foot to the fire scene.
3. The inherent inability of Central to precisely locate a train within the TBT not only impeded the O.F.D. and S.F.F.D. rescue and fire suppression efforts but substantially exacerbated the actual emergency by prompting the incorrect operation of the ventilation system.
4. The serious problem of Central's proper operation of the critical emergency fan and ventilation system requires more detailed analysis than this inquiry can undertake. However, it is apparent that imprecisions in Central's written manual for operation of the ventilation system served in conjunction with the absence of accurate information concerning incident location to render the manual not only useless, but actually counterproductive. Common sense finally resulted in a modified method of using the manual; but by this time other factors such as automatic train operation in the tube, open gallery doors, gallery leaks, etc., tended to limit the positive effects of the properly operated ventilation system.
5. Contrary to all expectations, the use of the gallery as a safe passage proved to be completely ineffective. At no

time during the critical periods was it possible to evacuate people or move rescue personnel through the gallery as originally planned. The very fact that the O.F.D. used the gallery originally for an attempted rescue of the train passengers, and then themselves had to be rescued, proved this ineffectiveness, and actually compounded the rescue effort.

6. Communications between the two fire departments and between each department and BART Central were difficult at best and actually impossible in numerous circumstances. A mixture of radio transmissions, emergency telephones, dedicated fire lines, and even an occasional dime in a pay telephone simply did not work because all communications eventually had to be channeled through BART Central at its one control console. The inability of one console operator to cope effectively with an emergency was documented by BART itself as early as September, 1977. Misinterpretation of information often resulted from this overwhelming situation, and important telephone calls remained unanswered for as long as seventeen minutes. The physical limitations of the communication system in conjunction with numerous human errors in relaying critical information served to seriously hinder the efforts of BART, O.F.D. and the S.F.F.D. to effect a safe and speedy evacuation of passengers, employees and injured firefighters.
7. BART's lack of well defined and well drilled emergency procedures resulted in serious judgmental errors, such as sending trains with revenue passengers aboard, on two separate occasions, into the emergency area.
8. Despite the fact that they were NOT designed specifically as personnel carriers, the BART highrail emergency vehicles were useful in transporting firefighters and their equipment. However, the process of getting them to the event scene was far too slow and consumed valuable time in the rescue and firefighting effort. Since golf carts are potentially an un-dependable vehicle and the gallery is not well designed for their passage, dependence on the carts was not effective.
9. Other than masks, firefighting equipment proved satisfactory at the scene of the fire. Equipment included hoses, nozzles, fittings and a portable generator. Portable radios could not be used because of the lack of in-tunnel antenna. Difficulty would have been experienced if standard fire department basket stretchers had been required because of confined clearances.
10. BART Police Services (BPS) performed well as individuals, but the lack of an emergency plan hampered their ability to effectively deal with the crisis. The BART title of "on-site coordinator" conferred on the individual officers meant well as planned, but it proved ineffective and ill defined as actually practiced. The post evacuation scene at Oakland West Station was chaotic despite the efforts of the BPS, indicating the need for much better emergency response planning.



### C. TRANSIT OPERATIONS

1. The handling of this emergency by BART management personnel shows that internal procedures for both management deployment and management responsibility were not of sufficient depth to effectively control an event of this magnitude. A number of methods and procedures were generally followed, but much more flexibility by management is required to properly supervise this type of an event to obtain a successful resolution. Written procedures always presuppose that success will follow. However, under real life conditions, major decisions must be made intuitively to correct situations that are rapidly deteriorating. The unexpected smoke in the gallery, and the smoke that enveloped Train 117 defied all previously written documents, and actually showed up errors in these documents. Management personnel must be available and capable of making proper decisions as unforeseen events occur.
2. Too much is expected of BART Central Control during an event of this size. In addition to the life-and-death emergency situation, passengers were still riding the remainder of the BART system, and found themselves stranded due to the inattention of BART Central to any situation except the dire emergency. Concurrent emergencies could well have occurred on other parts of the system, further exacerbating a difficult situation.
3. Communications between BART Central Control and BART train and line supervision are primitive at best. To expect a system of this size to function with one radio channel is unbelievable. The night of the event was an ordeal for everyone concerned, leaving uncertain train operators making uncertain moves, and burdening BART Central with trivia as well as important communications.
4. Outside operations line supervision was practically nonexistent during this entire event. Only one line supervisor was ever noted as being on the scene during this emergency, and he was trapped in the burning train. Even the various rescue trains were sent into the tube without benefit of having line supervision onboard to aid or control the train movements. Again Central Control could not be expected to handle all train movements merely by computer or radio communications.
5. Finally, the institutional problems between BART and the many other governmental agencies such as the CPUC, the Legislature, CAL OSHA, and the involved fire departments makes one wonder as to what the role of the BART Board of Directors is in a situation of this kind. Since the Board is an elected body, it must bear the major responsibility for dealing with the other governmental entities. To expect

the day-to-day operating management of BART to resolve these institutional problems is to defy the political realities of the situation. Political agencies must still deal with other political agencies from the strength of the top personnel. The BART Board should take up this responsibility and produce a lasting workable relationship among all the agencies involved. The continued successful operation of BART is certainly dependent upon a clear understanding among BART and the various agencies. Failure of all agencies to cooperate will return BART patrons to their previously inadequate methods of transportation. After all, the purpose of BART is to transport the people of the Bay Area.

#### IV. RECOMMENDATIONS

##### A. MANAGEMENT

1. BART should employ a liaison officer who is directly responsible to the General Manager for all emergency procedures, drills and training.
2. BART should have a written "Emergency Procedures Policy and Agreement" with all local fire departments, emergency medical service, local police, and the Office of Emergency Service.
3. BART should immediately implement the development of an "Emergency Management Program" which will provide proper procedures, training, and assignment of responsibility to specified management personnel.
4. BART should have an internal procedures plan for informing, caring for, and evacuation of passengers and employees involved in emergencies.
5. BART should set up a thorough training program for employees concerning passenger control during emergencies.
6. BART should prepare a public education program for its riders which should include emergency evacuation procedures.

##### B. TRANSIT OPERATIONS

1. There must be annual reinstruction on train operation for all train operating and supervisory personnel.
2. Key operating personnel should be given first aid training, including CPR.
3. Institute predispach walkaround inspections of all trains prior to leaving yards.
4. If physically possible, perform an immediate on-site walk-around inspection of any train when smoke or fire is reported under train.
5. All personnel working on or around trains in line or yard operation must be required to carry BART approved flashlights.
6. ATO is not to be used in the area of an emergency situation.
7. Develop a means of identifying key BART personnel at scene of emergency.

8. When special tests are made around the system in anticipation of unusual events, responsible personnel should be present from all concerned departments.

C. CENTRAL CONTROL

1. When Central Control is informed of fire or smoke on a train, immediate action must be taken by the controllers to contact appropriate fire departments and other personnel, as necessary.
2. Central Control must immediately call both fire departments (San Francisco and Oakland) in the event of any report of fire or smoke in the Transbay Tube.
3. The Central Control Operating Manual should be revised to reflect correct procedures during emergencies.
4. The train display board in Central Control should be modified to provide more accurate identification of train locations in tube and tunnel areas.
5. Emergency fan operation regimes should be revised to correctly insure the proper damper operation under any fire conditions.
6. Third rail power should normally be turned off at the location of tube fire incidents. However, for a fixed time, power may be left on in an effort to move a train in order to evacuate the passengers.
7. Trains with passengers should not be sent into tubes or tunnels during a fire or smoke emergency.
8. Central Control personnel should regularly be given outside assignments in order to familiarize them with the physical layout of the wayside facilities.
9. A train numbering system must be developed that does not duplicate emergency train numbers during a calendar day.
10. During emergency operations, consideration should be given toward permitting the local on-scene people to have a blanket work order establishing definite work limits so that Central Control will be relieved of this responsibility.

D. BART POLICE SERVICES

1. Develop an emergency operations plan.

2. BPS to drill and review plans and procedures systematically and on a regular basis. BPS to make sure all BPS personnel are exposed to these drills and involved in the drills.
3. Develop ability or program to call additional help from off-duty BPS officers under emergency conditions.
4. Develop a coordinated plan with local police agencies as a backup to BART officers if BART police are involved in an emergency operation, or to assist BART police.
5. Consider installation of hot lines to local police for coordination and information dissemination.
6. Isolate emergency operations from routine operations in BPS dispatch center during emergencies to better handle both operations simultaneously.
7. Familiarize BPS with all BART operations in order to better understand and communicate with BART operating personnel.
8. Train BPS personnel in crowd control and evacuation tactics and procedures.
9. Utilize BPS as first line emergency personnel to direct evacuation and passenger control until arrival of fire services.
10. Train BPS on use of equipment and emergency vehicles.
11. Train BPS on use of breathing apparatus.

E. ROLLING STOCK

1. Provide suitable mechanism for securement of all undercar equipment covers.
2. Reinstruct shop personnel on the importance of securing undercar equipment covers.
3. Add item to Shop Check-Off Sheet that all cars leaving repair facility must have undercar equipment covers in place and secure.
4. Stencil car numbers on inside of its equipment covers.
5. Paint covers to make them more visible in case they drop off.
6. Investigate the possibility of using non-metallic equipment covers.

7. Car annunciator system be studied to give clearer indication of car problems.
8. Consider the recommendations of "Fire Hazard Evaluation of BART Vehicles" NBSIR 78-1421, particularly those dealing with flammability of floors, walls, ceilings and seat assemblies. Materials other than neoprene should be investigated.
9. That a test be conducted to determine if the third rail collector shoe breaks at the pre-designed (pre-determined) break point.
10. Investigate possibility of relocating manual uncoupling device so that it can be actuated from inside the car body.
11. "A" cars should be rewired so that headlights on lead "A" car would be energized when hostler controls are used.
12. Cabs should be rewired so that taillights are illuminated when train is unattended.
13. Electronic Equipment Technicians who are used on the line should be aware of modifications made to car equipment.
14. Electronic Equipment Technicians who are used on the line should be qualified to operate trains in an emergency.

F. POWER AND WAY

1. Modify all highrail emergency vehicles (EV's) to provide a safe means of carrying additional personnel.
2. Improve methods and facilities to expedite the placement of highrail emergency vehicles on the tracks.
3. Operators of highrail emergency vehicles should be trained and qualified to operate all equipment on the vehicles.
4. Immediate on-site walking inspection of any area where smoke or fire is reported.
5. BART diesel locomotive should be manned and prepared for service during major train emergencies.

G. TRANSBAY TUBE

1. BART should employ a qualified fire protection engineering firm to investigate and determine the most effective way to provide built-in fire and life safety in the TBT.

Some recommended areas of investigation are:

- a. Feasibility of a sprinkler system in the TBT.
  - b. Feasibility of pressurizing the lower gallery.
  - c. Feasibility of an undercar fire extinguishing system.
  - d. Feasibility of hatchcover opening detection system.
2. Daily inspections should be made of all hatchcovers and gallery doors to insure that they are properly secured.
  3. A wet standpipe system should be installed within the gallery with hose outlets near doors so that firefighters will have charged hose lines prior to opening gallery doors.
  4. The walkway obstructions, particularly steps and doorsills in the lower gallery, should be painted with bright colors or identifying markings to aid in the evacuation procedures.
  5. Station mobile generators at the vent structures until redundant power supplies are available.
  6. Station qualified personnel at the vent structure until a redundant ventilation control system is installed by BART (Data Transmission System - DTS).
  7. Seal all poke-thrus between upper and lower gallery.
  8. Modify latching mechanism on hatchcovers between lower and upper galleries to insure proper sealing.
  9. A study should be made to better coordinate the numbering system of doors, dampers, telephones, etc. in the Transbay Tube.
  10. Provide clear identifying lights at all gallery doors both in the Tubes and in the gallery.
  11. Provide lockers for emergency fire equipment at Embarcadero and Oakland West Stations.
  12. Replace all rod latching hardware on gallery doors with flat bar type hardware.
  13. Remove all locks from gallery doors so that access to opposite trackways is unimpeded during evacuation.
  14. Install heavy duty door closures on gallery doors to insure positive closing.
  15. Install guard rails on trackways at gallery doors to provide a safety barrier when persons are exiting from the gallery.

## H. COMMUNICATIONS

1. Tube radio communication equipment should be modified to permit operation of fire department portable radios in the Transbay Tube, as well as other BART subway areas.
2. Train operators, line supervisors, line electronic technicians, and operators of emergency vehicles should carry portable radio on the train frequency.
3. Obtain additional radio channels for BART train operations.
4. Modify the present system to permit train operators to hear both sides of train radio conversations.
5. Design and install an adequate hardwire telephone system to provide the communications contacts between:
  - a. Fire Department Communication Centers and BART Central.
  - b. Command Post to Command Post.
  - c. Command Posts to Forward Command Posts.
  - d. Command Posts to BART Central.
6. Familiarize all appropriate personnel with all new communications systems.
7. All BART employees who have reason to be in the tube area should be trained as to the sound emanating from the emergency telephone when it is activated.
8. Provide color identification of phone plug-in locations and dedicated fire phone and complete installation of plug-in jacks at every gallery door.
9. A study should be made of the BART communications system to insure its adequacy and capability during emergencies.



## APPENDIX B

### TRANSBAY TUBE MODIFICATIONS AND PROCEDURES (Modifications or Changes Begun Since January 17, 1979)

<u>I. REQUIRED EQUIPMENT/MODIFICATIONS (CPUC Order)</u>	<u>STATUS</u>
1. Hatchcover Locking Device	Completed
2. Data Transmission System, Remote Switching Capability (Redundant Controls for Fan)	Completed
3. Emergency Vehicle Modification to Carry Additional Personnel	Completed
4. Golf Carts	Awaiting UMTA Approval, 180 Days After Approved, Procurement
5. Remove Gallery Door Locks and Modify Latch Mechanism	Completed
6. Gallery Doors Painted Chrome Yellow	Completed
7. Gallery Door Identification	Completed
8. Install Yellow Identification Lights At Gallery Doors	Completed
9. Install Third Rail Dummy Coverboard in Front of Gallery Doors	Completed
10. Paint on Larger Blast Damper Numbers	Completed
11. Flourescent and Non-Skid Stripping on Tube Steps	Completed
12. Obtain Additional Breathing Equipment	Expected Delivery April 6 - 13, 1979
13. Seal Poke Thru's Between Upper and Lower Gallery	Completed
14. Delivery of Remaining Breathing Masks	Should Arrive Between April 6 - 13, 1979
<u>II. PHYSICAL MODIFICATIONS/PROCEDURES - REQUIRED BY BART ONLY</u>	
1. Procedure for Cover Checks With Sign-Off	Completed
2. Install Positive Locking on Line Switch Box Covers	In Progress As Of March 12, 1979

	<u>STATUS</u>
3. Tightened Track Inspection Procedures (a) Train Operations (b) Central Operations	Completed
4. Added All Found Debris to Power & Way Daily Report	Completed
5. Tube Markings (a) Arrows on Bore Wall 20' Apart (b) Additional Painted Mileposts (c) Additional Mileposts (Signs)	Completed Completed Researching Materials
6. Collector Shoe Paddle Tests	Completed
7. Flashlights For Line Personnel	Completed
8. Yellow Stripe on Equipment Pads	Completed
9. Stencil Car Number on Inside of Covers with Tape	In Process
10. Increase Visibility of Covers with Flourescent Tape	In Process
11. Extend Planking for Emergency Vehicle (to Facilitate Set On)	Completed
12. Tube/Train Location Graphics Tool in Central	Completed
13. Undercar Cable Tiedown	Final Design Stage
14. Installation of Transparent Plastic Grip Handles on Gallery Doors	Completed
15. Install "Caution 5 Foot Drop" Signs Over Gallery Doors	Completed

### III. VENTILATION SYSTEM

1. Power Generator for S.F. Vent Structure	Ready - Available for Revenue Service Transbay Tube
2. Redundancy of Vent System Controls	Manual System in Place, Automatic Switching Complete April 16, 1979

STATUS

3. Backup Ventilation Expert in Central

Organization Arrangements Completed - Ready for Transbay Tube Revenue Service

IV. EMERGENCY PLAN/EVACUATION PROCEDURES

1. Develop Transbay Tube Emergency Plan
2. Develop Evacuation Procedures
3. Develop Passenger Safety Information Program
4. Taped Message for Emergency Situations
5. Construct Storage Areas for Fire Departments at Embarcadero and Oakland West Stations

Completed

Completed

Passenger Safety Bulletin Ready for Revenue Service. Car Cards Printed and Ready for Installation by April 15, 1979

Under Consideration

Temporary Facilities Available at Embarcadero - Permanent Installation in Design. Permanent Installation in Place at Oakland West

V. TRAINING

1. Train Operator's Training on Emergency Procedures
2. Central Personnel Training on Emergency Procedures
3. BART Police Services Training on Emergency Procedures

Begins April, 1979  
Estimated Completion  
End May, 1979

Completed

Completed

STATUS

4. Training for Emergency Procedures Advisors

Training in Progress  
March 27, 1979 -  
Estimated Completion  
March 31, 1979

VI. LONG RANGE IMPROVEMENTS

1. Explore Feasibility of Undercarriage Fire Extinguishers and Undercarriage Fire Detection System

Project Study in Progress

2. Undercar Sprinklers

Project Study in Progress

3. Fire Resistent Materials Research

Project Study in Progress

4. Improved Car Floor Fire Resistance Capability

Project Study in Progress

5. Manual Car Uncoupling Capability (Inside Car)

Project Study in Progress

6. Explore Modifications to Allow Car Air-Conditioning to be Turned Off Without Cutting Out Vital Systems

Project Study in Progress

7. Traction Power Wayside Fault Protection

Project Study in Progress

8. More Sensitive Electrical Fault Protection

Project Study in Progress

9. Grounding of Under Vehicle Air Tanks

Project Study in Progress

10. Evaluation of Vehicle Fuse Protection Capability

Project Study in Progress

11. Extend Railing in Tube Near Ramp

Design Assessment in Progress

12. Emergency Status Board in Central

Requirements Document Being Prepared

13. Develop Overall Numbering System for Wayside Equipment

Project Study in Progress

STATUS

- |  |   |
|--|---|
| 14. Installation of Mine Page Telephone System in Transbay Tube Gallery  | Install 25 Cable Pairs in Gallery by April 20, 1979.<br>Complete Installation June 30, 1979 |
| 15. Installation of Telephone Jacks by Transbay Tube Gallery Doors       | Install 25 Cable Pairs in Gallery by April 20, 1979.<br>Complete Add-on Jacks May 31, 1979  |
| 16. Assess Feasibility of Installing Catwalks On Third Rail Side of Bore | Study to Begin April 1, 1979  |
| 17. Assess Design and Availability of New Hatch Covers                   | Study of Progress   |

PROJECTS UNDERWAY PRIOR TO JANUARY 17 (Long Range)

RADCOM - Study and design to provide additional train radio frequencies, maintenance radio underground, police radio underground, and fill in all areas not covered by present radio. Design in process.

CABLE PLANT - New cable plant to provide improved controls and alarms. Data communications video communications, telephones and additional train control circuitry. Requirements Phase in process.

INTEGRATED CONTROL SYSTEM - Central Computer Replacement which will give block by block resolution of train location.



BAY AREA RAPID TRANSIT DISTRICT  
 800 Madison Street  
 Oakland, California 94607  
 Telephone (415) 465-4100

*Grimes*

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*(Hand Delivered)*

April 3, 1979

JOHN H. KIRKWOOD  
 PRESIDENT

JOHN GLENN  
 VICE-PRESIDENT

KEITH BERNARD  
 GENERAL MANAGER

DIRECTORS

BARCLAY SIMPSON  
 1ST DISTRICT

NELLO J. BIANCO  
 2ND DISTRICT

ARTHUR J. SHARTSIS  
 3RD DISTRICT

HARVEY W. GLASSER, M.D.  
 4TH DISTRICT

ROBERT S. ALLEN  
 5TH DISTRICT

JOHN GLENN  
 6TH DISTRICT

WILFRED T. USSERY  
 7TH DISTRICT

EUGENE GARFINKLE  
 8TH DISTRICT

JOHN H. KIRKWOOD  
 9TH DISTRICT

Mr. John E. Bryson, President  
 Public Utilities Commission  
 State Building  
 San Francisco, CA.

Dear Mr. Bryson:

Commissioner Grimes expressed a desire to hear from the BART Board of Directors regarding their support for the Safety Program at BART. Unfortunately I was unable to reach Director Kirkwood until Monday, at which point I discovered that he was away from the Bay Area until later this week. As I testified, however, the BART Board of Directors has gone on record in support of this program and I am attaching to this letter a copy of the first page from the minutes of the Board's meeting on March 22, 1979 which attests to that fact.

Also attached for your information are excerpts from the Engineering and Operations Committee meeting on March 8, 1979 and the Board Meeting of March 22d wherein Director Simpson, I believe, speaks the mind of the Board with regard to BART's overall commitment to safety and a major expanded program in that area.

Sincerely,

*Keith Bernard*

Keith Bernard  
 General Manager

Encl: a/s  
 cc: PUC Commission Members

Engineering and Operations Committee  
March 8, 1979  
Side 1

#786

Director Simpson (Chairperson of the Engineering  
and Operations Committee)

On the safety consultant and the Board safety program. We have by now had a chance to look at the report of our Board of Inquiry, the BART Board of Inquiry. It comes down pretty hard on BART, deservedly so, it also comes down on the Board, I think they were too easy on the Board myself. But, you can be sure, and I do think I speak for everybody here too and those who aren't, that the Board is very much concerned in safety and the Board is going to be taking more of a hand in it. Mr. Bernard has worked out a program here and let's go over it. Keith.....

(Mr. Bernard speaks of recommendations of Board of Inquiry and reviewing the report)

\*\*\*\*\*

Board Meeting  
March 22, 1979  
Side 1, #217

Director Simpson (Chairperson of the Engineering  
and Operations Committee)

One comment on the Engineering Committee's role in this, we aren't just going to drop it when the tube gets opened. The Engineering Committee is going to feel itself totally responsible for safety in the entire system on all phases of it, and we will stay with it.

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT  
800 Madison Street, Oakland, California 94607

Minutes of the 578th Meeting  
Board of Directors

March 22, 1979

A regular meeting of the Board of Directors was held on March 22, 1979, convening at 9:00 a.m. in the Board Room, 800 Madison Street, Oakland, California. President Kirkwood presided; Phillip O. Ormsbee, Secretary.

Directors present: Directors Allen, Garfinkle, Glenn, Simpson, Ussery, and Kirkwood.

Absent: Directors Bianco and Glasser. Director Shartsis entered the meeting later, as noted in these minutes.

Consent Calendar items brought before the Board were:

1. Minutes of Board meetings.
2. Legislation relating to BART.

Director Garfinkle moved that the minutes of the meetings of March 1 and 15, 1979, be approved as submitted. Director Allen seconded the motion, which carried. Ayes - 6: Directors Allen, Garfinkle, Glenn, Simpson, Ussery, and Kirkwood. Noes - 0. Absent - 3: Directors Bianco, Glasser, and Shartsis.

Director Garfinkle moved that the Board of Directors support AB 86, support amendment of AB 120, and oppose SB 283. Director Allen seconded the motion, which carried. Ayes - 6: Directors Allen, Garfinkle, Glenn, Simpson, Ussery, and Kirkwood. Noes - 0. Absent - 3: Directors Bianco, Glasser, and Shartsis.

Director Simpson, Chairperson of the Engineering and Operations Committee, reported regarding discussion of Board of Inquiry Report.

Director Shartsis entered the meeting.

At the request of Director Allen, Director Simpson referred back to the Engineering and Operations Committee the matter of discussion of the Board of Inquiry Report.

Director Simpson, continuing, reported regarding BART Systemwide Emergency Preparedness and Fire Safety Program.

Director Simpson moved that the Board endorse the BART Systemwide Emergency Preparedness and Fire Safety Program and authorize the General Manager to retain an emergency and fire protection safety consultant. Director Glenn seconded the motion, which carried. Ayes - 7: Directors Allen, Garfinkle, Glenn, Shartsis, Simpson, Ussery, and Kirkwood. Noes - 0. Absent - 2: Directors Bianco and Glasser.



## Concurring Opinion of Commissioner Richard D. Gravelle

The patrons of BART who utilize its service through the transbay tube should be fully aware that the instant order does not in any way provide a guarantee of safe transit. Absolute safety is obviously unattainable and we have never imposed such a standard, but even reasonable safety has not been assured in my view, between January 17 and today. What has been accomplished is a marked improvement in transbay safety (attaining a minimum acceptable level), and hopefully, a recognition by BART's elected directors and management that they bear the primary responsibility for discerning and solving safety problems, so that the public will eventually be provided a reasonably safe transit system -- both in and out of the transbay tube.

BART has many considerations other than safety that it must address. Its emphasis in the past has been on operations, economics and public relations. I believe that emphasis has been modified by the events of the past two-and-one-half months, so that safety has become an equal partner on management's agenda. Given the hundreds of riders on a BART train, the potential for tremendous loss of life clearly exists in the event of a serious accident. Our own safety focus in the past has been on avoidance of collisions. Our focus has now been broadened to include fire, until the highly flammable

C. 9867      D. 90144

and toxic nature of the rolling stock is modified. System-wide evacuation procedures have been overlooked by both BART and the PUC in the past. The situation cannot be allowed to continue in the future.

As the Commissioner to whom this proceeding has been assigned, I feel a special obligation to the public who utilize BART. I therefore caution not only BART, but also our staff personnel assigned to carry out the Commission's statutory oversight responsibility that compliance with the reporting requirements in today's order will result in action by the Commission if substantial progress in systemwide safety is not achieved. I fully expect our staff to exercise their independent judgment with respect to all safety problems within their knowledge and to promptly inform the Commission of areas which call for direct action on our part.

April 4, 1979

  
Richard D. Gravelle

C. 9867 - D. 90144


CLAIRE T. DEDRICK, Concurring  
LEONARD M. GRIMES JR., Concurring


We Concur with the following request:

The matter of the role of this Commission and the responsibility of BART management is of major importance to the ongoing and efficient operation of the system in behalf of the public. The oversight role of this Commission is clearly set forth by statute. Of special concern to us is the dedication and support of the BART Board of Directors, the policymaking body for the system. During the three days of the hearing leading to this order, the Commission received repeated statements of good faith intent to improve both the operations as well as the safety of the system from Mr. Keith Bernard, General Manager, as well as other members of the operating management. We have received correspondence from the General Manager (attached) assuring us that he has the complete support of his Board. We accept Mr. Bernard's assurances. However, we feel strongly that a direct statement from the Board of Directors expressing their policy and support of the activity of BART's operating management is needed to complete our record. Mr. Bernard is not a Board member, but an employee subject to the direction of the Board of Directors. We therefore repeat the request made during the hearing that the Board of Directors of the BART system provide this Commission with a written statement of their concurrence with the

C. 9867 - D. 90144

representations of support for safety and other ongoing improvements discussed during these proceedings.

  
CLAIRE T. DEDRICK  
Commissioner

  
LEONARD M. GRIMES SR.  
Commissioner

Attachment

San Francisco, California  
April 4, 1979