Table 1. NFTA light rail bid price comparison.

Bidder	Fleet Size, Cars	Car Type	Percent Deviation From Low Bid[a]
A	33	4-axle	0
B	33	4-axle	+4%
C	27	6-axle	+16%
D	25	6-axle	+21%
E	25	6-axle	+38%

[a]Based on railcar costs, not including spares, software, and cost offsets (travel and maintenance costs) used as the basis for award.

the authority negotiating team has made it clear that a feature is desirable but not necessary, it is up to the respondent to decide whether he will keep it or remove it.

Clarifications and Additional Data

Given that proposals are responsive, the need for clarification and additional data from respondents will be in inverse proportion to the amount of detail in the RFTP. During the course of technical negotiations, it may become evident that more information is needed from some respondents. The obligation of the negotiation team is to make every effort to equalize the resulting effort required. Someone should keep careful track of who has been asked to do what. In the end, all respondents should have been asked to respond in essentially the same depth, with their proposals and additional data, on all issues.

Proposal Closing Date

During the course of the technical discussion meetings, agreements are reached and addenda issued, both to each respondent's proposal and to the authority's RFTP. At the end of the sessions, the authority's final addendum is issued (NFTA issued five addenda), and a closing date is announced for the receipt of all final proposals.

The essence of the step 1 negotiation process is reflected in the final RFTP; it will probably have been changed from its original version, though in no major respects, to encompass a number of different rail cars—all of which meet the needs of the purchasing authority. In the NFTA case, the proposed vehicles, of which there were six, ranged from a 67-foot, 4-axle car to a 98-foot, 6-axle articulated car.

Five of the proposal respondents submitted price bids in step 2. As shown in Table 1, the total spread in the bid price per car compared favorably with recent similar procurements.[4] Thus, two of the aims of the two-step procedure—to attract a good number of bidders and to receive reasonably competitive price bids—were accomplished.

REFERENCES

1. U.S. Department of Transportation. Procurement Study: An Evaluation of the Procurement Process Used to Purchase Rolling Stock and Technical Equipment for Mass Transit, March 1980.
2. M.A. Wood. Two Step Formal Advertising. Government Contracts Monograph No. 12, The George Washington University Government Contracts Program, 1979.
3. T.D. Beck. NFTA Bid Evaluation and Award. Paper presented at APTA 1981 Rapid Transit Conference, Philadelphia, PA, June 8-11, 1981.
4. E.T. Ireton. "Transit Car Procurement: Breakthrough in Buffalo," Railway Age, January 12, 1981.
5. C. Elms, et al. Light Rail Transit Car Specification Guide, UMTA-MA-06-0025-81-4, December 1981.
6. Tri-County Metropolitan District of Oregon. Light Rail Vehicle Procurement Document, Portland, OR, April 1981.

A Study of Transit Rail Car Guarantee Warranty and Reliability Contractual Provisions

C.P. ELMS, D.B. ELDREDGE and W.H.FROST, N.D. Lea & Associates, Inc.

Purchasers of light rail vehicles, concerned with the risks of developing new technology, have applied contractual remedies independently of one another. Members of the manufacturing and supply industry have complained that standardized guarantee/warranty/reliability (GWR) provisions in contracts for the procurement of transit rail cars were becoming too restrictive and could have adverse financial effects on the industry.

Analysis of recent rail car contracts and discussions with transit operators and equipment suppliers support this

claim. More importantly, operators and suppliers have generally not worked together in developing and drafting GWR terms and conditions. They have felt that because of the variations in rail cars being purchased (new versus existing designs) and differences in local/state laws and regulations, standardized GWR provisions were neither workable nor applicable. This report presents the results of a study of the need to develop standardized contract provisions.

The need to establish a cooperative spirit between operator and seller developed as a key consensus of the study. To encourage cooperation, a rail transit car contract warranty model and a screen for preparing rail transit car warranty/reliability contract provisions were developed. The screen is used in preparing the specific clauses of the model.

The screen and model presented in this paper are for guidance only; they are not recommended for direct use in a contract. They summarize the ideas of the operators, suppliers, and engineers interviewed in this study and should be presented to the rail transit industry for further refinement. Ultimately they should be reviewed and modified by competent legal counsel for consistency with local laws and regulators.

Light rail vehicle (LRV) procurement is one of the important issues in the implementation of a light rail system. A large proportion of the cost of the system goes toward vehicle purchase. From the design through specification and manufacturing, there is a concern that this investment be made carefully, that the LRVs purchased be safe, reliable, and easily maintained. The system operator has sought this objective by asking for guarantees and warranties and by specifying a level of reliability for the rail car.

LRV technology in the United States had been stalled for 30 years between the last order of PCC cars and the development of the standard LRV for Boston and San Francisco. This gap meant that there was no slow iterative application of new technology to the LRV and that the recent rapid advances in technology, although necessary, brought some risk of failure. The guarantee, warranty, and reliability (GWR) clauses added to contracts were intended to reduce these risks.

The initial objective of this study was to assess the suitability of developing standardized GRW contract clauses for rail car procurement. Support for such a study dates from mid-1975, when the Railway Progress Institute (RPI) complained to the U.S. Secretary of Transportation and the administrator of the Urban Mass Transportation Administration (UMTA) about the contract terms and conditions used by transit authorities in rail transit equipment purchases. RPI claimed that these provisions were having severe financial effects on rail transit car manufacturers and their suppliers.

Because UMTA helps finance most rail transit equipment purchases, RPI sought federal assistance in monitoring such contracts for fairness. With the participation of RPI and the American Public Transit Association (APTA), UMTA assembled a review group to investigate the validity of the RPI claims and recommend contract terms and conditions. As a result, on March 1, 1978, the UMTA administrator issued 16 special guidelines for rail transit equipment purchases.

Because of the variety of local circumstances influencing rail transit car procurements and because consensus from all parties could not be achieved, UMTA was not able to issue guidelines covering all aspects of rail transit car contract terms and conditions. In January, 1980, N.D. Lea and Associates, Inc. (LEA), was asked by UMTA to study the feasibility of developing standard guarantee, warranty, and reliability specification clauses.

REVIEW AND ANALYSIS OF CURRENT GWR CONTRACT PROVISIONS

Is There a Problem?

Trends in the last decade of U.S. rail transit car purchases support the claim that a once-stable domestic rail transit industry has seriously deteriorated. Awards for 8 of the 14 most recent UMTA-funded rail transit car purchases, representing 29 percent of the rail cars purchased in the past decade, have gone to foreign manufacturers.

Foreign bid participation is most active in light rail purchases, which have tended toward existing designs purchased with a two-step negotiated procurement. The lack of a U.S. manufacturer with a proven light rail car design experience has essentially forced this result.

Both domestic and foreign car builders have had trouble with rapid rail car procurements. These cars have typically been purchased with detailed design specifications and in a sealed-bid selection process. The designs have required the introduction of sophisticated and unproven equipment, which has led buyers to include more stringent GWR requirements to ensure a reliable vehicle.

These contract provisions, while protecting the buyer, appear to have placed greater risks on the manufacturers. They have had to warrant designs and materials over which they have had little control. As a result, two U.S. car builders have announced that they would no longer bid on transit procurements because their resources could be invested in other markets at less risk.

Recent problems with vehicles delivered to BART, NYCTA, MARTA, MBTA, and SF MUNI and the withdrawal of St. Louis Car, Rohr, Pullman-Standard, Boeing, and General Electric from the car-building industry strongly indicate that the concerns and claims of both the rail transit operators and the manufacturers are legitimate.

Assessment of GWR Contract Provisions

The U.S. General Accounting Office (GAO) documented several examples of the failure of operators to administer rail transit car warranties. The GAO findings identified the need for complete and precise guarantee and remedy provisions in the rail transit car contract warranty. Just as warranty periods in excess of the custom for new rail transit equipment can be labeled inappropriately stringent, loose or ambiguous remedies can also lead to an inequitable assignment of contract responsibility and liability. On this basis, the LEA assessment of rail transit car GWR contract provisions was carried out.

The assessment of GWR contract provisions followed the structural outline shown in Figure 1. This outline, which classifies rail transit car warranty and guarantee provisions by function, was used to evaluate the completeness and precision of each warranty reviewed. It was also used in the development of the Proposed Rail Transit Car Contract Warranty Model presented at the end of this paper.

One objective of the assessment was to investigate the trends toward increased stringency in GWR contract provisions. Several functional groups of GWR provisions were identified and charted to establish their behavior over the past decade. The examination first focused on the length of the warranty periods—the basic warranty on all parts of the car and the extended warranties on specific subsystems or elements (see Figure 2). Warranty periods of typical subsystems and elements were then examined and charted. Results for car body structure and truck frame, propulsion motor, and propulsion gear unit warranty periods were not conclusive; it was difficult to document trends of increasing stringency for these examples even though there were variances in the length of warranty periods.

Although not as common as the functional groups discussed above, warranty of reliability has been applied to recent rail transit car contracts. As typically applied, warranty of reliability is accomplished through "fleet defect" or "fleet failure rate" provisions. Such provisions state that if the failure rate of any warranted subsystem exceeds a contractually established threshold over a given period of time, the entire population of that subsystem shall be considered as failed, and remedies shall be set forth. To examine these provisions for trends of increased stringency, the threshold levels of several reliability warranties were charted in conjunction with the basic warranty periods and a lower threshold failure rate level. Figure 3 shows the behavior of these warranties for 12 rail transit car contracts let in the past 10 years. Although here again it is difficult to define any clear trends, the inclusion of a reliability warranty is in itself a definable trend during the past decade.

Figure 1. Rail transit car warranty structural outline

I. Initiation of warranty period

II. Period of warranty protection
- A. Basic warranty—All parts of the car
- B. Extended warranty—Specific subsystems and elements

III. Definition of "failure"

IV. Records and documentation
- A. Maintenance records
- B. Failure documentation and reporting
  1. Notification to seller
  2. Failure analysis

V. Corrective action
- A. Responsibility for corrective action
  1. Buyer
  2. Seller
- B. Repair/replacement option
- C. Approval of corrective action
- D. Warranty corrective action costs liability

VI. Reliability guarantees
- A. Fleet defect provisions
  1. Failure rate trigger levels
  2. Corrective action provisions
- B. Allowable failure rate provisions
  1. Application to extended warranties
  2. Allowable failure rate levels
  3. Corrective action provisions

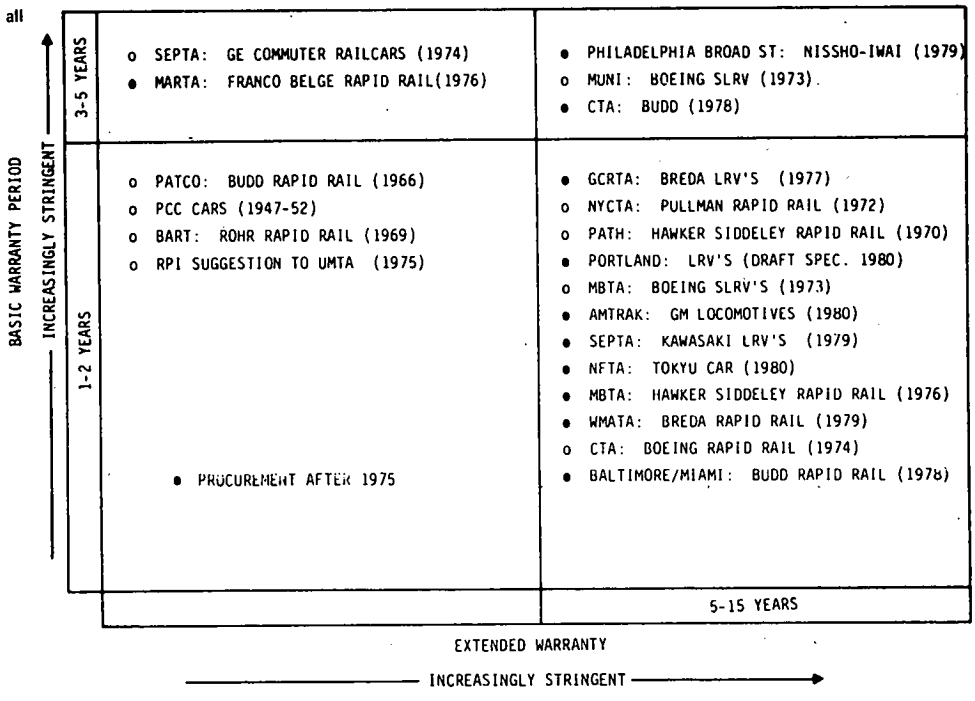
Other Measures to Ensure Reliability

Non-rail-transit organizations and other large-volume equipment users permit the following alternative approaches, which may be applied in specifying rail car reliability:

- No reliability specifications are given; the warranty handles reliable performance by means of fleet defect clauses.
- No reliability specifications are given; the warranty handles reliable performance by means of fleet defect clauses and fleet availability requirements.
- Reliability goals are given, which the builder is expected to meet; however, some specifications use these goals as requirements that the builder must meet.
- Reliability specifications are given that the builder must meet through demonstration.
- Reliability specifications are given; however, the builder must propose reliability specifications according to a given format and must meet these through demonstration.

It has been claimed that rail transit car procurements before the 1970s emphasized use of the contract warranty and close working relationships between buyer and seller. This differs significantly from the approach used during the

Figure 2. Length of warranty coverage on all parts of car.



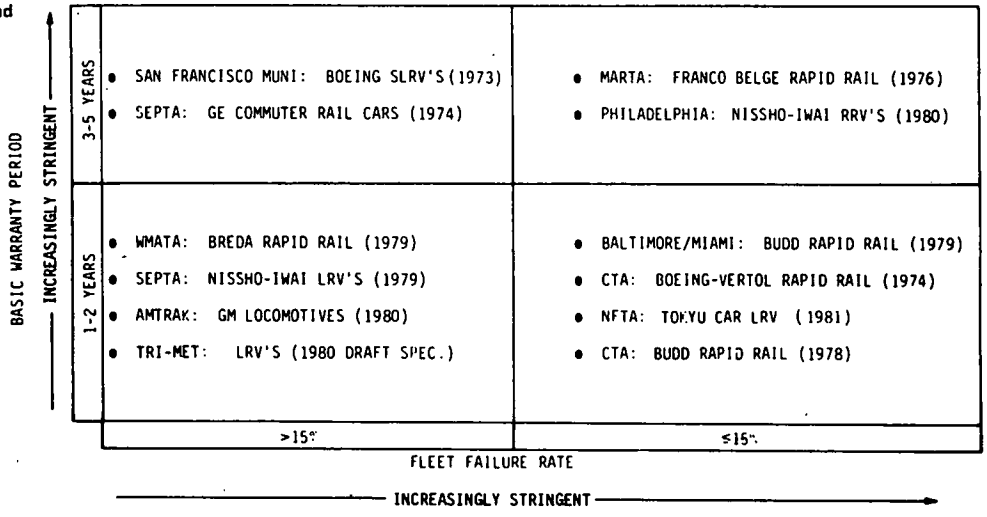


Figure 3. Length of warranty coverage and failure rate.

past decade in which reliability requirements such as those used in the aerospace industry have been included. However, neither buyer satisfaction nor rail car reliability has improved.

Costs

The costs of GWR requirements are difficult to estimate. They encompass the cost for warranty provisions and the associated risks, the direct costs of engineering and implementation of reliability requirements, and the costs associated with reconfiguration, redesign, or replacement of components that may be affected by GWR requirements.

In a cost study of the standard light rail vehicle specification performed by LEA for UMTA,[1] estimates for warranty and field service amount to 2.5 percent, and estimates for potential savings from simplifying reliability requirements amount to 1.8 percent. Thus, overall costs of GWR requirements amount to an estimated 4.3 percent of the purchase price.

Another report gave a conservatively estimated figure of 2 percent.[2] However, not all of these contractors were rail car builders, and the estimate does not necessarily include reliability requirements costs.

To substantiate these estimates, a quick telephone survey was taken of five car builders/system suppliers in May 1980. The estimates given were similar to those of LEA and GAO. Higher figures are quoted in the airline industry,[3] where warranty costs range from 4 to 10 percent of the purchase cost per year of warranty.

There has also been concern that increased warranty periods have caused escalation in car prices. In July 1975, Pullman-Standard gave UMTA a response to this hypothesis. It indicated that (a) longer warranty periods on the car structure are less significant (a ratio of approximately 1 to 15) than longer warranty periods on all parts of the car; and (b) impact (in 1981 dollars) of the warranty period on all parts of the car are as follows:

- 1 year—base price, no impact
- 3 years—$24 000 extra per car
- 5 years—$57 000 extra per car

It would appear that there are opportunities to reduce GWR costs.

EXCHANGES WITH THE TRANSIT INDUSTRY

The results of the review and analyses of recent rail car contract documents were reviewed with UMTA. While conclusions could not be drawn immediately, a number of questions were raised and possible directions for study were identified. These were formulated into a discussion outline, and arrangements were made to meet with transit operators and suppliers to determine if a consensus could be reached. Two series of visits were carried out. The first series was used to focus the second.

The results of these discussions were eventually used for the development of a proposed rail transit car contract warranty model and a proposed screen for preparing rail transit car GWR contract provisions. During the visit with Pullman-Standard, it was suggested that a "screen" might be the most useful product of this effort. A GWR provision screen could be used as a guide for preparing contract terms and conditions in much the same way that the APTA and RPI Standardization Committee's screen is used to prepare technical rail car specification provisions.

A draft guarantee/warranty screen was then developed on the basis of previous reviews and analyses and the information obtained during these three visits. The discussion agenda was also refined, and a second set of visits was planned.

It was during these visits that the idea of the rail car contract warranty model was proposed. The screen could then serve as a set of instructions and guidelines for a transit authority to complete a guarantee/warranty from the model.

Note: The screen and model presented here are not in their final form and are not recommended for immediate and direct use in a contract. They are drafts based on discussions and correspondence with suppliers and transit operators. Because of variations in laws and regulations from state to state and locality to locality, any GWR clauses should be reviewed by legal counsel at each specific site and appropriately modified before they are used.

RECOMMENDATIONS

It was assumed originally that a standard set of guarantee/warranty/reliability contract provisions would be of value for the transit industry. The results of our analyses and discussions with transit operators and suppliers do not support such a conclusion. There are too many variations in procurement regulations and laws across the different state and local jurisdictions, and standard contract provisions would not always be applicable to equipment being purchased (a new design car versus an existing and service-proven design).

During the visits with transit operators and suppliers, it was proposed that a set of guidelines, agreed on by both purchasers and suppliers, might be the best standards to develop. Also, the idea of a GWR model was suggested. These two suggestions were then developed into the pro-

posed screen for preparing rail transit car GWR contract provisions and the proposed rail transit car contract warranty model, which are presented below. (It should be noted that the model references by item number the suggestions in the screen that apply to the development of specific terms and conditions.)

It was also recommended that some terms and conditions be negotiated with potential bidders before bids are taken. If this is to be done, the specific term or condition should be defined, but notations made that can be negotiated later on the basis of the screen. Such an approach could lead to the development of a guarantee/warranty that better fits the practices of both the seller and buyer and minimizes the risk costs to both parties. Such practices could serve to instill a more positive spirit and reduce past adversary positions.

PROPOSED SCREEN FOR PREPARING RAIL TRANSIT CAR GWR CONTRACT PROVISIONS

The following are proposed as guidelines for the preparation of GWR Contract Provisions for rail car equipment.

GUARANTEE/WARRANTY PROVISIONS

Preamble

In drafing a warranty it is important to understand that a warranty is the "promise" to meet contractual requirements. The warranty binds the contractor to meet performance and other technical requirements. Therefore, it is important to define what the warranty is intended to promise—performance, design, or hardware specifications.

Initation of Warranty

1. Warranties/guarantees of the car and/or major subsystems shall commence upon final acceptance of the rail car by the Buyer, or initiation of the rail car into revenue service, whichever occurs first. The terms and conditions for final acceptance are to be defined elsewhere in the contract and referenced in the warranty.

Warranty of spare parts shall commence upon placement of the cars in service or a fixed period from delivery to the Buyer. Delivery shall be defined in the contract.

Period of Coverage

General Warranty (All Parts of the Car)

2. The period of General Warranty will be 1 year minimum, 2 years maximum, continuous from the date of initiation of warranty.

Specific Warranty (Specific Subsystems/Components)

3. The intent of any specific warranty should be to correct defects in subsystems or elements which inherently display such defects after periods of use longer than the general warranty.

4. Specific warranties on specific sybsystems should be used only to protect the Buyer from such latent deficiencies and shall not be used to capitalize normal required maintenance.

5. Any specific warranty should be short in comparison to the expected useful lifetime of the affected subsystem or element, perhaps on the order of 25 percent but generally not longer than 5 years.

Note: See items 20, 21, and 22 for additional suggestions concerning specific warranties.

Records and Documentation

6. Maintenance and warranty records shall be required of the Buyer. Complete and accurate records will be required for all serialized major components (e.g., propulsion, braking, etc.) as verification of compliance with prescribed maintenance procedures and disposition.

7. The maintenance documentation and failure reporting mechanisms must be defined in the contract and in place prior to delivery of the equipment.

Definition of Failure

8. A subsystem or element shall be defined to be failed under warranty if there exists a loss of function or degradation of that particular subsystem or element as specified in the technical specifications. This will include primary failures, and secondary failures when the primary failure mode is a warranty failure; however, secondary failures (i.e., occurring as a consequence of primary failures) shall not be included in the calculation of reliability performance. Failures resulting from improper use of improper maintenance practices will not be considered warranty failures.

Corrective Action

9. The mechanisms for the reporting and analysis of failures shall be contractual. The requirements will cover provisions for failure reporting, analysis, and initiation of corrective action.

10. "Replacement" of a component or subsystem shall mean the removal of any such defective or failed item from the car and replacement with a like component or subsystem. "Repair" of any component or subsystem is defined to be identification of failed or defective parts or subassemblies contained in the component or subsystem and replacement of such failed or defective items, thus restoring the component or subsystem to its designed function.

11. The Seller shall be liable for all costs of warranty repair. The Buyer may be held responsible for replacement labor costs. Separate agreements will be reached where the Buyer is to conduct warranty repair. If the Seller is to be required to pay labor costs for "replacement," then the Buyer shall have well-established maintenance procedures and an accurate accounting system. A time study will be an appropriate method of establishing replacement labor requirements. The warranty shall include a reference to where the exact formulas for labor costs or any other associated costs are specified in the contract. Details of all warranty and guarantee financial responsibilities of the Seller shall be clearly spelled out in the contract, independent of who is required to complete the repairs.

12. The decision to repair or to replace and the method to repair a defective or failed item under warranty must be mutually agreed to between Buyer and Seller.

Reliability Guarantees

Fleet Defect Provisions

13. In the event that the failure rate of any subsystem or element exceeds a level prescribed in the technical provisions during any 12-month period of the warranty, the entire fleet population of that subsystem or element shall be considered to be failed.

14. The failure rate specified as constituting a fleet failure for a particular element or component will protect the Buyer from catastrophic failure rates in those items covered. The rate will reflect the amount of exercise a subsystem is expected to receive and the number of cars in service. Determination of this rate (fleet defect triggering level) must consider the size of the order. For example, a rate of 10 percent for an order of 30 cars would result in a triggering level of 3 cars. Such a small number of failures could be a material or workmanship defect. The Buyer should define the basis for counting failures in calculating the triggering level, i.e., all failures of the given subsystem or failures of the same type for the subsystem.

15. A failure analysis and plan for corrective action shall be required of the Seller for any subsystem or element exceeding the triggering level.

16. Corrective action to be taken when fleet defect levels are reached shall be stated within the guarantees and warranties contained in the contract terms and conditions.

17. In the event of a fleet defect, the Seller shall supply materials, parts, and labor to effect repairs on all cars in the fleet still covered by warranty.

18. In the event of a fleet defect, the Seller shall supply only the materials and parts necessary for repair of all cars in the purchase on which the warranty on the subsystem or element concerned has expired and where the subsystem or element has not failed prior to the expiration of the warranty.

19. Whenever practical, fleet defect repairs shall be completed in conjunction with scheduled maintenance or overhaul operations.

Allowable Failure Rate Provisions

20. Allowable Failure Rate Provisions could be used in connection with the Specific Warranties on certain subsystems as a means for Buyer and Seller to share risks of future problems and reduce up-front risk costs. As such, these technical reliability provisions shall specify an acceptable level of failures from items still warranted after the General Warranty has expired. The Allowable Failure Rate can act as a "deductible" which is the Buyer's share of the risk. Failures in excess of the Allowable Failure Rate become the responsibility of the Seller. It is suggested that the inverse of the MTBF be the Allowable Failure Rate. The Allowable Failure Rate Provision may not be applicable to some subsystems, such as structural items.

21. The Allowable Failure Rate could be stated within the reliability requirements contained in the technical specification. The remedies for the Allowable Failure Rate type of specific warranties shall be included with guarantees and warranties contained in the contract terms and conditions.

22. The Seller shall supply repairs or free exchange for all failed subsystems or elements covered by the specific warranty that exceed the allowable failure rate.

RELIABILITY/AVAILABILITY PROVISIONS

Technical Requirements

23. Reliability/availability requirements are technical performance requirements and shall not be included with the contract terms and conditions as warranties or guarantees.

24. Current data are not sufficient to establish complete reliability baseline requirements. Reliability growth requirements are appropriate for new designs or new applications of equipment. Specific reliability requirements shall be consistent with available documentation that the requirements are achievable. Otherwise, it would be better not to quote reliability requirements.

25. The data collection and analysis mechanisms specified in the contract, which are to be used to determine compliance with the technical reliability/availability requirements, shall be in place prior to delivery of the contracted equipment.

26. All reliability/availability requirements, however statistically stated, shall be mathematically compatible.

Contract Requirements

27. All corrective action to be taken for equipment not meeting technical reliability/availability requirements shall be included only in the contract terms and conditions and not in the technical specification.

28. The contract terms and conditions will require the Seller to submit a plan for corrective action when equipment falls below the contractual reliability/availability requirements.

29. The Seller shall supply all labor and materials necessary to demonstrate subsystem or element compliance with reliability/availability requirements. These costs are those above the costs the Buyer bears in normal operation and maintenance of the cars during the demonstration period.

30. Demonstration of all reliability/availability requirements for a subsystem or element shall be required before the end of the warranty period for that subsystem or element over a definite time period.

31. All corrective actions for noncompliance with the technical reliability/availability requirements shall be contained in the contract terms and conditions.

PROPOSED RAIL TRANSIT CAR CONTRACT WARRANTY MODEL*

The Seller guarantees to the Buyer that the rail transit cars purchased under this contract shall be free from defects in design, materials and workmanship, and will comply with the requirements of the contract documents. The General Warranty on all parts of each of the rail transit cars purchased under this contract shall commence upon final acceptance of each car by the Buyer or its initiation into revenue service, whichever occurs first. (1) Each car accepted or placed into revenue service will have a warranty initiation date assigned to it. This date will be used to calculate the warranty period for all affected subsystems and elements for each car. The period of the General Warranty for each car shall be (TBS) year(s). (2) continuous from the date of initiation. The period of guarantee for spare parts shall be (TBS) year(s) from the date of delivery of the parts or (TBS) year(s) after placement into service, whichever occurs first.

######Option 1 (Special Subsystem)—Specific Warranties are provided for (TBS) subsystems or elements. (3,4) The period of the Specific Warranty for the (TBS) (subsystems or elements) shall be (TBS) years or (TBS) miles respectively, whichever occurs first, continuous from the date of initiation. (5)######

######Option 1.1 (Allowable Failure Rate Specific Warranty) (20)—The Specific Warranty guarantees that the Seller shall provide repair or free exchange materials for all failures of the (TBS) subsystems or elements exceeding (TBS) percent of the fleet population of that subsystem or element during any 12-month period of its Specific Warranty. (21,22) Failures less than this (TBS) percent are not covered by the Specific Warranty and are the responsibility of the Buyer.######

If, within the above-specified warranty periods, any equipment purchased under this contract shall fail in accordance with the terms of this warranty and the failure definition contained in the technical contract requirements, the Buyer guarantees, upon discovery, to notify the Seller or his Representative of the failure in writing within (TBS) hours. (8,9) The Seller shall thereupon initiate corrective action within (TBS) hours of the notification of failure by (at its option) approving repair or free exchange for the failed subsystem or element. The General Warranty for the car shall not be affected by said repairs or parts replacement. ******The Buyer shall be responsible

* The model uses a number of symbols and notes:

- the numbers in parentheses correspond to the applicable GWR screen items presented in the previous section.
- TBS-to be specified by the buyer.
- Optional text has been indicated as it begins and ends by the symbols.######
- Screen item #8 definitions will appear with the technical provisions.
- Text appearing between the two sets of symbols, ******, must be deleted if option 2 is applied.

for carrying out the replacement of warranted items; that is, the removal of the failed subsystem or element and installation of a new or repaired item supplied by the Seller. (11) The Seller shall guarantee free repair of any item failed under warranty; that is, identification and free exchange of any defective parts or subassemblies contained in the failed subsystems or elements, thus returning that item to compliance with the technical contract requirements. (10,11,12) The Seller shall be responsible for stocking and supplying warranty exchange parts. The Seller shall guarantee to promptly resupply, on a free exchange basis, replacement parts which the Buyer supplies from his maintenance spare parts stock for warranty repairs. Replacement of failed items with the Seller supplied or approved repair or exchange parts shall constitute continuation of the Seller's warranty for that item.******

######Option 2 (Buyer Completes all Warranty Work)—The Buyer shall be responsible for replacement and repair of all items failing under warranty. The Seller shall guarantee free exchange of all items needed by the Buyer for repair and/or replacement of failed warranty items, and actual labor costs for the repair of any failed warranty items. (10) Labor costs shall be computed as follows: (TBS). (11) The Seller shall be responsible for stocking and supplying warranty exchange parts. The Seller shall guarantee to promptly supply free exchange for warranty replacement parts which the Buyer supplies from his maintenance spare parts stock. Replacement of failed items with Seller supplied exchange or approved repair or exchange parts shall constitute continuation of the Seller's warranty for that item. (12)######

######Option 3 (Fleet Defect Warranty) (20)—A Fleet Defect Warranty shall be in effect for the entire warranty period of any subsystem or element of the rail car purchased under this contract. If the failure rate for (TBS) subsystems or elements exceeds (TBS) percent of that elements' or subsystems' fleet population during any 12-month period of its warranty, the entire fleet population of that subsystem or element shall be considered to be failed. (13,14) Whereupon the Buyer invokes the Fleet Defect Warranty, the Seller shall promptly provide the Buyer with a written Failure Analysis and Plan for Corrective Action including scheduling and scope of the fleet repair plan within (TBS) weeks. For those failed items which are still under warranty, the Seller shall provide FOB the Buyer's property or point of repair, parts and labor for (at its option) the repair or free exchange of failed items. (15,16,17) For those items included in a fleet failure for which the warranty period has expired, the Seller shall guarantee to provide FOB the Buyer's property or point of repair, (at its option) repaired or free exchange parts to return the car to compliance with the technical requirements. (11,12,18) Whenever possible, Fleet Defect repairs and replacements will be completed in conjunction with scheduled maintenance or scheduled overhaul operations. (19)######

During the periods of the foregoing warranties, the Buyer guarantees to operate, maintain, repair and overhaul the rail equipment purchased under this contract in accordance with the requirements procedures prescribed in the Technical Contract Requirements and the Seller's Operating and Maintenance Manuals. The Buyer shall be responsible for maintenance records for each car covered under warranty as verification of compliance with the technical maintenance requirement provisions. (6,7) The Seller's warranties shall not apply to equipment that has failed or been damaged due to improper use or improper maintenance. (8)

In any case in which a part, component or item of equipment shall fail after the end of its normal service life (considering the usage to be expected in Buyer's normal service), and such failure shall occur prior to the expiration of the applicable guarantee period, such part, component or item of equipment shall be deemed to be outside the coverage of the guarantee. (4)

The foregoing guarantee is exclusive and in lieu of all other guarantees or warranties, whether written, oral, implied or statutory (except as to title). In no event shall the Seller be liable for incidental or consequential damages.

REFERENCES

1. N.D. Lea and Associates, Inc. Cost Savings Potential of Modifications to the Standard Light Rail Vehicle Specification. UMTA-MA-06-0025-79-11, February 1979.

2. U.S. General Accounting Office. Transit Equipment Warranties Should Be Enforced. GAO Report No. PSAD-80-12, December 1979.

3. Review of Commercial Airline Acquisition Methodology.

Rationalization of the Light Rail Vehicle Specification Process for Cost-Effectiveness

THOMAS J. MCGEAN, N.D. Lea & Associates

Light rail vehicle (LRV) requirements should reflect site-specific transportation service needs, performance requirements, and life-cycle costs. This paper examines the process of defining these requirements. It addreses both technical and nontechnical issues. Technical issues include the justification processes and attendant costs for critical vehicle options such as articulation, bi-directionality, doors on both sides, and propulsion system. Nontechnical issues include contractual requirements that might cause higher assigned risk costs.

The benefits of various LRV features and contract provisions are compared with the costs, both capital and operations and maintenance, and perspectives are established. Such considerations enable the buyer to maximize the return on his vehicle budget commensurate with real needs.

The process of defining light rail vehicle (LRV) requirements should consider site-specific transportation service needs and performance objectives in a cost-effective manner. The process is intended to be used in conjunction with the new Guideline Specification for Procurement of Light Rail Vehicles,[1] which was developed with UMTA funding through the cooperation of transit agency and