

Decision No.

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)

TWELFTH INTERIM OPINION

INTRODUCTION

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

On January 17, 1979, a fire occurred in BART's Transbay Tube and necessitated the temporary closure of the Tube to revenue service. By Decision No. 89902, issued by the Commission on January 19, 1979, continued closure of the Tube was directed until certain safety-related conditions were met by BART.

On April 4, 1979, the Commission issued Decision No. 90144 which permitted the resumption of Transbay Tube revenue service subject to certain conditions. Ordering Paragraph 1 of that decision stated that:

"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."

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In compliance with this directive, BART, since resumption of Transbay Tube service on April 5, 1979, has staffed revenue trains operating through the Tube with a second uniformed employee who is trained in emergency response procedures.

In addition to the above-mentioned condition, Ordering Paragraph 1 of Decision No. 90144 required that:

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

Pursuant to this directive, BART submitted a document to the Commission on July 3, 1979, entitled "Analysis of the Value of a Second Attendant on Trains Operating Through the Transbay Tube and Berkeley Hills Tunnel." BART's analysis concluded, among other things, that the second uniformed employee should remain on trains travelling through the Transbay Tube in the peak direction during rush hours until a mine phone system and bidirectional arrows are installed in the Transbay Tube. The analysis further determined that the presence of a second employee was not warranted at times other than rush hour.

Based upon the aforementioned analysis, BART, by petition filed with the Commission on July 27, 1979, formally requests an order modifying Ordering Paragraph 1 of Decision No. 90144 to

require only that a second employee ride on westbound Transbay Tube trains during the hours of 7:00 a.m. to 9:00 a.m. and on eastbound Transbay Tube trains during the hours of 4:00 p.m. to 6:00 p.m., Monday through Friday. BART further requests an order permitting the elimination of the second employee on Transbay Tube trains following installation of the mine phone system and bidirectional arrows in the Tube.

STATEMENT OF PETITIONER'S POSITION

In its filing of July 27, 1979, BART submitted its best analytical effort to balance the degree to which passenger safety is enhanced by the presence of a second attendant aboard revenue trains against the economic costs of providing such a service. This cost-benefit analysis was intended to provide the Commission with an objective measure for determining whether and to what extent a uniformed second attendant should be stationed on BART revenue trains.

The staffing levels and attendant costs required to provide a second uniformed employee on trains have been analyzed for different areas of the system: (1) Transbay Tube only; (2) Transbay Tube and Berkeley Hills Tunnel; (3) all underground areas; and (4) systemwide. The cost of only providing the second attendant during peak commuter periods was also considered. Further, projections were provided for both the present schedule and possible close-headway operation. The staffing requirements and labor costs for the various options are estimated by BART as follows:

STAFFING REQUIREMENTS AND ANNUAL COST

<u>Transbay Only</u>	<u>Peak Periods, Mon. - Fri. Only</u>		<u>All Revenue Hours</u>	
	<u>Present</u>	<u>Close Headways</u>	<u>Present</u>	<u>Close Headway</u>
Personnel Required	16	16	25	25
Annual Cost	\$331,000	\$568,000	\$517,000	\$575,000
<u>Transbay & Berkeley Hills</u>				
Personnel Required	28	25	46	43
Annual Cost	\$579,000	\$575,000	\$951,000	\$990,000
<u>All Underground</u>				
Personnel Required	73	98	103	131
Annual Cost.	\$1,510,000	\$2,256,000	\$2,130,000	\$3,016,000
<u>Systemwide</u>				
Personnel Required	102	128	143	174
Annual Cost.	\$2,110,000	\$2,947,000	\$2,958,000	\$4,006,000

As indicated, the annual costs range from \$331,000 for stationing a second attendant only on Transbay Tube trains during peak periods to \$4,006,000 - the cost of providing a second employee on a systemwide basis during all revenue hours.

Against these relative costs, BART attempted to weigh the safety advantages gained by the presence of the second uniformed attendant on trains in the Transbay Tube and the Berkeley Hills Tunnel. BART analyzed the benefits derived from a second employee aboard these trains during normal revenue service as well as during emergency conditions.

BART asserts that there are three primary functions which could be performed by the second attendant during normal revenue operations: (1) provide medical assistance to passengers; (2) deter arson and vandalism; and (3) troubleshoot equipment malfunctions.

With respect to the first function, BART assumes that a second attendant trained in emergency first aid might save from one to five minutes time in providing assistance to passengers that have medical problems or are involved in on-board accidents. BART records reflect that during 1978, 132 passengers were involved in train-related accidents. These incidents occurring in the main when passengers were struck by train doors upon entering and exiting or when sudden acceleration or deceleration caused falls, resulted primarily in injuries requiring no medical care. During the same period, three patrons suffered apparent heart attacks requiring immediate assistance and were removed from the train at the next station. Since approximately 25 percent of the BART's total passenger miles occur in the Berkeley Hills Tunnel and Transbay Tube and given the probability of three heart attacks per year systemwide, BART posits the occurrence of a heart attack in either the Transbay Tube or Berkeley Hills Tunnel about once every 16 months.

While BART questioned the extent to which arson and vandalism might be reduced by the presence of a second attendant

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on trains in the Transbay Tube and Berkeley Hills Tunnel, it did present a dollar estimate of potential savings from arson and vandalism deterrence. Given annual arson damage of approximately \$45,000 if it were completely eliminated in the Transbay Tube and the Berkeley Hills Tunnel, in which seven (7) percent of BART's annual car hours occur, the estimated savings would approximate \$3,000 per year. Since repair and replacement occasioned by vandalism costs BART approximately \$90,000 annually, it is estimated that if the presence of a second employee could eliminate slashed seats in the Transbay Tube and Berkeley Hills Tunnel, this amount might also be reduced by about seven (7) percent or \$6,300 annually.

With respect to the function of a second attendant troubleshooting technical problems, BART demonstrated that approximately 22 mainline equipment failures are reported on trains in revenue service on a typical weekday. In perhaps two or three instances per day, a train must hold on the average about ten minutes until a mainline technician arrives. If the second attendant were a qualified mainline technician, BART estimates that his presence in the Transbay Tube or Berkeley Hills Tunnel might eliminate one ten-minute delay per week.

Based upon the above-referenced analysis, BART concludes that the benefit from a second attendant during normal revenue service is not substantial.

BART next analyzed the tasks which a second attendant might perform in an emergency evacuation situation. It was suggested that there are primarily eight ways in which having a second BART employee aboard the train could reduce the hazards to passengers during a fire situation occurring in the Transbay Tube or Berkeley Hills Tunnel: (1) provide the first response fire suppression; (2) determine the location of the fire to permit optimum utilization of the ventilation system; (3) uncouple cars behind the fire car and move away while train operator does the same with forward cars; (4) eliminate delay while train operator traverses train to attempt roll-out in reverse direction; (5) provide evacuation instructions to passengers in the rear of the train should the train PA system be rendered inoperative; (6) open car doors in the event they cannot be opened automatically by the train operator from the lead A-cab; (7) expedite the evacuation by aiding the train operator in establishing evacuation routes and reducing bottlenecks; and (8) aid the train operator in performing a sweep of the train to ensure all passengers have been evacuated.

(1) Early Fire Suppression:

In the event that an undercar fire has caused the train to stop, the second employee could exit the train and attempt to extinguish it. Given severe smoke conditions, it

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is unrealistic to expect someone to crawl beneath the train to locate and extinguish a fire, even if supplied with breathing equipment. It is also unlikely that an undercar fire could be contained using a fire extinguisher.

A second attendant could probably extinguish arson-related interior fires, yet it is unlikely that these would cause a serious hazard because: (a) they occur only on lightly loaded trains, (b) they are usually extinguished by passengers, and (c) they are unlikely to disable the train.

Therefore, BART concludes that a second attendant would be of little value for suppression of either interior or undercar fires.

(2) Determine the Location of the Fire to Permit Optimum Utilization of the Ventilation System:

In the event of fire breaching the interior, it is likely that the passengers will call the train operator on the intercom to report the fire location if it can be determined. In the case of an undercar fire BART, upon the basis of past experience, assumes that the location of the fire cannot be determined before it breaches the floor.

A second attendant might leave the train soon after it stopped and look for the fire; but because of the trailing smoke and piston air movement, it would be difficult to accurately determine fire location. Because of this difficulty, the ventilation response has been planned to minimize passenger

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exposure and is based on knowing train location rather than fire location.

(3) Uncouple Cars Behind the Fire Car and Drive Away While Train Operator does the Same with Forward Cars:

BART's emergency procedures allow uncoupling before initiating evacuation only if the passenger load is light. BART asserts that the second attendant would only be of value in assisting with uncoupling in the unlikely situation that all of the following conditions occurred: (a) passenger load is light; (b) fire is located in the center of the consist; (c) it is not possible to assemble all passengers in one end of the train; (d) third-rail power is not short-circuited; and (e) the entire consist cannot be moved.

(4) Eliminate Delay While Train Operator Traverses Train to Attempt Roll-out in the Reverse Direction:

Roll-out of a train from the Transbay Tube is not possible. Throughout most of its length, the Berkeley Hills Tunnel slopes downward from east to west at 1.75 percent or more. It may be possible to roll out a train which cannot be moved under power. If the train were bound from Orinda to Rockridge, the train operator could simply release the brakes and allow the train to roll out. However, if the train line were broken, it may be impossible to release the brakes on those cars behind the break; and they may have to be uncoupled. If the train were travelling in the opposite direction, it would be necessary

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for the train operator to change ends before attempting roll-out. In these cases, a second attendant could prevent a delay of up to 15 minutes depending on the train loading.

(5) Provide Evacuation Instructions to Passengers in the Rear of the Train Should the Train PA System be Rendered Inoperative:

By stationing a second attendant at the rear of the train who has radio communication with the train operator and with BART Central, immediate action can be taken if those at the rear are not receiving instructions. Without the second attendant, it would currently be necessary for the train operator to travel either through the train or through the gallery to the rear of the train to instruct the passengers. On a lightly loaded train, this could be done in two or three minutes and would not critically affect the evacuation. However, on a heavily loaded train, the delay could be from three to five minutes if the train operator used the gallery or as much as 15 minutes if she/he must pass through the train.

However, BART is presently installing a mine phone system in the Transbay Tube. This system will provide public address capability for both the train operator and BART Central. When this system is operational, BART concludes that little benefit would be derived from the second attendant.

The evacuation plan for the Berkeley Hills Tunnel calls for opening of selected doors by BART personnel. Therefore, the loss of PA capability does not directly affect the evacuation.

There is, however, an increased risk that without instructions, passengers may become panicked and open train doors themselves, thereby increasing their exposure to toxic combustion products.

(6) Open Car Doors in the Event that They Cannot be Opened Automatically from the Lead A-Cab:

It is possible that car doors in the rear of the train will not operate in response to the signal from the cab if train line has been damaged. In this situation, a second BART employee located in the rear of the train could proceed forward either through the cars or outside along the walkway and key open car doors so passengers could evacuate.

BART demonstrated that during the evacuation drill conducted on March 15, 1979, that once instructed to do so, passengers will rapidly open car doors using the emergency door release. Therefore, with the provision of interior communication capability using the mine phone or alarm system, BART concludes that little would be gained from a second attendant in the Transbay Tube.

The Berkeley Hills Tunnel evacuation plan calls for opening all doors only after the evacuation is completed in order to ventilate the fire and allow fire department access. Evacuation of passengers will be done through only two door sets to reduce smoke infiltration and minimize exposure. Therefore, the loss of remote door operation capability does not affect the evacuation.

(7) Expedite the Evacuation by Aiding the Train Operator in Establishing Evacuation Routes and Reducing Bottlenecks:

A second attendant may be able to reduce the time required for evacuation by encouraging passengers to keep moving and to use all available gallery doors during evacuation from the Transbay Tube. By giving the proper directions, in certain situations passengers could be encouraged to use an additional cross-passage route for evacuation. In the case of a ten-car train carrying 1,500 passengers, this means that passengers would evacuate through four gallery doors rather than three, which reduces the time for all passengers to exit from the incident bore from about 20 minutes to 16 minutes.

With the installation of the mine phone system, it will be possible for BART Central to instruct the passengers, both while in the trackway and in the gallery. With this capability, passengers can be given instructions from BART Central to use all available routes and to keep moving. Additional signing (bidirectional arrows) will also be painted on the wall above the walkway to direct evacuating passengers to all gallery doors.

When installation of the mine phone system and additional signing have been completed in the Transbay Tube, BART asserts that there would be little benefit from a second attendant.

Since the Berkeley Hills Tunnel evacuation plan calls for exiting through only two door sets, one on each end of the train, it will be necessary for the train operator to instruct patrons not to open doors, but to wait until the specific doors to be used are opened. This may be one door set in each A-car or it might be a door set somewhere in the middle of the consist (adjacent to a cross-passage door) and a second door set in one A-car depending on the train location. In this situation, a delay of as much as 15 minutes could result while the train operator opens the front door set, instructs passengers locally and traverses the train to the rear door set. A second attendant could go directly to the rear door set (which would be in the trailing A-car approximately 75 percent of the time). After opening the rear door set, the second attendant could circulate through the rear half of the train and instruct the patrons to leave the other doors closed and to proceed in the proper direction to exit.

(8) Aid the Train Operator in Performing a Sweep of the Train to Ensure All Passengers have been Evacuated:

The evacuation instructions given to passengers request them to provide assistance to those who require it, particularly the elderly and handicapped. BART contends that it is questionable how much the train operator or a second attendant could do to help people exit the train that passengers would be unable to do.

Based upon its analysis of conditions which may exist during a train fire in an underground area, BART reached the following conclusions:

- An evacuation plan which relies on BART personnel performing critical tasks in an environment which exposes them to a significant amount of smoke for any length of time cannot be considered reliable.
- Due to the combustibility of materials presently on the BART car, if a fire occurs on a heavily loaded train in the Transbay Tube or Berkeley Hills Tunnel, conditions which cause delay in moving passengers to safety could increase the possibility that they will be exposed to harmful levels of heat or smoke.
- With lighter passenger loads, evacuation can be accomplished more rapidly and orderly, significantly reducing the chance that passengers may become panicked. Because of this, when loads are light, there is a margin of safety that does not exist with heavy loads,

and a short delay in moving the passengers to safety is much less critical provided the delay does not significantly increase their exposure to smoke.

- The potential benefit which would be derived from a second attendant during normal revenue service (i.e., arson and vandalism deterrence, passenger assistance, and troubleshooting) is very small.

Given these conclusions, BART asserts that the added safety benefit of the second attendant on lightly loaded trains is considered marginal and does not justify the additional cost. However, on heavily loaded, rush-hour trains, BART recommends a second attendant until certain changes are made. For the Transbay Tube, BART recommends that the second attendant be retained until the mine phone system is operational and additional signing is in place. For the Berkeley Hills Tunnel, BART recommends presence of the second attendant until the seats of the BART car have been replaced and the floor hardened to reduce fire spread and toxic gas generation.

DISCUSSION:

The value of the second attendant on BART revenue trains operating in the Transbay Tube and Berkeley Hills Tunnel is extremely difficult to assess for various reasons.

BART's analysis, albeit a sincere, "best-efforts" showing, is based on certain assumptions and conclusions which may or may not be true in most underground emergency situations. To date, BART has experienced only one major fire in an underground area. BART's analysis, of necessity, is partly based on data collected after the January 17 Transbay Tube fire and partly on conjecture. Both BART's underground emergency response procedures and the analysis of the value of the second attendant rely heavily on the information collected by Kaiser Engineers respecting probable passenger flow rates and expected evacuation times in the event of emergencies. However, the data was collected under test conditions which do not necessarily reflect actual emergency circumstances. Therefore, BART's study, to a certain extent, assumes that panic situations will not occur and that passengers will act in an orderly manner. Any effort to check the validity of such assumptions is rendered meaningless by the absence of sufficient historical data.

The existence of a large number of variables further exacerbates the difficulty of evaluating the merits of a second attendant on-board BART trains. For example, fire configuration, types of fire, fire location, train location, differing

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communication and support systems, e.g. ventilation systems, potential escape routes, availability of fire-fighting equipment, emergency plans and evacuation procedures, load factors and human response factors in panic situations are some of the variables, each having a direct bearing on any determination of benefits derived from the presence of a second attendant.

Finally, the decision we are asked to make poses the very real dilemma of balancing two very disparate concepts. It involves the age-old problem of comparing "apples and oranges." In one case, we are confronted with the very real objective economic costs to BART occasioned by the presence of a second attendant aboard revenue trains. Against this, we must balance subjective notions of how much additional safety is purchased by the presence of the second attendant. No one, save higher beings, can project the number of lives saved and injuries prevented as a direct consequence of such expenditures. Lacking omniscience, this Commission must act with prudence in dealing with an issue fraught with such variables and unproven assumptions.

Thus, in reaching a decision our rationale is based upon facts of which we are more certain. This Commission previously concluded in Decision No. 90144 that both the seats and the fiberglass reinforced plastic wall and ceiling materials in BART cars are extremely flammable and represent a

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very grave fire danger. Measures, such as provision of second attendants aboard trains in the Transbay Tube and Berkeley Hills Tunnel, are merely efforts to mitigate the severe hazard posed by the presence of such combustible materials in BART trains. We take this opportunity to reiterate our strong directive to BART to proceed with all due haste to improve the fire-safety of their rolling stock both by removing polyurethane and other fiberglass reinforced plastic materials and by hardening the car floors against penetration of fire. Accomplishment of this goal could well moot the question of the necessity for a second attendant.

Among other facts, Decision No. 90144 also found that as passenger loading on BART cars increases the danger posed by a fire condition in underground areas correspondingly increases. The converse is equally true in that non rush-hour lightly loaded trains can be evacuated in more rapid and more orderly fashion. We are persuaded by BART's presentation that when passenger loads are light there is a margin of safety that does not exist with heavy loads. When measured against the relevant costs, we conclude, in concurrence with BART, that the added safety benefit of the second attendant on lightly loaded trains does not justify the additional cost.

We also conclude that on heavily loaded, rush-hour trains a second attendant is warranted. BART has presented

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information indicating that heavy passenger loading primarily occurs on rush-hour trains heading in the commuter direction. BART has further defined these peak passenger hours as occurring on weekdays on westbound trains between the hours of 7:00 a.m. to 9:00 a.m. and on eastbound trains between the hours of 4:00 p.m. to 6:00 p.m.

BART's petition will be granted to the extent we modify Ordering Paragraph 1 of Decision No. 90144 to require that a second employee ride on westbound Transbay Tube trains during the hours of 7:00 a.m. to 9:00 a.m. and on eastbound Transbay Tube trains during the hours of 4:00 p.m. to 6:00 p.m., Monday through Friday. Pursuant to BART's recommendation, we will further order the presence of a second attendant on westbound Berkeley Hills Tunnel trains during the hours of 7:00 a.m. to 9:00 a.m. and on eastbound Berkeley Hills Tunnel trains during the hours of 4:00 p.m. to 6:00 p.m., Monday through Friday.

With respect to BART's request to eliminate the second uniformed employee riding through the Transbay Tube following installation of the mine phone system and bidirectional arrows, we find such a proposal premature. We are persuaded that the interests of safety warrant the presence of a second attendant in both the Transbay Tube and Berkeley Hills Tunnel during peak hours and in the peak direction until the combustibility of BART cars is reduced through materials replacement and fire hardening. We will so order.

Finally, we will direct BART to verify through appropriate analysis submitted to staff within 90 days of the effective date of the order, that the peak hours, with attendant heavy passenger loading, are indeed westbound 7:00 a.m. to 9:00 a.m. and eastbound 4:00 p.m. to 6:00 p.m., Monday through Friday.

In order that BART may modify its operations to implement this order immediately upon resumption of full revenue service, we deem it necessary that this order be effective on the date of signature.

FINDINGS:

(1) Provision of second attendants aboard trains in the Transbay Tube and Berkeley Hills Tunnel is merely an effort to mitigate the severe hazard posed by the presence of combustible materials in BART trains.

(2) Replacement of flammable materials and fire hardening of the floors in BART rolling stock could moot the question of the necessity for a second attendant.

(3) As passenger loading on BART cars increases the danger posed by a fire condition in underground areas increases.

(4) When passenger loads are light, there is a margin of safety that does not exist with heavy loads in that lightly loaded trains can be evacuated in more rapid and more orderly fashion.

(5) BART's heaviest passenger loads occur westbound 7:00 a.m. to 9:00 a.m. and eastbound 4:00 p.m. to 6:00 p.m., Monday through Friday.

CONCLUSIONS:

(1) When measured against the relevant costs, the added safety benefit of the second attendant on lightly loaded trains does not justify the additional cost.

(2) When measured against the relevant costs, the added safety benefit of the second attendant on heavily loaded, rush-hour trains does justify the additional cost.

(3) BART should be ordered to require the presence of a second attendant in both the Transbay Tube and Berkeley Hills Tunnel on westbound trains during the hours of 7:00 a.m. to 9:00 a.m. and on eastbound trains during the hours of 4:00 p.m. to 6:00 p.m., Monday through Friday.

(4) The interests of safety warrant the presence of a second attendant in both the Transbay Tube and Berkeley Hills Tunnel during peak hours and in the peak direction until the combustibility of BART cars is reduced through materials replacement and fire hardening.

IT IS ORDERED THAT:

(1) Ordering Paragraph 1 of Decision No. 90144 is modified to require BART to station a second ^{*uninformed*} attendant in both *Kn*

the Transbay Tube and Berkeley Hills Tunnel on westbound trains during the hours of 7:00 a.m. to 9:00 a.m. and on eastbound trains during the hours of 4:00 p.m. to 6:00 p.m., Monday through Friday.

(2) The presence of a second ^{uninformed} attendant aboard such trains shall be continued until BART, by proper showing, satisfies the Commission that the combustibility of BART cars has been significantly reduced through materials replacement and fire hardening.

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(3) Within 90 days of the effective date of this order, BART shall submit to the Commission verification, through appropriate analysis, that the peak hours with heaviest load factors are westbound 7:00 a.m. to 9:00 a.m. and eastbound 4:00 p.m. to 6:00 p.m., Monday through Friday.

The effective date of this order is the date hereof.

Dated at San Francisco, California this 30th day of November, 1979.

John E. Byrne

 President

William L. Steiner

Robert D. Swalle

Clare M. DeFuria

James M. [unclear]

 Commissioners