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ALTERNATIVES ANALYSES

AUXILIARY VEHICLES

Prepared by
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WBS 14CAE13

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EXECUTIVE SUMMARY

The auxiliary vehicle alternatives analysis was performed to investigate the cost-effectiveness of using locomotives with flatcar vs. self-propelled vehicles, and the purchasing of rail grinding equipment vs. contracting the work. In performing this analysis, it was necessary to investigate all of the various work tasks that will be performed on the SCRTD System by auxiliary vehicles.

Information was available from an analysis by Kaiser Engineers, Baltimore that outlined the work functions, methods, and equipment utilized by other transit properties. This report updates that information and presents the basic requirements and costs associated with the various work/maintenance functions related to auxiliary vehicles.

A summary of work functions, preferred methods, and annual costs (where applicable) is shown in Table A. An attempt was made to identify all work functions that might require an auxiliary vehicle. In the course of the alternatives analysis, it became apparent that an auxiliary vehicle would not be required to perform some of the identified work functions. These are marked N/A (not applicable) in Table A. A partial listing of available equipment with specifications and associated costs is shown in this report (See Appendix C).

It can be concluded from this analysis that it would be less costly to purchase a locomotive and flatcars rather than self-propelled vehicles and that it would be less costly to contract out the work of grinding the rails rather than purchase rail grinding equipment. Specially designed self-propelled vehicles are very expensive due to the one-time engineering costs associated with only one vehicle. There is a less significant cost difference between contracting vs. purchase of rail grinding equipment.

Table A

WORK FUNCTION SUMMARY

Function	Preferred Method	Annual Cost
1. Tunnel cleaning/maintenance	Wash/vacuum train or hi-rail	53,520
2. Station cleaning	Local equipment	N/A
3. Rerailing track	Self-propelled work car/flatcar	13,890
4. Rerailing vehicles	Portable hydraulic equipment	4,930
5. Trash collection	Via street through stations	N/A
6. Emergency water pumping	Rental/contract equipment	N/A
7. Rail grinding	Contract	15,625
8. Ultrasonic inspection	Contract	165/mile
9. Vehicle towing	Small locomotive/work car	*
10. Yard/shop moves	Car mover	26,950
11. Misc. yard maintenance	Multipurpose crane/loader	19,880
12. Substation/electrification	Street and rail equipment	N/A
13. Cash collection	Street or rail	N/A

*Covered under rerailing track and yard/shop moves.

Chapter 1

INTRODUCTION

1.1 BACKGROUND

In WBS element 14CAE13, Kaiser Engineers' task was to develop information on the auxiliary vehicle alternatives and, where possible, make appropriate choices among the alternatives. KE was to analyze only those items that would have a major impact on the Metro Rail system.

Kaiser Engineers prepared a list of candidate design alternatives based upon SCRTD's list of Metro Rail Project Major Alternatives. This list was presented and discussed with the Metro Rail Project staff at a meeting on March 3, 1982. At that time the following two items were selected for auxiliary vehicle analysis studies:

- Self-propelled vehicle vs. locomotive with unpowered vehicle for service and maintenance
- Purchased vs. leased rail grinding and track alignment equipment

1.2 PURPOSE/OBJECTIVES

Kaiser Engineers' primary task was to support the District in establishing the auxiliary vehicle subsystem information for comparing alternatives. KE was also to develop the preliminary information in sufficient detail to enable the District to make the most beneficial selections from the alternatives.

1.3 SCOPE

The preliminary auxiliary vehicle design criteria, furnished by the District and critiqued by Kaiser Engineers in WBS 13CAE13, outlined certain maintenance functions. Section 2.3 of Chapter 2 lists all these functions that serve as a basis for this report.

1.4 METHODOLOGY

Prior to the collection of data for the performance of WBS 14CAE13, the alternatives to be considered were discussed with the Metro Rail Project staff. In addition, the MRP staff determined a set of critical evaluation factors and economic parameters to be used in the analyses. Each alternative was to be evaluated on an annual cost basis, with consideration given to cost of procurement (capital cost), operating costs, and maintenance of equipment costs. In addition, the availability of the equipment and the technical risk involved in its usage were to be considered.

1.4.1 Design Assumptions

To determine the equipment operating and maintenance costs on a reasonable basis, design assumptions were made with regard to equipment usage based on the SCRTD preliminary auxiliary vehicle criteria, the preliminary operating plan, and the preliminary draft functional plan for yards and shops. Assumptions for usage frequency and duration of each function were based on the maintenance policies of other transit properties operating similar systems.

A. General criteria. The following are the general criteria for the design of all auxiliary vehicles:

- Dimensions should not exceed passenger vehicle clearance diagram
- Track gauge of 4' 8 1/2"
- Track wheel base of 7' 6"
- Maximum speed of 70 mph
- Withstand buff load (static compressive end load) of 200,000 lb
- Utilize full width anti-climbers
- Be equipped with two four-wheeled trucks
- Utilize couplers to match passenger vehicle
- Be provided with Automatic Train Protection functions including overspeed protection
- Be provided with radio communications as in all passenger vehicles
- Be designed for 30-year life

B. Design Assumptions. Criteria for specific auxiliary vehicles considered for the maintenance functions in this study are as follows:

- o Crane car
  - electrically propelled standard flatcar
  - 4 to 16 feet boom extension
  - 5000-lb lifting capacity
  - remote control by umbilical cord

- o Train jacking car
  - apparatus to rerail empty passenger vehicle
  - self-propelled diesel capable of towing one passenger vehicle

- o Tunnel/station maintenance car
  - self-propelled diesel
  - wash equipment with brushes
  - tanks with 18.6 mi cleaning capacity
  - vacuum system for dust and debris in tunnel
  - man-lift device for relamping light fixtures
  - compressor for aeration and pneumatic tools

- o Trash collection vehicle
  - electrically self propelled
  - trash compactor with dump capability

1.4.2 Vendors, Users, and Associates

Technical, cost, and performance data were obtained from equipment suppliers, maintenance staff with existing transit systems, and engineering associates in the rail transit and railroad fields (See Appendix A).

1.4.3 Cost Evaluations

Where applicable, all analyses considered capital costs, annualized capital costs (based on 32 years at 12% interest), operating costs, and equipment maintenance costs. All cost values are given in 1982 dollars.

Chapter 2

AUXILIARY VEHICLE ANALYSES

2.1 INTRODUCTION

The purpose of this work task was to develop, analyze and evaluate information on auxiliary vehicles including maintenance and failure recovery equipment. The evaluations will indicate the cost effectiveness and practicality of possible equipment usage on the SCRTD Metro Rail System.

2.2 METHODOLOGY

A similar analysis and research task was conducted by KE Baltimore in 1978. Results of the effort were not published as a public document, but were available in the KE files and are included here (See Appendix B). The Baltimore investigation studied the functions to be performed by auxiliary vehicles, how other transit properties accomplished the functions, and what equipment was generally available. Data from the following nine transit properties were considered in the study: MARTA, WMATA, BART, PATCO, TTC, MBTA, CTA, SEPTA, and NYCTA.

Based on the directive that Metro Rail will use only proven, available equipment wherever possible, the District-prepared preliminary auxiliary vehicle criteria were compared to the material produced in the 1978 Baltimore study. The comparison indicated that proven equipment capable of complying fully with the criteria listed in Chapter 1 (Section 1.4.1) is not available in some cases. This may indicate that some criteria may have to be changed, or that additional information should be added. For the purposes of this study, the decision was made to present material in this report on the basis of each work function to be performed and the possible methods and equipment available for accomplishing that particular function.

2.3 SCOPE

Consideration is given in each case to the use of self-propelled vehicles, locomotives, flatcars, and contractor-performed tasks. The following work functions form the basis for this report:

- Tunnel cleaning and maintenance
- Station cleaning and maintenance
- Rerailing track
- Rerailing passenger vehicle
- Trash collection
- Emergency water pumping
- Rail grinding
- Ultrasonic inspecting of rail
- Towing of maintenance and transit vehicles
- Miscellaneous yard maintenance
- Electrification/substation maintenance
- Cool collection

In most cases, capital costs can be compared for the alternatives. With many variables and unknowns at this stage of system design, the operating and equipment maintenance costs can only be roughly estimated. Assumptions can be made for many work functions with regard to labor and frequency of operation, but predictions as to frequency of derailments, replacement of track, switch alignment, tunnel lighting maintenance, and maintenance of wayside signal equipment cannot be made at this time. The lack of these assumptions do not affect the analysis.

2.4. RESULTS

The following paragraphs discuss the basic work functions as outlined in the SCRTD auxiliary vehicle criteria. Estimated capital costs shown do not include the cost of automatic train protection (ATP), communications, or transit-type couplers.

2.4.1 Tunnel Cleaning and Maintenance

Of the nine properties surveyed, eight performed periodic wash/vacuum maintenance of tunnels (See Appendix B). All eight performed the work in-house with various types of equipment, ranging from in-house-built manual devices to high-pressure water/detergent/vacuum apparatus (used by BART and MARTA).

The BART equipment is a special design utilizing high-pressure water spray, nonfoaming detergent, 2500 gallon water capacity and a 12 cubic yard vacuum mounted on a 2 1/2 ton Ford truck. The water tank capacity enables approximately 1000 feet of tunnel to be cleaned. The MARTA unit is similiar except it is mounted on a rail flatcar. The MARTA wash/vacuum unit was designed and furnished in 1981 at a cost of $300,000.

Assuming the use of equipment similar to that used by MARTA and a cleaning frequency of six months, the annual cost of tunnel wash/vacuum is $53,520, as shown on Table 2-1.

Table 2-1

TUNNEL CLEANING AND MAINTENANCE COST ANALYSIS

Critical Area	Cost
Capital Cost	$300,000
Operating Cost (annual)	
a) labor @ $19.30/hr x 790 mannhours	15,285
b) fuel cost (2 engines @ 200 hrs each)	335
c) water cost (445,000 gal)	445
Total Operating Cost	$ 16,065
Maintenance Cost (annual)	
a) clean filters (each 6 months)	160
b) engine maintenance	160
c) material (filter,oil,etc.)	150
Total Maintenance Cost	$ 470
Total Operating and Maintenance Cost	16,535
Annualized Capital Cost	36,985
TOTAL ANNUAL COST (1982 dollars)	$53,520

Wash/vacuum equipment of this type has been widely used by the construction, municipal maintenance, railroad, and other industries. The technical risk should be minimal and the equipment is readily available.

2.4.2 Station Cleaning and Maintenance

Except for trash collection (paragraph 2.4.5), almost all properties maintain stations on an individual or group basis, utilizing equipment either stored in the station (scrubbers, mops, etc.) or transported from station to station via street vehicles. Occasional maintenance such as wall and ceiling washing, painting, or major repairs is generally more cost effective when contracted. For the above reasons, no foreseeable requirements exist for providing auxiliary vehicles for the purpose of station maintenance.

2.4.3 Rerailing Track

Replacement of rail sections and special trackwork requires the use of a flatcar for transporting material, a crane for handling the material, and a prime mover to move the work train to the work location. The prime mover/crane combination is available in at least three different configurations:

(1) Locomotive with crane mounted on a flatcar

(2) Small locomotive/work car with integral mounted crane

(3) Self-propelled crane capable of towing a material car

Flexibility and the possibility of utilizing the equipment for other functions must be considered in making a final purchase decision. The frequency of rail and trackwork replacement, as well as the required crew size, is not known at this time. For this reason, only capital costs are shown on Table 2-2.

Table 2-2

CAPITAL COST OF TRACK RERAILING EQUIPMENT

	(1) Locomotive	(2) Self-Propelled Work Car	(3) Self-Propelled Crane
50-Ton locomotive	400,000		
Self-propelled work car		200,000	
Self-propelled crane			175,000
Flatcar(s)	50,000	25,000	25,000
Crane	21,000	21,000	
Total Capital Costs	$471,000	$246,000	$200,000
Annualized Capital Costs	$ 58,065	$ 30,325	$ 24,655

A. Costs Equipment data are shown in Appendix B. For this analysis, the assumed equipment is a locomotive similar to the Plymouth CR-8 50 ton; the self-propelled work car is similar to the Plasser PMC 30; and the self-propelled crane is similar to the Pettibone 40 LPC-SC. Flatcar (50 feet) cost is estimated to be $25,000; a crane with approximately 7500-lb lift capacity, suitable for installation on a flatcar or work car, is estimated to cost $21,000.

The Table 2-2 shows a cost advantage for configuration (3), the self-propelled crane. If, however, equipment utilization is considered, and rerailing track is assumed to use only one-third of the available time for the locomotive and work car, the annualized capital cost becomes $25,190 for configuration (1), $13,890 for configuration (2) and remains at $24,655 for configuration (3). This indicates a cost advantage for the self-propelled work car (2) with attached crane. Although it is difficult to place dollar values on flexibility and versatility, the self-propelled workcar (which is essentially a small locomotive) rates very high.

B. Availability and technical risk. All of the equipment considered for rail replacement is readily available at this time and can exhibit a proven successful history.

The use of dual purpose hi-rail (highway and rail) vehicles (configuration [2]) has become more popular in recent years with railroads and the newer transit properties. In many cases, the cost of hi-rail vehicles is less than a vehicle designed for rail use only. The safety related requirement that calls for detection of vehicle equipment on the rail by Automatic Train Control is not as easy to obtain with the use of hi-rail vehicles, but is possible with the addition of reasonably low-cost devices. A major accident on the BART System involving a hi-rail maintenance vehicle resulted in modifications to all of their hi-rail equipment to enable detection and provide the necessary safety. The modification involved the installation of equipment that transmits a jamming signal into the running rail to insure reliable detection. To date, the method has been satisfactory and reliable.

2.4.4 Rerailing Passenger Vehicle

To replace a derailed passenger vehicle, which has not been extensively damaged, on the running rails, generally requires only portable hydraulic equipment. Equipment is available with vertical jacking and traverse motion in excess of that required for rerailing an 80,000-lb transit vehicle. The equipment is portable, includes the necessary hydraulic pump and controls, and can be transported to the work area on a small hi-rail vehicle or a work car (configuration (2) described in paragraph 2.4.3 above). Cost of a complete unit, as furnished by Simplex is estimated to be $20,000 in 1982 dollars (See Appendix C). Life of the equipment is estimated to be 15 years. The annualized capital cost for equipment to perform this function is estimated to be $4,930.

Once the passenger vehicle has been replaced on the rail, towing can be accomplished by other passenger vehicles or a small locomotive or work car. Since this is equipment utilized on an infrequent basis and shared with other functions, no cost for towing is assigned to the function of rerailing passenger vehicles.

2.4.5 Trash Collection

The survey indicated that most properties collect and remove trash using their own in-house personnel (See Appendix B). Of the nine properties surveyed, four removed trash from stations via surface vehicles, three utilized rail vehicles, and two employed a combination of both methods. Only two properties used a designated trash collection car.

A. Method. The method employed for collection of trash seems to depend largely on station access. The newer properties with elevator street access prefer street collection; older properties have no choice but to haul trash by rail to a central collection point. Adequate enforcement of "no food or drink" rules on platforms and within paid areas and vehicles will minimize the amount of trash and confine it to the station entrance areas. Newspapers and miscellaneous items dropped on-board the trains will be removed by car cleaners in the yard and disposed of at that location.

B. Mainline access. The complexity and sophistication level of the Metro Rail system will require proper, and perhaps frequent, maintenance of track and wayside equipment to provide the planned levels of comfort, reliability, and service. Mainline access time for maintenance is very limited. Scheduling of maintenance functions that must be performed on the mainline during off-hours is an ongoing problem for all transit properties. The addition of one more daily function, trash collection by rail, may possibly be detrimental to the overall maintenance program. For the above reasons, it is recommended that trash collection for the starter line be accomplished through stations from the surface, by either in-house or contracted personnel.

2.4.6 Emergency Water Pumping

It is assumed that tunnel and station designs will include pumps with pumping capacity adequate for normal drainage. Sump pumps are usually monitored to detect failures in sufficient time to allow for repair or replacement of pumps prior to a flood condition. In the event of a water main failure or a natural disaster which could cause excessive water collection, and complete utility power outage, high capacity auxiliary pumping equipment may be required. The equipment would include a diesel-powered pump, hose and powered reel mounted on a flatcar bed to be moved to the work site by locomotive or work car. The cost analysis indicates a capital cost of approximately $156,000 (See Appendix G). Annualized cost, assuming $500/year maintenance, becomes approximately $20,000.

2.4.7 Rail Grinding

Periodic grinding is required for maintaining proper railhead profile and removing rail-wear corrugations. It is customary for the original track contractor to initially grind all rail to a desired profile and finish. The initial grind will generally suffice for the first two to three years of system operation. After that, most properties grind the running rails annually.

Of the nine properities surveyed , three contracted for rail grinding, five performed the function in-house, and one did not require rails to be ground (See Appendix B). Those that grind rails in-house generally use equipment mounted on old transit or street cars. Indications from three railroads (Southern Pacific, Santa Fe, and Union Pacific), and one railroad equipment rental company were that they would not consider contracting or leasing their rail grinding equipment (See Appendix E). Further investigation found two contractors (A.T. Bruno and Speno Rail Services) actively engaged in the rail grinding business.

A. Cost. Cost data on large grinding equipment was not available at this time. Data was available, however, on a small unit that is designed for future expansion (See Appendix E). The small unit is not self-propelled, but does include the necessary generator for grinder-motor power; it is estimated to cost $125,000. Operating cost is based on one complete grind (2 passes) per year, 36 miles of track, and 96 manhours. Fuel cost includes that of the locomotive or work car used to propel the grinding equipment (See Appendix F).

Table 2-3

RAIL GRINDING EQUIPMENT COST ANALYSIS

Critical Area	In-house	Contracted
Capital Cost	$125,000	
Operating Costs (annual)		
a) contractor		15,000
b) labor (96 manhours)	1,850	
c) fuel	625	625
Total Operating Costs	$ 2,475	$15,625
Maintenance Costs (annual)		
a) labor	155	
b) material	1,500	
Total Maintenance Costs	$ 1,655	$15,625
Total Operating & Maintenance Costs	4,130	15,625
Annualized Capital Costs	15,410	
TOTAL ANNUAL COST	$ 19,540	$15,625

Table 2-3 indicates a definite advantage for contracted grinding until such time as the line is extended beyond the 18.6 miles. At the contractor's current price of $300 per hour, and grinding at the rate of 1.5 mph for two passes, the break-even point (without additional equipment purchase) is for a line-length of about 30 miles.

B. Availability and technical risk. Rail grinding equipment is currently being manufactured, although usually to special design, and is in use throughout Europe and North America. Availability should be good for equipment purchase, but marginal if contracted. Technical risk should be minimal in either case.

2.4.8 Ultrasonic Inspection

All transit properities that ultrasonically inspect track do so on a contractual basis with Sperry Rail Service Division, the manufacturer of the equipment. The annual cost estimate is $165/mile (See Appendix E).

2.4.9 Towing of Maintenance and Transit Vehicles

Towing of nonpowered maintenance vehicles and removal of disabled transit vehicles from any point on the mainline will require a diesel-powered locomotive or work car. Locomotive size will depend on the weight of the tow-load, and locomotive manufacturers' catalog data indicate that a 25-ton hydraulic locomotive will tow two 80,000-lb vehicles up a 4% grade.

Availability of diesel hydraulic locomotives is presently very good; diesel electric locomotives in the smaller sizes (under 60 tons) are available from only one source (GE). All-electric work cars/ locomotives are also not generally available. A summary of various types and sizes of self-propelled vehicles is provided (See Appendix D).

2.4.10 Yard Moves of Disabled Passenger Vehicles

Moving disabled passenger vehicles between the storage yard and shop areas requires a versatile vehicle. Properties that use locomotives for this function complain of restricted visibility, restricted track access, and cumbersome operation. A small on-off rail car-mover type vehicle, similiar to the Pettibone 250 or the Whiting Trackmobile is recommended for this task because of flexibility. Car-mover capital cost is estimated to be $82,500, and equipment life is estimated to be 15 years. Operating and maintenance costs shown on Table 2-4 are based on running time of 6 hours per day and maintenance servicing twice a year. Operating cost does not include labor, which will be performed by a maintenance shop worker. Equipment capable of performing the yard move function is proven in use and readily available.

Table 2-4

CAR MOVER COST ANALYSIS

Critical Area	Cost
Capital Cost	$165,000
a) 2 cars @ $82,500	
Operating Cost	$ 6,280
a) fuel	
Maintenance	
a) labor	310
b) material	100
Total Maintenance Costs	$ 410
Total Operating & Maintenance Costs	6,690
Annualized Capital Cost	20,260
TOTAL ANNUAL COST	$ 26,950

2.4.11 Miscellaneous Yard Maintenace

Many miscellaneous maintenance functions will require the use of a multipurpose vehicle with crane, clamshell, rail handling equipment, winch, etc, similar to the Pettibone 441 B Speed Swing. Capital cost of the unit is $107,500 and estimated life is 20 years. Operating and maintenance costs, which depend on usage, cannot be determined at this time. Annualized capital costs are estimated to be $19,880.

2.4.12 Electrification/Substation Maintenance

Routine maintenance of all electrical facility equipment (except third rail) will likely be performed on a regular work shift schedule; rail access and special rail equipment will probably not be needed. Third rail replacement/repair and substation heavy equipment replacement will require rail access and a flatcar or self-propelled work car with crane. Since the equipment will be used on a shared basis, and is covered elsewhere in this report, this function is mentioned only for future reference.

2.4.13 Cash Collection

For purposes of work task inclusion, money collection and transportation of collected funds is also mentioned here. Whether transported via street or rail, no special vehicle is required to accomplish the task. If rail transport is chosen and revenue passenger vehicles are utilized, special cash-handling equipment designed for train access and load distribution will be required. No cost analysis is shown for this function at this time.

2.5 CONCLUSION AND RECOMMENDATIONS

Self-propelled auxiliary vehicles of the type initially required by the design criteria would be very expensive due to the engineering cost associated with the purchase of only one unit. The work functions identified in this analysis that would have been performed by self-propelled vehicles, can be performed by a locomotive and flatcars. Self-propelled vehicles of the type required by the criteria are not to be confused with the self-propelled hi-rail type vehicles. The self-propelled type are electrically propelled in a manner similar to the transit vehicles while the hi-rail type are powered by diesel engines. Hi-rail vehicles may be substituted for a locomotive for various work functions as identified throughout this analysis.

For the function of rail grinding, Section 2.4.7 provides a cost analysis on the two basic alternatives of contracting the work or purchasing the rail grinding equipment. The results show that it is less expensive by about $4,000 per year to contract the work.

Based on the results of this analysis, it is recommended that a locomotive and at least two flatcars be purchased and that the design and purchase of unique electrically self-propelled vehicles no longer be considered. It is also recommended that the function of rail grinding be contracted. If extensions or additional lines are built, the advantage of purchasing rail grinding equipment may be realized and therefore this recommendation should be re-analyzed at that time.

Appendix A

BIBLIOGRAPHY - SOURCES - ACRONYMS

Appendix A

BIBLIOGRAPHY - SOURCES - ACRONYMS

I. BIBLIOGRAPHY

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SCRTD Metro Rail — Design Criteria, Section VI, Auxilairy Vehicles

Preliminary Operating Plan, January 1982.

Preliminary Draft Functional Plan for Yards & Shops, May 1982.

II. SOURCES

VENDORS

Anbel Corp: Ken Nichols
ATB Associates: A.T. Bruno
Burro Crane, Inc.: Chuck Edwards
General Electric: Bill Sinclair, Sam Dunham
McCormick Morgan, Inc.: Andrew Garcia
Pettibone Corp.: R.P. Cardew, N.P. Frazzini, R.L. Itter
Plasser American Corp.: Gerhard Polterauer
Plymouth Locomotive Works: Bill Ross
Simkins Co, Inc.: J.E. Simkins, Jr.
Speno Rail Services, Inc.: Bob Walter
Tamper Corp.: Jim O'Neal
Whiting Corp.: Carl Kempe
Sperry Rail Service: Dan Mc Coy
Allis Chalmers: Ken Rush
Goodall Rubber Hose: G. Kereska

USERS:

BART: J.P. Van Overveen, A. Gieda, Chuck Pelton
MBTA: Ed Neeco

ASSOCIATES:

KE Baltimore: Scott Rodda, A. Virginkar
KE Boston: Ward Kingma
KE Houston: R. Rypinski

III. ACRONYMS

BART - Bay Area Rapid Transit District, San Francisco
CTA - Chicago Transit Authority
KE - Kaiser Engineers
MARTA - Metropolitan Atlanta Rapid Transit Authority
MBTA - Massachusetts Bay Transportation Authority
NYCTA - New York City Transit Authority
PATCO - Port Authority Transit Corporation
SCRTD - Southern California Rapid Transit District
SEPTA - Southeastern Pennsylvania Transportation Authority
TTA - Toronto Transit Commission
WMATA - Washington Metropolitan Area Transit Authority

Appendix B

WORK TRAIN TASK AND EQUIPMENT ANALYSIS:

KE REPORT - DECEMBER 1978

Dec 22 1978

THE WORK TRAIN TASK AND EQUIPMENT ANALYSIS

1.0 INTRODUCTION

1.1 BACKGROUND:

In a work statement presented in January '78, the General Consultant described the services to be performed for the Work Train Procurement Contract No. XO-16-02. This report constitutes the research phase and is patterned after the outline of subjects contained in the scope.

The objective of this document is to evaluate the work train equipment requirements through data collection and analysis, and to form the basis for preparation of necessary procurement documents.

The work train procurement is very closely associated with other facets of the BRRT project such as trackwork requirements, structural parameters, maintenance and operations plans and so on. After discussions with these other project groups, formulation of certain assumptions appeared imperative for a more concise and clearer conceptualizing of the tasks. These assumptions, therefore, serve as principal guidelines in the entire evaulation process.

1.2 THE REPORT:

This report consists of the following major parts:

The summary and recommendations are discussed in Section 2.

Section 3 presents analysis of various work train related tasks and conceptualization of BRRT system applicable tasks.

Sections 4 & 5 reflect the preliminary maintenance equipment and special features analysis and initial results of the equipment selection process designed to meet the above stated objectives.

Section 6 highlights comparison of various operating properties while Section 7 discusses budgetory cost data for the recommended equipment.

Lastly, analysis supportive data is attached in appendices.

2.0 SUMMARY AND RECOMMENDATIONS

2.1 SUMMARY

A. The analysis effort consisted of discussions held with involved DMJM/KE project groups, particularly the Trackwork department, to gain an understanding of the track and way maintenance equipment requirements. Further, data obtained from other transit systems pertaining to their equipment inventory and usage was used in the analysis.

B. Data collection effort consisted of contacts with representative suppliers of rapid transit and railroad maintenance equipment for the purpose of:

1. determining equipment available in the marketplace;

2. determining which items will interface with the BRRT system, as it is presently developed, through the task analysis; and

3. obtaining an estimated cost of each item which appears to be needed to service the system.

2.2 RECOMMENDATIONS

A. Analysis of the work train related tasks concluded that the tasks listed below will require purchase of one or more items of the work train equipment:

Task	Equipment Required
1. Track & way maintenance	medium/heavy duty crane, push truck(s), flat car(s), locomotive
2. Maintenance vehicle & transit vehicle hauling	locomotive
3. Snow removal	snow plow mounted at F-end of locomotive & transit vehicle(s)
4. subway vacuuming	vacuum cleaner mounted on a flat car.

B. Other tasks are assumed to have been contracted and are as listed below:

1. Trash collection and removal from stations via surface;

2. snow removal from station platforms;

3. cleaning of parking lot areas, and landscapes;

4. tunnel walls cleaning including those exposed to public view;

5. periodic ultrasonic testing of rail joints, switches etc.; and

6. periodic rail grinding.

C. Based on the equipment analysis, the following items are recommended for procurement:

1. Two general purpose flat cars.

2. One on-off track self propelled crane and associated accessories.

3. One diesel hydraulic locomotive.

4. Snow plows.

5. Vacuum cleaners.

D. Crane, locomotive and flat cars are recommended to be equipped with the transit vehicle type coupler and a trainlined brake pipe air connection. Further, the locomotive and the crane should be equipped with two way radio system identical to transit vehicles. In addition, the locomotive should be provided with cab signalling capability without overspeed protection.

E. Quantities of the snow plows and the vacuum cleaners will be determined and procured under Maintenance equipment Procurement Contract No. XO-16-03.

F. While it is realized that many items of equipment are available in the used equipment market, the same are not considered in the analysis due to problem history associated with the secondhand equipment performance and also based on the unfavorable usage experience of other properties. It might be necessary, however, to procure rebuilt flat cars because of the fact that most suppliers have amassed backlogs on future orders and are not interested in small orders.

3.0 TYPICAL WORK TRAIN TASKS

3.1 GENERAL:

Work train is primarily a combination of one or more equipment items operating on rail and engaged in maintenance or maintenance support activities of the transit system operations.

A rail inspection car with rail wear and rail fault detection equipment, for example, is a work train involved in preventive maintenance. A revenue train carrying station cleaning crew and their equipment at a predetermined frequency is also a work train engaged in maintenance support activity. These and other examples of work train functions are grouped under five major tasks. Analysis based on each task description and underlying assumptions, will then lead to identification of specific equipment needs in the work train procurement.

3.2 TASKS AND THEIR DESCRIPTION:

Maintenance and maintenance support tasks which may require possible work train involvement can be grouped under the following major headings:

A. Trash collection and removal.

B. Track and way maintenance.

C. Maintenance vehicle and transit vehicle hauling.

D. Snow removal.

E. Subway vacuuming and cleaning.

A brief description of each task is given below as a prelude to determine its contribution to the work train equipment procurement.

Trash collection and removal will be necessary in parking lots, free & paid areas of stations, landscaped areas, Northwest Shop and OCC building.

Track and way maintenance will include periodic inspection, repair/replacement, maintenance of rail, contact rail, ties, joints, crossovers, switches, etc.

Haulage will involve non-powered maintenance vehicles to their work destinations. Similarly, transit vehicles will have to be hauled in the absence of the third rail power.

Snow accumulation will have to be cleared from station platforms, parking lots, mainline track and yard areas.

Dirt, dust and trash accumulation under platforms, in the tunnels and on aerial structures will require periodic vacuuming. In addition, dust accumulation on tunnel walls from revenue service and work train operations will need washing.

3.3 ASSUMPTIONS IN THE TASK ANALYSIS:

The task analysis and the recommendations in the succeeding articles use the following assumptions:

A. Trash collection and removal will be contracted.

B. Trash from the stations will be carried to the outside via elevators.

C. Snow removal from the station platforms will be contracted.

D. Parking lot area cleaning will be contracted to keep them free of snow accumulation using rubber tired vehicles with snow removal attachments.

E. Tunnel walls including those exposed to public view will be cleaned at least annually using the services of a contracted agency.

F. Work train vehicles will not be leased to other railroads, and, as a rule, they will not operate outside BRRT system limits.

G. Revenue trains, as a general practice, will not carry work train related equipment or transport work train task personnel.

H. Periodic ultrasonic testing of rail joints, switches, etc. and periodic maintenance activities such as rail grinding, alignment, etc. will be contracted.

I. Delivery of maintenance material such as ballast, ties, etc., to the Administration property will be handled by the rubber tired vehicles.

J. Third rail power outage on the main line and/or in yard will occur.

K. Portions of subway route will experience flooded conditions with up to four feet of water.

L. Fifteen inches of snowfall in 24 hours is expected during winter season.

3.4 ANALYSIS:

A. Trash Collection & Removal: Based on the assumptions stated in the previous article, the contracted agency will collect and remove trash from stations, parking lots, Northwest Shop and OCC building. Elevators will facilitate trash removal from stations to the outside. Adequate graphics representation to prohibit food or drinks in the vehicles, its strict enforcement by the security personnel and prosecution of the violators is expected to keep the trash generation to a minimum. This alternative allows after revenue service track testing and maintenance work to be free from possible disruption due to trash collection car movements.

B. Track & Way maintenance: Track maintenance tasks and equipment requirements are adequately covered under two separate procurements: Procurement of maintenance equipment, contract No. XO-16-03 and rubber tired maintenance equipment contract No. XO-16-04. The work train equipment, however, must extend an added flexibility by supplementing the rubber tired maintenance equipment effort, wherever such equipment is deficient in capacity and performance. Specifically, the work train equipment will require bulk material, immobile equipment and emergencies handling capability. A few of the major work train related track maintenance supportive tasks are listed below:

- rail laying
- loading and transportation of tie plates, rail joints, scrap metal, ballast, etc.
- moving complete panel track sections
- rerailing of derailed revenue cars.

A study of these applications reveals the requirement of a medium to heavy duty crane to lift the rails, track sections, etc. with push trucks to carry smaller load, and flat cars fitted with any special features as necessary to carry the larger, odd size load.

Track maintenance tasks of rail grinding, inspection, etc. involving special equipment on rail will not be part of work train equipment, by the stated assumption that these services will be contracted.

C. Maintenance vehicle & transit vehicle hauling: A typical hauling scenario will involve non-powered flat cars carrying unaccepted transit vehicles to be hauled to the unloading track upon their arrival on the Administration property. Once the transit vehicles have been unloaded, they would be hauled either in the shop or to the yard storage tracks awaiting the acceptance cycle. Another transit vehicle haulage situation will arise in the event of the third rail power outage to transit vehicles. This will involve a train consisting of up to six transit cars, each weighing approximately 75,000 lbs. Yet another situation based on tunnel flooding conditions assumption will involve either a six car train haulage or transportation of emergency equipment with a work train. In addition, normal maintenance vehicle haulage will require pulling non powered maintenance car(s), in applications described in an earlier paragraph, to the track maintenance destinations.

A further analysis of above circumstances identifies the requirement of a locomotive with a 455,000 lbs. hauling capacity, traveling at a maximum speed of up to 40 mph, meeting structural clearances, independent of third rail power and capable of operating in tunnels flooded with up to four feet of water.

D. Snow Removal: A potential problem due to heavy snow accumulation between the tracks and icing up could result in unwarranted trip-cock trips, causing emergency brake applications. This problem can be easily remedied by making snow plow attachment provisions to transit car, locomotive and other on rail vehicle F-end and using this snow plowing equipment as situations demand.

Study of the mainline contact rail location from Mondawmin Portal to the Reisterstown Road Station indicates that for the most part, the contact rail is situated on the inside, away from the safetywalk and the retaining wall and is not susceptible to excessive snow accumulation. Scheduled train movements will, therefore, keep the contact rail clean and will help blow off residual snow build up around it.

Consideration should be given to procure snow plows which could also be equipped on the rubber tired vehicles to plow parking lots and other areas if necessary.

E. Subway Vacuuming: A major source of dust accumulation in the tunnels will be the train operations (brake shoe dust, for example). If not cleaned, this dust will blow into stations by train movements and can be hazardous to public health. There will also be other trash thrown under the platforms. This trash, unless cleared periodically, will obstruct effective filtering action on transit vehicle subsystems and contribute to less efficient performance and increased maintenance costs. As is the experience of some other operating properties, such trash can well be a potential fire hazard. As a start, tunnel vacuuming on a monthly basis is recommended.

Noting the frequency of tunnel vacuuming, consideration should be given to procurement of general purpose flat car mounted detachable type of vacuum cleaning equipment with could also be used in other relevant applications on the system.

F. Subway cleaning: Tunnel walls cleaning including station walls should be contracted for manual cleaning on an "as-required" basis and this will eliminate the need of a special wash train. Such a wash train, as acquired by WMATA and MARTA at a capital cost of $450,000 is a costly investment for once a year application and the existing size of BRRT system subway route cannot justify its procurement.

4.0 MAJOR WORK TRAIN EQUIPMENT

4.1 GENERAL:

This section identifies major equipment used in work train applications. Each equipment item capability is discussed and its applicability analyzed in view of BRRT system work train requirements along with the earlier assumptions and recommendations. Equipment manufacturers' technical data is also presented in Appendices A and B. The following equipment items are discussed:

- Flat car -- general purpose
- Locomotive
- Crane and associated accessories
- Snow plows
- Vacuum cleaners

4.2 EQUIPMENT ANALYSIS:

The analysis effort consisted of discussions with other involved DMJM/KE project groups, information gathering from other properties, and discussions with the equipment manufacturers.

A. Flat car: Flat cars will be needed primarily to haul large size loads such as 39' or 78' rails, panel track sections or other odd sized loads. Task analysis from section 3.0 indicates need of a minimum of two general purpose flat cars. The deck bed material of the flat cars should be suitable to provide mounting arrangements for detachable equipment. Development of Work Train and Maintenance Equipment contracts will determine if other special features are desired.

B. Crane and Associated Accessories: Crane can either be a self-propelled on rail/on-off rail type or be fixed mounted on a non-powered flat car to be hauled by locomotive or transit vehicles. Latter's dependency on another power source severely restricts its movement flexibility and makes it less responsive to emergency applications.

Self-propelled crane with on/off rail capability is therefore recommended. Preliminary haulage and loading data was given to the crane manufacturers who recommended one or more specific models from their product line which will best suit BRRT system needs. Their product description and design data is included in Appendix B. An on/off rail type self propelled crane will provide added movement flexibility and is cheaper in price to an on-rail type crane of comparable capacity.

Although a variety of accessories are offered by the crane manufacturers, a few major ones are listed below, based on the task analysis:

- Lifting magnet w/ generator
- Clamshell bucket
- Push trucks
- Track cleaning bucket

Other accessories will be specified, as necessary, during design development of the procurement documents.

C. Locomotive: A locomotive will serve the following functions:

1. To haul flat cars carrying unaccepted, unpowered transit cars when they first arrive on Administration property;

2. To haul train consists of up to six cars, in the absence of contact rail power, from mainline to yard or within the Northwest yard and shop area; and

3. To haul work trains on the mainline and/or in yard.

Four different types of locomotives are available in the marketplace:

- Diesel hydraulic
- Electric
- Diesel electric and
- Battery/electric

Our earlier assumption of emergency operations under flooded conditions will rule out all but the diesel hydraulic type locomotive. A preliminary locomotive haulage data attached in Appendix C, delineating track characteristics and other critical parameters, was submitted to locomotive manufacturers. They responded with specific model description and design data, to best suit BRRT system, which is attached in Appendix A. Detailed design provisions of optional equipment such as, exhaust conditioner, two-way radio, cab signalling equipment and so on, shall be dealt with during development of the procurement documents.

D. Snow plows: Although fifteen inches of snow fall in 24 hours is expected, history of past winter seasons in Baltimore metropolitan area indicates the average snowfall was not anywhere close to properties operating in heavier snowfall region, such as Toronto or Boston. Investment in a snow clearing car will, therefore, not be cost effective. Snow plow attachments on locomotive, crane and flat cars should adequately serve the snow removal task. They will be procured under Maintenance Equipment Procurement Contract No. XO-16-03.

E. Vacuum cleaners: Past work train related documentation had presented the concept of a pickle/trash/vacuum train. A re-evaluation of that concept in light of the assumptions in the preceding section concluded that pickling is not being contemplated; trash collection and removal will be from the surface; and tunnel vacuuming will be carried out on a monthly basis or at a longer frequency. It will, therefore, be wasteful to invest in a special pickle/trash/vacuum car for only a third of its original utility. Rather, portable vacuum cleaning equipment capable of being mounted either on flat cars or rubber tired vehicles should be procured and tunnels can then be vacuumed manually. Quantity of vacuum cleaners will be determined and procured under Maintenance Equipment Procurement Contract No. XO-16-03.

Yard Maintenance (hauling) - Shop move -
Style on/air Transit Veh -
Spot Platforms -
Load - unload material -
Re-rail assist in yard -
} highway/rail vehicle w/ Crane, Winch, Air Compressor (Small)

5.0 SPECIAL FEATURES

5.1 GENERAL:

Each equipment item will be equipped with special optional features unique to its performance requirements. These will be finalized during design development process. This section discusses in brief, certain other features, as listed below, which are common to two or more items:

- Coupler connection
- Trainlining brakes
- Cab signalling capability
- Two-way communications

5.2 COUPLER CONNECTION:

We have assumed that the work train equipment will not operate outside BRRT system limits and this will result in primary interface with the transit vehicles. Consideration should therefore be given to equip crane, flat cars and locomotive with the transit vehicle type coupler. Cost impact and the design complexity in adapting to transit car coupler arrangement will be investigated during the specification writing stage. It may be of interest to note that some of the transit properties such as WMATA and CTA are now changing AAR type couplers on their work train equipment to be compatible with the transit vehicles.

5.3 TRAINLINING BRAKES:

Trainlining the brake pipe is presently incorporated in transit vehicle design and is recommended to be extended to work train equipment which will make them compatible with transit vehicles for the intended interface. Trainlining the service brakes is ruled out because of added design complexity involving electric trainline signals and related equipment.

5.4 CAB SIGNALLING CAPABILITY:

Cab signalling with overspeed protection offers maximum protection and safety in train operations. Preliminary inquiries and discussions with the Train Control Project Group indicated that extending overspeed protection to locomotive will result in increased equipment costs of over $100,000. In order to provide Overspeed Protection to ensure collision avoidance and enforce civil restrictions, several system design parameters must be considered. Safe braking distances are dependent on all the kinematic parameters pertaining to our transit vehicle. These kinematic parameters are mass, velocity, acceleration, response times and deceleration characteristics as well as other influencing hardware constraints. It is very unlikely that all these parameters will be reproducible in our locomotive. Therefore, the system speed limits and block design will not be directly applicable to the locomotive. It is possible, however, with considerable design effort, to sub-optimize the locomotive system performance such that the locomotive may operate with Overspeed Protection within the existing system block design. The design effort would require that a completely different set of ATP equipment be designed and built specifically for the locomotive with totally new interface definitions. Cab signalling may be provided with little or no modifications to the existing transit vehicle equipment and conceivably may be furnished through the spares commitment in the TC&C contract. Cab signalling capability w/o overspeed protection is, therefore, recommended.

5.5 TWO-WAY COMMUNICATIONS:

For the purpose of compatibility with the remainder of the rail operations, both locomotive and self-propelled crane are recommended to be equipped with a two way radio system identical to transit vehicles.

6.0 COMPARISON OF OPERATING PROPERTIES:

6.1 GENERAL:

Major transit properties were contacted by telephone to gather information about their work train related functions, equipment and operations experience. This data is presented in Appendices D and E. Field trips were also conducted to obtain supplementary evidence. These trip reports are presented in Appendix F. The main purpose of this comparison study was to observe emergence of any common trends in their equipment inventory and usage. Only MARTA, among the properties listed, has not yet achieved an operating status, but it is well ahead in the equipment procurement process and as such, their information will serve as a valuable guide in understanding the philosophy incorporated in equipment procurement.

Time and schedule constraints have limited the comparison of operating properties to the information gathering through telephone conversations with property personnel. A broader understanding and verification of this information can be better achieved by making additional field trips to these properties during the design development process.

6.2 WORK TRAIN FUNCTIONS COMPARISON OF PROPERTIES:

The majority of the properties collect trash using their own personnel. Older properties remove it by rail, while newer properties such as BART and WMATA do so via the surface. MARTA is also planning to remove trash from the surface. Major factors influencing trash removal from stations were availability of elevators in stations and of the track for testing and maintenance work after revenue service. The equipment on rail varied from converted old transit cars to special trash collection cars.

Most properties agreed that running revenue service trains was the most effective means of keeping the track clear of snow. Their snow removal equipment, they claimed, has been used mainly in the yard.

Subway vacuuming and washing on a monthly basis was cited as an important factor in efficient transit vehicle subsystems operations but cost effectiveness of the expensive equipment used, according to some properties, remains doubtful.

Rail grinding periodic maintenance is contracted by the newer properties, while older properties have in-house equipment and personnel to do the job. Most properties contract out periodic rail inspection and ultrasonic testing tasks.

6.3 EQUIPMENT COMPARISON OF PROPERTIES:

A significant commonality observed among most properties was the type of equipment owned. Most of them own or have procured at least one or more self-propelled cranes, locomotives, flat cars and old transit cars as a part of their work train equipment fleet. Properties with a greater number of route miles have larger quantities of these equipment.

The self-propelled crane received high marks for flexibility. Some properties with a past history of frequent derailments, recommended a higher capacity crane (in excess of 20 ton) as a re-railing device. Properties (as well as manufacturers) expressed grave doubts in equipping cranes with cab signalling capability, although such a feature is highly desirable. Common coupler connection used was AAR type. However, at least two properties are now in the process of converting to transit car coupler to achieve greater flexibility and time savings in operations.

All properties recommended buying either rebuilt or new locomotives. WMATA's experience, in particular, with used locomotives has been very unpleasant, involving high maintenance costs and poor availability. Diesel hydraulic or diesel electric type of locomotives in a 35 - 50 ton capacity range are common. Locomotives use standard AAR type coupler. Some properties, such as MBTA and CTA, provide cab signalling feature.

Most properties use flat cars, fitted with special features as necessary, for vacuuming, tunnel washing and so on. Buying old cars from the railroads and refurbishing them appeared to be the most common mode of acquisition among majority of the properties. Properties also convert retired transit cars into work trains because their self propelling capability offers added flexibility and AAR type flat cars cannot meet their system clearances.

7.0 PRELIMINARY COST DATA

7.1 GENERAL:

Following the recommendations presented in Sections 3 and 4, and preliminary haulage data supplied to the industry, budgetary price estimates in 1978 dollars were obtained from the locomotive, self propelled crane and flat car manufacturers. These and other pertinent information are presented below.

7.2 LOCOMOTIVE:

Manufacturers of a new, diesel hydraulic locomotive (without any special features) presented the following estimated price:

Cost Source	Price
ALCO Traction, GEC Ltd.	$350,000 (38 ton)
Plymouth	$475,000 (45 ton)
PORTEC	$375,000 (50 ton)
ANBEL Corp.	$650,000 (50 ton)

Price estimates for any of the remaining three categories of locomotives (i.e., diesel electric, electric or battery/electric) were substantially higher, in the range of $600,000 and above.

All manufacturers quoted 14 - 18 months as a comfortable delivery time period.

7.3 FLAT CAR:

Of all the flat car manufacturers contacted, only three expressed interest in a two car order of a 53', 50 ton, general purpose flat car. Their price data is listed below:

Cost Source	Price
Briggs and Turivas	$25,000.
Portec	$35,000.
Maxon Car	$57,000.

(It may be noted that the lowest bidder's per car price, on MARTA flat car procurement contract for six flat cars, was $20,000 higher than his earlier estimated quote. MARTA consequently,rejected all bids and rebuilt cars are being procured from Southern Railroad.)

Other manufacturers seemed uninterested below a 100-200 car minimum order.

Thrall Car Manufacturing Co., on the other hand, proposed that BRRT could purchase their present production line design of 53'6", 100 ton flat car in the first quarter of 1980, if it is compatible with BRRT's schedule and design requirements. Their budgetory price is approximately $45,000.

Although, normal lead time on a flat car delivery appears to be 4-6 months, most manufacturers have built up a backlog running into first quarter of 1980.

7.4 SELF-PROPELLED CRANE:

Manufacturers of a new self-propelled crane, without any accessories, presented the following base price data:

Manufacturer	Price
On Rail Type	
Burro (12-1/2 ton)	$154,000
Little Giant (15 ton)	$175,000
On-Off Rail Type	
Little Giant (15 ton)	$130,000
Pettibone (15 ton)	$105,000

Lead time on either type of self propelled crane delivery was quoted as 6-8 months.

NOTE: The cost data presented in this section is based on preliminary parameters which are subject to change during further progress. This cost data should, therefore, be looked at from a budgetary perspective and not construed to be a final design estimate.

APPENDIX D

WORK TRAIN FUNCTIONS COMPARISON OF PROPERTIES

WORK TRAIN RELATED MAJOR FUNCTIONS	PROPERTIES: MARTA**	WMATA	BART	PATCO	TTC	MBTA	CTA	SEPTA	NYCTA
A. Trash Collection & Removal									
1. Contracted or by in-house personnel	Contracted	In-house	In-house	In-house	In-house	In-house	In-house	Part both	In-house
2. Removal via rail or from stations	Station	Station	Station	Rail	Rail	Stations	Both	Part both	Rail
3. Equipment for removal via rail	--	--	--	Old transit car	trash collection car	--	Old transit car	Flat Car	Trash Collection Car
4. Frequency of trash collection & removal	Weekly	Alternate Days	Nightly	Weekly	Nightly	Daily/weekly	Nightly	Nightly	Nightly
B. Snow Removal (Track & wayside)	None	None	None	None	In yard only		In yard only	None	
1. Snow removal equipment used	--	--	--	--	Snow plow	Snow plow, snow blower	Snow plow	--	Snow plow, snow blower
2. Snow removal equipment fitted on	--	--	--	--	Locomotive	Flat car & old transit car	Transit car	--	Locomotive
3. Revenue service as a snow clearing aid	Yes	Yes	--	Yes	Yes	Yes	Yes	Yes	Yes
C. Subway vacuum cleaning					None			None	
1. Contracted or by in-house personnel	In-house	In-house	In-house	In-house	--	In-house	In-house	--	In-house
2. Vacuum cleaning equipment fitted on	Wash/Vacuum train	Wash/vac.train	Rubber tired vehicle	Vacuum car	--	(Manually)	(Manually)	--	Vacuum car
3. Frequency of vacuum cleaning	Monthly	Monthly	As required	Monthly	--	As required	As required	--	Monthly
D. Subway washing						None	Inverts only	None	None
1. Contracted or by in-house personnel	In-house	In-house	In-house	Contracted for painting	In-house	--	In-house	--	--
2. Washing equipment fitted on	wash/vac.train	wash/vac.train	Rubber tired veh.	Contracted for painting	Wash car	--	Done manually	--	--
3. Frequency of washing	Monthly	Monthly	As required	As required	As required	--	As required	--	--
E. Track Maintenance									
1. Rail Grinding						None			
a. Contracted or by in-house personnel	Contracted	Contracted	In-house	Contracted	In-house	--	In-house	In-house	In-house
b. Rail grinding equipment fitted on, if not contracted	--	--	Rail grinding train	--	PCC street cars	--	Old transit car	Old transit car	Old transit car
c. Frequency of rail grinding	Bi-annually	As Required	Annually	Bi-Annually	As required	--	As required	As required	Daily

WORK TRAIN FUNCTIONS COMPARISON OF PROPERTIES

PROPERTIES

WORK TRAIN RELATED MAJOR FUNCTIONS	MARTA**	WMATA	BART	PATCO	TTC	MBTA	CTA	SEPTA	NYCTA
2. Ultrasonic Testing						None	None		
a. Contracted or by in-house personnel	Contracted	Contracted	Contracted	Contracted	Contracted	--	--	Contracted	Contracted
b. Test equipment type, if not contracted	--	--	--	--	--	--	--	--	--
c. Frequency of testing	Every 2-3 years	3 times a year	Annually	Annually	Annually	--	--	Annually	Tri-monthly
F. Maintenance & Transit Vehicle Hauling									
*1. Maintenance vehicles (non-powered) hauled by	L, S	L, S	L, S	L	L	T, S	T, L	S	L
*2. Disabled or unpowered transit vehicles hauled by	T, L, S	T, L	T, L, S	T, L	T, L	T	T	T, S	T, L

* NOTE= Abbreviations for hauling equipment

T = transit vehicle
L = Locomotive
S = Other self propelled vehicles

** At the time of this information, MARTA has not started revenue service.

APPENDIX E

WORK TRAIN EQUIPMENT COMPARISON OF PROPERTIES

WORK TRAIN RELATED MAJOR FUNCTIONS — **PROPERTIES**

WORK TRAIN RELATED MAJOR FUNCTIONS	MARTA**	WMATA	BART	PATCO	TTC	MBTA	CTA	SEPTA	NYCTA
A. Crane									
1. Fleet quantity and capacity	2:15 Ton	3:15T & 20T	2:60T & 20T	1:10 Ton	1:5 Ton	3:10 Ton	2:20 Ton	1:10 Ton	4:3 Ton
2. Self Propelled or non powered crane car	Self Prop.	Self prop.	Self prop.	Non power	Self prop.	Self prop.	Self Prop.	Self prop.	Both
3. If self propelled: on Track or on/off Track	on/off track	On/off track	On/off track	--	On track	On track	On track	On track	On track
4. Cab signalling provisions	No	No	No	No	No	No	Yes	No	No
5. Coupler: transit vehicle type or AAR type	AREA	None	Both	AAR	Transit car	Transit Car	Transit car	Transit Car	Both
B. Locomotive							None	None	
1. Fleet quantity and capacity	1:50 Ton	2:40T(1:50T on order)	1:50 Ton	1:50 Ton	2:50 Ton	2:45 Ton	--	—	34:45-50T
2. Acquired new, old or rebuilt	New	Old	New	Old	New	New	--	—	New
3. Locomotive type: diesel hydraulic, diesel electric, electric or battery/electric	Diesel hydraulic —	Diesel hydraulic --	Diesel hydraulic --	Electric --	Diesel Hydraulic Battery/elec.	Electric --	-- --	— —	Diesel elec. --
4. Cab signal Provisions	None	None	None	None	None	None	—	—	None
5. Coupler: transit vehicle type or AAR type	Transit car	AAR	AAR	AAR	Transit Car	Transit car	--	—	Both

APPENDIX E (cont'd)

WORK TRAIN EQUIPMENT COMPARISON OF PROPERTIES

WORK TRAIN RELATED MAJOR FUNCTIONS	MARTA**	WMATA	BART	PATCO	TTC	MBTA	CTA	SEPTA	NYCTA
C. Flat Car							None		
1. Fleet quantity and length	6 : 45'	12 : 40'	8:70'	2 : 45'	1 : 64'	20(approx):40', 45' & 50'	--	4 : 40' & 65'	N/A: 46' & 50'
2. Acquired new, old or rebuilt	Rebuilt	Old	Old	Old	New	New	--	Old	Both
*3. Flat car application	V, W, M	V, W, M	M, B	V, C	T, W	M	--	M, T, C	M
4. Coupler: transit vehicle type of AAR type	AREA	Both	AAR	AAR	Transit car	Transit car	--	Transit Car	Both
D. Transit car as a work train									
1. Fleet quantity	--	--	--	2	2	15 (approx)	N/A	2	10 (approx)
2. Using existing revenue car or retired car	--	--	--	Retired Car	Retired car	Both	Both	Retired car	Retired car
*3. Application	--	--	--	T, M	R	M, C	M, C	R, M, T	V

*Note: Abbreviations for applications & features

V = vacuum
W = tunnel wash
C = crane car
B = ballast car
T = trash collection
R = rail grinding
M = miscellaneous
N/A = not available.

**At the time of this information, MARTA has not received delivery of any of the work train related equipment.

APPENDIX F

Distribution: J. Francomacaro
P. landis
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S. Rodda -
D. Shoff
D. Wellington
P. Schmidt (MTA)
W. Valkmer (KTG, Miami)

November 13, 1978

TO: Distribution

FROM: A. Virginkar

SUBJECT: VISIT TO THE WASHINGTON METRO AREA TRANSIT AUTHORITY (WMATA) FOR INFORMATION ON WORK TRAIN AND MAINTENANCE EQUIPMENT PROCUREMENT - OCTOBER 17, 1978.

Attendees:

DMJM/KE	KTG (Miami)
L. Sanders	W. Volkmer
S. Rodda	
A. Virginkar	

A visit was made to WMATA for the purpose of acquainting ourselves with their work train and maintenance equipment, obtaining first hand experience in its usage and understanding the concepts involved in equipment procurement.

We first met with Mr. Tom O'Donnell, superintendent of Right-of-Way maintenance for WMATA at WMATA's Maintenance of Way Headquarters in Silver Spring. During the brief discussions with him, Mr. O'Donnell covered the subjects such as WMATA's present equipment and furture procurements.

We then visited the Brentwood Shop with Mr. Tim Reed, a field supervisor, who along with the supervisor of track and equipment, Mr. C. Crickenberger showed various items of equipment present on the site and allowed us to photograph them.

Self Propelled Crane:
WMATA, at the present time, owns two Pettibone Speed-swings which cost approx. $180,000 including all accessories, but they do not have any type of on-track or on-off track crane and feel an eventual need for one. Consequently, they have ordered a 20 ton, on-off track type Grove Crane which will cost approximately $183,000. It will be used principally to lift heavy objects onto the right-of-way and perhaps to assist in rerailing operations, should it become necessary.

Trackmobile:
During the Brentwood Shop visit, we witnessed "Kal-Trac" on-off track dump truck/hydraulic crane in operation, lifting portable electric screw jacks (weight: 3 ton) from the pavement along the track side and placing in a pickup truck to be transported to WMATA's New Carrolton Shop. WMATA maintenance personnel seemed impressed with "Kal-Track's" ability to do many different types of work.

WMATA is in the process of procuring two "cherry pickers" from Pacton Michell for approximately $203,000 each under the trade name "Super Snooper". WMATA plans to use them for future extension of their system which will be extensively located on elevated structures.

We questioned Mr. O'Donnell on the capability of hi-rail equipment to shunt signals. He stated that WMATA does not rely on the shunting capability of this equipment and takes adequate precautions when hi-rail equipment is on the main line.

Locomotive:
WMATA, at the present time owns two navy surplus locomotives, but is unhappy with their service record to date. For this reason, they have ordered a new diesel hydraulic locomotive from Portec Company, costing $499,000 and manufactured in France by Secmafer Company.

Mr. O'Donnell stated that the locomotive ordered was mainly needed to carry rail to the rail renewal destinations. Mr. Volkmer questioned him as to how often the rail must be replaced and if it could not be transported by highway and then lifted on to the quideway site with a crane. Mr. O'Donnell replied that this would be all but impossible due to the length of time involved in arranging the highway permits to carry the rail over the road to the required site. WMATA is planning to install transit car couplers on locomotive, but will not provide the locomotive with any cab signalling capability.

Mr. O'Donnell then produced photographs showing worn rail, worn switch points and worn switch stock-rails which are in need of replacement, after the system has only been in operation for approximately 18 months. He stressed one particular case which is a 400 foot radius curve near the National Airport which must be replaced quite often and the only way that can be successfully done is using the locomotive and flat car. Mr. O'Donnell insisted that time is of essence in such type of maintenance work and the rubber tired vehicles are no match to a locomotive for speed.

Flat Car
WMATA has acquired sixteen, 40'-7" long flat cars from government surplus and activated four of them. Two cars are equipped with tunnel washing and vacuuming equipment costing approx. $300,000. While this wash/vacuum train is hauled by the locomotive, vacuuming is performed manually by WMATA personnel riding the train. Mr. O'Donnell justified the investment into Wash/Vacuum train in order to require clean tunnels, to keep low transit vehicle maintenance costs, and clean tunnel walls exposed to public view.

Other Maintenance Equipment:
Mr. O'Donnell strongly recommended to procure a small switch tamper, such as a Placer Tamper or Jackson Tamper, to cover any track maintenance emergencies.

Upon discussing the possibility of purchasing equipment from the track construction Contractor and/or allowing the Contractor to use Authority procured equipment, we received a negative answer on both issues. Mr. O'Donnell emphasized that such arrangements result in abuse of the loaned equipment and/or acquisition of abused equipment.

WMATA System also owns a Schramm Model HT300A "Pneumatractor", diesel powered, hi-rail air compressor. They find it to be an indispensible piece of equipment which can provide on-site compressed air to air operated tools.

WMATA contracts out ultrasonic testing to Sperry Rail Service three times a year, but they rely very heavily on visual track inspection on a daily basis.

At the conclusion of our visit to WMATA maintenance facilities and at the request of Mr. Volkmer, we visited the Silver Spring Station on the WMATA System to observe the functions of the Station Agent and the various controls located in the Supervisory Control Center (SCC). In addition to taking photographs of the station layout and SCC equipment, we made the following observations:

- Elevator was not functioning and the Agent reset the breaker once.

- A considerable portion of the Station Agent's time was spent clearing patrons through the exit turnstiles because of malfunctioning ticket media, and/or ticket transporters. The Agent took apart at least three of the ticket transporters to clear jammed tickets within an hours duration.

- None of the handicap service gates would latch when they were released to swing shut and the alarm system on all of the gates was shut off because, as the Station Agent claimed, all the gates were out of adjustment most of the time.

- Two of the eight farecard vending machines were out of service.

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TO Distribution

FROM W. Volkmer - MHMC -

SUBJECT: Visit Report to the Washington Metro Transit Authority (WMATA) on October 17, 1978

DATE: October 19, 1978

REFERENCE: MAINTENANCE EQUIPMENT PRELIMINARY DESIGN REVIEW ACTION ITEMS:

#8 - Wisdom of purchasing used equipment items

#12 -Define main-line at-grade track configuration as it applies to track maintenance requirements

#13 -Evaluate the need for owning a ballast tamper which includes lining capabilities.

#14 -Determine the need for a dedicated wreck truck.

#16 - Refine cost estimate data

#19 - Consider the use of a multicrane in lieu of burro crane for increased versatility

#20 - Consider the use of a "Speed Swing" in lieu of the back-hoe and other equipment items which the speed-swing is capable of handling.

A visit was made by the writer to the Washington Metro for the purpose of interviewing the various maintenance of way personnel and observing their opinion (s) on the various items of maintenance of way equipment to aid in our decision making process of determining which items of maintenance of way equipment will be procured for Dade County. I was accompanied to WMATA by three engineers from the Kaiser/Baltimore operation; Scott Rodda, Arun Virginkar and Lou Sanders.
Out first stop on the visit was to the WMATA Maintenance of Way Headquarters in Silver Spring, where we met with Mr. Tom O'Donnell, Superintendent of Right of Way Maintenance for WMATA. Our question and answer session was necessarily brief due to pressing business on his part, but in the short period of time that we were able to spend with him, we covered the various items of Maintenance of Way Equipment which WMATA owns at the present time, or intends to procure in the future. At the same time we tried to secure from him a little bit of their philosophy as to why they procured the items they did and how they were able to justify them.

20 Ton "Grove" Crane (Hydraulic)

WMATA does not, at the present time, own any type of rail crane or hi-rail crane and they feel an eventual need for one. Consequently, they have ordered a 20-ton, hi-rail , Grove Crane (multi-crane) which will cost $183,000. This crane is a very low profile, rubber tired crane. It will be used principally to lift heavy objects onto the right of way such as traction power equipment and in some instances it will be used to assist in rerailing operations, should it become necessary.

Hi-Rail "Cherry Picker"

WMATA does not own a rail cherry picker, at the present time, mainly due to the fact that only a very small portion of their present 25 mile system is built on elevated structure. However, future extensions will be extensively located on elevated structure and for that reason they are in the process of procuring two "cherry pickers", which they refer to as "down and unders". The machine that they have elected to procure is manufactured by Paxton Michell under the trade name "Super Snooper", which they feel is the best of the only two hi-rail "cherry pickers" which could be considered for Rapid Transit guideway work. The "Super Snooper" will cost $203,000 per copy. The only other cherry picker which could have been considered is marketed by the T.C. Johnson Company under its trade name "Sky Worker". The WMATA people have heard several negative reports about the safety aspects of the "Sky Worker" and that is the principal reason that they have rejected the use of it.

Work Train Locomotive

Mr. O'Donnell was very adamant that every rapid transit system needs a locomotive as an indispensable part of their work equipment roster. WMATA, at the present time owns two Navy surplus locomotives which, through cannobalization of one has made the other one usable, but they are very unhappy with the service they are getting out of this locomotive, and for this reason they have recently ordered a brand new locomotive from the Portec Company of Pittsburgh Penn. The locomotive which they are going to receive is manufactured in France by the Secmafer Company and will cost $499,000. Mr. O'Donnell was quick to point out that the locomotive which they really would have liked to have purchased was similar to the locomotive that the Toronto Transit Commission uses, namely the "Anbel" Locomotive which turned out to be high bidder, coming in something over $500,000. The principal reason Mr. O'Donnell gave for the need of a locomotive is to deliver rail to the site where renewal is required. I questioned Mr. O'Donnell as to how often the rail must be replaced, and could we not transport rails by highway to the site and lift it on to the guideway with a crane? Mr. O'Donnell replied that this would be all but impossible due to the fact that, for one thing, we would have to employe a man practically full time just to arrange the highway permits to carry the rail over the road to the required site. At this point Mr. O'Donnel produced a stack of Polaroid photographs showing worn rail, worn switch points, and worn switch stock-rails, all of which have had to be replaced or are in need of replacement at the present time, after the system has only been in operation approximately 18 months. One particular case which he sighted is a 400 foot radius curve near the National Airport which must be replaced quite often and the only way they can do it successfully is by locomotive and flat car. Mr. O'Donnell also pointed out that time is of the essence when transporting rail and materials over the Rapid Transit right of way and rubber tired highway equipment is not successful, at all in competing with the locomotive for speed.

Pettibone"Speed Swing"

WMATA, at the present time, owns two"Pettibone Speedswings" which cost somewhere in the neighborhood of $180,000 each, including all of the appliances or accessories that can be purchased in conjunction with it. WMATA is very impressed with its capabilities and its' utilitarian nature. He highly recommends that we buy at least one. Note: While WMATA track maintenance forces do not own a back-hoe, the building maintenance forces do. At this point I questioned Mr. O'Donnell on the capability of hi-rail equipment to shunt signals and whether or not every piece will shunt or will some of the pieces shunt, or none of them. The reply was that, some of the equipment does shunt the signals, others do not, but it does not matter to WMATA whether they do or don't because WMATA takes adequate procautions when hi-rail equipment is on the line they do not depend on it to shunt the signals and they do not intend to depend on it.

Ballast Tamper

I had previously ruled out the procurement of a tamper for the Dade County System because of the high cost and low utilization factor of this machine (see action item #13 of the maintenance equipment PDR). However, in discussing the need for a tamper with the Kaiser/DMJM/Track man in Baltimore, Mr. Don Shoff, I found that there is a definite need to have at least a small switch tamper available for emergencies. For this reason I persued this subject with Mr. O'Donnell to get his opinion. Mr. O'Donnell concurred that we do indeed need a small switch tamper, on the property at all times, to cover emergencies regardless of whether we intend to contract the major track maintenance to contractors or not and he suggested that we look into buying either a small Placer Tamper or a small Jackson Tamper. Either one would have track-lining capabilities

At this point I discussed the possibility of purchasing equipment from the track-construction Contractor and/or allowing the Contractor to use equipment which the Dade County System has purchased. I received a negative answer on both counts. Mr. O'Donnell emphasized that, by the time the contractor is finished working with his equipment, it is worn out, and I should not even consider purchasing equipment second hand from the contractor, or for that matter from anyone else, because it is a waste of money. He strongly advised against loaning Authority (owned) equipment to the Contractor.

Hi-Rail Air Compressor

The WMATA system owns one hi-rail air compressor, which they find to be an indispensable piece of equipment. The machine that they own is the same machine that MARTA specified. Namely a Schramm Model HT300A "Pneumatractor". This is a hi-rail diesel powered air compressor which can be operated at reasonable speed to any site requiring compressed air for operating the drilling equipment used to drill the holes in the "direct fixation" track or for use in operating paving breakers or any of the other air to operated tools.

Welding Equipment

The WMATA system, at the present time, own one rubber-tired Lincoln Model SAE 400, DC welder, which they use in the field. It cost $3,300. They recommended that we equip our MW shop with a small AC welder and purchase a DC welder similar to their machine for use in the field.

The second stop on our visit was to the Brentwood Shop accompanied by one of the field supervisors who showed us and allowed us to photograph the various items of MW equipment. We were met at the shop by the Supervisor of Track and Equipment, Mr. C.C. Crickenberger. Mr. Crickenberger has had many, many, years of experience in track maintenance, having worked for a railroad, and a track construction contractor, prior to coming to WMATA. We questioned him at length on his feelings about various items of equipment.

Trackmobile

At the time of our visit the "Kal-Trac" track-mobile/dump truck/hydraulic crane was being used ajacent to the rail-car shop to lift some 3 ton (weight) portable electric screw jacks from the pavement to a near-by pickup truck so that they could be transported to their New Carrolton shop for continued use there. We had the opportunity to witness the operation of the Kal-Trac "Yard Maintenance Vehicle", which is held in high regard by WMATA for its ability to do many different types of work. MARTA and BART both have one or more of these identical machines, which are made by the Tamper Corp. of Columbia, S.C. Mr. O'Donnell mentioned earlier that, while they like the Kal-Trac switcher very much, it still does not completely substitute for the need to own a locomotive.

Miscellaneous Track Tools

After showing us the various items of Maintenance of Way equipment which WMATA has on hand, Mr. Crickenberger then showed us through their make-shift Maintenance of Way facilities which WMATA presently operated out of. The ultimate goal of WMATA is to build a complete Maintenance of Way Shop at Vienna, Virginia, which is located on a stage of the Rapid Transit which is now under construction, but not open for revenue service. Hence, they must operate out of small temporary headquarters located ajacent to the Brentwood car-shop. Mr. Crickenberger showed us several of the small hand tools which he felt were indispensable in maintenance of the track at WMATA.

Rail-Anchor Drills

They own at the present time, three-rail anchor drills together with the necessary accessory equipment. Another item which we observed was what they refer to as a "hand vibrator" arrangement. This machine is made by the Jackson people and it comes with a gasoline powered generator and four hand vibrators which can be used to do small tamping jobs, by hand in an emergency. WMATA has approximately eight of these hand vibrators, but they felt that for a system of our size, four will probably suffice. I questioned Mr. Crickenberger a little bit about the size of their track crew, and he indicated that their daytime crew consists of about eight men on an average. Two of these men are engaged in walking the track for inspection purposes and the nighttime crew was a little more than double the daytime track crew. I might point out that WMATA does not put a lot of faith in mechanized track inspection equipment. They do have the Sperry people come in and ultransonic test the entire system three times per year, but as far as the track geometry goes, they rely very heavily on visual inspection on a daily basis, particularly looking for loose bolts and loose anchors. These seem to be the major problem at WMATA.

After the conclusion of our visit to the WMATA Maintenance of Way Facilities we still had some time to kill before plane time so I elected to visit the Silver Sping Station on the WMATA system to observe the function(s) of the Station Attendant and the various controls that are located in the Station Attendant's Booth. After spending about five minutes in the Station Attendant's Booth, I came to the conclusion that the scene was more like a three-ring circus than a Rapid Transit Station operation, thus, I will illustrate some of my observations in the hour or so that I spent at the station.

- An elderly couple came to the Attendant and informed him that the elevator was not functioning. The Attendant reset the breaker in the booth and told the couple to go ahead and use the elevator. They then informed him that they wanted to come down from the track platform and had already used the escalator and that they had only wanted to inform him that his elevator did not operate. Three seconds later the same couple had to come back to the Station Attendant to secure help in exiting through the fare gate due to a malfunctioning ticket. A large amount of the station attendant's time was spent clearing patrons through the exit turnstiles because of malfunctioning ticket media, and/or ticket transporters. I then realized that the station employed a full time, or more or less full-time turnstile repairman. During the course of an hour he had at least three of the ticket transportors apart clearing jammed tickets. Of course, we in Dade would hopefully not encounter the same problems that WMATA has with their magnetic tickets.

- One thing that I observed was that the transfer machines are not in any way controlled from the Attendant's Booth. The paper stock, when it becomes low in supply, lights a red light on the machine which indicates to the Station Attendant that he must replace the stock. Apparently this must be done several times a day for each machine, of which there are two.

- I noticed that none of the various handicap service gates would latch when they were released to swing shut. I questioned the Station Attendant as to whether or not they had an alarm system on the gate, which was set to sound if the gate remained open, say more than 30 seconds. He informed me that "yes, indeed, all the gates were equipped with an alarm", but because of the fact that all of the gates were out of adjustment, all of the time, so they elect to leave the alarm system off. He then demonstrated to me after closing the gate and returning to the Attendant's Booth how the alarm system is reset. Due to the fact that one of the other gates was not latched, the alarm promptly went off and this brought in a phone call, immediately from the other Station Attendant, located on the other side of the station, asking "What was happening?", because the alarms were ringing. The point here is that they do pay attention to alarms, when they go off, but most of the alarms are set to be inoperative most of the time.

- Another "case in point" was when I asked the Station Attendant if I could visit the ancillary rooms in the station, and the Station Attendant told me to "help myself". I asked him if he would unlock the door for me so that I could go in, he said, "The door is never locked go ahead and go in". I noticed that they had a large piece of cardboard taped over the door latch so that the door was never locked. The point here being that, again all the money spent for the alarm system(s) appears to be money wasted, because they have been one way or another overriden. The same probably holds true for the elevator controls.

° I noticed that the Silver Spring Station has absolute no emergency egress provisions and, according to the Attendant, they had never ever needed any and had never given any thought to emergency egress of patrons.

° Having noted the dirty condition of the station floor, I asked the Station Attendant how often it is cleaned, His answer was that "they have a Custodian for every two stations on the system" and early in the morning the Custodian comes by and sweeps up the cigarette butts and trash and deposits it in one of the trash cans. The same man is supposed to bring,periodically, (two to three times a week) a floor scrubber to clean the floor and wash the windows in the attendant's booth. It appears to the writer that the floor had not been washed in many many weeks for whatever reason.

° Another item that was noted in the station area was the method of paying for the parking. We pulled into a lot which had a sign displayed which stated that the fee for parking was"$1 between 10 a.m. and 3 p.m". We saw no means evident of paying for the parking, so we just parked the car and walked into the station (approximate distance 500 feet). Upon entering the station we noted a lock box which indicated that we were obligated to deposit $1 into the slot numbered the same as the place we had parked the car. We could not remember seeing a number where we had parked. I made the observation to the others that it was a good thing we were not commuters late for work, and who failed to notice our parking number, because we could have to go back to our car and find out what our parking slot number was and then return to the station and deposit our $1. Within ten minutes of making this observation, I saw a girl walk up to the Station Attendant and announce that she had paid her fare and entered the turnstile, but had failed to remember to deposit her $1 in the slot. The Attendant had to manually release the exit gate so that she could go and pay her parking ticket and then allow her to return to the station. The point here is that it appears to the writer that WMATA has a very cumbersume method of collecting parking fees at least in this station.

° I questioned the Station Attendant as to how he felt about having the booth located in the center of the turnstile array as opposed to off to one side. He felt that this way was best for him (i.e have the booth centrally located among the various turnstiles).

° I noticed in the design of the station barriers that it would be very easy for a fare evader to skirt the end of the barrier, which is a low profile iron railing separating the free area from the paid area and I questioned the Station Attendant as to whether or not very many people attempt to evade the fare by going around the railing. He indicated only on very rare occassions has he ever caught anyone attempting to do this.

° In the hour I spent at the station, not once did the station attendant observe any of the seven CCTV monitors in the booth. During the entire visit I took several photograph of both the maintenance of way equipment and the station layout which I will have in my office for anyone to view if they are interested.

Appendix C

EQUIPMENT DATA SHEETS

Appendix C

BASIC DATA SHEETS

BASIC DATA SHEET No. 1: LOCOMOTIVE, DH-700

1.	Vehicle type	Locomotive, DH-700 (nominal 50 ton)
2.	Manufacturer	Anbel Corp., Houston, TX (713) 977-9737
3.	Sales representative	Ken Nichols, Anbel Corp.
4.	Capabilities	Work train/revenue rescue, 38,000 lb tractive effort starting
5.	Usage	Toronto (DH-7005)
6.	Power rating	700 hp (2 diesel engines), GM Detroit 8V71T
7.	Power transmission	Hydraulic, torque converter (Clark), 4-speed transmission
8.	Energy consumption	750 gal capacity
9.	Maximum speed	60 mph
10.	Braking equipment	Air, WABCO 27LA, 50 cfm compressor
11.	Weight	98,000 lb empty, 105,00 lb w/fuel and provisions
12.	Size (l x w x h)	41'9" x 10' x 12'
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $4,000/year
15.	Estimated cost (1982)	$500,000, including air conditioning, catalytic exhaust, full controls
16.	Delivery	Unknown
17.	Accessories	Hydraulic crane Power winches Cummins engines Caterpillar engines (about same price as GM motors) Radio

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BASIC DATA SHEETS

BASIC DATA SHEET No. 2: LOCOMOTIVE, CR-8

1.	Vehicle type	Locomotive, CR-8 (nominal 50 ton)
2.	Manufacturer	Plymouth Locomotive Works, Plymouth, OH
3.	Sales representative	McCormick Morgan, Inc., San Francisco (415) 826-9559 Andrew Garcia
4.	Capabilities	Work train/revenue rescue
5.	Usage	BART (50 ton), Baltimore (60 ton)
6.	Power rating	670 hp (2 Cummins NT-855-L4)
7.	Power transmission	Hydraulic torque converters (twin disc), 2-speed transmission
8.	Energy consumption	300 gal capacity
9.	Maximum speed	Unknown
10.	Braking equipment	Air
11.	Weight	Approximately 100,000 lb
12.	Size (l x w x h)	42' x 10' x 10'6"
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $4,000/year
15.	Estimated cost (1982)	$400,000 F.O.B. Plymouth
16.	Delivery	12 months
17.	Accessories	Transit coupler

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BASIC DATA SHEETS

BASIC DATA SHEET No. 3: LOCOMOTIVE, JTDW

1.	Vehicle type	Locomotive, JTDW (25 ton)
2.	Manufacturer	Plymouth Locomotive Work, Plymouth, OH
3.	Sales representative	McCormick Morgan, Inc., San Francisco (415) 826-9559 Andrew Garcia
4.	Capabilities	Work train/yard moves, about 2 cars up 4% grade
5.	Usage	Unknown
6.	Power rating	12,500 lb drawbar pull on level track
7.	Power transmission	Hydraulic, torque converter
8.	Energy consumption	Unknown
9.	Maximum speed	Unknown
10.	Braking equipment	WABCO, air
11.	Weight	50,000 lb
12.	Size (l x w x h)	16' x 107" x 8'11"
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $3,000/year
15.	Estimated cost (1982)	$160,000
16.	Delivery	Unknown
17.	Accessories	Couplers Exhaust scrubber

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BASIC DATA SHEETS

BASIC DATA SHEET No. 4: LOCOMOTIVE, R77

1.	Vehicle type	Locomotive, R77, diesel electric (50 ton)
2.	Manufacturer	General Electric, Erie, PA
3.	Sales representative	S. B. Dunham, Jr. (415) 546-4327
4.	Capabilities	Tow work trains, freight cars, and disabled vehicles; provide auxiliary power (air)
5.	Usage	NYCTA, MARTA, MIAMI
6.	Power rating	335 hp Cummins NTA-855-L
7.	Power transmission	4 traction motors, GE 763
8.	Energy consumption	Unknown
9.	Maximum speed	30 mph
10.	Braking equipment	Automatic air
11.	Weight	100,000 lb
12.	Size (l x w x h)	34' x 8' x 10'8"
13.	Estimated life	30 years
14.	Estimated maintenance	$3,000
15.	Estimated cost (1982)	$576,500 F.O.B Erie
16.	Delivery	15 to 18 months
17.	Accessories	Unknown

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BASIC DATA SHEETS

BASIC DATA SHEET No. 5: WORK CAR

1.	Vehicle type	Electric, self-propelled work car/locomotive, 600 VDC
2.	Manufacturer	Maxson, St. Paul, MN
3.	Sales representative	Maxson
4.	Capabilities	15,000-lb load
5.	Usage	Specified by MBTA, 1980, <u>Did not</u> exercise contract
6.	Power rating	1.0 mphps acceleration w/200,000-lb trailing load
7.	Power transmission	4 motors, axle-mounted gear boxes
8.	Energy consumption	Unknown
9.	Maximum speed	40 mph w/200,000-lb trailing load
10.	Braking equipment	Air
11.	Weight	85,000 lb maximum
12.	Size (l x w x h)	43'6" x 8' x 11'6"
13.	Estimated life	50 years
14.	Estimated maintenance	$1850/year
15.	Estimated cost (1982)	Bid price, $1,500,000 (MBTA estimated should cost $500-600,000)
16.	Delivery	Unknown
17.	Accessories	Hydraulic crane (included) Suspension - spring (steel leaf or helical) Brakes - air, tread Couplers - transit, mechanical only Cam controller propulsion Current collection - pantograph and trollypole, plus 3rd rail Utility power - 10 kw 120/240, 1 phase, motor-alternator set

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BASIC DATA SHEETS

BASIC DATA SHEET No. 6: WORK CAR

1.	Vehicle type	Self-propelled work car/electric 750 VDC
2.	Manufacturer	KE estimate
3.	Sales representative	None
4.	Capabilities	Light towing, vacuum duty, trash collection, tunnel lighting maintenance, personnel transport
5.	Usage	Most systems use old transit cars
6.	Power rating	Unknown
7.	Power transmission	Electric motor/gearbox (same as transit car)
8.	Energy consumption	6.5 kwh/car mile
9.	Maximum speed	70-75 mph
10.	Braking equipment	Same as transit car
11.	Weight	Approximately 60,000 lb
12.	Size (l x w x h)	75' x 10' x 12'
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $1,850/year
15.	Estimated cost (1982)	

Carbody (1/4 enclosed-3/4 flatbed)	$100,000
Cab and controls	10,000
Trucks	60,000
Propulsion	175,000
Brakes	50,000
Auxiliary power (3-phase 440 VAC)	50,000
Batteries	3,000
ATP	25,000
Couplers	20,000
Communications	3,000
Current collectors	5,000
Design and documentation	150,000
TOTAL	$650,000

16.	Delivery	2 years

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BASIC DATA SHEETS

BASIC DATA SHEET No. 7: WORK VEHICLE

1.	Vehicle type	Permanent Way Motor Vehicle, PMC 30
2.	Manufacturer	Plasser, Vienna, Austria
3.	Sales representative	Plasser American, 2001 Myers Road, Chesapeake, VA (804) 543-3526 Gerhard Polterauer
4.	Capabilities	10-man cab and flat load area
5.	Usage	Austria
6.	Power rating	210 hp, Caterpillar 3208
7.	Power transmission	4-speed, torque converter
8.	Energy consumption	Unknown
9.	Maximum speed	Unknown
10.	Braking equipment	Air, tread
11.	Weight	40,000 lb
12.	Size (l x w x h)	31'8" x 8' 2 1/2" x 10'4"
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $3,000/year
15.	Estimated cost (1982)	$150,000-200,000
16.	Delivery	Unknown
17.	Accessories	4-wheel drive Couplers Crane Generator (5kw AC) Trailer

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BASIC DATA SHEETS

BASIC DATA SHEET No. 8: WORK VEHICLE

1.	Vehicle type	Permanent Way Motor Vehicle, PMC 10
2.	Manufacturer	Plasser, Vienna, Austria
3.	Sales representative	Plasser American, 2001 Myers Road, Chesapeake, VA (804) 543-3526 Gerhard Polterauer
4.	Capabilities	3-man cab and load area
5.	Usage	Austria
6.	Power rating	Unknown
7.	Power transmission	Torque converter
8.	Energy consumption	Unknown
9.	Maximum speed	Unknown
10.	Braking equipment	Air
11.	Weight	Unknown
12.	Size (l x w x h)	Unknown
13.	Estimated life	30 years
14.	Estimated maintenance	Operating and maintenance, $2,000/year
15.	Estimated cost (1982)	$100,000
16.	Delivery	Unknown
17.	Accessories	Crane Couplers 4-wheel drive

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BASIC DATA SHEETS

BASIC DATA SHEET No. 9: LOW-PROFILE CRANE

1.	Vehicle type	Low-profile crane, model 40 LPC-SC
2.	Manufacturer	Pettibone, Chicago
3.	Sales representative	N. P. Frazzini, Hayward (415) 489-2700
4.	Capabilities	40,000-lb capacity at 10' radius
5.	Usage	Many
6.	Power rating	122 hp, GMC 4-53
7.	Power transmission	Hydraulic
8.	Energy consumption	60-gal tank
9.	Maximum speed	17.2 mph on road
10.	Braking equipment	4-wheel, air over hydraulic
11.	Weight	56,150 lb, w/outriggers and rail wheels
12.	Size (l x h)	36' x 9'8"
13.	Estimated life	30 years
14.	Estimated maintenance	Unknown
15.	Estimated cost (1982)	$175,000 F.O.B. Chicago
16.	Delivery	Unknown
17.	Accessories	Unknown

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BASIC DATA SHEETS

BASIC DATA SHEET No. 10: MULTIPURPOSE CRANE

1.	Vehicle type	Multipurpose crane "Speed Swing," model 441 B
2.	Manufacturer	Pettibone, Chicago
3.	Sales representative	N. P. Frazzini, Hayward (415) 489-2700
4.	Capabilities	180° boom, 8,000-lb lift, on/off track, 4-wheel steer/drive
5.	Usage	Many
6.	Power rating	122 hp diesel GMC
7.	Power transmission	Torque converter, 6-speed transmission
8.	Energy consumption	Unknown
9.	Maximum speed	Unknown
10.	Braking equipment	4-wheel, air over hydraulic
11.	Weight	23,000 lb
12.	Size (l x w x h)	Approximately 17'6" x 8'2" x 8'8"
13.	Estimated life	20 years
14.	Estimated maintenance	Factory overhaul, $65,277
15.	Estimated cost (1982)	$107,500 w/coupler, catalytic converter, hi-rail
16.	Delivery	30 days
17.	Accessories/cost	Heater and air conditioning $1,300
		Clamshell 7,500
		Backfiller blade 4,800
		Switch broom 7,700
		Rail threader 1,600
		Winch 6,700

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BASIC DATA SHEETS

BASIC DATA SHEET No. 11: RAIL CAR MOVER

1.	Vehicle type	Rail car mover, model 250
2.	Manufacturer	Pettibone
3.	Sales representative	N. P. Frazzini, Hayward (415) 489-2700
4.	Capabilities	Hi-rail, yard moves
5.	Usage	Unknown
6.	Power rating	118 hp, Detroit diesel 4-53N, 11,000-lb drawbar pull on rail, 25,000-lb pull on tires
7.	Power transmission	Torque converter, 4-wheel drive/steer
8.	Energy consumption	Unknown
9.	Maximum speed	23 mph on rail
10.	Braking equipment	4-wheel, air over hydraulic
11.	Weight	36,000 lb
12.	Size (l x w x h)	19' x 9'4" x 9'11"
13.	Estimated life	15 years
14.	Estimated maintenance	Operating and maintenance, $6,610/year
15.	Estimated cost (1982)	$82,472 w/hi-rail and sanders
16.	Delivery	Unknown
17.	Accessories	Many

Appendix C

BASIC DATA SHEETS

BASIC DATA SHEET No. 12: RERAILING EQUIPMENT

1.	Vehicle type	Rerailing equipment, hydraulic
2.	Manufacturer	Simplex
3.	Sales representative	Simkins Company, Los Angeles (213) 754-2956
4.	Capabilities	Jack derailed vehicle, carry in hi-rail vehicle (pickup truck)
5.	Usage	Many railroads
6.	Power rating	135 ton, 17" lift
7.	Power transmission	Gasoline-powered pump
8.	Energy consumption	Unknown
9.	Maximum speed	NA
10.	Braking equipment	NA
11.	Weight	NA
12.	Size (l x w x h)	NA
13.	Estimated life	15 years
14.	Estimated maintenance	NA
15.	Estimated cost (1982)	$20,000
16.	Delivery	Unknown
17.	Accessories	NA

Appendix C

BASIC DATA SHEETS

BASIC DATA SHEET No. 13: TUNNEL VACUUM

1.	Vehicle type	Tunnel vacuum
2.	Manufacturer	Vac-All
3.	Sales representative	Simpkins Co., Los Angeles (213) 754-2956
4.	Capabilities	Vacuum tunnel and roadbed, mounted on hi-rail vehicle, 16 cubic yard capacity
5.	Usage	BART (modified with wash equipment)
6.	Power rating	12,000 cfm blower, 175 mph air speed
7.	Power transmission	Diesel auxiliary engine
8.	Energy consumption	Unknown
9.	Maximum speed	NA
10.	Braking equipment	NA
11.	Weight	Unknown
12.	Size (1 x w x h)	Unknown
13.	Estimated life	15 years
14.	Estimated maintenance	$800/year
15.	Estimated cost (1982)	$110,000
16.	Delivery	Unknown
17.	Accessories	Catalytic exhaust Sweeping brooms Power flush

Appendix D

EQUIPMENT COST SUMMARY

Appendix D

EQUIPMENT COST SUMMARY

Vehicle/Equipment	Capital Cost	*Estimated Annual O & M Cost	Total Annual Cost
1. Locomotive/Anbel DH-700 (50 ton)	500,000	4,000	65,640
2. Locomotive/Plymouth CR-8 (50 ton)	400,000	4,000	53,310
3. Locomotive/Plymouth JTDW (25 ton)	160,000	3,000	22,725
4. Locomotive/GE model R77 (diesel electric)	576,500	3,000	24,070
5. Work car, self-propelled, electric per MBTA spec. (Maxson bid)	1,500,000	1,850	186,770
6. Work car, self-propelled, electric modified transit car (KE estimate)	650,000	1,850	81,980
7. Work vehicle, diesel/Plasser PMC 30 (20 ton)	200,000	3,000	27,655
8. Work vehicle, diesel/Plasser PMC 10	100,000	2,000	20,490
9. Crane, low-profile/Pettibone 40 LPC-SC (40,000 lb)	175,000	**	21,575
10. Crane, multipurpose/Pettibone 441B Speed Swing	107,500	**	19,880
11. Rail car mover/Pettibone 250	82,500	6,610	26,950
12. Rerailing equipment, hydraulic, Simplex	20,000	**	4,930
13. Tunnel vacuum, hi-rail mounted	110,000	800	14,360

*Estimated operating and maintenance costs include fuel, equipment maintenance, and maintenance labor.

**Operating and maintenance costs depend on usage which cannot be estimated at this time.

Appendix E

TELECON REPORTS & CORRESPONDENCE

KAISER ENGINEERS

TELECON REPORT

DATE June 14 1982 JOB NO 81152 ROUTING

CALL TO – D. Kriens

CALL FROM – Speno Rail Services
Bob Walter – Sales Mgr.
(315) 437-2547

SUBJECT – Rail Grinding –
Speno has contract units available –
Self propelled units, grind .002 –.004 inch per pass.
New rail requires two passes. MARTA uses 2 pass – 1/year.
Grind at speed of 2 mph.
Cost. – approx $200 per mile per pass.
Add. transportation charge – unknown amt.

ACTION REQUIRED –

KAISER ENGINEERS

TELECON REPORT

DATE June 10 1982 JOB NO 81152 ROUTING

CALL TO – A.T. Bruno
(315) 437-6371

CALL FROM – D. Kriens

SUBJECT – Rail Maintenance.

Has rail grinding equipment for contract work. Designed for Fairmont. Cost = $300/hour + shipping + fuel + water. Minimum of 5 days.

Recommended track contractor be required to grind (at least 3 passes) which should be okay for first two-three years.

Grinds WMATA once per year. Rail on concrete slab appears to accelerate rail corrugation.

Designed wash/vacuum equip for MARTA. - Flat car mount cost $300,000 in 1981.

Has prototype unit available (grinder) designed as a starter unit & can be expanded - Not self propelled - includes power unit for grinder motors. Cost estimated at 125K!

ACTION REQUIRED –

telecon report

Raymond Kaiser Engineers

date: June 10 1982 job no: 81152

routing:

call to: D. Kriens KE

call from: DAN McCoy
Sperry Rail Service
(203) 748-3581

subject: Rail inspection -

Current rate for ultrasonic inspection is $165 per mile.
Minimum of 20 miles per day - minimum charge of two days ($6600)

Inspection performed for BART on an annual basis.

Machine not for use on girder rail.

action required:

KAISER ENGINEERS

TELECON REPORT

DATE May 28 1982 JOB NO 81152

ROUTING

CALL TO – Ward Kingma - KE Boston -

CALL FROM – Don Kriens

SUBJECT – MBTA WORK CAR Bid -

Received only one bid (early '82) for self-propelled electric work car with crane. Estimate was 500 - 600K. Bid from MAKSON - St. Paul for 1.5M. MBTA did not exercise contract. Other suppliers presently proposing off shelf equipment. (T) must decide within few weeks on how to go -

Ward also heard that NYCTA is about to purchase self powered work cars. - Larger than for MBTA. No further details. -

ACTION REQUIRED –

TELECON REPORT

KAISER ENGINEERS

DATE May 26 1982 JOB NO 81152 ROUTING

CALL TO - TAMPER CORP. Columbia S.C.
(803) 794-9160
JIM O'Neal

CALL FROM - D. Kriens

SUBJECT - Requested data on car mover -

Was informed that Tamper is no longer in the business of furnishing car moving equipment. Only handle track maintenance machinery -

ACTION REQUIRED -

TELECON REPORT

KAISER ENGINEERS

DATE May 21 1982 JOB NO 81152 ROUTING

CALL TO – Chuck Pelton - BART
(415) 465-4100 ext 530

CALL FROM – D. Kriens

SUBJECT – Tunnel Cleaning.

BART has Tunnel Wash/vacuum unit mounted on hi-rail 2½ Ton Ford truck.

Unit mfg by VAC ALL, has approx 12 cubic yard capacity, has 2500 gal water tank sufficient for 1000' of Tunnel. Has spray bar for high pressure water & non foaming detergent. Unit works well - no problems -

BART washes Bay Tube on a 90 day frequency.
Other parts of system (tunnels) on 6 month cycle.

ACTION REQUIRED –

TELECON REPORT

KAISER ENGINEERS

DATE May 21 1982 JOB NO 81152 ROUTING

CALL TO – Plasser American
(804) 543-3526

CALL FROM – D. Kriens

SUBJECT –

Requested data and cost info on plasser Equipment –
Track surface cleaning – vacuum – 40R110.
Permanent Way vehicle – OBW 10.
Grinding Trailer – SSM 112,
New permanent way vehicle using American equip – PMC-30
specs & price will be sent. Others come from Vienna –

ACTION REQUIRED –

telecon report

Raymond Kaiser Engineers

date: May 20 1982 job no: 81152

routing:

call to: J. P. Van Overveen
BART -

call from: D. Kriens KE

subject: Maintenance Equipment -

1. BART has Plymouth 50 Ton Loco (also one on order) - Uses Cummins diesel -
2. Wrecking equipment (hydraulic) carried to site in hi rail van. Never used to date in tunnel or subway.
3. Track inspection once per year by Sperry. Cost $25,000. - 150 miles -
4. Rail grinder made by Fairmont - Sold by Spero. Used as required -
5. Tunnel wash & vacuum - not familiar with equipment - usage is approximately once each 6 months.

action required:

McGonn [illegible] Manning [illegible] SF [illegible]
Plymouth [illegible] [illegible] – Locomotive [illegible] [illegible]
Locomotive [illegible]
[illegible] Ross
Donald E. Shanke 419-687-[illegible]
[illegible] Work Train
Subway Emergency-Locomotive

Plymouth 50 ton Diesel Locomotive
Model CK-E w/ Hydraulic Torque Conv.

Coupling: AAR Type or
Transit Vehicle Type

Exhaust [illegible] w/ complete exhaust gas
treatment & [illegible]
Diesel Engine
Deutz [illegible]
[illegible]

Specs similar to SEPACT District [illegible]
Proposal No. L-20-76

Shipment: 8-12 months
Price: $375 - $400,000 50-ton
F.O.B. Plymouth $422,000 65-ton

AMECO CORP. 713-977-1737
HOUSTON TEXAS (800-231-1390)

ALAN CRIPE V.C. CHIEF ENGINEER

KEN R. NICHOLS PRESIDENT

LOCOMOTIVE FOR WORK TRAIN

50-TON DIESEL - HYDRAULIC

—($650,000) IN 1978

MODEL A-700 GM TWIN DIESEL 300 HP EA

SAFETY ELECTRIC
GEAR BOXES OR CUMMINS [illegible]

– PLATFORM [illegible]

[illegible] CONTROL

PLYMOUTH — [illegible] DIESEL-HYDRAULIC — [illegible]

PRICE: $ [illegible] APPROX.

PORT OF
F.O.B. BROWNSVILLE, TEXAS

SHIPMENT: 12 MONTHS

PETTIBONE

J. J. OLLENDORF -

NESTER KRABBIN - FURBY

BOB ITTER - RAILROAD REP.

SOLD MICHELLE CRANE

ON-OFF RAIL TYPE

RECEIVED LITERATURE ON

1. LOW PROFILE HYDRAULIC CRANE 40,000 LBS
MODEL 40LPC-SC W/ 353 GMC DIESEL ENGINE $17,000

2. 30 CWR & 26 CWR

3. RAIL CAR MOVER - ROUGH TERRAIN
MODEL 250

MODEL 40-RS MULTIKRANE 20 TON CAPACITY
w/ 453 GMC DIESEL 4-CYL ENGINE $120,975
TWO COUPLERS HYDRAULIC PIN PULLER 9,582.00
HI RAIL ATTACHMENT 26,275.00
LIGHTS
CLAMSHELL ATTACHMENT
EXTRA ELECTRIC BRAKE BY CALIFORNIA STD.

MAY 5, 1982

BURRO CRANE INC. MAY 12, 1982
CHICAGO ILL.

MR. RANDY BURGARDT OUT FOR THE DAY
MR CHUCK EDWARDS 312 - 521 - 9200

12½ TON - ON RAIL TYPE
SELF-PROPELLED CRANE
WITHOUT ANY ACCESSORIES
PRICE : ($154,000 IN 1978) $198,000
LEAD TIME : 6-8 MONTHS 6 MOS

471 GMC 3-4 CARS
+ CRANE FUNCTION
CLUTCHES AIR OPERATED
NO HYDRAULIC

MAGNET GENERATOR $220,000
FLOOD LIGHT $223,000
CATALYTIC CONVE
OXYCATALYST

Internal Quotation — Original

NOTICE

This quotation is subject to our Standard Conditions of Sale and to our approval as to quantity (unless specified). It expires thirty days from its date and in the meantime is subject to change upon notice. — Shipping dates are approximate and subject to change by reason of factory conditions. — The quotation and promise sheet must be noted on requisition.

Quotation No. KD2-1656

June 14, 1982

Promise Sheet No.

PA deMaintenon, 42-4
GW Jacobs, 14-4
G. Golub, 12-2

S.B. Dunham, Jr.
General Electric Company
55 Hawthorne St.
San Francisco, California 94105

Subject: Diesel Electric Switching Locomotive
Kaiser Engineers Inc.
Bermuda Building
3rd Floor
Oakland, California 94623

Dear Sam:

We are pleased to submit this bid for a 50-ton diesel electric switching locomotive for work train application as requested by Kaiser Engineers, Inc. The locomotive proposed will be identical to those to be built for NYCTA on their Contract R-77, except for the paint scheme. The locomotive is described in the enclosed G.E. Specification RY-24910A, which in turn describes the technical requirements outlined in the R-77 Contract. Any agreed upon changes that may develop during the course of the R-77 Contract with NYCTA will be applied to all locomotives and Kaiser would be so informed.

By combining the one (1) locomotive for Kaiser with the 25 for NYCTA on the same production order, the economy of mass production can be realized. This quotation is submitted based on a continous production flow of identical locomotives, except for paint scheme.

Price

Total price, 50-ton locomotive per Specification RY-24910A

.... $576,464 each net.

Price is net f.o.b., Erie, Pa., no freight allowed, and subject to escalation in accordance with ISD Clause 5, attached, from base to date of March, 1982 until shipment. Title will pass at the factory.

Payment

A down payment of 25% of total price is required at time of placement of order. The remaining 75% is due on receipt of invoice.

Terms and Conditions

General Electric Standard Terms and Conditions, per the attached, will apply. Warranty is extended as noted following.

Warranty

Warranty on the total locomotive will be extended to 2 years from date of placement in service or 25 months from date of shipment, whichever is soones The warranty provisions and application of the service and warranty policy are enclosed with this quotation.

Service Engineering

Three full days of field service engineering are provided at no charge to the customer. The service engineer will supervise customer's labor to prepare the locomotive for service and to instruct operators and mechanics in the proper operation and the maintenance of the locomotive. Additional supervision can be provided at standard GE Installation and Service Engineer ing rates.

Shipment

Shipment of the locomotive from the factory can be made in October 1983 subject to receipt of purchase order by June 30, 1982. Shipping method is to be determined by General Electric. The locomotive will be shipped fully assembled either on a Railroad flatcar or on it's own wheels. If shipped on it's own wheels, the traction motor pinions will be removed to prevent motor damage in transit. In either case, fuel oil, engine and compressor lube oil and engine coolant will be removed prior the shipment. It will be the customer's responsibility to provide these running supplies at destination.

General

A sample locomotive will be built for NYCTA and will be fully inspected by NYCTA. All other production locomotives will be built like the sample and with any agreed upon changes resulting from final sample inspection. The one (1) locomotive for Kaiserwill be part of the "production" run.

Inspection

Kaiser inspector(s) is welcome at the factory to observe the progress of the locomotive. Inspection is limited to the completed locomotive. Test records of engine, motors, gear boxes, generator and total locomotive will be provided.

General Electric trusts that this bid will be carefully considered and would welcome your valued order.

Respectively,

Bill

J.W. Sinclair
Sr. Sales & Application Engineer
Bldg. 14-4, (814) 875-3615

mp

KAISER
ENGINEERS

KAISER ENGINEERS, INC.
425 SOUTH MAIN STREET
8th FLOOR
LOS ANGELES, CALIFORNIA 90013
TELEPHONE: (213) 972-6033

June 4, 1982

File: 81152-408
WBS: 14CAE13 A/2439

MEMO TO: W. J. Rhine

FROM: P. M. Burgess

SUBJECT: Auxiliary Vehicle Alternative - Lease vs Own Rail Grinding Equipment

The following Railroad and Rental agencies were contacted regarding renting or leasing their rail grinding equipment, with or without their crews.

- Santa Fe Railroad
  Mr. C. W. Groh
  Mr. Hap Luttrelle
  (213) 267-5567

- Union Pacific Railway
  (800) 372-6530

- Southern Pacific
  (213) 437-0639

- Equipment Rental
  Arizona
  (505) 247-0741
  ext. 232

Not one of the above is willing to rent or lease their equipment for one or more of the following reasons:

- Their equipment is old and in need of frequent repairs, which they do themselves, but could not expect a rentor or leasee to repair and maintain.

- Only 36 miles of track would mean that the equipment would be needed for very short periods of time. They view the rental possibilities as bothersome interruptions.

- Some do not lease or rent their equipment as a matter of policy.

Although it is possible to obtain leasing costs from Contractor's Equipment Leasing Manuals, the lease alternative does not appear to be feasible because of availability. Therefore we recommend dropping this alternative from the WBS 14CAE13 analysis.

PMB:CMC:mea

Appendix F

CALCULATIONS

KAISER ENGINEERS

JOB No. 81152
SHEET 1 OF 3

AUXILIARY VEHICLE CALCULATIONS

DESIGNED BY D. Gieus DATE 6/25/82
CHECKED BY DATE

TUNNEL WASH & VACUUM -

18.6 miles tunnel. - Twin bore = 37.2mi = 196416 ft.
16 stations @ 600 ft each = 9600 x 2 = 19,200 ft platform
Tunnel = 196416 - 19,200 = 177216 ft.

1 mph = 1.47 ft/sec = 680 sec/1000 ft = 0.2 manhours/1000 ft.
Fill time, 2500 gallons = 10 min = 0.17 hr.
Travel time = 10 min = 0.17 hr.
Total time to wash 1000 ft = 0.54 hours
Total time for 177,210 ft = 96 hours.
Wash at 6 month interval = 192 hours

3 man operation - 4 hours/night = 48 nights/year.
Add 1.5 hours setup and dump time = 264 operating hrs/year.
264 x $19.3 x 3 = $15,285/year Labor.

Equipment Maintenance - Clean filter - 2/year = 8 mh = $160
Engine work - 2/year = 8 mh = $160
Materials = $150

Equip Maint $ 470.

Fuel Cost - 2 engines ~ 200 hours/year
40 Lbs fuel/hr x 200 hrs = 16000 Lb.
16000/6 Lb/gal = 267 gal x 1.25/gal = $334/year.

Water Cost - 2500 gal/1000 ft x 177K ft x $1/1000 gal = $445./year.

Total O&M cost for Tunnel Wash & Vacuum = $16,535/year.

KAISER ENGINEERS

Job No.

Designed by D. Kyriens   Date

Checked by   Date

Auxiliary Vehicle Calculations

Self Propelled Rail Grinder

Assume one complete grind each 12 months.
Grind rate : 1.5 mph.
Running time + Time in & out = 48 hours/year -
2 man operation x $19.3/hour = $1850/year Labor.

Equipment maintenance -
Once per usage = 8 mh/year = $155/year
24 stones at $50/stone Material = 1500/year.
Maint. = $1655
Fuel - 26 gal/hour x 24 hours/year = 624 gal = $625

Total O & M Costs/year = $4130.

Diesel-Hydraulic Locomotive

Operation - Assume one round trip/day, 5 days/week
fuel mileage, 3 mpg (50 Ton) · 5 mpg (30 Ton)
36 mi x 5 x 52 = 9360 miles/year.
50 Ton = $3120/year fuel
30 Ton = 1872/year fuel -

Maintenance - (2500 mile interval.)
9630 mi/2500 = 3.74/year.
Labor @ 4 mh x $19.3 x 3.74 = $290
Material $150/P.M x 3.74 = $560

Total O&M - 50 Ton = $3970
30 Ton = $2722

CALCULATIONS KE Form No. E-6 Rev. 10-71

Auxiliary Vehicle Calculations

DESIGNED BY D. Kriens DATE

CHECKED BY DATE

Car Mover.

Operation - Daily usage = 6 hours.
Fuel - 46 lb/hr = 276 lb/day = 34 gal.
@ $1.00/gal = $6200/year.

Maintenance - 2/year - @ 8 man hours each -
16 mh x $19.3 = $310
Material = $100.

Total O&M = $6610/year.

Electric Work Car -

Assume 10,000 miles/year -
Service 4/year - 4 mh/service x $19.3 = $310 labor/year
Materials (Brakes, filters, etc.) = 150/year
Overhaul in 15 years = $20,000 = 660/year
Power usage @ 10 KWh/car mile = 700/year

Total O&M = $1800/year

Appendix G

EMERGENCY PUMPING ANALYSIS

AUXILIARY VEHICLE EMERGENCY PUMP SYSTEM.

A. RECOMMENDED SYSTEM CONSISTS OF THE FOLLOWING:

(1) PUMP

ALLIS CHALMERS AUXILLY - SPLIT - DOUBLE SUCTION PUMP, 10 x 6 x 22, [illegible] 500 GPM, 300 FT TDH WITH DIESEL ENGINE GM 04-AN, 74 BHP, RATED AT 189 HP MAX, AT 1770 RPM.

THE UNIT INCLUDE PUMP, ENGINE, MOUNT. FRAME, PRIMER AND [illegible]

TOTAL COST OF UNIT $31,200.-

(2) HOSE

GOODAL RUBBER CO. 6"ϕ F 500 RUBBER HOSE, DOUBLE JACKET POLYESTER, 200 [illegible] WORKING PRESSURE.

COST $ 15/LFT TOTAL $60000 FOR 4000 FT

(3) HOSE REELS

TWO POWERED HOSE REELS FOR 2000 FT OF 6"ϕ HOSE EACH.

TOTAL COST OF EACH REEL UNIT WITH GAS ENGINE $10,000

(4) FLAT BED CAR

50 TON CAP, 53 FT LONG

TOTAL COST $25,000

B. TOTAL COST OF AUXILIARY VEHICLE EXCHANGE PUMP SYSTEM :

ONE PUMP WITH ENGINE	31,200
4000 FT OF 6" HOSE	60,000
TWO HOSE REELS	20,000
FLAT BED CAR	25,000
ASSEMBLY OF ABOVE	20,000

TOTAL COST $156,200

EMERGENCY PUMP SYSTEM CRITERIA

PUMP CAPACITY	500 GPH
PUMP SUCTION LIFT	10 FT
IMPELLER DESIGN TO ACCOMODATE	1" SOLIDS
DISCHARGE TO A FLEXIBLE HOSE	300' TDH *
DISCHARGE HOSE LENGTH	4000 FT

* NOTE: TDH IS BASED ON THE FOLLOWING:

- 100 FT LIFT OF WATER FROM LOW POINT OVER THE NEAREST HIGH POINT OF THE TUNNEL.
- DISTANCE TO HIGH POINT MAX 4000 FT
- FRICTION LOSS IN FLEXIBLE - LAY FLAT HOSE 2.0 PSI/100 FT

Raymond Kaiser Engineers

JOB NO. B1152
SHEET 1 OF 2

DESIGNED BY ______ DATE ______
CHECKED BY ______ DATE ______

PUMP CALCULATIONS

1,3" A-C, PUMP

CAPACITY 500 GPM WATER W/ 2" SOLIDS
DISTANCE TO PUMP WATER 4000 FT
LIFT 100 FT

① PUMP DISCHARGE HEAD:

ASSUME * 5 FT PRESS LOSS /100 FT

$5{,}0 \times \frac{4000}{100} =$ 200,0

NET LIFT 100 FT 100,0

TOTAL 300,0 TDH

PRESSURE $\frac{300}{2.33} = 129$ PSI

② PUMP SELECTION
SEE ATT'D TELECON REPORT

* BASED ON STEEL PIPE 4,09 FT/100 FT PRES. LOSS & INCREASED BY 25%

CALCULATIONS KE Form No. E-6 Rev. 10-71

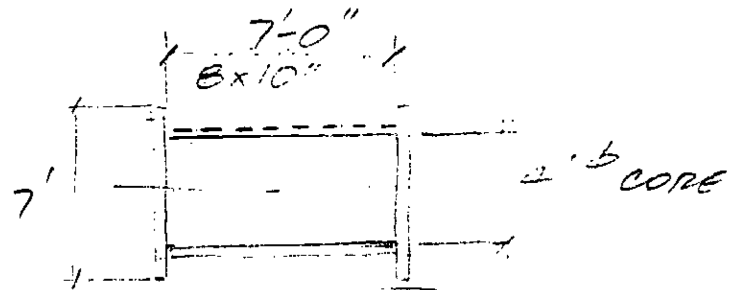
Raymond
Kaiser Engineers

JOB No. ______ SHEET 2 OF 7

DESIGNED BY ______ DATE ______
CHECKED BY ______ DATE ______

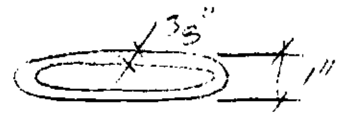
HOSE REELS

ASSUME 7' WIDE REEL FOR 6"φ FLEX
(LAY FLAT HOSE)
CAPACITY 2000 FT EACH REEL



NO. OF LAYERS $\frac{2000}{5' \times \pi \times 10} = 12.7$ (12.7)

ASSUME LAY FLAT HOSE



REEL O.D. = 4' + 2 × 12" = ~ 6'φ

WEIGHT OF HOSE 2000' × 2.4#/FT = 4800#

WEIGHT OF REEL

7'φ 1/4" STEEL PL × 2 = 800#

4'φ 1/4" × 7' LG = 900#

STR. STEEL & SUPPORTS = 1000#

SAY 3000#

GAS ENGINE 10 HP

COST 3000# STEEL	$6000
HARDWARE	$2000
ENGINE & HYDRAULIC DRIVE	$2000
EACH REEL	$10,000

CALCULATIONS KE Form No. E-6 Rev. 10-71

telecon report Raymond Kaiser Engineers

date: 2/28/83 job no: 81152 routing:

call to: KEN RUSH - ALLIS-CHALMERS
J. SODDY

call from: G. TRNKA

subject: AUXILIARY VEHICLES - EMERGENCY PUMP

500 GPM, 300' TDH PUMP FOR EMERGENCY TO PUMP WATER FROM FLOODED TUNNEL.

ALLIS-CHALMERS PUMP

10 X 6 X 22, 9000 SERIES, 1770 RPM

DRIVEN BY GENERAL MOTOR DIESEL ENGINE

GM 04 AN w/ PRIMING UNIT & VENT VALVE

74 BHP, RATED AT 189 HP MAX.

50% EFFICIENCY, 15"φ IMPELER, 1.3" MAX. [illegible]

COST OF COMPLETE UNIT INCLUDING ENGINE $31,188

action required:

telecon report

Raymond Kaiser Engineers

date: 2/25/83 job no: 81152 routing:

call to: GOODALL RUBBER HOSE CO.
GEORGE KERESKA

call from: GITRNKA

subject: AUXILIARY VEHICLES - RUBBER HOSE FOR PUM

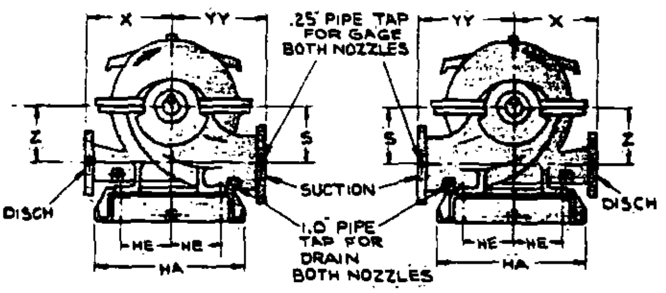
500 GPM CAPACITY AT 300' TDH

RECOMMENDED HOSE: (LAY FLAT TYPE)
6" φ F 500 RUBBER HOSE W/ DOUBLE JACKET POLYESTER, 6¾" O.D, 2.4#/LFT, 200PSI
COST $15/FT.

action required:

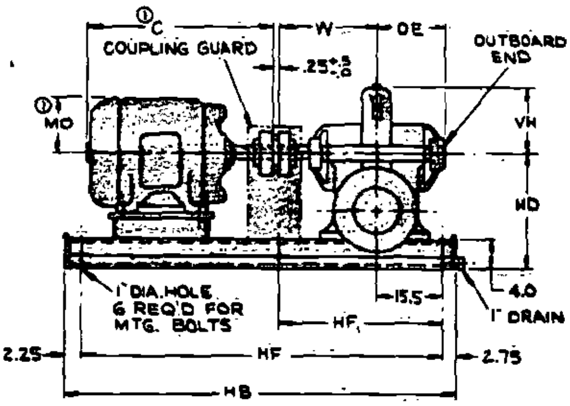
AXIALLY-SPLIT PUMPS
9000 Series Single-Stage Double-Suction Pumps with Mechanical Seals or Packing
Key No's 71, 72 and 73
Steel Drip-Lip Baseplates
Model 150

FLANGED NOZZLES ②



CLOCKWISE   COUNTERCLOCKWISE

ROTATION VIEWED FROM COUPLING END



ALL DIMENSIONS IN INCHES

DIMENSIONS DETERMINED BY PUMP										
KEY NOS	PUMP SIZE	SUCT.	DISCH.	OE	S	Z	VH	W	X	YY
71 ②	10x6x22	10	6	20.7	12.00	12.00	14.90	28.25	19.00	20.00
72 ②	12x8x22	12	8	20.7	12.00	12.00	15.25	28.25	21.00	21.00
73	14x10x20	14	10	23.00	13.00	13.00	14.75	30.50	19.00	21.00

BASE DIMENSIONS					
BASE NO.	HA	HB	HE	HF	HF_1
I	30.0	73.0	11.62	68.0	34.0
II	30.0	85.0	11.62	80.0	40.0
III	34.0	93.0	13.62	88.0	44.0
IV	39.0	102.0	16.12	97.0	48.5

DIMENSIONS DETERMINED BY MOTOR								
KEY NOS.			71		72		73	
MOTOR FRAMES	① C	① MO	10x6x22		12x8x22		14x10x20	
			BASE NO.	HD	BASE NO.	HD	BASE NO.	HD
286TS	24.8	7.8	I	25.12	I	25.12		
324TS	26.2	8.6	I	25.12	I	25.12		
326TS	27.8	8.6	I	25.12	I	25.12	I	27.25
364TS	28.8	9.2	I	25.12	I	25.12	II	27.25
365TS	29.8	9.2	I	25.12	I	25.12	II	27.25
404TS	33.4	10.4	II	25.12	II	25.12	II	27.25
405TS	34.9	10.4	II	25.12	II	25.12	II	27.25
444TS	38.5	11.8	II	25.12	II	25.12	II	27.25
445TS	40.5	11.8	II	25.12	II	25.12	II	27.25
447TS	44	11.8	II	25.12	II	25.12	III	27.25
503US	36.0	14.0	II	25.12	II	25.12	II	27.25
504UUS	41.8	14.0	II	25.12	II	25.12	III	27.25
505US	43.8	14.0	III	25.12	III	25.12	III	27.25
507US	47.8	14.0	III	25.12	III	25.12	III	27.25
586US	49.0	20.0	IV	25.12	IV	25.12	IV	27.25
587US	52.0	20.0	IV	25.12	IV	25.12		
588US	55.0	20.0	IV	25.12	IV	25.12		

NOTES

1. UNIT MUST BE LEVELED, SET AND ROUGH ALIGNED ACCORDING TO INSTRUCTIONS PRIOR TO GROUTING.
2. BASE MUST BE COMPLETELY FILLED WITH AN APPROVED GROUT AND ALLOWED TO SET BEFORE PIPING.
3. CUSTOMER TO SHIM UNDER MOTOR WHEN ALIGNING COUPLING. ALIGNING MUST BE DONE AFTER GROUTING BASE IN PLACE AND BEFORE CONNECTING PIPING. ALIGNMENT SHOULD BE RECHECKED AFTER UNIT IS ASSEMBLED AND PIPING INSTALLED.
4. BOTH SUCTION AND DISCHARGE PIPES MUST BE SUPPORTED INDEPENDENTLY NEAR THE PUMP TO REDUCE STRAIN ON THE PUMP CASING. ALSO EXPANSION JOINTS, IF USED, MUST NOT EXERT FORCE ON CASING.
5. HOLES IN SUCTION AND DISCHARGE FLANGES STRADDLE CENTERLINE.

① ALL DIMENSIONS ARE MAXIMUM FOR GIVEN ALLIS CHALMERS MOTOR FRAMES.
② FLANGES ARE 125# FF SUCTION 250# FF DISCHARGE.

NOT FOR CONSTRUCTION, INSTALLATION OR APPLICATION PURPOSES UNLESS CERTIFIED

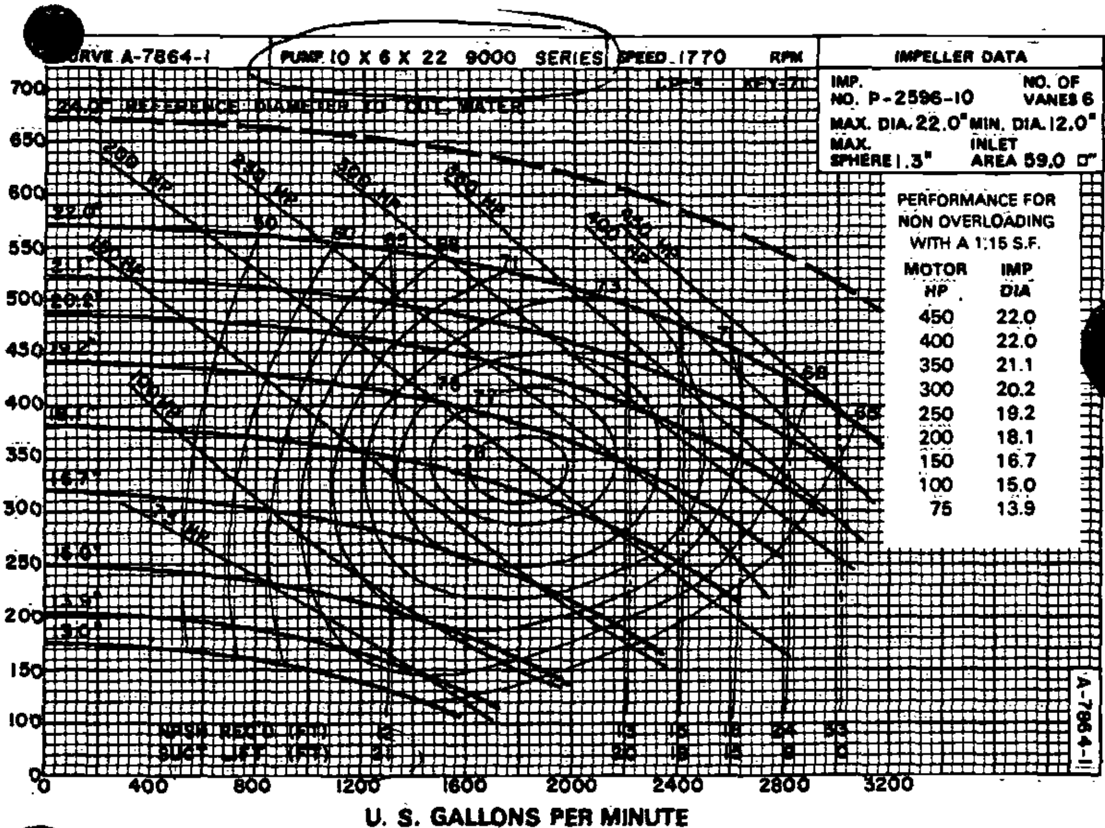
Certified For:

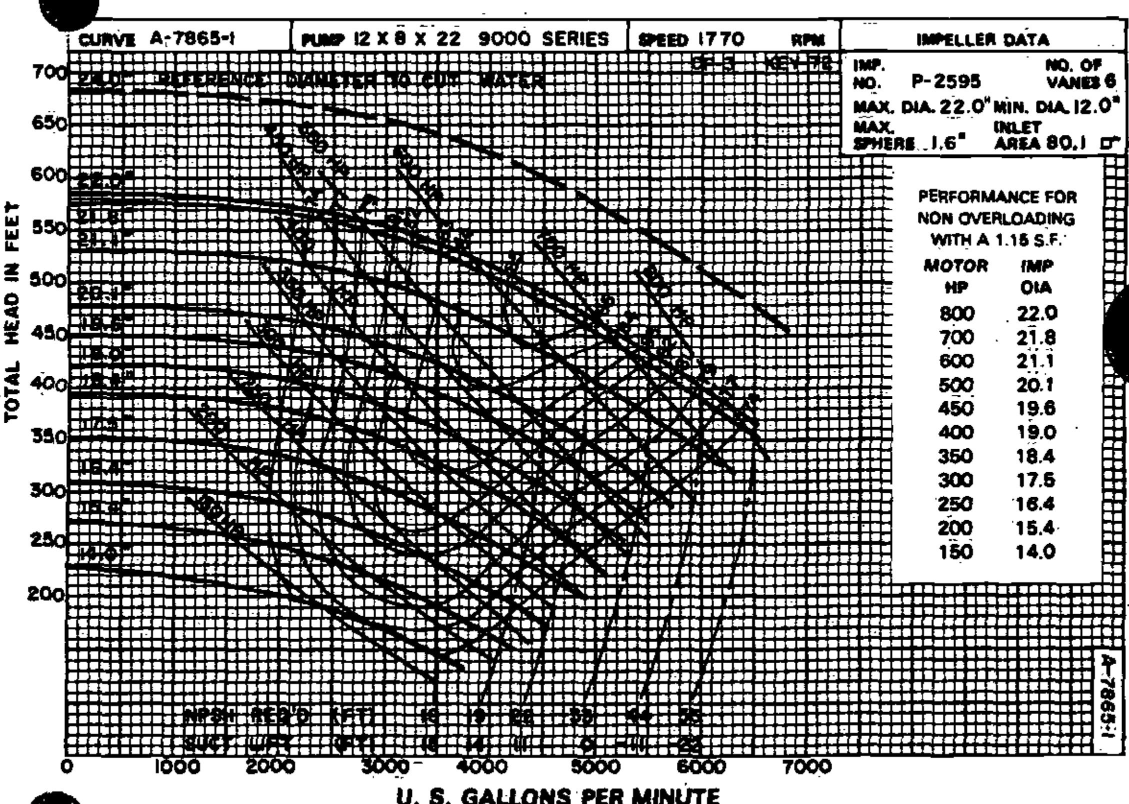
CO #   ID #   SO #

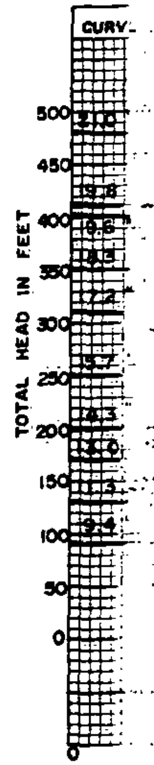
PUMP DATA	Size & Type	Model	Curve No.		GPM	Head	Rotation		Flanges
							CW	CCW	
MOTOR DATA	HP	RPM	Phase	Hertz		Volts	Frame Size		Enclosure
			3	50	60				

Sign: Date ____/____/____

AXIALLY-SPLIT PUMPS
Single-Stage, Double Suction Pumps with Mechanical Seals or Packing
Performance Curves — 1770 Rpm







Curves show performance with clear water at 85°F. If specific gravity is other than 1.0, BHP must be corrected.

INVESTIGATION OF TUNNEL LOW POINTS

LOCATION OF LOW POINT	VERTICAL FT	DISTANCE TO NEXT HIGH POINT	TDH
(1) END LINE AT YARD	300 - 200 = 100	3000	
(2) UNION STATION	10	2000	
(3) LINE 190	270 - 190 = 90	4000	
(4)	10	2000	
(5) LINE 300	230 - 180 = 50	4000	
(6) LINE 340	50	2000	
(7) LINE 390	20	4000	
(8) LINE 530	155 - 100 = 55	9000	OR 80' & [illegible] TO DISCHARGE FROM WILSHIRE/FAIRFAX STATION
(9) LINE 710	O/K		
(10) LINE 950	O/K		

USE 100' LIFT AT 4000' DISTANCE

F. The vehicle rerailing apparatus shall be contained in a steel box with a hinged cover. Eyebolts shall be provided on the box to facilitate its lifting out of a flat car.

G. The control of the vehicle movement along the traverse beam and the control of the outrigger cylinders shall be from a central point at least 20 feet from the vehicle. This control shall be capable of being accomplished by a single person.

V-6.10 EMERGENCY PUMP APPARATUS

A. Auxiliary pumping apparatus shall be provided to augment the capacity of the tunnel sump pumps during emergencies and in cases when the combined action of the installed sump pumps is not sufficient to evacuate water at the required rate.

B. The auxiliary pumping apparatus shall be transported on board an auxiliary vehicle. The apparatus shall be able to function from on board the vehicle and shall be able to be unloaded from the vehicle and function on site.

C. The auxiliary pumping apparatus shall be capable of pumping water from the deepest point in the tunnel system to the surface at a rate of 500 gallons per minute. The apparatus shall be capable of functioning unattended, once started, and shall be able to function at maximum capacity for a period of four hours without refueling.

D. The pump shall be self-priming, and the impeller designed to accommodate solids of up to 2 inches in diameter. Minimum suction lift shall be 10 feet. The prime mover shall be an internal combustion engine propelled by either diesel fuel, or gasoline. Diesel shall be the preferred fuel due to its non-volatile characteristics. The engine shall be equipped with a battery operated electric starter.

E. The apparatus shall be equipped with sufficient length of discharge hose to reach the surface from the deepest point in the tunnel system. As water accumulation is likely to occur at points served by sump pumps, the discharge hose shall be capable of being connected to the discharge system of the sump pumps.