

**ORIGINAL**Decision No. 84582

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)

Morrison & Foerster, by Robert D. Raven,  
Charles R. Farrar, Jr., and Nelson G. Dong,  
Attorneys at Law, and Sherwood G. Wakeman  
and Malcolm Barrett, Attorneys at Law, for  
Bay Area Rapid Transit District, respondent.  
Charles R. Woodhouse, for Parsons Brinckerhoff-  
Tudor-Bechtel; Pettit, Evers & Martin, by  
Joseph Martin, Jr., Attorney at Law, for Rohr  
Corporation; Charles M. Carver, for himself;  
and T. Richard Brown, Attorney at Law, for  
TRW, Incorporated; interested parties.  
Vincent MacKenzie, Attorney at Law, for the  
Commission staff.

INTERIM OPINIONProceeding

Hearing on this investigation on the Commission's own motion into the safety appliances and procedures of the San Francisco Bay Area Rapid Transit District (BART) was held after due notice before Commissioner Ross and Examiner Coffey in San Francisco, California, on February 18, 19, 20, 21, and March 26, 27, and 28, 1975. The matter was submitted on April 29, 1975 upon the receipt of reporter's transcripts and late-filed exhibits.

After determining during the initial four days of hearing that severe procedural deficiencies existed in BART's operations, formal hearings were temporarily suspended at BART's request to permit extensive informal discussion between BART, the Commission staff (PUC staff), and Commission consultants (PUC consultants) to develop most expeditiously the basis for an order, or orders, to be issued by the Commission.

After a month of discussions between BART, the PUC staff, and the PUC consultants, hearing was resumed to place in evidence the areas of agreement and disagreement.

#### Background

During January 1975, three accidents occurred on the BART system which, together with other reports of various failures of BART cars, caused the Commission to order this investigation to insure the safety of passengers and employees.

The three accidents of immediate concern in this proceeding are the following:

1. On January 10, 1975, a BART train sideswiped a second BART train operating on a yard track in the Concord train yard, resulting in damage to three train cars.
2. On January 19, 1975, a BART train struck a "hi-rail" maintenance vehicle on the main line track, thereby killing the operator and causing extensive damage to the maintenance vehicle and the train equipment.
3. On January 27, 1975, a single unattended BART car rolled uncontrolled through the MacArthur, 19th Street, and 12th Street stations in Oakland, presenting a potential hazard to equipment and the traveling public.

#### Jurisdiction

The jurisdiction of the Commission relative to BART is set forth in Division 10 of the Public Utilities Code as follows:

##### "DIVISION 10. TRANSIT DISTRICTS

##### Part 2. San Francisco Bay Area Transit District

##### CHAPTER 6. POWERS AND FUNCTIONS OF DISTRICT

##### Article 5. Rapid Transit Facilities and Service

"29047. The district shall be subject to regulations of the Public Utilities Commission relating to safety appliances and procedures, and the commission shall inspect all work done pursuant to this part and may make such further additions or changes necessary for the purpose of safety to employees and the general public.

"The commission shall enforce the provisions of this section. (Added 1957, Ch. 1056; amended 1961, Ch. 1967.)"

Scope of Investigation

This investigation was instituted for the purpose of determining whether the existing orders of the Commission, including General Orders Nos. 22-B, 26-D, 108, 110, and 127, as well as the operating rules and the various safety reporting procedures of BART, are sufficient to assure and provide for safe train operations.

The order opening the investigation requires that a determination be made "whether any further order, reporting procedures, or safety regulation should be issued pertaining to train safety of BART trains and cars in addition to the existing orders, reporting procedures, and rules of the Commission in order to prevent occurrences of the nature heretofore recited or other occurrences that may jeopardize the safety of the passengers and employees of BART". BART was required to respond to the following specific areas of inquiry:

1. Techniques employed for evaluation of completeness and adequacy of operating procedures and rules.
2. Techniques employed to analyze operating procedures and rules for identification of weaknesses and failure modes.
3. Procedures utilized to obtain authorization for implementation of operating rules and procedures.
4. Techniques employed to insure the integrity of the implementation of authorized operating procedures and rules.
5. Internal BART procedures employed to determine the impact on safety of such related factors as vehicle availability and wayside reliability.
6. Methods by which safety impact influences priorities throughout the BART system.
7. The process by which safety reporting is expedited within BART.
8. Criteria for establishing need of additional automatic safeguards to supplement procedures.

9. Procedures for certifying that maintenance vehicle operators are fully trained and competent to operate maintenance vehicles in accordance with appropriate rules and procedures.

Pending hearing on the above matters, BART was ordered to institute and implement the following procedures in the conduct of its train operations to prevent future accidents pending the outcome of this investigation:

- "1. Train movements in the vicinity of on-rail maintenance equipment shall be made in manual mode at a speed not exceeding that which will permit the train to stop before reaching such vehicle or vehicles but not exceeding 25 mph. Train operators shall advise Central Control that the maintenance vehicle involved is clear of the track on which the train is running before Central authorizes the train to proceed in automatic mode.
- "2. The train controller at Central, wherever possible, shall align all routes for both revenue and non-revenue vehicles during the movement of maintenance vehicles.
- "3. All accidents or incidents that have caused or could cause accidents arising out of or involving operations in either main line or yard track areas shall be reported by telephone to the Commission within 24 hours.
- "4. Upon completion of the normally required procedures and upon arrival at their maintenance area, maintenance vehicle operators shall make a final readback to Central Control of their nearest milepost location."

Finally, BART was required to present to the PJC staff, before February 19, 1975, "plans for adding a device or devices to maintenance vehicles used on-rail which will make such vehicles detectable to the train control system, the purpose of which would be to insure that no automatic train operations may be carried on within the immediate area in which maintenance equipment is operating."

Presentations

Prior to the recess of the hearing, BART presented 43 exhibits and the testimony of five witnesses, including that of the acting general manager, in response to the requirements of the order of investigation. After the recess, BART presented six more exhibits and the testimony of four witnesses.

The PUC staff and the PUC consultants presented, during both series of hearings, three exhibits and the testimony of one PUC staff witness and three PUC consultants.

During the first two days of hearing, BART introduced into the record a number of exhibits which were not sponsored by a witness or subjected to cross-examination due to the change in the direction of this proceeding after the hearing recess. The motion of staff counsel to strike the following exhibits from evidence has been granted:

<u>Exhibits Nos.</u>	<u>Proposed Witness</u>
4, 4-A	Kramer
6, 6-A	Somerton
7, 7-A, 7-B	Carroll
8, 8-A, 8-B	Denowitz
9, 9-A, 9-B, 9-C	Denowitz
10	Carroll
11	Harl
13, 13-A, 13-B, 13-C	Kramer
14	Kramer

The granting of this motion does not remove the exhibits from the record of the proceeding. The exhibits will remain a part of the response of the respondent to the "interim directives" outlined by the Commission and addressed to BART in the Order Instituting Investigation (OII).

During the proceedings the PUC consultants were each offered an opportunity to submit ordering paragraphs which would implement their recommendations. As of May 25, 1975, the date of

preparation of late-filed PUC staff Exhibit No. 25, none of the consultants had indicated a desire to submit a proposed order for consideration.

Concord Yard Accident

Exhibit No. 2-G, a copy of a memorandum dated February 13, 1975 to the acting general manager of BART from the BART director of transportation summarizes the facts surrounding the collision of two BART trains in the Concord yard on January 10, 1975. The memorandum indicates that Trains 393 and 397 were brought to a halt with each on an arm of a "Y" shaped section of track in the Concord Yard. The front and rear wheels of Car No. 529, the last car of Train 397, straddled the switch of the "Y". It is alleged that the operator of Train 393, contrary to the specific instruction of the yard supervisor, caused the switch of the "Y" to be thrown while it was straddled by the last car of Train 397. After hearing on his yard portable radio the instruction of the yard supervisor to the operator of Train 393, a yard foreman started to move Train 397 ahead into the shop. The misaligned switch caused the front wheel-truck of Car No. 529 to follow Train 397 toward the shop and caused the rear wheel-truck to move toward Train 393 along the other arm of the "Y" until the side of Car No. 529 struck Car No. 148, the end car on Train 393.

BART maintains that the movements made by Trains 393 and 397 were routine and procedurally safe if the operator of Train 393 had complied with the instruction of the tower supervisor. BART attributed the cause of the accident to the operator of Train 393 and terminated the operator's employment with BART subject to arbitration proceedings under the terms of the collective bargaining agreement. The BART director of transportation recommended that the program of strict enforcement of instructions and procedures and thorough investigation of all known infractions be continued.

None of the parties to the accident appeared before the Commission. It appears that a written log of instructions or a taped record of oral instructions are not maintained by BART. It is not the purpose of this proceeding to arrive at findings of individual responsibility for accidents. However, from the record in this proceeding, it appears that operating and communication procedures in the movement of trains and cars in BART yards should be reviewed to lessen the risk of accidents.

Collision of Train and Maintenance Vehicle

Exhibit No. 2-H is a copy of a memorandum to the acting general manager of BART of the investigation by a BART board of inquiry into the collision between Train 973 and Maintenance Vehicle 544 on Sunday night, January 19, 1975. Due to the serious nature of the accident and the probability of future legal actions, we shall include Exhibit No. 2-H with this decision as Appendix A.

The board of inquiry set forth eight recommendations in Exhibit 2-H. Comment in detail on these recommendations would be premature considering the continuing formal review by BART of its procedures. Nevertheless, this record on this accident indicates that further consideration should be given to operation and communication procedures. The cross-examination of the superintendent of central operations clearly demonstrates this need, particularly in the area of improved communications.

Runaway Vehicle Incident

Exhibit No. 2-I is a copy of the report to the acting general manager of BART of the investigation by a BART board of inquiry into the runaway vehicle incident on Monday, January 27, 1975. We include Exhibit No. 2-I with this decision as Appendix B.

In this incident, a single car rolled on the main line during revenue hours without power from MacArthur Station past the 19th Street and 12th Street Stations until it stopped in the Oakland Wye enroute to Lake Merritt Station. Exhibit No. 2-I indicates

that when the train controller was notified at 3:26 p.m. that the car was rolling downgrade toward the Oakland Wye, he "immediately implemented actions to hold all train movements that might conflict with the probable route being traveled by the loose vehicle."

There has been public comment critical of the Commission's insistence that BART's automatic train control system reliably detect the presence of a single dead car since the minimum BART revenue train consists of two cars. This incident graphically demonstrates the soundness of the criteria that a rapid transit automatic train control system must be capable of reliably detecting the presence of a single dead car if the safety of the public is to be maintained.

The recommendations of the board of inquiry set forth in Exhibit No. 2-I agree with the need demonstrated by this record for a constructive review by BART of its procedures and equipment to insure the future safety of its system operations.

#### Maintenance Vehicle Detection Device

The OII required BART to expedite the development of plans for adding a device to maintenance vehicles which would insure their detection by the train control system. Exhibits Nos. 5 and 5-A are timely responses to this requirement. Exhibits Nos. 16 and 21 set forth the details of the maintenance vehicle detection feasibility investigation by a special task force composed of personnel from BART, Lawrence Berkeley Laboratory (LBL), the PUC consultants, and the PUC staff.

In response to the requirement that BART submit a plan for providing detection of maintenance vehicles, a task force was formed to evaluate alternative methods for achieving maintenance vehicle detection, to select those methods which best satisfy the performance criteria and existing system constraints, to perform field experiments to determine the feasibility of the methods selected, to use field results to select and refine the most appropriate method, and to design and test a final prototype. A specific goal of producing



preliminary field test data by February 14 was agreed upon. This task force mission was limited to the completion of the prototype. Installation of the device on BART's 37 maintenance vehicles capable of operating on the track was not undertaken by the task force.

Review of this operation is of interest as a case study of the use of task forces to solve urgent technical problems.

The task force initially considered (1) detection system performance specifications, (2) track-circuit characteristics, (3) receiver characteristics, and (4) maintenance vehicle characteristics. The objective of this analysis was to determine the set of constraints for selecting the fundamental electronic techniques to provide detection. Alternative methods of providing detection include inserting a new signal or attenuating an existing signal in the track circuits. Alternative methods by which signals can be coupled into track circuits are: inductively coupling (antenna) or conductively connecting (direct contact) the vehicle to the rails.

Voltage track circuit characteristics favor the conductive connecting method. Knowledge of the wheel-rail interface characteristics gained from LBL's previous basic signal behavior investigation indicated that insertion of signals into the track circuit was a promising solution. Insertion of selective frequencies requires less power than a broad band of frequencies. Therefore, the task force elected to perform, as an initial field test, an experiment using a four-frequency current source connected between the insulated wheels of a maintenance vehicle and powered from a 12-volt battery.

Preparation for the initial field testing of the selected method continued from February 10 through 13, with BART and LBL providing the appropriate equipment and each task force member assuming responsibility for a specific area of construction of the experiment. On February 12, the experimental maintenance vehicle was ready for field testing on BART tracks. The first field test was run

on Hayward Yard tracks on February 13 and continued on Saturday, February 15, on revenue tracks between Concord and Lafayette stations. Detection sensitivity to signal power levels and minimum open-circuit voltages required for wheel-rail interface breakdown were explored. On February 15, the field tests successfully demonstrated that the experimental vehicle was detectable in both voltage- and current-type track circuits. The tests indicated that some modification may be necessary at the interface between some current-type track circuits and adjacent voltage circuits. The effect on certain voltage track circuit components will also require study. The task force will continue to refine the technique employed for detection and will examine the potential of other techniques. Means of verifying detection performance from on board the maintenance vehicles will also be explored. The results of the tests, and preliminary examination of the areas remaining to be addressed, indicate that the method of detection used in the experiment is feasible.

In one week, a task force was formed and demonstrated the feasibility of providing detection for maintenance vehicles. This task force made the expertise of all members simultaneously available so that the conventional process of a consultant independently preparing recommendations for the client to consider was bypassed. Detection of maintenance vehicles will affect several other BART subsystems: Sequential Occupancy Release (SOR), Computer Automated Block System (CABS), and Operating Rules and Procedures (O/R). The maintenance vehicle detection task force will not directly address those affected areas. LBL is performing a preliminary analysis of the effect on, and the potential improvement in, safety level that might be offered by CABS, SOR, and central computer subsystems when all maintenance vehicles eventually become detectable.

We understand that automatic detection systems for maintenance vehicles do not presently exist for the railroad industry. Exhibit 5-B indicates that installation of the device on all maintenance vehicles will be completed 40 weeks after February 10, 1975.

PUC Consultant Recommendations

The following recommendations by PUC consultants from LBL are set forth in Exhibit No. 16, entitled "LBL Role and Recommendations with Respect to PUC Hearings on BART Safety Appliances and Procedures", dated February 18, 1975:

Recommendation 1, Reliability Impact on Safety and Task Force Approach

Determine whether certain types of vehicle reliability problems adversely impact safety. Establish priorities for solving those reliability problems that do impact safety. Use a task force where necessary to produce the quickest results for attacking top priority problems.

The task force would (1) be comprised of an integrated team (BART, PUC, and consultants) coordinated under BART leadership; (2) intensely address a single high-priority problem through common design effort; and (3) have the sole objective of producing a prototype solution which later can be subjected to reliability testing.

Recommendation 2, Maintenance Vehicle Detection Feasibility Experiment 1/

Conduct a feasibility experiment to consider alternative solutions for maintenance vehicle detection and to select the one best satisfying the system constraints. The feasibility experiment should produce preliminary results as quickly as possible, and thus the task force approach should be used. The objectives of the task force should be limited to the detailed design, construction of a prototype and final verification of the prototype performance.

Additional concerns that must be addressed by others than the task force include reliability testing, safety impact on SOR and CABS, and possible modification of O/R.

---

1/ Implementation of this recommendation was discussed in preceding paragraphs.

Recommendation 3, O/R Failure-Mode Techniques

Employ techniques to analyze each O/R for identification of weaknesses and failure-modes.

Recommendation 4, O/R Safety Policies

Consider including in BART's safety policies, a set of principles such as outlined in the nine areas of inquiry furnished by LBL to the PUC and included as Appendix A of the OII of February 4, 1975.

Recommendation 5, O/R Authorization Procedure

Expand the O/R authorization procedure between BART and the PUC, to ensure timely feedback to BART of the results of PUC analysis and review of O/Rs submitted to the PUC. This may require additional PUC staffing and changes in the existing PUC orders.

Recommendation 6, O/R Integrity Test Techniques

Employ integrity test techniques to help ensure compliance with authorized O/Rs.

Recommendation 7, Criteria for Additional Automatic Safeguards

Establish criteria to determine when additional automatic safeguards are needed to supplement O/Rs. A process should exist for establishing a need for added automatic safeguards when a failure-mode analysis of O/Rs demonstrates either: (a) too much reliance is placed on the human element, or (b) the complexity of the O/Rs has reached a level wherein they are subject to misinterpretation, and further O/Rs would result in a state of diminishing returns.

Recommendation 8, Interim Road Manual Operation

Review with the PUC, after a maintenance vehicle detection system is eventually installed, the interim PUC order requiring road manual operation (25 mph maximum) of trains in the vicinity of on-rail maintenance vehicles. Consider whether a higher level of safety can be obtained by automatic train operation at some reduced mode, such as Performance Level 6 (40 mph maximum), in the vicinity of detected maintenance vehicles.

The recommendations of Dr. W. H. Wattenburg, the originator of the concept of putting a special device on board BART vehicles generally parallel those stated above. Dr. Wattenburg's recommendations and comments are set forth in detail at pages 398 to 418, pages 444 to 451, and pages 591 to 611 of the transcript.

PUC Staff Recommendations

A PUC staff witness made the following recommendations as set forth in Exhibit No. 22:

I. WORK GROUPS OR TASK FORCES

- A. BART, within 10 days, should establish and identify task forces or work groups that are to be assigned in the following areas: Operating rules, car reliability, maintenance vehicle detection, central control computer, and station and wayside failures.
- B. Commission consultants should be allowed to become part of these groups and the Commission staff should continuously be made aware of the workings of these groups.
- C. Monthly status reports should be filed by BART in each area.
  1. The monthly status reports on operating rules should include reporting of efforts being made in training, efficiency tests, and rule enforcement in all departments.
  2. Included in the monthly status reports on central control computer should be a maintenance schedule, procedures, test results, and failure reports.

II. OPERATING RULES

- A. BART, within 10 days, should file three copies of their existing operating rules and procedures with the Commission. Any modification should be filed three days in advance of their implementation or, in the case of an emergency, within three days after being put into effect, including full explanation.
- B. All operating rules should be reviewed and where applicable revised. System maintenance and control center rules should be revised in their entirety within six months.

- C. The rules should be standardized so they are common between departments and under the same rule number. These rules should be reduced to pocket size form and distributed to all affected employees.
- D. Procedures should be established by BART to insure that central control or central personnel do not allow movement of defective equipment when it is unsafe to do so, in either revenue or nonrevenue service.
- E. Central control should maintain a log of maintenance vehicles whenever they are operating on the main track.
- F. Instructions or procedures should not be included in the operating rules but should be supplements or appendices to the operating rules.

### III. BOARD OF INQUIRY

- A. BART should file a detailed report with the Commission as to the implementation of the Board of Inquiry's recommendations. Monthly status reports should be filed until all of these recommendations are carried out or concluded.

### IV. ACCIDENT/INCIDENT REPORTING

- A. All accidents, incidents, or "unusual occurrences" which have caused, or could have caused, impact, collision, derailment, fire, explosion, or other events involving the operation of railroad on-track equipment (standing or moving); or which caused, or could have caused, property damage or personal injury or death to passengers or employees, shall be reported by telephone to the Commission (telephone 557-2271) within 24 hours from the time of such event. A follow-up written report should be filed within 20 days of such event.

### V. OTHER REQUIRED REPORTS

- A. Car Report Weekly Summary, filed weekly (Form No. 0742).
- B. Monthly "failure" reports (vehicles, central control, and station and wayside) should be filed monthly. Reports for months of January, February, and March 1975 should also be filed with April report.

- C. Manual Intervention Log with summary should be filed weekly.
- D. Central supervisors daily log should be filed daily.

Post-Recess Proceeding

The acting general manager in Exhibit No. 18 summarized the deliberations which occurred while the proceeding was adjourned between February 21 and March 26, 1975, summarized the agreements reached among the parties, and indicated BART's proposed plan of action with respect to reliability problems which may affect safety and review of BART's operating rules and procedures. Parallel testimony was presented by the PUC consultants and the PUC staff. From a review of the testimony and BART's late-filed Exhibit No. 24, it appears that there are no major conflicts to be resolved.

Attached as Appendices 3 and 4 are copies of memoranda dated March 18, 1975 and March 21, 1975, which include summaries of the PUC-BART meetings, and delineate the progress of the informal discussions, and set forth the agreements reached. We note that the parties discussed achieving certain goals within specified time limits. However, BART, while willing to strive for the goals, had reservations that the goals may not be achieved within the specified time.

The parties agreed that the order of the OII limiting the manual mode of the movement of trains in the vicinity of on-rail maintenance equipment should be modified to apply only to the first train through the vicinity if the operator of the first train advises central control that the track is clear. We will order the proposed change.

Plan For Equipment Reliability Improvements

The acting general manager testified that the BART staff, working with the PUC staff and the PUC consultants, has identified system equipment reliability areas which should receive high priority in attaining improvements. These are composed of three primary

subsystems: the vehicle, the central computer, and the wayside train control equipment. Relative to the vehicle, a subset of four problem areas was agreed upon. These are the propulsion system, the vehicle automatic train operation, the door system, and the friction braking system.

Three engineering task forces will be established to address each primary subsystem problem area. Separate resources, dedicated to each particular task, will be allocated to each task force. These resources will include BART engineering staff members, BART consultants already under contract (and involved in such work to some degree), and, where appropriate, industry consultants. Other resources will include equipment and physical material needed for testing, etc., outside laboratory facilities, BART vehicles, support personnel for data gathering and evaluation of design fixes, and appropriate working space and shop equipment.

The vehicle task force will be subdivided into four parts to address the propulsion, train control, auxiliary, and mechanical vehicle system problems. These systems are of differing technical nature, requiring different levels and types of professional expertise. All BART personnel assigned to each of these four vehicle tasks, and to the other two main tasks, will be dedicated solely to that task, and to the extent practical, the consulting personnel will also be so dedicated.

A vehicle task force leader, heading the work of the four vehicle subsystem groups, will be responsible for the overall coordination and efforts of these groups. This responsibility includes planning and directing the task force activities, insuring that sufficient resources are continuously available and are being used on each problem, evaluating and assessing progress, establishing priorities or criteria for priorities, and liaison with other departments supporting this effort. The leader will also be the primary technical contact point with the PUC staff and consultants on



the vehicle task force work. While BART has agreed to involve the PUC staff in deliberations regarding the problem areas, the PUC staff is expected to retain its independent role. Accordingly, PUC staff personnel will not become members of the task forces.

The task leaders will be given full authority within the charter of their respectively assigned tasks to carry out the work in a timely and efficient manner. Where additional resources are needed, the task leaders are responsible for promptly advising BART management so that such resources shall be made available. These needs will be immediately communicated to the appropriate level of BART management to enable highest priority support of these task groups.

Reporting on the progress of the work of the task forces will be in accordance with the requirements established by the PUC. Periodic technical reviews will be held to assure the visibility of the work to BART management, the PUC staff, and PUC consultants. In addition, continuing technical liaison between the BART task forces and PUC staff and consultants is anticipated.

The foregoing discussion on responsibilities and authority for the vehicle task force will apply directly to the central computer task force and to the station wayside equipment task force. In general, equal management priority will be given to each of the three areas. The resources applied, however, will be indicative of the estimated amount of work involved in establishing solutions to the particular problems and to a degree will be indicative of the technical priority of each task. In addition to the assessment of progress by the task force leaders and the PUC staff and consultants, BART management will continuously oversee the general progress to assure that all reasonable efforts are being expended and that the goals of this effort are being attained.

Exhibit No. 18 delineates the staffing plan established by the BART engineering staff for each of the task force groups. This plan includes outside consultant support as well as BART engineering assignments.

### Discussion

We are primarily concerned here with the level of safety of BART operations to insure that no member of the public or any BART employee is harmed by these operations. This record indicates that BART meets minimum standards of safety for continued operation, but BART is not nearly as safe as it could and should be. The high rate of equipment failure produces a constant need for manual intervention in a system designed to run automatically.

While procedures can be designed that permit safe operation either in the manual or the automatic mode, when operating conditions shift from normal, stress conditions arise which increase the potential hazard level. It is under these conditions that behavior becomes unpredictable and errors of judgment and in applying prescribed procedures occur. To remedy these deficiencies, this record contains many recommendations for new operating procedures to be developed and existing rules to be changed. The need for systematic review and testing of operating procedures and rules has become obvious. BART is moving to accomplish this by the recent formation of a safety department. One of our concerns is to insure that this systematic review is implemented immediately and completed promptly.

BART operations have been plagued by equipment failures and defects in vehicles, central control, and station and wayside equipment. Failures of car bodies, doors, brakes, suspension, trucks, communication, propulsion, air conditioning equipment, electric auxiliaries, and train control have all required vehicles to be removed from service and have affected revenue service. The highest failure rates have been experienced by the propulsion and train control equipment. Our interest in the immediate solution of these and similar problems, which appear at first glance to be primarily of maintenance and service, is imperative due to the high levels of potential hazard created by these failures.

Our concern with the solution to equipment and system failure problems and with verifying that the system is operating at the lowest level of hazard should not cause BART to interfere with its routine and periodic maintenance of equipment and systems.

We shall adopt the recommendations of the PUC staff and the PUC consultants and shall hold hearings to receive progress reports from BART.

Findings and Conclusion

1. BART revenue and nonrevenue operations meet minimum standards of safety for continued operation at this time.
2. BART revenue and nonrevenue operations are not as safe as is desirable and feasible. Prompt solutions must be found to a range of problems affecting the reliability of systems and procedures.
3. The recommendations of the PUC staff and the PUC consultants are reasonable.

We conclude that BART should be required to implement the recommendations of PUC staff and PUC consultants. Significant progress in solving the safety problems of the system must be shown within one year of the date of the order. At that time, the Commission will review BART's operations and decide whether to authorize service at a reduced, expanded, or unchanged level. ✓

INTERIM ORDER

IT IS ORDERED that:

1. The requirement in the Order Instituting Investigation that train movements in the vicinity of on-rail maintenance equipment shall be made in the manual mode is modified to read:

The first train movement in the vicinity of on-rail maintenance equipment shall be made in manual mode at a speed not exceeding that which will permit the train to stop short of any obstruction but not to exceed 25 mph. The train operator shall advise Central Control of the track status. If the track on which the train is operating is clear, Central Control may then authorize the first train to proceed in automatic mode. Subsequent trains may operate on the track previously inspected in the automatic mode.

All other interim orders remain in effect except those involving accident reporting and maintenance vehicle detection which are superseded by this order.

2. All accidents, incidents, or unusual occurrences which have caused, or could have caused, impact, collision, derailment, fire, explosion, or other event involving the operation of railroad on-track equipment (standing or moving) including those occurring on passenger loading platforms which caused, or could have caused, property damage or personal injury or death to passengers or employees, shall be reported by telephone or telegraph to the Commission (telephone 557-2271) within 24 hours from the time of such event. A follow-up written report shall be filed with the Commission within 20 days of such event.

3. One copy of the following San Francisco Bay Area Rapid Transit District (BART) operating documents shall be filed with the Commission at the indicated intervals until further ordered.

- a. Car Report Weekly Summary, Form No. 0742 - file weekly.
- b. Monthly failure reports for vehicles, central control, and station and wayside equipment - file monthly. Reports for prior months in 1975 shall be filed with the first report filed in compliance with this order.
- c. Manual Intervention Log, with summary - file weekly.
- d. Central Supervisors Daily Log - file daily.

4. Within ten days after the effective date of this order, BART shall file three copies of their existing operating rules and procedures with the Commission. Any modifications shall be filed three days in advance of their implementation or, in the case of an emergency, within three days after being put into effect, and shall include a full explanation.

5. All BART operating rules and procedures shall be reviewed and where applicable revised using the analysis techniques set forth in Exhibit No. 18. System Maintenance and Control Center rules shall be revised in their entirety within six months of the effective date of this order.

6. The revision of BART rules shall include the following:

- a. Operating rules shall be standardized so that rules used by more than one entity shall have the same number and have identical phraseology.
- b. Operating rules shall be issued to all affected employees in a pocket size and current revisions shall be maintained.
- c. Procedures shall be established by BART to insure that Central Control or Central personnel do not allow movement of defective equipment when it is unsafe to do so, in either revenue or nonrevenue service.
- d. Central Control shall maintain a log of maintenance vehicles whenever they are operating on the main track.
- e. Administrative instructions or procedures shall not be included in the operating rules but may be attached as supplements or appendices to the operating rules.

7. BART shall file with the Commission within ten days of its issue, a copy of the report of each board of inquiry which relates to safety, hazards, or the application of system operating procedures and rules. Thereafter, monthly reports shall be filed with the Commission concerning the implementation of board of inquiry recommendations until all recommendations are implemented or otherwise concluded.

8. Within ten days after the effective date of this order, BART shall establish and name the responsible personnel assigned to the following BART Reliability Task Forces:

- a. Propulsion Reliability.
- b. Vehicle Automatic Train Operation Reliability.
- c. Door System Reliability.
- d. Braking System Reliability.
- e. Central Control Reliability.
- f. Station and Wayside Reliability.

9. BART shall file monthly with the Commission until further order, progress reports for each task force established by paragraph 8

herein. Each progress report shall include, to the extent applicable to the task force:

- a. Monthly status reports on operating rules shall include reports of efforts being made in training, efficiency tests, and rule enforcement in all departments.
- b. Monthly status reports on the Central Control Task Force shall include a maintenance schedule, procedures, test results, and failure reports.

10. BART shall file monthly status reports on the progress of developing and installing a detection device on all maintenance vehicles.

11. The Commission staff and designated consultants shall have access to information concurrently with all members of the task forces and shall be informed of task force activities in order to monitor their progress and report to the Commission as necessary.

12. Further hearing on this matter shall be held approximately three months after the effective date of this order for the purpose of receiving a public progress report from BART and any further recommendations by the PUC staff and the PUC consultants.

13. BART shall demonstrate during the year following the effective date of this order that significant progress has been made by it to solve the major safety problems revealed at these.

proceedings. At the conclusion of that period, the Commission will review BART's operations and decide whether to authorize service at a reduced, expanded, or unchanged level. ✓

The effective date of this order is the date hereof.

Dated at San Francisco, California, this 24th  
day of JUNE, 1975.

Vernon L. Sturgeon  
President

Leonard R. [illegible]  
[illegible]  
Commissioners

Commissioner William Symons, Jr., being necessarily absent, did not participate in the disposition of this proceeding.

## SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

## INTER-OFFICE COMMUNICATION

To: Lawrence D. Dahms  
Acting General Manager

Date: February 6, 1975

From: Board of Inquiry

Subject: Investigation Report - Collision Between Train 973 and  
Maintenance Vehicle 544 on Sunday, January 19, 1975

SUMMARY OF INCIDENT

At approximately 8:30 p.m. on Sunday, January 19, 1975, Mr. Arthur L. Briggs reported for work at the Bay Area Rapid Transit District's Oakland Shops for a shift commencing at 9:00 p.m. Shortly thereafter, Mr. Jessie Johnson also reported to the Oakland Shops, and both were briefed by Mr. Johnnie Simpson, the Foreman on duty, as to the work and the work areas in which they would be performing that night. Mr. Billie R. Moore and Mr. James D. Coppedge were assigned to Mr. Briggs' crew to work Maintenance Vehicle 544 in which Mr. Briggs was the Lead man. Mr. Jessie Johnson and Mr. J. E. Vargas were assigned to Maintenance Vehicle 496 with Mr. Johnson as the Lead man.

At approximately 9:42 p.m. Maintenance Vehicle 496 was given run orders by the Train Controller to run from MW13 and A-2 Track to Mile Post 1.8. These run orders were read back by Maintenance Vehicle 496 and confirmed by BART Central, at which time BART Central notified Maintenance Vehicle 496 that they were unable to automatically align a route out of MW13. Maintenance Vehicle 496 confirmed the order and proceeded to A-2 Track, Mile Post 1.8.

At approximately 9:42 p.m. Train 973 manned by Train Operator Robert Harrigan advised BART Central that he was standing by at ATF01 in the Hayward Yard for movement orders. He was instructed to stand by by BART Central. At approximately 9:44 p.m. the Operator on Train 973 was told to load Destination 25 (Richmond Yard) and to stand by in automatic and that he would be running on the A-2 Track to A-45 crossing over and running the A-1 Track to R-25 where he would again cross to the R-2 Track and proceed to the Richmond Yard.

At approximately 9:53 p.m. Maintenance Vehicle 544 advised BART Central that they were at MW13 standing by for run orders, at which time BART Central advised them to run MW13 and A-2 Track to Mile Post 1.8. At this time Maintenance Vehicle 544 gave a wrong "Read Back." BART Central again advised Maintenance Vehicle 544 to run MW13 and A-2 Track to Mile Post 1.8.



APPENDIX A  
Page 2 of 2

Again, Maintenance Vehicle 544 gave an erroneous "Read Back," and again BART Central advised them to run MW13 and A-2 Track to Mile Post 1.8. Again, Maintenance Vehicle 544 gave an erroneous "Read Back." BART Central again advised Maintenance Vehicle 544 to run MW13 and A-2 Track to Mile Post 1.8. Again, Maintenance Vehicle 544 gave an incorrect "Read Back." BART Central again advised Maintenance Vehicle 544 to run MW13 and A-2 Track to Mile Post 1.8. After this fifth run assignment, Maintenance Vehicle 544 read back a hesitantly correct run order. BART Central then advised them of the restriction to work on sight with Unit 496.

At approximately 9:57 p.m. Maintenance Vehicle 496 advised BART Central that they were at Mile Post 1.8, A-2 Track awaiting orders, and BART Central confirmed that Maintenance Vehicle 496 was to work the A-2 Track between A-10 and A-45 until 0400 hours which Maintenance Vehicle 496 confirmed by a correct read back. BART Central then advised them of the restriction to work on sight with Maintenance Vehicle 544.

At approximately 10:00 p.m. BART Central called Train 973 and instructed that he hold at Fruitvale Station, which was confirmed by Train 973.

At approximately 10:00 p.m. BART Central advised Maintenance Vehicle 496 that there would be train activity on the A-1 Track. The reception of this message was confirmed by Maintenance Vehicle 496.

At approximately 10:00 p.m. BART Central advised Train 973 that there would be personnel working on the A-2 Track, and this message was confirmed by Train 973.

At approximately 10:08 p.m. Maintenance Vehicle 544 called BART Central and advised them that their position was on the M-2 Track, Mile Post 1.8, at which time BART Central gave them their work orders to work the A-2 and C-1 Tracks between A-15 and K-25, at which time Maintenance Vehicle 544 confirmed. BART Central also advised Maintenance Vehicle 544 that power was off in their work area and that there would be train activity on the A-1 Track. Maintenance Vehicle 544 confirmed.

At approximately 10:10 p.m. BART Central called Train 973, holding at Fruitvale Station, and advised the Train Operator that his train was released in automatic.

At approximately 10:13 p.m. contact rail sections KL06, AR01 and AR02 tripped. At this time BART Central attempted to contact Train 973 with no success. They then contacted Maintenance Vehicle 496 who advised them that their last sighting of Train 973 was when it was on its way toward Lake Merritt.

At approximately 10:14 p.m. BART Central attempted to contact Maintenance Vehicle 544 also with no success. They then contacted Maintenance Vehicle 496 and requested that they proceed back to A-15. According to Mr. Moore's testimony, Maintenance Vehicle 544 was stopped on the A-1 Track at Mile Post 1.8 when they requested work orders. As previously stated, this request for work orders was requested at approximately 10:08 p.m. and was confirmed by Maintenance Vehicle 544 at approximately 10:10 p.m. Mr. Moore then states in his testimony that Mr. Coppedge was sitting in the middle of the vehicle filling out the work order sheet, looked up and said "here comes the train." Mr. Moore, who was sitting on the passenger side next to the door, jumped from the truck and turned in time to see the train hit Maintenance Vehicle 544. Mr. Moore ran around the train and started up the

A-2 Track where he found the body of Mr. Briggs. He also saw Train Operator Harrigan standing on the A-2 Track, and Mr. Coppedge pulling himself out of the wreckage. Mr. Moore then ran to the Oakland Shops, which was approximately one-half mile away, where he met Mr. Johnnie Simpson, the Foreman, coming out of the Shop. They both proceeded to Mr. Simpson's office where Mr. Simpson called the Grove Street Ambulance Service and then called BART Central to advise them what had occurred. Mr. Simpson requested that Mr. Moore return to the site and stay with Mr. Coppedge, which he did.

By this time BART Police Services had been advised of the incident and had proceeded to the accident scene. They requested the Oakland Fire Department and an ambulance. Shortly thereafter, the Oakland Fire Department arrived on the scene and BART Police advised the firemen to cut the fence to permit the ambulance crews on to the site. The ambulance arrived and removed Mr. Briggs and Mr. Coppedge from the scene.

BART Police Services also requested BART Central to call out a major maintenance crew. It was also noted by them that Gap Breaker Station AXJ was completely destroyed.

Train Operator Harrigan reported to the BART Police that he saw the Maintenance Vehicle; and when he realized they were on the same track and on a collision course, he pushed the stop button and immediately vacated the cab and went to the back of Vehicle 152.

It was later determined that Train 973 was on the A-1 Track with A-Car 152 derailed and stopped approximately 455 feet north of Mile Post 1.8, and B-Car 709 was also derailed. Maintenance Vehicle 544 was wedged partially under Vehicle 152 and along the west side of the north bound train and was completely destroyed.

AC Transit service instituted a bus bridge between Colliseum Station and 19th Street Station - Oakland until approximately 4:30 p.m. on Monday, January 20, 1975, when normal service was restored.

#### ESTABLISHMENT OF THE BOARD OF INQUIRY

A special committee was formed to investigate the incident, establish the cause and make recommendations to reduce to a minimum the possibility of such an incident occurring again. This committee consisted of: W. F. Brundrit, Manager of Transit, Toronto Transit Commission, Toronto, Canada; W. D. Lamprecht, Vice-President - System Operations (Retired), Southern Pacific Transportation Company; H. C. Munson, Vice President and General Manager of Operations (Retired), Western Pacific Railroad Company, currently on the Board of Directors; Richard Pasini, Chairman of the Safety Committee of United Public Employees - Local 390, and a BART employee; R. W. Carroll, Director of Maintenance - BART; L. J. Hoagland, Manager of Insurance and Safety - BART; A. E. Wolf, Director of Transportation - BART; and E. J. Ray, Executive Assistant - Operations, Chairman - BART.

3. The various rules governing employees do not appear to be properly coordinated nor are they in such form that they can be readily carried by the employees as required. It was found that rules governing one class of employee were not furnished to them and reliance was placed on various types of safety meetings to see they were acquainted with the rules. These and other matters developed should be corrected.
4. The surviving crew members of Maintenance Vehicle 544 testified they heard the transmission of the run order, in fact one member helped the deceased copy it. Yet they did not realize they were on the wrong track when they stopped for work orders. Employees should be instructed in the various route designations, wayside and the like.
5. Moves by maintenance vehicles should be made through centrally controlled switches whenever possible.
6. With respect to actions by BART Central Control, it is very evident that the Train Controller had grave doubts about the Operator's condition and ability. If BART does not presently have such a rule one should be instituted reading, "In case of doubt or uncertainty, the safe course must be taken." This would mean that Maintenance Vehicle 544 would have stayed on MW13 until the Train Controller was satisfied by a Supervisor that the Operator of Maintenance Vehicle 544 was in a condition to properly function.
7. All maintenance vehicles should carry on them in a readily accessible place a schematic drawing of the BART System showing the designation of all tracks, crossovers, maintenance of way access points, and such other designated areas which are necessary for the safe operation of maintenance vehicles.
8. Procedures should be established to periodically review the competency of Operators and Leadmen in operation of maintenance vehicles and radio communications.

Due consideration was given to the toxicology report of the Alameda County Coroner's Office dated January 22, 1975. This report disclosed that the deceased's blood ethyl alcohol content was 0.11. A qualified medical witness called by the attorney for the deceased's family testified that he would have doubts about the results of this report in the absence of clinical evidence of intoxication. In addition, the witnesses called, who had seen the deceased before the accident, testified that he showed no signs of consumption of alcohol or intoxication. In view of the conflicting evidence, it was impossible to reach a firm conclusion on the possible effect of alcohol on the deceased.

\*

W. F. Brundrit  
Manager of Transit  
Toronto Transit Commission

*W. D. Lamprecht*  
W. D. Lamprecht (Retired)  
Vice President - System Operations  
Southern Pacific Transportation  
Company

*H. C. Munson*  
H. C. Munson (Retired)  
Vice President and General Manager  
of Operations  
Western Pacific Railroad Company

*Richard Pasini*  
Richard Pasini  
Chairman of the Safety Committee of  
United Public Employees - Local 390

*R. W. Carroll*  
R. W. Carroll  
Director of Maintenance - BART

*L. J. Hoagland*  
L. J. Hoagland  
Manager of Insurance and Safety - BART

*A. E. Wolf*  
A. E. Wolf  
Director of Transportation - BART

*E. J. Ray*  
E. J. Ray  
Executive Assistant - Operations  
Chairman - BART

\*The foregoing contents of this report were read over the telephone to Mr. W. F. Brundrit by Mr. E. J. Ray this date, and agreed to by Mr. Brundrit. A letter of confirmation will be forthcoming from Mr. Brundrit and will be attached hereto.



## SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

## INTER-OFFICE COMMUNICATION

To: Lawrence D. Dahms  
Acting General Manager

From: Board of Inquiry

Subject: Investigation Report - Runaway Vehicle Incident  
of Monday, January 27, 1975

Date: February 4, 1975

SUMMARY OF INCIDENT

At 9:35 a.m. on Monday, January 27, 1975, Train 383-1 was taken out of service at Daly City and at 9:49 a.m. was parked in Zone TM-3 at Daly City. At 10:45 a.m. Craig Rhorsen, main line technician, was sent to Daly City to check out the consist which was reported to have propulsion problems on Vehicle 116. Upon arriving at Daly City, he asked for a train operator. Steve Estes was assigned to this task. Vehicle 116 had a steady system dynamic and reverser annunciator on at high speed. Rhorsen and Estes uncoupled Vehicle 116 in an attempt to clear the reverser annunciator, but it would not clear. After recoupling Vehicle 116, the train was moved forward to see if any annunciator showed. Although no annunciator showed, the train did seem to move sluggishly. At that time an operator on the platform said he saw sparks on the "Y" end truck of Vehicle 116. At this time the technician Rhorsen cut out the friction brakes on both the "X" and "Y" trucks on Vehicle 116. The train was then hostled back and forth the length of the platform to ensure that all wheels moved freely. At this time Rhorsen contacted Central to have the train released back to the Concord Yard. After dispatch Rhorsen rode in Vehicle 116, which was the tail end car, to watch for problems. After a couple of stations, the "X" end truck started to smoke and Central was informed. The hydraulic power unit for Vehicle 116 was dumped removing all brake pressure control for the braking system, and the train proceeded to MacArthur Station. Although the train would have normally proceeded in a half-speed mode, the technicians had "jumped" the train consist so that it would operate at 80 MPH, and it was at this speed that it proceeded to MacArthur Station.

The train was now resting on Track C-4 at the K-35 interlocking. The third rail power was cut off and technicians Rhorsen and Shelley inspected the "X" end truck of Vehicle 116. Upon inspection it was found that the traction motors 1 and 2 had burned. While the train was being inspected, Operator Estes found that there were no chocks on his train, and he managed to get chocks from a Richmond bound train which he placed under the leading ends of both the "X" and "Y" end trucks on the downhill side. He radioed Central of his actions and proceeded back to C-60 at approximately 1:30 p.m.

Also at approximately 1:30 p.m., James Fergus, Foreman II at Concord Shops, received a call from the technicians who had been working on Vehicle 116 who informed him that No. 1 traction motor on Vehicle 116 had flashed over and there was smoke and sparks coming from the motor. Due to the possibility of a bearing lock up and resulting serious wheel and gear damage, Mr. Fergus accompanied by two General Car Repairmen went to K-30 to uncouple the motor from the gear box. They arrived at MacArthur Station at approximately 2:30 p.m. and received safe clearance from Central about 2:50 p.m. Mr. Fergus decided to uncouple Vehicle 116 from the consist and placed one chock about 2 feet ahead of the leading truck and instructed one of the technicians with him to stand by at wheel #1 with a pry bar so that he could move the vehicle when Fergus hit the uncouple button. At this time the car control panel status showed propulsion and logic cut out and brakes, mechanical and electrical, cut out. At this point Mr. Fergus hit the uncouple button and the vehicle immediately separated from Vehicle 687, and the impetus provided by the uncoupling at a descending grade (2.04%) lurched the vehicle over the chock in front of wheel #3. At this time Mr. Fergus de-energized the electrical cut out and started for the cab of Vehicle 116 to warn Central on the train telephone; but upon looking out the window and seeing the speed at which the vehicle was going, he decided to evacuate the vehicle. He ran to MacArthur Station and phoned Central from the Agent's booth of the runaway.

At approximately 3:26 p.m. Mr. McPherson, train controller, received a call from Mr. Fergus reporting that a vehicle had become unsecured from the consist at K-35, TM-2. The vehicle was rolling downgrade toward 19th Street Station in the Oakland Wye. Mr. McPherson notified Jack Bradley, Central Supervisor, and immediately implemented actions to hold all train movements which might conflict with the probable route being traveled by the loose vehicle. It should be pointed out that the train control board display indicated the loose vehicle which was now stopped on the C-2 Track at A05 between Gates P and F.

Mr. Paul Couture and Mr. Paul Shelley were dispatched into the Oakland underground to locate the vehicle and report to Central. Mr. A. Johnson, Zone Supervisor on the "K" Line was notified to board Train 389 and enter the tunnel at 12th Street.

At approximately 3:40 p.m., reports from Mr. Couture fixed the location of the loose vehicle at Mile Post 0.1, C-2 Track. Passengers aboard Train 111 were disembarked, and Train 111 proceeded to the location of the loose vehicle where coupling was completed at approximately 3:59 p.m. Train 111 with Vehicle 116 in tow was routed out of service to the Hayward Yard, arriving at approximately 4:30 p.m.

Switch and Lock crews and Electrical Units inspected A05, K-25 and K-35 for damage and found the damage was insufficient to interfere with normal operations. Minor damage was discovered at K-35, Gate B and repairs were deferred until the non-revenue hours.

INVESTIGATION OF CAUSE AND RECOMMENDATIONS

A special committee was formed to investigate the incident, establish the cause and make recommendations to reduce to a minimum the possibility of such an incident occurring again. This committee consisted of: James F. Elder, Superintendent of Operations, Port Authority Transit Corporation, Camden, New Jersey; W. D. Lamprecht, Vice President - System Operations (Retired), Southern Pacific Transportation Company; H. C. Munson, Vice President and General Manager of Operations (Retired), Western Pacific Railroad Company, currently on the Board of Directors; Dick Pasini, Chairman of the Safety Committee of United Public Employees - Local 390; R. W. Carroll, Director of Maintenance - BART; L. J. Hoagland, Manager of Insurance and Safety - BART; A. E. Wolf, Director of Transportation - BART; and E. J. Ray, Executive Assistant - Operations, Chairman - BART.

CAUSE

The Foreman II lacked the necessary knowledge and experience required for the task for which he was assigned. He admittedly had no mainline experience and this inexperience led him to underestimate the significance of uncoupling a vehicle sitting on a 2.04% descending grade, and the ease with which a vehicle will roll on such a grade. Other contributing factors were:

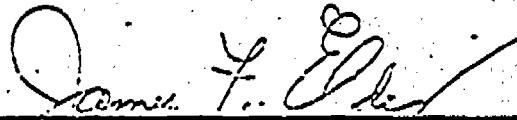
- a. There was no written procedure spelling out the details of how to handle a move such as was attempted.
- b. All brakes with the exception of the parking brake were cut out on the vehicle.
- c. The chocks used were insufficient and improperly placed.
- d. Failure of the Foreman to operate the Parking Brake Button on the hostling panel after the vehicle started rolling allowed the vehicle to keep rolling.

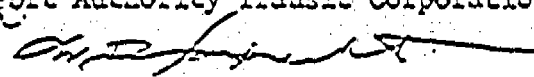
RECOMMENDATIONS


1. Establish a written procedure spelling out the necessary safety precautions that should be followed when performing inspections and/or major repair work on revenue vehicles on the mainline.
2. The District should review its policy regarding the qualifications of individuals who are allowed to supervise or perform major repair or inspections on revenue vehicles while such vehicles are on the mainline. Any such work should include the presence of a Transportation Supervisor.




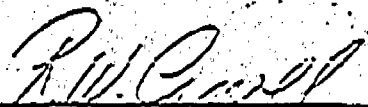
3. Any uncoupling of revenue vehicles on the mainline should be accomplished only if an emergency exists. The only exception should be for normal uncoupling consist changes at end-of-line terminals.
4. If uncoupling becomes necessary, it should always be accomplished in the power mode, third rail energized, and by uncoupling the vehicles on the upgrade from those on the downgrade. All downgrade vehicles should be secured with chocks and have the parking brake set prior to making a vehicle uncoupling move.
5. Revenue vehicles should be supplied with a suitable number of chocks.
6. Chocks used on grades should at least be similar to what is called a skid type and should be permanently located in selected locations on the system.
7. The decision making process as to when vehicles are removed at normal operating speeds for traction motor failures should be reviewed.

  
James F. Elder  
Superintendent of Operations  
Port Authority Transit Corporation

  
W. D. Lamprecht (Retired)  
Vice President - System Operations  
Southern Pacific Transportation  
Company


  
E. C. Munson (Retired)  
Vice President and General Manager  
of Operations  
Western Pacific Railroad Company

  
Dick Pasini  
Chairman of the Safety Committee of  
United Public Employees - Local 390

  
R. W. Carroll  
Director of Maintenance - BART

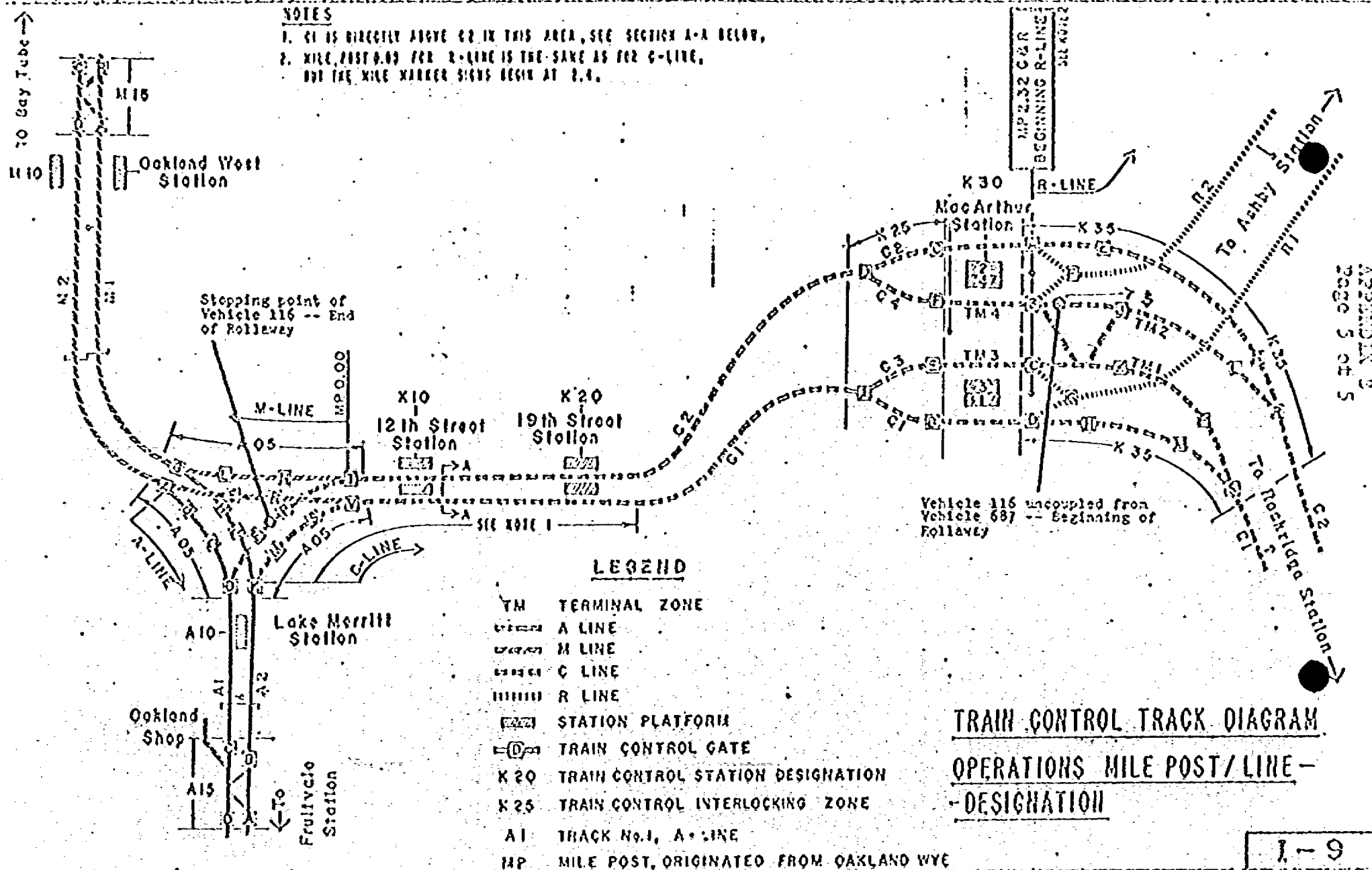
  
L. J. Hoagland  
Manager of Insurance and Safety - BART

  
A. E. Wolf  
Director of Transportation - BART

  
E. J. Ray  
Executive Assistant - Operations  
Chairman - BART

## NOTES

1. C1 IS DIRECTLY ABOVE C2 IN THIS AREA, SEE SECTION A-A BELOW,
2. MILE POST 0.00 FOR R-LINE IS THE SAME AS FOR C-LINE, BUT THE MILE MARKER SIGNS BEGIN AT 2.4.



TRAIN CONTROL TRACK DIAGRAM  
OPERATIONS MILE POST/LINE -  
DESIGNATION

## ATTACHMENT 1

To: Attendees Date: March 18, 1975  
From: R. C. Snyder  
Subject: Synopsis of CPUC - BART Meeting, March 14, 1975

I. Attendees - March 14, 1975

T. A. Bratz	BART
J. G. Bolger	LBL
H. N. Buchanan	TRW
L. D. Dahms	BART
M. A. Denowitz	BART
D. M. Evans	LBL
K. V. Hari	BART
R. Harris	TRW
C. O. Kramer	BART
M. Lari	BART
L. Lee	CPUC
W. L. Oliver	CPUC
H. Privette	CPUC
W. J. Rhine	BART
D. T. Scalise	LBL
R. C. Snyder	BART
J. L. Thomas	BART

II. Background

Previous meetings had been held between BART and CPUC to discuss preparations for the CPUC hearings to be held beginning March 26, 1975.

- A. February 25, 1975 (AM) - CPUC Counsel, Staff and Consultants (LBL) and Bill Wattenberg; and BART staff and TRW attended. CPUC presented a three point outline (Attachment A) and described the information to be required. CPUC and BART agreed on assignment of items of work to be accomplished.
- B. February 25, 1975 (PM) - CPUC, LBL and BART staff and TRW attended. Development of the index to fulfill Item 1 of the three point outline (Attachment A) was discussed.
- C. February 27, 1975 - CPUC, LBL and BART staff and TRW attended. The Item 1 index discussion continued. The data required was tentatively identified.
- D. March 3, 1975 - CPUC Counsel and staff, LBL, Bill Wattenberg and BART staff and TRW attended. The CPUC presented a four point outline (Attachment B). Attachment B replaces Attachment A. BART presented a data collection methodology to support development of the Item 1 index which was agreed to in principle by the CPUC. BART also presented material pre-

pared by TRW defining a detailed procedure for operating procedures review and for hardware failure mode and effects analysis. It was explained that this material was intended to be responsive to Item 2 of Attachment A (Attachment B, Item 3); but that such detailed analysis would necessarily be limited to a small percentage of BART's procedures and hardware. In order to be responsive to Commissioner Ross' desire for affording the CPUC a check on BART's approach to analyzing the full range of operating procedures, additional material would be submitted to the CPUC later in these deliberations. It was also agreed that two specific procedure review examples, that is relative to the January 19 and 27 incidents, would be provided.

It was agreed that BART would concurrently develop safety priorities in lieu of waiting for development of the index as previously agreed on February 25 in order to be prepared for CPUC review prior to the hearing dates. Recommencement of the CPUC hearings tentatively was indicated to be March 24, 1975. (Subsequently changed to March 26, 1975)

### III. Discussion - March 14, 1975

The data collection results were reviewed and agreement reached on next steps as outlined below.

- A. Data Collection - It was agreed that existing data now being collected and reported by BART are sufficient and that the recording of manual intervention data at BART Central need not continue. Specifically, the existing Trouble Reporting System will provide equipment failure data while the computerized Manual Intervention Log will record instances of manual interventions. The latter needs to be automatically summarized, however, to facilitate the monitoring process.
- B. Priorities and Measurement of Progress Relative to Reliability Problems which May Affect Safety - It was agreed that BART Engineering Priorities developed based on the existing BART Trouble Reporting System are appropriate. These priority items with proposed weighting factors were listed in the BART Director of Engineering's memorandum of March 10, 1975.


The Director of Engineering, using BART's Trouble Reporting System for the data base, subdivided reliability problems as they affect three subsystems: (1) vehicle borne equipment (2) the central control computer and (3) station and wayside equipment. It was agreed that engineering priorities established in this manner are appropriate for prioritizing efforts directed at reliability problems which may affect safety. Priority setting and progress measurement relative to each of the three subsystems are identified briefly below:

Category 1 - Vehicle Borne Equipment - Priorities will be established by the weighting factors to be further developed and assigned by BART Engineering. Progress will be monitored by the improvement on an appropriate sample of vehicle installations by means of failures normalized by some factor such as car miles (in revenue service).

Category 2 - Central Control Computer - This item will be given a high priority because of its effect upon the entire system. The weighting factor assigned by Engineering does not adequately adjust for this because of the infrequent computer failures. Progress in improvement may be measured by the mean time to restore (MTTR) the system after a central computer failure, and by the number of manual interventions. Such improvement will involve development of diagnostic routines and software improvements to the CABS algorithms. It was agreed that MTBF in this case is not as relevant as the MTTR measure.

Category 3 - Station and Wayside Failures - Priorities will also be established by the weighting factors to be further developed and assigned by BART Engineering and again progress in improvement will be measured by means of number of failures per period on an appropriate sample of wayside installations. Progress in reducing manual intervention to align routes will be monitored also.

It was agreed that each of the above three categories would be the focus of separate reviews. While the joint deliberations of BART and CPUC staff and consultants has produced an agreed basis for establishing priorities and agreed indicies for measuring improvement, the base and the expected rate of improvement has not been established as part of these deliberations. It will therefore be necessary to rely upon further professional judgment by CPUC staff and Consultants in consultation with BART staff in monitoring the improvement indicies.

  
Roy C. Snyder

RCS:kb  
Attachments

ATTACHMENT A

1. BART will prepare an outline and define specific safety problem areas and safety-related car reliability problems after receiving from LBL (for CPUC) and CPUC staff a definition of "standards of safety." (By Monday, March 3, 2:00 p.m. - BART Hdqtrs). (LBL (Evans, Scalise), CPUC staff (Oliver, designee, VM) and BART (Kramer, Hari, et al) assigned to begin work today at 3 p.m. at BART Hdqtrs).
  - (a) A specific timetable then to be established for attacking problem areas (no time set).
2. BART to develop by Monday, March 3, a draft of a set of procedures required to make failure mode analyses of safety problems.
  - (a) Specific problem areas defined will later be related to f/m/a.
3. CPUC staff, by March 3, will draft a suggested method of BART reporting and enforcing accidents/incidents/"unusual occurrences" to P.U.C.

ATTACHMENT B

1. Develop a criteria ("yardstick") for measuring safety related problems. 3-3 (LEL)
2. Define and outline specific safety problem areas and safety related car reliability problems. 3-10 (BART)
  - a. Establish timetable for attacking problems; include reduction of service threshold.
3. Develop comprehensive set of procedures required to make failure mode analyses. 3-3 (BART)
  - a. Analyze and evaluate BART operating rules and procedures with recommended improvements. (BART/CPUC)
4. Establish a method of reporting accidents/incidents/unusual occurrences to CPUC. (CPUC Staff)

ATTACHMENT 2 March 21, 1975

To: Attendees

From: R. C. Snyder

Subject: Synopsis of CPUC - BART Meeting, March 19, 1975

I. ATTENDEES - MARCH 19, 1975

J. G. Bolger	LEL
H. N. Buchanan	TRW
R. W. Carroll	BART (Part time)
L. D. Dahms	BART
D. M. Evans	LEL
K. V. Hari	BART
R. Harris	TRW
C. O. Kramer	BART
L. L. Lee	CPUC
V. V. MacKenzie	CPUC
W. L. Oliver	CPUC
H. Privette	CPUC
W. J. Rhine	BART
T. E. Rogers	CPUC
D. T. Scalise	LEL
R. C. Snyder	BART
S. G. Wakeman	BART
W. H. Wattenburg	CPUC Consultant
A. E. Wolf	BART (Part time)

II. DISCUSSION - MARCH 19, 1975

The synopsis of the March 14, 1975 meeting at which the CPUC Staff and Consultants (LEL) and BART Staff and Consultants (TRW) were in attendance, was submitted to the attendees. All attendees concurred in the statements and agreements set forth in the March 14, synopsis, particularly with regard to the method of data collection and the need to further define measures of progress.

A memorandum from BART's Director of Engineering to the Acting General Manager dated March 10, 1975 with attachments setting forth engineering priorities was discussed in detail. It was agreed that the focus of this meeting was directed specifically toward reliability problems which may impact safety, notwithstanding the fact that BART must give high priority to other potential safety problems identified in the March 10 memorandum.



The data now being collected and reported by BART relative to failures indicates that the four most significant areas affecting reliability on the vehicles are as follows:

Propulsion  
Train Control (car borne)  
Brakes  
Door System

It was agreed by the attendees that these four are established as the priority items to be addressed by the participants.

Dr. Wattenburg suggested the following timetable for addressing the four vehicle subsystems:

Within 60 days from the end of the PUC hearing, BART will identify the causes of each problem and specify one or more feasible design solutions.

Within 90 days a means to solve each problem will be selected, and a supplier identified.

Within 6 months the test "fix" will be installed in a test fleet.

BART agreed to the following goal which it would strive to achieve:

Within 90 days the problems would be investigated and understood, a design solution specified, and sources selected.

Within 6 months the test "fix" will be installed in a test fleet.

BART also stated that it would prepare its own schedule relative to the priority items. The schedule would reflect urgency, and be realistic, however, it might not substantiate the likelihood of achieving the goal.

After considerable discussion regarding the "task force" approach, it was agreed that the basic intention is to address two concerns:

- 1) That BART can demonstrate assignment of adequate resources to the four target subsystems;
- 2) That CPUC staff and/or consultants have adequate opportunity to be fully informed in a timely manner of progress and decisions. Thus CPUC concerns and objections could be made on a timely basis.

Given these common objectives, BART agreed to specify the full extent of engineering resources to be assigned.

Further, BART agreed to involve the CPUC staff and/or consultants in its deliberations, much in the manner of a task force. BART and CPUC would retain their independent roles, however.

BART agreed to prepare and submit its formal review procedures. In addition, as examples, TRW is preparing analyses of the rules and functions pertaining to the maintenance vehicle incident (January 19, 1975) as well as the runaway vehicle incident (January 27, 1975). It was agreed that CPUC staff will review BART procedures on a continuing basis. BART will, therefore, submit its rules and procedures to the CPUC staff and notify the CPUC immediately when such rules are revised as a matter of course. Accompanying such notification will be documentation of the review given the revision.

Further, it was agreed that BART would lead off the presentation at the forthcoming hearings by documenting the work of the participants in the interim since February 21 in arriving at an agreed basis for data collection, determining priorities, progress and roles. In addition, BART will present a progress report on the Maintenance Vehicle Detection Device. BART's presentation will be followed by testimony of CPUC Consultants and Staff. BART agreed to provide this synopsis to the CPUC office by noon Friday, March 21. It was agreed that all parties to the forthcoming hearings would exchange drafts of prepared testimony by noon Monday, March 24, 1975, for review of the CPUC counsel, and the information of all. It was further agreed that any participant objecting to any of the material in the March 19, 1975 synopsis or in the draft testimony of any of the participants would make their objections known to the authors by noon Tuesday, March 25, 1975, in order to provide an opportunity to clarify any misunderstandings.

With respect to statements made by Dr. Wattenburg at the previous hearing concerning the time required to install detection devices on the maintenance vehicles, it was noted that Dr. Wattenburg's determination was based on the assumption that BART would manufacture the devices in house, while BART's determination was based on manufacture of the devices by others through the competitive bidding process.

  
Roy C. Snyder