FINAL REPORT

NEW JERSEY RAIL EQUIPMENT MAINTENANCE FACILITIES STUDY

PROJECT NO. IT-09-0058, TS F-212

Prepared by:

SEELYE STEVENSON VALUE & KNECHT, INC.
Engineers and Planners

December 1980

The preparation of this report has been financed in part through a grant from the U.S. Department of Transportation, Urban Mass Transportation Administration under the Urban Mass Transportation Act of 1964, as amended. This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

SEELYE STEVENSON VALUE & KNECHT

ENGINEERS AND PLANNERS. 99 PARK AVENUE NEW YORK, NEW YORK 10016
PHONE 212 867-4000 CABLE SESTEVAL NEW YORK

December 22, 1980

State of New Jersey
Department of Transportation
Division of Commuter Services
1035 Parkway Avenue
Trenton, New Jersey 08625

Attention of Mr. Jack M. Kanarek
Project Manager

RE : Contract No. TS F-212
D-142363 IT-09-0058
New Jersey Rail Equipment
Maintenance Facilities Study:
Final Report

Gentlemen:

Enclosed please find thirty copies of the Final Report and Appendices for TS F-212" Rail Equipment Maintenance Facilities Study for the State of New Jersey. In addition, as required by the Contract, we are submitting one set of reproducible originals.

To meet the present and future needs of passenger rail services operating in northern New Jersey, this Report recommends the construction of a Consolidated Main Repair/ Rebuild (MR/R) Shop and Service and Inspection (S&I) Facility at the presently available Koppers Coke site in Kearny, New Jersey. Also recommended is the upgrading of daily inspection, servicing, fueling and running repair facilities at the existing Hoboken Terminal area. In addition, we recommend major improvements to the METRO Shed at Sunnyside Yard in Long Island City, Queens, New York, a facility needed to support New Jersey Transit's passenger rail services along the Northeast Corridor and the North Jersey Coast Line.

Where passenger rail services in southern New Jersey are concerned, we recommend the construction of a Service, Inspection and Repair (S,I&R) Shop in Atlantic City, New Jersey. This new maintenance facility should be designed to accommodate the existing rail diesel car (RDC) fleet, as well as replacement rolling stock (either self-propelled or locomotive-hauled push-pull coaches) that may be purchased in the future.

STV Engineers, Inc., Consulting Engineers, Architects, Planners, Construction Managers. THE STV FIRMS **Sanders & Thomas, Inc.**, *Consulting Engineers, Architects, Planners* **Seelye Stevenson Value & Knecht, Inc**, *Engineers and Planners* **S&T Western, Incorporated**, *Architects and Engineers* **Baltimore Transportation Associates, Inc.** *Consulting Engineers* **Charles S. Bicksler & Associates**, *Architects* **Santafric**, *Engineers and Economists* LOCATIONS New York, Rochester, Plainview N.Y. Pottstown, Pa. Baltimore Boston Nashville Miami Lakehurst N.J. Stratford Conn. Newport Beach, Calif., Abidjan, Ivory Coast Cotonou, Benin

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

INTRODUCTION

The objective of this study was to analyze and evaluate the servicing, inspection and maintenance requirements and facilities for the locomotives, standard coaches and electric self-propelled cars operated in passenger service by the New Jersey Department of Transportation (N.J. DOT) through the year 2000.

The state-owned fleet is currently serviced at 22 facilities at scattered locations both within and outside of New Jersey (see Figure S-1). In general, these facilities are old and have become inefficient or inadequate. The fleet presently consists of 1,053 pieces of equipment and is expected to total 964 pieces by the year 2000,[1] identified as follows:

	Present Fleet	1980 Fleet	1985 Fleet	1990 Fleet	2000 Fleet
Diesel Locomotive	63	73	60	62	72
Electric Locomotive	13	13	--	--	--
Dual Mode Locomotive	--	--	12	12	22
MU Car	579	339	356	369	385
Standard Coach	378	343	352	369	465
Rail Diesel Car	20	20	20	20	20

About half of the present fleet was built prior to 1950 and nearly a third prior to 1935. The combination of old and unreliable equipment and deteriorating maintenance facilities presents a formidable problem to the provision of attractive commuter services.

The prevailing guidelines that were endeavored to during the performance of this study are:

- o Power and train consists to maintain advertised service should be available at all times.
- o Out-of-service status should not exceed 10 percent for locomotives, 5 percent for electric self-propelled cars, and 3 percent for standard coaches.
- o In-service equipment failures should be minimized.

[1] The "present" fleet pertains to New Jersey equipment as it existed in the latter part of 1977. The various fleet projections were also determined at that time. Much of this data has since changed. Rather than continuously update the inventory and projections throughout the course of this study, it was decided to base the study effort on the figures shown while keeping aware of continuing changes in equipment status. This ensured that the facilities ultimately recommended contain the flexibility to accommodate the most current fleet projections as well as the base projections, without over-or under-designing.

- Car interiors and exteriors should be clean.
- Benefit should be made of the latest diagnostic testing and surveillance technology.
- Costs should be minimized consistent with good service and passenger safety.

RECOMMENDED MAINTENANCE PROGRAM AND FACILITY TYPES

In order to accomplish these goals, a program of preventive and systematic demand maintenance is recommended, employing the concept of thorough surveillance of all equipment components. In the long-term, this will best provide a high degree of system reliability, equipment availability, and passenger safety on an economical basis. The program should be performed in accordance with the maintenance procedures and guidelines contained in this report. The recommended program conforms to all inspection requirements mandated by the Federal Railroad Administration. The program recommends, and describes the scope of inspection and maintenance functions to be performed at daily, monthly, 3-month, 6-month, yearly, 2-year, 4-year and 12-year intervals. The program covers maintenance guidelines for each of the types of equipment previously described, under each of the following general component categories, as applicable:

- Engine
- Electrical Equipment (High Voltage)
- Electrical Equipment (Low Voltage)
- Trucks
- Cab
- Car Body
- Mechanical System
- Lubrication System
- Fuel Systems
- Cooling Systems
- Brake Systems
- Air Systems
- Steam Generators
- Safety Appliances
- Wash Rooms
- Miscellaneous Items

One caution should be stressed regarding this program. Prior to the institution of this comprehensive program, those pieces of equipment which have incurred deferred maintenance must undergo an overhaul to correct existing deficiencies. This servicing would be generally comparable to that performed at 4 years, as proposed in the recommended guidelines.

Based on this recommended maintenance program and the projections of the future New Jersey fleet, estimates of the average inspection requirements for a typical day through the year 2000 were made (excluding Atlantic City equipment) and are summarized as follows:

	Monthly Inspections to be Performed Each Day			
Equipment Type	1980	1985	1990	2000
Electric Locomotive	1	1	1	1
Diesel Locomotive	4	4	3	4
MU Car	18	18	19	19
Cab Control Car	2	2	2	2
Standard Coach	21	20	21	26
Total	46	45	46	52

These requirements can also be summarized according to service terminals:

	Monthly Inspections to be Performed Each Day			
Service Terminal	1980	1985	1990	2000
Hoboken	22	24	25	26
Penn Station, Newark	15.5	12	12	17
Penn Station, New York	8.5	9	9	9
Total	46	45	46	52

The maintenance program should be conducted along four levels of maintenance activities, each primarily performed at a maintenance facility specifically designed for these activities. There will be some overlap of maintenance responsibilities among facility types. In general, all facilities should be capable of also handling all lower-level maintenance activities. The four types of facilities and their primary functional responsibilities and major components/equipment are as follows:

1. Layover/Turnaround Facility

   Primary Activities

   - Trip Inspections
   - End of Run Inspections
   - Layover/Overnight Storage
   - Internal Car Cleaning
   - Minor Running and Emergency Repairs

- o Lighting, Heating, Ventilating, and Air Conditioning System Inspections

Major Support Equipment/Facilities

- o Storage and Maneuver Tracks
- o Outlets for Pre-Cooling/Pre-Heating
- o Small Hand Tools and Testing Devices

Normal Repair Shopping Limit: 4 Hours

2. <u>Lighting Running Repair Facility</u>

Primary Activities

- o Light/Running and Emergency Repairs; No One Repair to Exceed 30 Minutes
- o Internal Car Cleaning
- o Daily/Trip Inspections
- o End of Run Inspections
- o Locomotive Fueling and Sanding
- o Service Supplies Replenishment
- o Lighting and Air Circulation Inspection and Correction

Major Support Equipment/Facilities

- o Equipment Servicing Accessories/Facilities
- o Air, Water, and Electrical Connections
- o Jacks, Forklifts, Hoists, and Portable Hand Tools and Equipment

Normal Repair Shopping Limit: 8 Hours

3. <u>Service & Inspection (S&I Facility)</u>

Primary Activities

- o Scheduled Routine Inspections of all Mechanical and Electrical Systems and Components
- o Scheduled Operation, Checking, and Diagnostic Testing of all Systems
- o Scheduled and Unscheduled Intermediate Repairs and Minor Modifications and Component Changeouts
- o Scheduled Light/Running Repairs
- o Component Replacement (when judged more expedient than on-car repair)
- o Lubrication
- o Wheel Truing
- o Exterior Cleaning

- Equipment Servicing (fueling, sanding, etc.)

Major Support Equipment/Facilities

- Storage, Test, and Maneuvering Tracks
- Wheel Truing Machine
- Running Geart Blow Pit
- Jacks, Lifts, Equipment-Moving Vehicle, and Hoists or Bridge Cranes
- Portable Hand Tools and some Machine Tools, Testing Equipment, and Work Benches

Normal Shopping Limit: 72 Hours

4. Major Repair/Rebuild (MR/R) Shop

Primary Activities

- Scheduled Major Improvements/Modifications
- Unscheduled Heavy Repairs
- Disassembly and Repair/Rebuild of Components or Assemblies
- Repair/Rebuild of Car Body, Car Underframe, and On-Board Items
- Preparation of Unit Parts/Components for Movement to Specialized Contractor or Maintenance Shops
- Diagnostic Testing
- Major Truck and Running Gear Handling, Cleaning, and Maintenance
- Interim and Major Overhauls
- Computer Control of Maintenance Records

Major Support Equipment/Facilities

- Storage, Test, Ready, Bad Order, and Shop Lead Tracks
- Component Shop (e.g. Wheel Shop, Body Shop, etc.)
- Blow Pit
- Bridge Cranes, Hoists, Lifts, Drop Tables, Transfer Table, Equipment-Moving Vehicles, and Power Machine Tools and Equipment

Normal Shopping Limit: 720 Hours (30 Days)

Each facility will also include an appropriate amount of parts and materials storage facilities and personnel welfare, supervisory, and clerical facilities.

INSTITUTIONAL ALTERNATIVES

Six alternatives for the institutional responsibility of managing, operating, and owing and/or leasing the rail equipment maintenance facilities to serve the N.J. DOT fleet were evaluated. The alternatives selected were:

- The State of New Jersey
- An Agency or Authority Under State Jurisdiction (New Jersey Transit)
- Conrail
- Amtrak
- Port Authority of New and New Jersey (PANYNJ)
- A Private Firm

The evaluation addressed five interrelated aspects: ownership, operations, labor, legality, and finances. Each alternative exhibited specific benefits and disadvantages/impediments. The private firm and the PANYNJ alternatives were determined to be least promising because of fiscal considerations, in the case of the former alternative, and due to the existing PANYNJ convenant against involvement with rail deficit operations. The other alternatives were considered more viable. The major problems of the State alternative or State agency alternative are possible local jurisdiction tax losses and present lack of manpower and expertise. The Conrail alternative constitutes a continuation of the "status quo." Potential obstacles of the Amtrak alternative concern legal interpretations, e.g., whether N.J. DOT train operations are "intercity" services as defined by the federal legislation which created Amtrak.

Having undertaken only a brief evaluation of six selected institutional alternatives, and with the knowledge that this subject is being analyzed in greater detail by the Conrail Alternatives Study, no final recommendations were proposed.

OPERATIONAL ALTERNATIVES ANALYSIS

An analysis of operational maintenance alternatives was conducted to evaluate various combinations of the recommended types of facilities. An integral part of this analysis was a comparison of the merits of facility consolidation vs. facility decentralization. Among the benefits of maintenance activity consolidation (both within and among activity levels) are the following:

- Faster Accomplishment of In-Shop Functions
- Maximum Flexibility of Personnel Assignments and Equipment Utilization
- Reduced Overall Materials Inventory
- Reduced Capital Cost Requirements
- Reduced Operating Costs
- Improved Control of Manpower

The advantages of a decentralized maintenance operation include:

- Reduced Costly Deadheading Requirements
- Reduced Out-of-Service Time Due to Deadheading
- Easier Storage of Equipment

o Availability of Emergency Alternate Maintenance Sites

Final recommendations concerning maintenance facility consolidation or decentralization were made during the remainder of the operational maintenance alternatives analysis. The analysis was conducted on a subsystem basis, corresponding to the historical and current operations of New Jersey rail passenger service. A total of four service areas were comprehensively analyzed and were designated as follows:

- o Hoboken Terminus - Reflective of all Former Erie-Lackawanna Services that Terminate at Hoboken.
- o Penn Station (New York) Terminus - Reflective of all Northeast Corridor and North Jersey Coast Line Services that terminate in New York.
- o Newark Terminus - Reflective of all former Central of New Jersey Services that Terminate at Penn Station, Newark.
- o Atlantic City Operations - Reflective of all former Pennsylvania - Reading Seashore Lines Services.

Within each of the service areas were developed various alternatives for maintenance performance. Alternatives were selected to represent all reasonable degrees and combinations of consolidated and decentralized facilities. The alternatives selected within each service area adhere to one of the following general descriptions:

- o A Null Alternative; Continuation of Existing Maintenance Operations.
- o Alternatives Concerning the Physical Upgrading or Improved Efficiency of Some or All Existing Maintenance Facilities.
- o Alternatives Concerning the Replacement of Some or All Existing Maintenance Facilities with New Facilities.

The analysis within some service areas served as input to the analysis of other areas, thus the areas were not studied within a "vacuum." The alternatives ~~and primary results~~ of the four area analysis area as follows:

1. <u>Hoboken Terminus</u>

Alternative 1: Null Alternative

Advantages

- o No Capital Expense

- o Minimal Deadheading for Daily and all MU and Coach Maintenance Functions

Disadvantages

- o Existing Shops Generally Inadequate; Require Extensive Rehabilitation
- o Some Activities Performed Outdoors
- o Inefficient Shop Track Spacing
- o Stub-End Operation
- o Poor Control of Manpower
- o Lack of MU Heavy Repair Facility
- o Limited Storage Tracks
- o Antiquated Tools and Machinery
- o Continued Costly Light Movements
- o Inability to Handle Future Needs

Alternative 2: Upgrade Existing Facilities at Hoboken and Elizabethport (E'port)

Advantages

- o Makes Maximum Utilization of Existing Capital Investments; Less Costly than constructing Completely New Facility
- o Minimal Deadheading for Daily and all MU and Coach Maintenance Functions
- o Improved Efficiency through use of Modern Tools and Machinery
- o Provides Facility for MU Heavy Repairs

Disadvantages

- o Extensive Renovation Required
- o Interference to Existing Yard and Revenue Operations; Need to Remove/Relocate Some Existing Facilities
- o Complicated Construction Phasing Plan Required
- o Continued Costly Light Movements
- o Stub-End Operation

2. Deadhead moves are defined as non-revenue movements of engines with coaches. Light moves are defined as non-revenue movements of engine only.

- o Limited Storage Tracks
- o Need to Locomotive-Haul MU's from Hoboken to E'port

Altrnative 3: Construct a New S&I Facility at the Existing Hoboken site and:

a. Maintain E'port as it Presently Exists;
b. Upgrade E'port; or
c. Construct a New MR/R Facility to Replace E'port.

Advantages

- o Minimal Deadheading for all but Heavy Repair Functions; Elimination of Current Light Movements
- o Improved Efficiency through Better Shop Layout and use of Modern Tools and Machinery
- o Potential reduction of Fleet Requirements Due to Theoretical Decrease of Out-of-Service Time

Disadvantages

- o Interference to Existing Yard and Revenue Operations; Need to Remove/Relocate many Existing Facilities
- o Complicated Construction Phasing Plan Required
- o Continued Light Movements for Heavy Repairs
- o Limited Storage Tracks

ALSO

- o Under Sub-Alternative 3a: Lack of MU Heavy Repair Facility
- o Under Sub-Alternative 3b: Need to Locomotive-Haul MU Cars from Hoboken to E'port

Alternative 4: Construct a New Consolidated MR/R and S&I Facility to Replace the Existing Facilities

Advantages

- o Minimal Deadheading for all Maintenance Functions (Depending on Location); Possible Resultant Reduction of Equipment Requirements
- o Provides Facility for MU Heavy Repairs
- o Improved Efficiency through Better Shop Layout, Use of Modern Tools and Machinery, Better Control of Manpower
- o Pull-Through Operation Possible
- o No Interference to current Operations During Construction
- o Allows Rearrangement/Modification of Existing Yard and Service Facilities
- o Potential Reduction of Fleet Requirements Due to Theoretical Decrease of Out-of-Service Time

Disadvantages

- o High Capital Cost

Alternative 5: Construct a New MR/R Shop and a separate S&I Facility to Replace the Existing Facilities.

Advantages

- o Same as Alternative 4

Disadvantages

- o High Capital Cost
- o Slightly Less Efficient than Alternative 4 Due to some Duplication of Items, Decreased Control of Manpower, Increased Overall Spare Parts Requirements, etc.

Recommended Alternative: Because the existing facilities are inadequate or difficult to upgrade, the best direction is to construct new facilities consolidated at one location (Alternative 4). Although most costly, this action would provide the most benefit and would eliminate the problems anticipated under other alternatives. Should a site to accommodate the entire consolidated facility not be available, Alternative 5 would become the best choice.

2. <u>Penn Station (New York) Terminus</u>

Alternative 1: Null Alternative

Advantages

- o No Capital Expense

Disadvantages

- o Existing Facility Inadequate for Short-Term Future Inspection Needs
- o Lack of Adequate Light Repair Facility
- o Poor Control/Monitoring of Manpower
- o Inadequate Parts Storage Facilities
- o Inadequate Welfare and Supervisory Facilities

Alternative 2: Upgrade the Existing Facilities at Sunnyside Yard

Advantages

- o Improved Control of Manpower

- Possible Reduction of Manpower
- Separation of NJDOT and Amtrak Maintenance Facilities/Operations
- Improved Quality Control
- Improved Control of Parts Storage and Costs
- Little or no Interference to Existing Operations during Construction
- Provision of Adequate Light Repair Facility
- Relatively Low Capital Cost; Optimal Use of Existing Capital Investments
- Early Potential Completion Date
- Continued Pull-Through Operation at Penn Station and Sunnyside Yard
- Improved Welfare and Supervisory Facilities

Disadvantages

- Continued Discharge of Cars into Congested Inbound Motor Track
- Significant Investment Outside State of New Jersey
- Slight Duplication of Proposed Amtrak Facility

Alternative 3: Participate with Amtrak in the Development of an Integrated Facility at the Sunnyside Yard Complex.

Advantages

- Capital Investments Incurred on Incremental Cost Basis
- Provision of Adequate Light Repair Facility
- Little or No Interference to Existing Operations During Construction
- Continued Pull-Through Operation at Penn Station and Sunnyside Yard
- Flexibility in Manpower Assignment
- Improved Storage and Welfare Facilities
- Designation of Tracks and Work Areas for NJDOT Use

Disadvantages

- More Expensive than Most Other Alternatives
- Use of One Long Track would be Less Efficient than Two Shorter Tracks of Alternative 2
- Continued Poor Monitoring of Manpower
- Current Uncertain Ability of Amtrak to Obtain Funds for Proposed Facility
- Potential for Future Conflicts on Facility Priority
- Later Estimated Completion Date
- Significant Investment Outside State of New Jersey

Alternative 4: Discontinue maintenance at Sunnyside Yard; Perform Maintenance of Existing Facilities in New Jersey.

Advantages

- No Capital Expense for Maintenance Facilities

Disadvantages

- o Existing Facilities are Inadequate to Handle the Demand
- o Need to Construct Adequate Track Connection(s)
- o Inadequate Existing Storage Tracks
- o Inefficient Stub-End Operation at Penn Station; Inadequate Availability of Penn Station Platform Space
- o Hudson River Tunnels Constrain Movements

Alternative 5: Construct a New Facility Either in New York or New Jersey for Exclusive NJDOT Use.

Advantages

- o Capital Investments incurred on Incremental Cost Basis (if Designed as Part of Proposed Hoboken Terminus Facility)
- o Provision of Adequate Light Repair Facility

Disadvantages

- o Electrified Track Connection and Access Tracks Required (Depending on Location)
- o New Storage Tracks Required
- o Inefficient Stub-End Operation at Penn Station; Inadequate Availability of Penn Station Platform Space
- o Hudson River Tunnels Constrain Movements
- o Difficulty in Completing Inspections During Midday Layover Period
- o Probable Late Completion Date Relative to other Alternatives
- o Non-Availability of Suitable Land at Reasonable Cost (if Located in New York)

Recommended Alternative: Alternative 2 presents the best opportunity for satisfactory maintenance program conditions while limiting implementation drawbacks. The utilization of the existing Sunnyside facilities, coupled with the proposed improvements, would allow the NJDOT fleet to be inspected and maintained in an efficient manner. Major repair work would be performed at the consolidated facility recommended as part of the Hoboken Terminus analysis.

<u>Newark Terminus</u>

Alternative 1: Null Alternative

Advantages

- o No Capital Cost
- o Minimal Deadheading for Daily Activities

Disadvantages

- o Poor Control of manpower and Work Quality; Wide Dispersion of Maintenance Activities
- o Some Activities Performed Outdoors
- o Continued Light Moves for Inspections
- o Some Duplication of Parts Inventory

Alternative 2: Upgrade the E'port Facilities

Advantages

- o Optimal use of Existing Capital Investments
- o Minimal Deadheading for Daily Activities

Disadvantages

- o Continued Wide Dispersal of Maintenance Activities
- o Some Activities Performed Outdoors
- o Continued Light Moves for Inspections
- o Some Duplication of Parts Inventory
- o Extensive Upgrading Required

Alternative 3: Construct New Facilities (Perferably Coinciding with the New Facilities Recommended as Part of the Hoboken Terminus Analysis).

Advantages

- o Capital Investments Incurred on Incremental Cost Basis
- o Reduced Light Movements
- o Improved Quality Control and Control of Manpower
- o Reduced Overall Parts Inventory Needs
- o Potential Reduction of Fleet Requirements Due to the Theoretical Decrease of Out-of-Service Time

Disadvantages

- o Construction of Track Connection Required
- o Some Overall Increase in Deadhead Moves

Recommended Alternative: Alternative 3, utilizing the recommended consolidated facility of the Hoboken Terminus analysis, exhibits far fewest potential negative results and helps to further justify the need for that new facility. The utilization of the proposed Hoboken Terminus facility will be contingent on the construction of a track connection between the Morristown Line and the Northeast Corridor Line.

Atlantic City Operations

Alternative 1: Null Alternative

Advantages

- o No Capital Cost
- o Minimal Deadhead Mileage

Disadvantages

- o Work Performed Outdoors

Alternative 2: Discontinue Existing Maintenance Operations: Deadhead Equipment to:

a. Some Other Existing Facility, or
b. A Transit Agency or Private Firm Willing to Perform the Work under Contract Arrangement.

Advantages

- o No Capital Cost

Disadvantages - Alternative 2a

- o Significant Increase in Deadhead Movements
- o Potential Increase in Fleet Requirements, Due to Theoretical Increae of Out-of-Service Time
- o Relocation of Manpower

Disadvantages - Alternative 2b

- o Significant Increase in Deadhead Movements
- o Potential Increase in Fleet Requirements, Due to theoretical Increase of Out-of-Service Time
- o Little Indication of Willingness by PATCO or SEPTA to Provide Service

Alternative 3: Contruct a New Maintenance Facility to Replace the Existing Facility.

Advantages

- o Improved Working Conditions, Machinery, Equipment, etc.
- o Minimal Deadhead Mileage

Disadvantages

- o High Capital Cost

Recommended Alternative: Alternative 3 is selected because it would modernize the maintenance tooling, equipment, and machinery while providing indoor working conditions conducive to quality work.

As a last step of the analysis efforts, a site analysis was conducted to identify the optiomal location(s) for each of the recommended facilities. The selection of Sunnyside Yard for the Penn Station Terminus monthly inspections and light repairs was inherent in the alternatives analysis. The scale of the southern seashore services made selection for the Atlantic City operations very straight-forward. Atlantic City was chosen for reasons of minimal deadheading (no increase from present operating costs) and centralized location. Thus, the site analysis efforts were concentrated on the proposed new Consolidated MR/R and S&I Facility and its alternative recommendation, new but separate MR/R and S&I facilities.

A site selection matrix was developed to determine the relative potential of the candidate sites. A total of 14 sites were considered. The matrix measured these sites according to four key factors, each broken down into 3 sub-factors:

1. Adequacy of Land

   o Adequacy for Shop Areas
   o Adequacy for Storage Tracks
   o Adequacy for Support Facilities

2. Land Availability

   o Degree of Present Property Development
   o Ownership Potential
   o Zoning and Compatibility with Existing Land Use

3. Suitability for Construction/Improvements

   o Site Conditions
   o Foundation and Soil Conditions
   o Availability of Utilities

4. System Accessibility

   o Proximity to Commuter Rail Lines and Terminals
   o Operational Feasibilities and Constraints
   o Vehicular Access

The sites were evaluated and graded on a scale of 1 to 5 in accordance with their potential within each of these sub-factors. The three highest-scoring sites were deemed able to accommodate the consolidated facility. These sites were:

- o Hoboken/Jersey City - South of Canal (52 out of a possible 60 points)
- o Kearny - Koppers Coke (50 points)
- o Jersey City - West of Croxton (48 points)

The location of each of these sites and their orientation to the rail system are presented in Figure S-2. Each of these three prime sites had its particular strong and weak points and, as indicated, were nearly equally desirable on the overall point basis. Hoboken/Jersey City was selected as the sites were evaluated and graded on a scale of 1 to 5 in accordance with their potential within each of these sub-factors. The three highest-scoring sites were deemed able to accommodate the consolidated facility. These sites were:

- o Hoboken/Jersey City - South of Canal (52 out of a possible 60 points)
- o Kearny - Koppers Coke (50 points)
- o Jersey City - West of Croxton (48 points)

The location of each of these sites and their orientation to the rail system are presented in Figure S-2. Each of these three prime sites had its particular strong and weak points and, as indicated, were nearly equally desirable on the overall point basis. Hoboken/Jersey City was selected as the best site.

Among the advantages of this site are:

- o It is immediately adjacent to the Hoboken Terminal, wherein 29 percent of all N.J. DOT daily rail dispatches are made. Deadheading would be minimal.

- o Construction would have little or no effect on present revenue and maintenance operations.

- o Minimal site preparation.

- o Easy access for materials/supplies and for personnel.

- o Relatively low acquisition cost.

Subsequent to this site analysis, the prospect emerged of utilizing the Hoboken/Jersey City site in conjunction with a planned residential/commercial redevelopment keyed to the Hoboken rail terminal/PATH complex. The maintenance facility is generally considered to be incompatible with this development plan, ruling out a joint use of the property. With this land use possibility in mind, further analysis of the two best alternative sites was conducted.

It was found that the "Koppers Coke" site is more readily available than the "Croxton" site. Preliminary investigations also reveal that the latter site should require a greater degree of site preparation. The Croxton site would require an estimated $2.6 million for track electrification to allow MU car access. The present owner of the Croxton site has plan that would preclude joint property use, and alternate sites for this owner are not feassible. The Koppers Coke site is located adjacent to the Morristown Line, is presently vacant, and is a convenient distance from both Newark and Hoboken. For these reasons, and because of the likely alternate use of the Hoboken/Jersey City site, the Kopper Coke site is ultimately selected as the best location, among the 3 prime sites, for the consolidated facility.

SUMMARY OF RECOMMENDATIONS

It is recommended that a program of preventive and systematic demand maintenance be implemented as described in Chapter III of this report. The program should be conducted on four activity levels, generally corresponding to four types of recommended facilities:

- o Major Repair/Rebuild Facility (MR/R)
- o Service and Inspection Facility (S&I)
- o Light Running Repair Facility (L/RR)
- o Layover/Turnaround Facility (L/T)

Specific recommendations within each of these facility categories are as follows:

1. MR/R Shop

A new MR/R Shop for almost all N.J. DOT equipment is recommended for construction at the Koppers Coke site in Kearny. The existing E'port faiclities would no longer be used for N.J. DOT work, due to the availability of the new Kearny facility. The Amtrak facility at Wilmington should continue to be used for major work on the N.J. DOT GG-1's for as long as they remain in service. No facility changes are recommended at Wilmington.

The new MR/R Shop would be built in consolidation with a new S&I shop also recommended at this site. The MR/R shop responsibilities would cover 1,002 vehicles (year 2000 projection) in use in all four service areas. The shop building would encompass 167,000 square feet and be manned by an estimated 152 persons (3 shifts). The major repair areas would contain 5 run-through tracks, each assigned a primary vehicle-type responsibility and designed to accommodate 2 vehicles.

2. S&I Facilities

It is recommended that new S&I facilities be constructed at the aforementioned Kearny site and at Atlantic City and that the existing facilities at Sunnyside Yard be expanded. S&I functions now being performed at South Amboy and some at Hoboken would be discontinued and transferred to the new Kearny facility. The facilities at all three sites would also have the ability to accommodate running repair work.

The Kearny shop building cover 200,000 square feet and have responsibility for 663 vehicles (year 2,00 projection), including diesel electric locomotives, electric locomotives, MU cars, and standard commuter coaches. An estimated 78 persons would be employed on 3 work shifts at this facility. The shop would include 2 tracks for commuter coach inspections, 2 tracks for MU inspections, and 1 track each for diesel locomotive and electric locomotive/MU car inspections. Each track would accommodate 3-4 vehicles, thus allowing the ability to handle the projected monthly inspections required each day. An additional 123 persons would be employed at the nearby Hoboken Terminal and Yard performing daily inspections, running repairs, car cleaning and diesel-electric locomotive refueling tasks.

The Atlantic City facility would actually be a cross between a MR/R shop and a S&I shop. It should accommodate two vehicles at one time and initially be responsible for the RDC fleet operated in this southern section of the state. A work force of 12 persons is recommended.

The existing METRO shed area at Sunnyside Yard should be upgraded by constructing a four-vehicle length inspection shop alongside the existing shop. The resulting total of 10 vehicle inspection spots would be adequate to handle the projected monthly inspections required to be performed daily. In conjunction with this construction, a two-track, four-vehicle capacity Light/Running Repair Shop would also be built alongside, and the existing storage and personnel welfare facilities would be expanded. The entire facility would employ an estimated 109 persons and be responsible for the maintenance of 180 MU cars and 22 electric locomotives (year 2000 projection).

3. Light Running Repair Facilities

Only one new facility is recommended, that being the aforementioned shop at Sunnyside Yard. No improvements to any of the existing Light Running Repair shops are recommended. Current activities at Harrison, Raritan, South Amboy, and Trenton should be discontinued and transferred to either the new Kearny or Sunnyside Yard S&I facilities.

4. Layover/Turnaround Facilities

The relocation of some of the Hoboken activities to the new Kearny facility will allow the abandonment of the existing MU car shop, Modoc shop, and support facilities. This area should then be converted to a locomotive servicing and daily inspection facility and additional terminal storage track area. The conversion work should also include modifications to existing buildings (washing facility, power plant, etc.) and installation of a 440-volt standby system. Recommended modifications to other existing sites are as follows:

Bay Head

- o Rehabilitate Yard Storage Tracks
- o Eliminate Fueling and Sanding Functions· Relocate to Hoboken

Dover

- o Rehabilitate Yard Storage Tracks
- o Eliminate Fueling and Sanding Functions; Relocate to Hoboken
- o Install 440-V Standby System

Gladstone, Morristown, and Summit

- o Rehabilitate Yard Storage Tracks
- o Improve Equipment/Facility Security

Lindenwold

- o Eliminate Fueling and Sanding Functions, Relocate to Atlantic City

Princeton

- o Improve Equipment/Facility Security

South Amboy

- o Eliminate Fueling and Sanding Functions; Relocate to Hoboken

Raritan

- o Install 440-V Standby System
- o Eliminate Fueling and Sanding Functions; Relocate to Hoboken

Waldick

- o Rehabilitate Yard Storage Tracks

As a result of proposed reductions or eliminations of work functions at various facilities, a reduction of about 176 persons could be realized in the entire system labor force.

OST ESTIMATES

he capital costs developed are exclusive of property acquisition or lease osts. These latter costs for the Koppers Coke facilities are estimated as p to $4.5 million. The estimated capital cost for all of the recommended acilities and facility improvements totals over $69 million, distributed as ollows:

Koppers Coke	$ 22.4 Million
Koppers Coke S&I Facility	28.8
Ancilliary Facilities at Koppers Coke Shops	3.0
Shop Machinery and tooling for Koppers Coke	2.0
Sunnyside Yard Facility Modifications	3.6
Hoboken Terminal Yard Facility Modifications	3.3
Atlantic City Facility	0.8
Modifications to Layover/Turnaround Facilities	3.0
Engineering design seravices and Construction contract administration	3.5
TOTAL	$ 69.3 Million

The estimated annual operating costs of the systemwide equipment maintenance operations would total approximately $35 million (in October 1979 dollars) - under the recommended facilities structure. This figure represents a potential annual saving of more than $9 million when compared with the estimated current cost.

TABLE OF CONTENTS

TABLE OF CONTENTS

CHAPTER I

INVENTORY OF EXISTING EQUIPMENT AND FACILITIES

TABLE OF CONTENTS

Chapter 1 (continued)

TABLE OF CONTENTS

CHAPTER II

PROJECTED RAIL SERVICES AND EQUIPMENT NEEDS

TABLE OF CONTENTS

CHAPTER III

MAINTENANCE REQUIREMENTS

TABLE OF CONTENTS

Chapter III (continued)

TABLE OF CONTENTS

Chapter III (continued)

TABLE OF CONTENTS

CHAPTER IV

INSTITUTIONAL ALTERNATIVES

TABLE OF CONTENTS

CHAPTER V

ALTERNATIVES ANALYSIS

TABLE OF CONTENTS

Chapter V (continued)

TABLE OF CONTENTS

Chapter V (continued)

TABLE OF CONTENTS

CHAPTER VI

RECOMMENDATIONS

TABLE OF EXHIBITS

TABLE OF EXHIBITS

TABLE OF EXHIBITS

CHAPTER I

INVENTORY OF EXISTING FACILITIES AND EQUIPMENT

CHAPTER II

PROJECTED RAIL SERVICES AND EQUIPMENT NEEDS

LIST OF EXHIBITS (cont'd)

CHAPTER III

MAINTENANCE REQUIREMENTS

LIST OF EXHIBITS (con't)

CHAPTER III

CHAPTER IV

INSTITUTIONAL ALTERNATIVES

CHAPTER V

ALTERNATIVES ANALYSIS

CHAPTER VI

RECOMMENDATIONS

LIST OF EXHIBITS (con't)

CHAPTER VI

CHAPTER I

INVENTORY OF EXISTING EQUIPMENT AND FACILITIES

CHAPTER I

INVENTORY OF EXISTING EQUIPMENT AND FACILITIES

1. N.J.DOT STUDY - TASK ONE

Much of the information contained in this chapter has been extracted from a draft of a report prepared by the Bureau of Common Carrier Planning and the Bureau of Rail Equipment of the New Jersey Department of Transportation entitled "New Jersey Rail Equipment and Facilities Inventory" dated June 1977. The complete report is contained in Appendix A.

This information has been verified, modified, updated and expanded as a result of additional research, field visits and interviews with maintenance personnel at the various maintenance facilities.

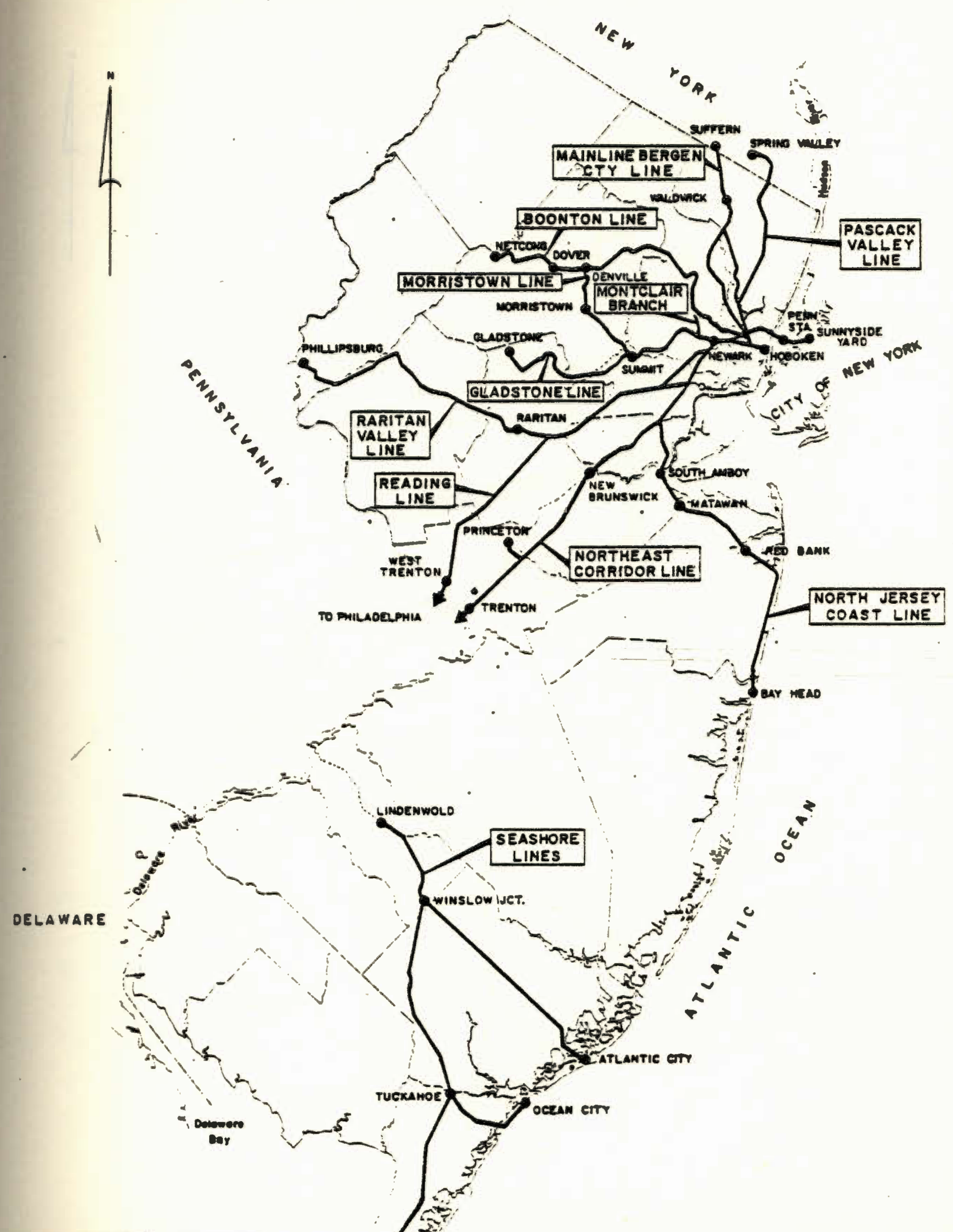
2. EXISTING PASSENGER SERVICES

The existing passenger rail system for the State of New Jersey is depicted on Exhibit I-1; a simplified schematic layout is given on Exhibit I-2.

Conrail operates commuter rail service on all passenger lines that were formerly operated in New Jersey by five bankrupt carriers: Erie-Lackawanna, Penn Central, Central Railroad of New Jersey, Pennsylvania-Reading Seashore Lines, and the Reading Railroad. These services are

EXISTING
PASSENGER
SYSTEM

EXHIBIT I - 1

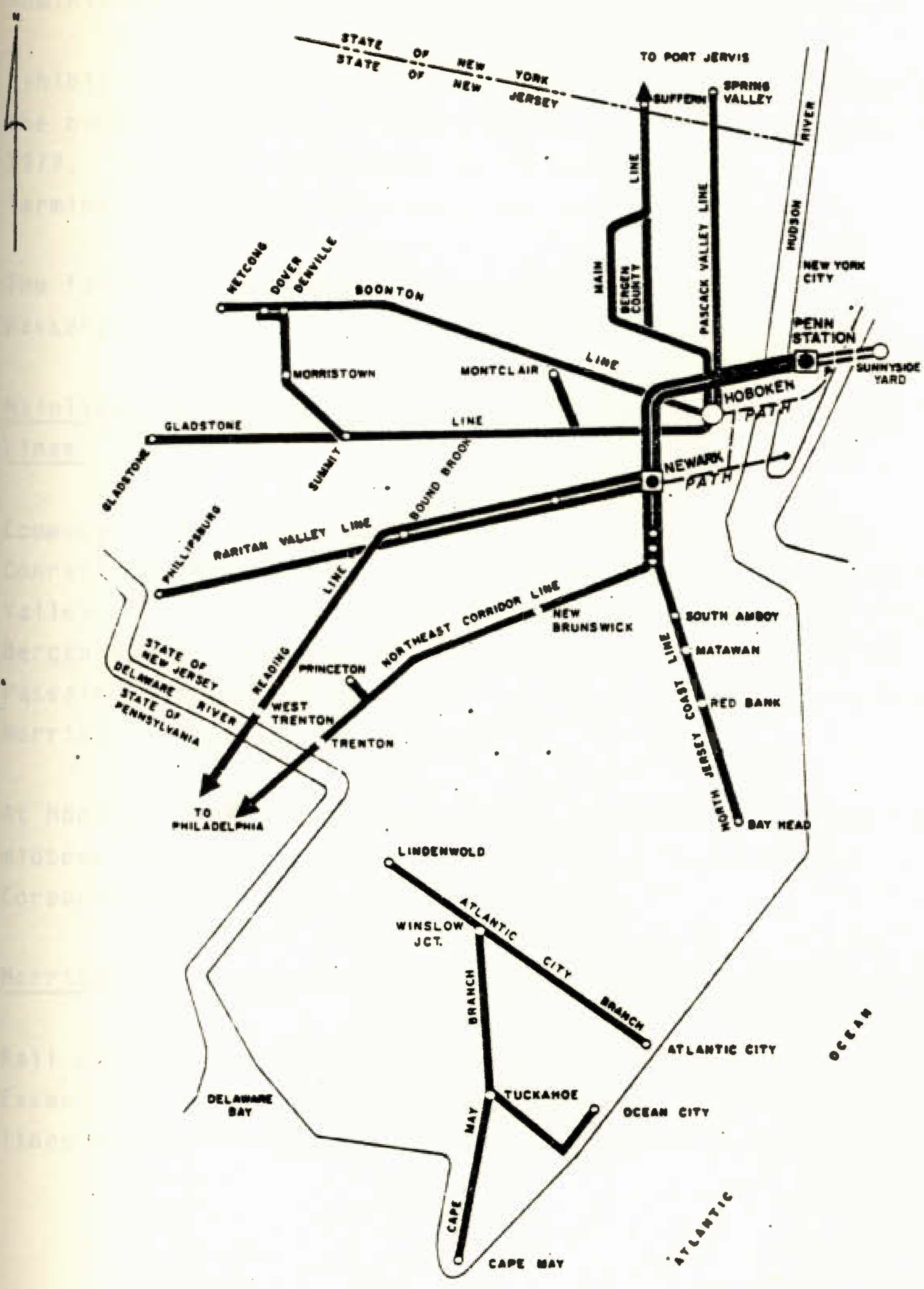


TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES

Seelye Stevenson Value & Knecht
Engineers and Planners
SSV&K

EXISTING PASSENGER RAIL SYSTEM SCHEMATIC

EXHIBIT I-2



TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES

Seelye Stevenson Value & Knecht
Engineers and Planners
SSV&K

currently subsidized by the Urban Mass Transportation Administration (UMTA) and the State of New Jersey.

Exhibit I-3 indicates the number of trains per week day and the number of passengers carried on an average week day in 1977. The daily passengers using each service, by Terminal, is graphically depicted in Exhibit I-4.

The following is a description of all state subsidized passenger services in the State of New Jersey .

2.1 Mainline, Bergen County, Pascack Valley and Boonton (MBPB) Lines

Commuter rail diesel service is provided to Hoboken by Conrail (Hoboken Division) over three lines - the Pascack Valley Line, serving eastern Bergen County, the Main Line - Bergen County Line, primarily serving western Bergen and Passaic Counties, and the Boonton Line, primarily serving Morris, Passaic and Essex Counties.

At Hoboken passengers may make connections to downtown and midtown Manhattan via the Port Authority Trans-Hudson Corporation (PATH).

2.2 Morristown, Gladstone and Montclair (MGM) Lines

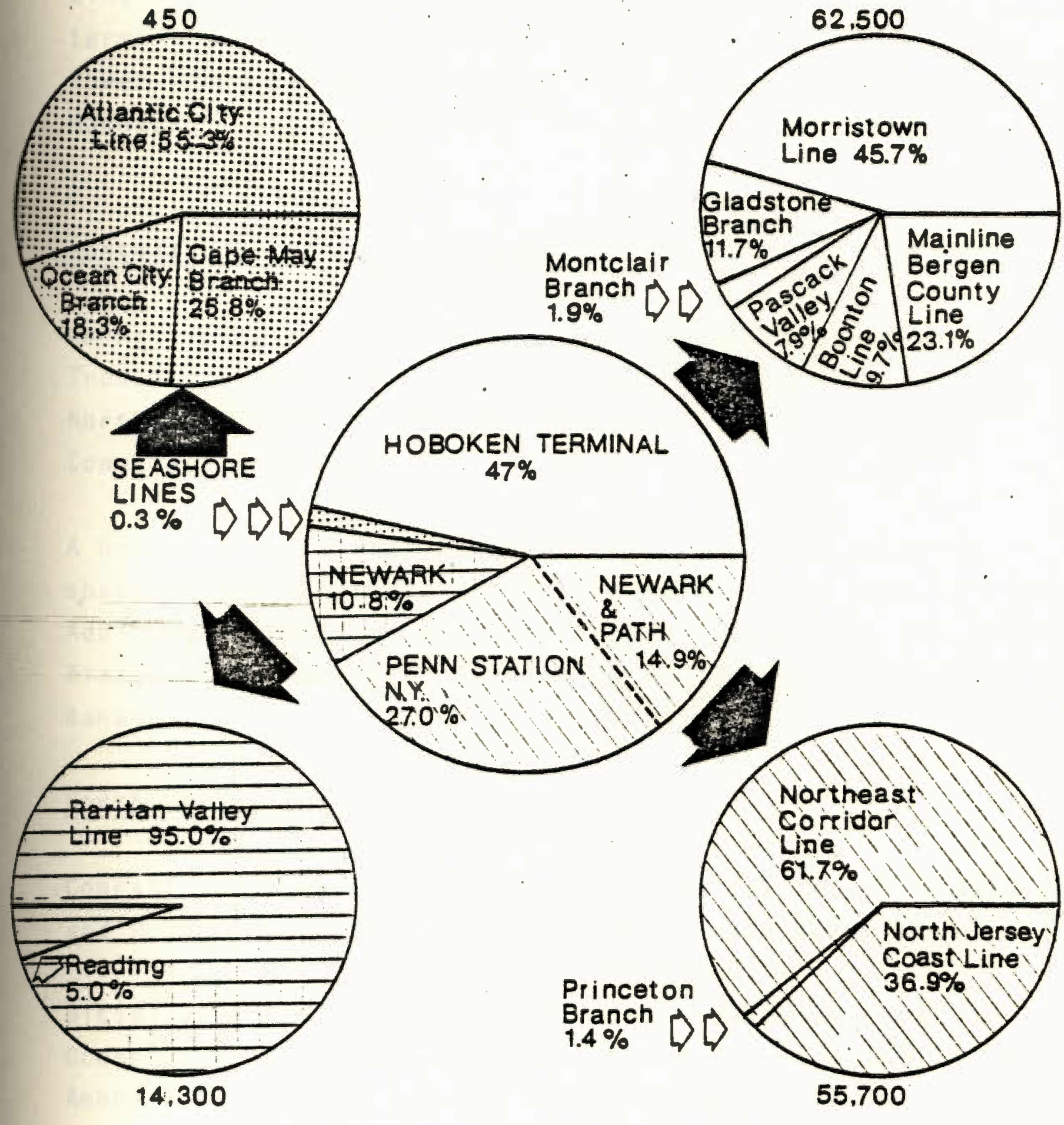
Rail commuter service to Newark-Broad St. is available from Essex, Morris and Somerset Counties over three electrified lines - the Morristown Line, serving Morris and Essex

Service	Trains per Day	Passengers per Day *	
		East	West
MBPB Lines			
Pascack Valley Line	12	2,551	2,368
Main Line - Bergen County Line	66	7,194	7,264
Boonton Line	25	3,067	2,996
MGM Lines			
Morristown Line	84	13,931	14,631
Montclair Branch	24	667	504
Gladstone Branch	39	3,706	3,624
Northeast Corridor and Princeton Branch			
Northeast Corridor	110	18,213	16,160
Princeton Branch	40	354	430
North Jersey Coast Line (NJCL)	54	10,346	10,175
Raritan Valley Line	60	6,818	6,766
Reading Line	2	354	354
Seashore Lines			
Atlantic City Line	6	120	122
Cape May Branch[1]	2	61	52
Ocean City Branch[2]	2	42	41
GRAND TOTALS	526	67,424	65,487

* Weekday - 1977

[1,2] Two additional trains run during June - September.

SOURCE: N.J. DOT


450
Atlantic City Line 55.3%
Ocean City Branch 18.3%
Cape May Branch 25.8%
SEASHORE LINES 0.3%
62,500
Morristown Line 45.7%
Gladstone Branch 11.7%
Montclair Branch 1.9%
Pascack Valley 7.9%
Boonton Line 9.7%
Mainline Bergen County Line 23.1%
HOBOKEN TERMINAL 47%
NEWARK 10.8%
NEWARK & PATH 14.9%
PENN STATION N.Y. 27.0%
Raritan Valley Line 95.0%
Reading 5.0%
14,300
Northeast Corridor Line 61.7%
North Jersey Coast Line 36.9%
Princeton Branch 1.4%
55,700

Counties, the Montclair Branch serving Essex County, and the Gladstone Branch, serving Somerset County. The latter two branch lines are connecting lines to the Morristown Line. The electrified service continues to Hoboken terminal where a transfer to PATH is made for midtown or lower Manhattan destinations. Direct access to midtown Manhattan via these Conrail lines are is not available.

2.3 Northeast Corridor (NEC) Line and Princeton Branch

Conrail provides electrified rail commuter service from Trenton to New York's Penn Station via a portion of the Northeast Corridor (Mercer, Middlesex, Union and Essex Counties) linking Boston and Washington, D.C.

A branch line between Princeton and Princeton Junction shuttles passengers to the Northeast Corridor Line. Additonal service to New York City originates at the Jersey Avenue 'Park and Ride' Station in New Brunswick and at Rahway.

2.4 North Jersey Coast Line (NJCL)

Conrail provides rail commuter service for Ocean, Middlesex and Monmouth Counties via the North Jersey Coast Line.

Diesel-operated service is provided between Bay Head in Ocean County, and Newark, and between Bay Head and South Amboy in Middlesex County. At South Amboy, the diesel locomotives of trains destined for Penn Station, New York are replaced with electric locomotives needed to operate through the Hudson River tunnels.

Electrified rail service also originates in South Amboy, providing direct access to Penn Station, N.Y.

.5 Raritan Valley Line

Conrail provides commuter rail diesel service between Phillipsburg and Newark serving Warren, Hunterdon, Somerset, Middlesex and Union Counties.

All passengers bound for lower Manhattan can transfer to PATH at Newark. Passengers bound for midtown Manhattan may board either PATH, Northeast Corridor Conrail or Amtrak trains at Newark.

.6 Reading Line

Conrail operates commuter rail service from Philadelphia and West Trenton to Newark. The service uses rail diesel cars (RDC's), and operates from its origin in Philadelphia, Pennsylvania, through Mercer, Somerset, Union, and Essex Counties to Pennsylvania Station, Newark. Manhattan - bound passengers must transfer to either Northeast Corridor trains or PATH at Newark. All passenger equipment on this service is currently owned by the Southeastern Pennsylvania Transportation Authority (SEPTA).

2.7 Seashore Line

Conrail operates passenger service between Lindenwold, in Camden County and communities in Atlantic and Cape May Counties. At Lindenwold, passengers can transfer to PATCO rapid transit trains for Camden and Philadelphia.

Rail diesel cars (RDC's) are used on all three branches of service. The Ocean City branch RDC's couple with Cape May branch RDC's at Tuckahoe for the westbound trip. At Winslow Junction, they use a portion of the Atlantic City branch tracks to Lindenwold. Atlantic City bound RDC's use the entire Atlantic City branch segment.

3. INVENTORY OF EXISTING STATE-OWNED ROLLING STOCK

This section describes in detail the existing state-owned rolling stock in active service. For each passenger rail line, the following information is presented:

- o type of equipment
- o quantity in active service
- o manufacturer
- o model/series number
- o year the equipment was built
- o year the equipment was rehabilitated (if any)
- o year the equipment is scheduled for rehabilitation (if any)
- o remaining service life

The New Jersey Department of Transportation (N.J. DOT) is in the midst of an ongoing program to replace and rehabilitate a considerable number of coaches, electric multiple unit (MU) cars and locomotives. The following program items will be accomplished by 1980:

- o Rehabilitation of 33 Arrow I MU cars built in 1968 serving the Northeast Corridor Line.
- o Purchasing of 230 new Arrow III MU cars. 180 of these cars will replace the 228 DC MU's, built during 1912-1930, when re-electrification of the Morristown, Gladstone and Montclair Lines is completed. 50 Arrow III cars will replace the 18 'Reds', built in 1912, when electrification of the North Jersey Coast Service is extended to Matawan and Red Bank.
- o Modifications of 70 Arrow II MU cars on the Northeast Corridor Line to be compatible with Arrow III's.
- o Rehabilitation of 10 RDC's in use on the Seashore Lines.
- o Rehabilitation of 117 coaches for service on the North Jersey Coast Line.

Exhibits I-5 through I-7 present an inventory of all state-owned equipment.

EXISTING STATE - OWNED ROLLING STOCK

EXHIBIT I-5

A. MAINLINE, BERGEN COUNTY LINE, PASCACK VALLEY AND BOONTON (MBPB) LINES

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Scheduled Rehabilitation	Proposed Replacement Year
Cab Control Car	22	Pullman Std.	1500	1971	------	------	2001
Cab Control Car	11	Pullman Std.	1500	1973	------	------	2003
Snack Car	9	Pullman Std.	1600	1971	------	------	2001
Coach	69	Pullman Std.	1700-1770	1971	------	------	2001
Coach	39	Pullman Std.	1771-1808	1973	------	------	2003
Locomotive	23	General Electric	U34 3300	1971	1978-9	------	2000
Locomotive	9	General Electric	U34 3300	1973	1978-9	------	2000

TOTALS Locomotives 32

Coaches 150

SOURCE: N.J. DOT

B. MORRISTOWN, GLADSTONE AND MONTCLAIR (MGM) LINES

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Scheduled Replacement
MU (DC)	47	Pullman Std.	3200	1925	------	1980
MU (DC)	8	Beth. Steel	3400	1912-25	------	1980
MU (DC)	84	Pullman Std.	3500	1930	------	1980
MU (DC)	56	Pullman Std.	4300	1917-20	------	1980
MU (DC)	33	Pullman Std.	4600	1929	------	1980

TOTAL 228

All cars scheduled to be replaced by 180 new Arrow III MU's after re-electrification

SOURCE: N.J. DOT

C. NORTHEAST CORRIDOR (NEC) LINE, SOUTH AMBOY BRANCH AND PRINCETON BRANCH

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Schedule Rehabilitation	Remaining Service Life
MU (AC)	33	St. Louis Car	Arrow I (500-533)	1968-69	------	1980	*
MU (AC)	70	General Electric	Arrow II (534-603)	1974-75	------	1980[4]	*
MU (AC)	18[1]	Altoona, P.R.R.	Reds (400)	1912	------	------	None[2]
MU (AC)	230[3]	General Electric	Arrow III (1304-1533)	1977-78	------	------	*
TOTAL	351						

[1]Currently leased to SEPTA

[2]Scheduled to be placed in NEC Emergency Storage in 1980.

[3]180 MU's will be reallocated to MGM lines after re-electrification.

[4]Includes modifications to make cars compatible with Arrow III's

*Service life of stainless steel cars indefinite if cars have a major overhaul and rewiring every 15 to 20 years.

SOURCE: N.J. DOT

D. NORTH JERSEY COAST LINE

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Rehabilitation or Replacement Year
Coach	6	American Car and Foundry	100	1953	1971	1985
Coach	28	Pullman Std.	100	1946-50	1973	1985
Coach	26	Budd Co.	2400	1938	1970	1985
Coach	16	Pullman Std.	2400	1938	1971	1985
Coach	26	Budd Co.	3000	1938	1969	1985
Coach	4	Budd Co.	3200	1949	1-1963, 3-1978	*
Coach	5	Budd Co.	4000	1947	----	1985
Coach	28	Budd Co.	1500	1949	1978	*
Locomotive	8	Electro-Motive	GP-7 1500	1952	----	1983
Locomotive	11	Electro-Motive	E-8 4200	1951	1978	1990
Locomotive	3	Electro-Motive	E-8 4200	1951	1979	1990
Locomotive	6	Electro-Motive	E-8 4200	1951	----	1982
Locomotive	13	General Electric	GG-1	1935	----	Expired

TOTALS
Locomotives 41
Coaches 139

* Service life is indefinite if cars have major overhaul every 15 to 20 years.

SOURCE: N.J. DOT

E. RARITAN VALLEY LINE

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Scheduled Rehabilitation	Proposed Replacement Year
Coach[1]	10	Pullman Std.	270	1965	1972	-----	1995
Coach	20	American Car and Foundry	300	1948	1968	-----	Expired
Coach	2	Budd Co.	300	1949	-----	-----	*
Coach	2	Budd Co.	300	1938	1968	-----	*
Coach	2	Pullman Std.	300	1947	1971	-----	Expired
Coach	53	Pullman Std.	1000, 1100, 1200, 1300	1923-31	1969	-----	Expired
Locomotive	13	Lend-Leased to NJDOT	GP-40(3671-83)	1968	-----	-----	1988
RDC[2]	10	Budd Co.	500	1950-53	1974-75	-----	*

[1]To be reallocated to NJCL.

[2]Surplus (Formerly used on Bayonne Shuttle)

*service life is indefinite if cars have major overhaul every 15 to 20 years

TOTALS Coaches 89
Locomotives 13

SOURCE: N.J. DOT

F. SEASHORE LINES

Equipment Type	Quantity	Manufacturer	Series	Year Built	Year Rehabilitated	Scheduled Rehabilitation	Remaining Service Life
Rail Diesel Car (RDC)	10	Budd Co.	402-413	1950-51	1969	1979-80	*
RDC (spare parts)	1	Budd Co.	554	1950-53	-----	-----	None

*service life is indefinite if cars have major overhaul every 15 to 20 years.

SOURCE: N.J. DOT

4. INVENTORY OF EXISTING RAIL EQUIPMENT MAINTENANCE FACILITIES

The State of New Jersey currently contracts with Amtrak and Conrail for all rail maintenance facilites that were formerly owned by the five bankrupt railroad companies. Although Conrail has assumed operation of all passenger services in the state, it does not own all maintenance facilities of the former companies. Amtrak and the State of New Jersey own certain facilities.

The following is a list of the rail equipment maintenance facilities that currently service state-owned equipment on each passenger rail line in New Jersey. The location of each facility is shown on Exhibit I-8. In addition, Exhibit I-8A presents an enlarged map depicting the facility locations in the northeast New Jersey area.

Raritan Valley Line

Handling locomotives, push-pull coaches and coaches.

- Elizabethport
- Harrison
- Raritan
- Phillipsburg

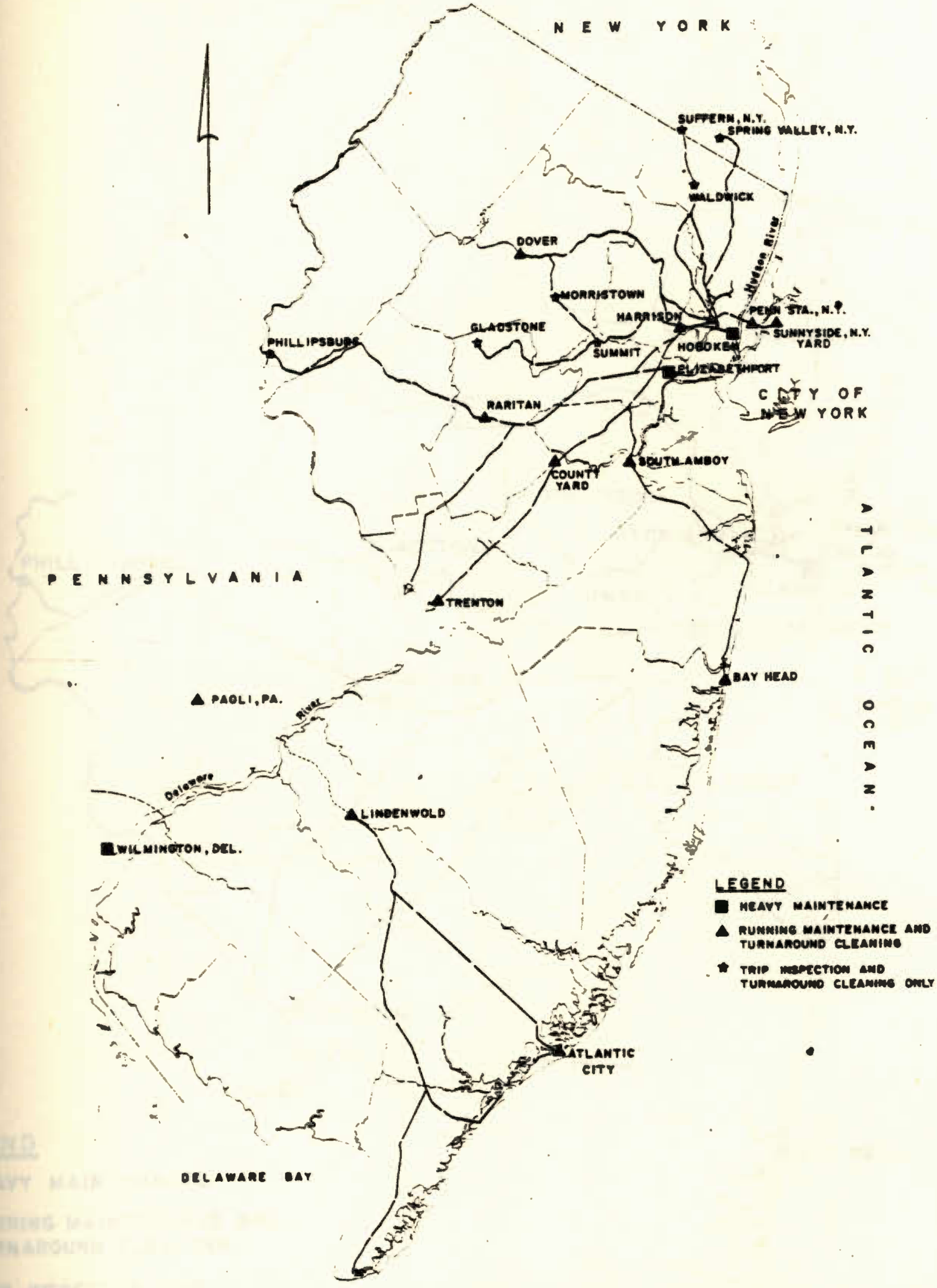
North Jersey Coast Line

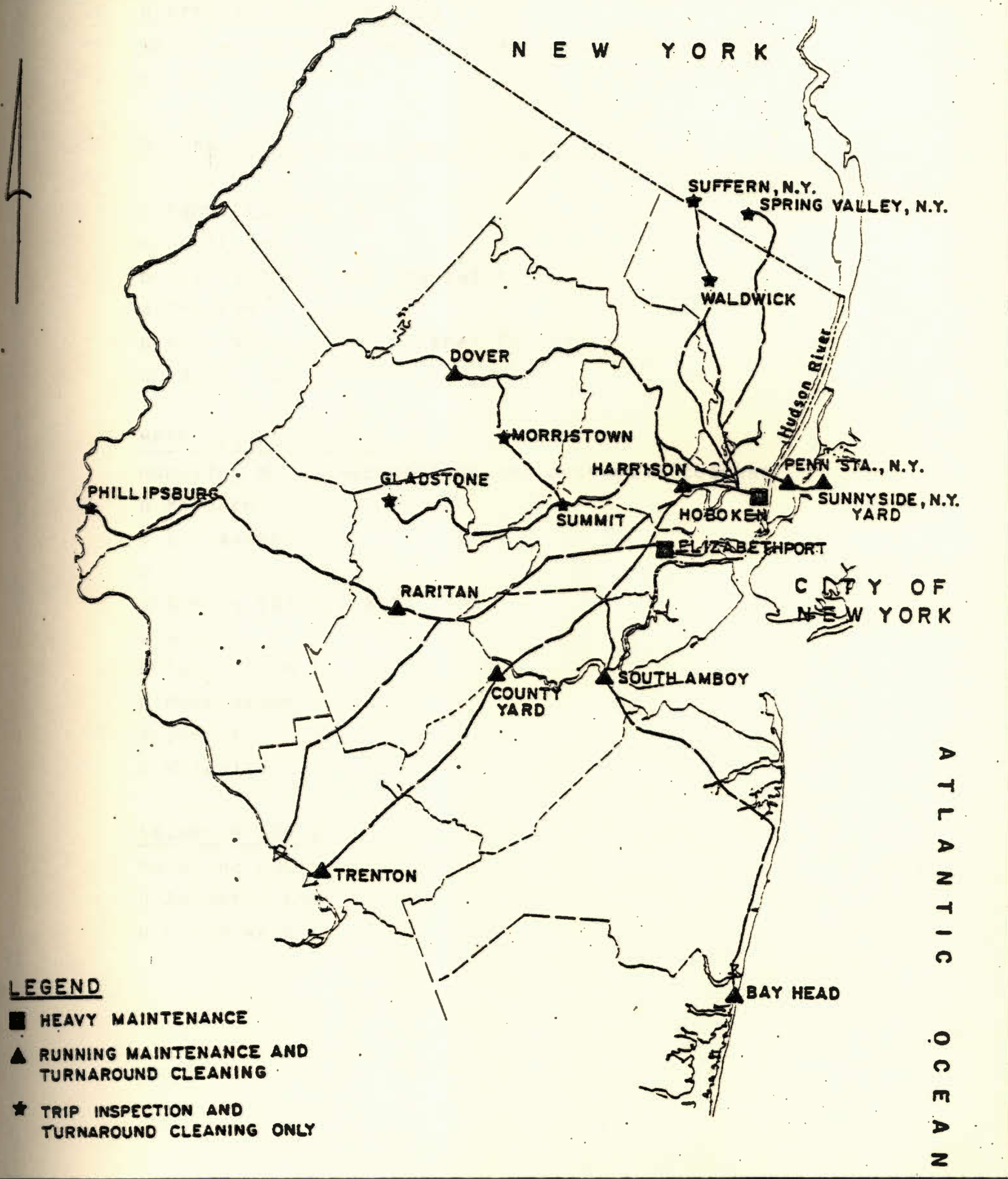
Handling MU's, locomotives and coaches

- Sunnyside, N.Y.
- South Amboy
- Bay Head
- Wilmington, Del.
- Elizabethport

RAIL EQUIPMENT MAINTENACE FACILITIES

EXHIBIT I-8




NEW YORK
SUFFERN, N.Y.
SPRING VALLEY, N.Y.
WALDWICK
Hudson River
DOVER
MORRISTOWN
HARRISON
PENN STA., N.Y.
SUNNYSIDE, N.Y. YARD
GLADSTONE
PHILLIPSBURG
SUMMIT
HOBOKEN
ELIZABETHPORT
CITY OF NEW YORK
RARITAN
COUNTY YARD
SOUTH AMBOY
TRENTON
ATLANTIC OCEAN
BAY HEAD
LEGEND
HEAVY MAINTENANCE
RUNNING MAINTENANCE AND TURNAROUND CLEANING
TRIP INSPECTION AND TURNAROUND CLEANING ONLY

Northeast Corridor Line

Handling MU's, locomotives and coaches

o Sunnyside, N.Y.

Northeast Corridor Line (Cont'd)

o Penn Station, N.Y.
o South Amboy
o County Yard (New Brunswick)
o Trenton
o Wilmington, Del. (Amtrak facility)
o Paoli, Pa.

MBPB and MGM Lines

Handling MU's, locomotives and push-pull coaches

o Hoboken
o Elizabethport
o Dover
o Spring Valley, N.Y.
o Gladstone
o Suffern, N.Y.
o Morristown
o Summit
o Waldwick

Seashore Lines

Handling RDC's

o Atlantic City
o Lindenwold

Each of these facilities was examined in order to determine current capabilities for servicing existing rolling stock.

Rail equipment maintenance facilities available to N.J. DOT vary according to their maintenance capabilities. The facilities generally fit into one of three categories:

- o Heavy Maintenance - i.e. annual FRA inspections, heavy repairs, major modifications and rebuilding.

- o Inspection, Running Maintenance and Turnaround Facilities - i.e. daily and monthly FRA inspections, running and light repairs, such as running gear, safety appliances, support components, etc.

- o Trip Inspection and Turnaround Cleaning Only - i.e. Layover and turnaround inspection, servicing, fueling, car washing, battery charging coaches, overnight storage, light bulb replacement, break shoes, windshield wipers, etc.

Exhibit I-9 summarizes train dispatchments, facility capabilities, personnel, etc. at each maintenance facility.

Facility	Number of Trains Dispatched Per Week Day	Type Equipment Dispatched	Equipment Layover Nightly	Fueling and Sanding Service	Electric Standby Available	Number of Storage Tracks	Track Condition	Water Outlets	Shop Facility	Number of Personnel Assigned L C MU	Periodic Test Assignments	Major Repairs	Minor Repairs	Engine Change	Wheel True	Wheel & Traction Motor Change	Major Car Clean	Minor Car Clean
HEAVY MAINTENANCE FACILITIES																		
Elizabeth-port	-	-	-	Yes	No	22	Fair	Yes	Yes	35 34 -	32-U34 13-GP40 8-GP7 MI	Yes	Yes	Yes	Yes	No	No	Yes
Hoboken	132	U34-P/P Coaches MU (DC)	20-MU	Yes	Yes	13	Fair	Yes	Yes	36 79 172	228-MU-(DC)	Yes MU & Coach	Yes	No	Yes	Yes	Yes	Yes
Wilmington	-	-	-	Yes	No	-	Fair	Yes	Yes	26 9 -	13-GG1-MI	Yes	Yes	No	No	Yes	No	No
INSPECTION, RUNNING MAINTENANCE AND TURNAROUND FACILITIES																		
Atlantic City	3	RDC	6 RDC	No	No	2	Fair	Yes	Yes	13 - -	11-RDC-MI	Limited	Yes	Yes	No	Limited	Yes	Yes
Bay Head	17	GP40 E8 Coaches	5-GP40 16-E8 130-Coaches	Yes	No	15	Fair	Yes	No	16 22 -	Daily Only	No	Yes	No	No	No	Yes	Yes
County Yard	23	MU (AC)	2[illegible]-MU	No	No	3	Fair	No	No	- - 17	Daily Only	No	Yes	No	No	No	Yes	No
Dover	38	U34-P/P Coaches MU (DC)	7-U34 33-Coaches 64-MU	Yes (Truck)	No	8	Fair	No	No	1 3 3	Daily Only	No	Yes	No	No	No	No	Yes
Harrison	21	GP40 GP7 Coaches	None	No	No	10	Fair	Yes	No	8 67 -	Daily Only	No	Yes	No	No	No	Yes	Yes
Hoboken	(see above)	-	-	-	-	-	-	-	-	- - -	-	-	-	-	-	-	-	-
Lindenwold	5	RDC	Spares 3 RDC	Yes	No	2	Fair	No	No	5 - -	Daily Only	No	Yes	No	No	No	No	Yes
Paoli, Pa.	-	-	-	-	-	-	-	-	Yes	*(Total-135)	Yes	No	Yes	No	No	No	No	No
Penn Sta. New York	63	GG1 Coaches MU (AC)	-	No	No	-	Good	Yes	No	*(Total-59)	Trip Insp. Only	No	Yes	No	No	No	No	Yes
Raritan	20	GP40 Coaches 4 Cont. Cars	5-GP40 7-GP7 50-Coaches	Yes	No	9	Fair	Yes	Yes	23 21 -	Daily Only	No	Yes	No	No	No	No	Yes
South Amboy	10	E8-GG1 MU (AC)	2-E8 13-GG-1 22-MU	Yes	No	5	Fair	Yes	Yes	20 - 4	20-E8 44MU(AC) MI	Yes	Yes	No	No	No	No	Yes
Sunnyside, New York	-	GG1 Coaches MU (AC)	-	No	No	-	Fair	Yes	Yes	(Total-159)	141-MU	No	Yes	No	No	Yes	Yes	Yes
Trenton	16	MU (AC)	28MU	No	No	2	Fair	No	No	- - 17	Daily Only	No	Yes	No	No	No	No	Yes
TRIP INSPECTION AND TURNAROUND CLEANING FACILITIES ONLY																		
Gladstone	16	MU (DC)	46-MU	No	No	6	Poor	No	No	- - 2	Daily Only	No	Yes	No	No	No	No	Yes
Morristown	7	MU (DC)	40-MU	No	No	5	Poor	No	No	- - 2	Daily Only	No	Yes	No	No	No	No	Yes
Phillipsburg	4	GP 40-P/P Coaches	2-GP 40 15-Coaches	No	No	3	Fair	Yes	No	- 1 -	Daily Only	No	Yes	No	No	No	No	Yes
Spring Valley N.Y.	6	U-34-P/P Coaches	5-U34 29-Coaches	No	Yes	3	Fair	Yes	No	1 3 -	Daily Only	No	Yes	No	No	No	No	Yes
Suffern, N.Y.	19	U34-P/P Coaches	6-U34 39-Coaches	No	Yes	5	Fair	Yes	No	1 2 -	Daily Only	No	Yes	No	No	No	No	Yes
Summit	7	MU (DC)	26 MU	No	No	3	Poor	No	No	- - 1	Daily Only	No	Yes	No	No	No	No	Yes
Waldwick	12	U34-P/P Coaches	4-U34 17-Coaches	No	Yes	6	Poor	Yes	No	1 3 -	Daily Only	No	Yes	No	No	Yes	No	No

* No. Assigned Personnel includes NJDOT and others.
P/P = Push-Pull
Source: N.J. DOT; Analysis SSV&K

TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES
SSV&K

5. HEAVY MAINTENANCE FACILITIES

Elizabethport

Maintenance Capability

Heavy Maintenance of locomotives, coaches and RDC's

Running Maintenance of locomotives and RDC's

Owned and Operated by Conrail

Personnel Assigned to N.J. DOT Fleet

(Diesel Shop)	(Car Shop)
2 Foremen	2 Foremen
3 Boiler Makers	2 Blacksmiths
15 Mechanics	3 Machinists
5 Plumbers	1 Pipe Fitter
5 Electricians	1 Electrician
1 Crane Operator	1 Crane Operator
1 Electrician's Helper	17 Carmen
1 Hostler	1 Cleaner
2 Laborers	4 Helpers
35 Total	1 Laborer
	1 Clerk
	34 Total

Elizabethport is a major locomotive and car maintenance facility located in Elizabeth, New Jersey, just east of the New Jersey Turnpike and south of Newark Airport. Two main buildings, each approximately 300' x 700' in size, are used for locomotive and car repairs.

All FRA periodic test work and heavy repairs on New Jersey DOT Model U34CH, GP 40 and GP 7 locomotives are handled in the locomotive shop. The 20 Model E8 locomotives that run in the South Amboy to Bay Head service also receive their 24 month inspection and major repairs at Elizabethport. Subcontractors are used for heavy engine overhaul, major generator and motor work, and steam generator rebuild. Air brake equipment cleaning and test work is now sent to Altoona. Elizabethport is currently in process of setting up an air brake cleaning and repair room to do this work in house.

The locomotive shop contains five run through tracks. Track numbers 1 and 2 are devoted to New Jersey DOT locomotive work. Two overhead 75 ton cranes are used to lift locomotives and heavy component parts. Other shop maintenance equipment includes one locomotive load box, three engine lathes, one hot water engine washer, four 50 ton drop tables, one 10 ton crane, and one 25 ton outdoor gantry.

Heavy repairs are performed in the car shop on 155 various steam and electrically heated coaches (as required). Two tracks within the car shop building are used exclusively for N.J. DOT car repairs. This shop also houses a separate wheel and axle shop, and two 15 ton overhead cranes.

Both facility repair shops at this location are in generally poor condition. The buildings are approximately 75 years old, roofs are in need of major repairs, and most shop machinery is antiquated.

* * *

.2 <u>Hoboken</u> (Heavy Maintenance Facilities Only)

<u>Maintenance Capability</u>

Heavy Maintenace on MU Cars.

<u>Owned by N.J. DOT</u>

<u>Operated by Conrail</u>

Personnel	
	(MU Shop only)
4	Foremen
14	Machinists
2	Machinist's Helpers
1	Sheet Metal Worker
1	Crane Operator
26	Electricians
6	Electrician's Helper's
17	Laborers
4	Car Cleaners
4	Painters
79	Total

The Hoboken maintenance facility is located immediately to the west of the railroad passenger terminal. Hoboken is the eastern terminus for the electrified Morristown, Gladstone and Montclair (MGM) Lines and the diesel-operated push-pull Mainline, Bergen County, pasack Valley and Boonton (MBPB) Lines.

Heavy maintenance is performed on a fleet of 228 DC MU's at the MU Shop. This is a three-track shop, approximately 480 feet long by 60 feet wide with adjacent office and store room areas.

Each end of the shop is equipped with a 25 ton overhead crane running the full shop width. Overhead walkways for pantograph access are located over the floor areas between the tracks. Tracks into the shop are dead-ended (no through tracks). No catenary is provided; cars are moved within the shop by means of plug-in 250 volt D.C. jumpers. The shop has a capacity of 12 MU's at one time. Cars can be lifted by means of four 35 ton electric Whiting jacks. Shop lighting is poor and the roof is in need of major repairs.

The structure is almost 50 years old and requires extensive rehabilitation. The track spacing, which is about 17 feet on center, will not be adequate for future MU repairs (Arrow cars). The rolling stock presently maintained are old DC MU's, scheduled to be replaced with new Arrow III (AC) MU's.

* * *

Wilmington, Delaware

Maintenance Capability

Heavy Maintenance on Electric Locomotives and Coaches

Rebuilding Components

Repair, Modification and Rewiring of Cars

Owned and Operated by Amtrak

Personnel Assigned to N.J. DOT Fleet

(Car Shop)

5 Electricians

4 Car Repairmen

(Locomotive Shop)

26 - Various trades

35 Total

The Wilmington Maintenance Facility is located on Third Street adjacent to the Northeast Corridor Mainline in Wilmington, Delaware. On February 24, 1976, Amtrak assumed the operation of the entire shop and on April 1, 1976 the property was officially conveyed to Amtrak as part of the Northeast Corridor.

All 13 of the GG-1 electric locomotives operating in New Jersey DOT service receive all periodic test work and heavy repairs at Wilmington. All New Jersey DOT-owned MU cars that are maintained at Sunnyside also receive necessary wreck repairs and modification work at Wilmington. All wheel work for these cars is also performed here.

The Wilmington facility has a very large assortment of buildings and facilities to handle passenger locomotives and cars.

The facilities include:

- o Motor Shop
- o Locomotive Shop
- o Machine Shop
- o Wheel and Blacksmith Shops
- o Electric Shop
- o 2 Car Shops
- o Storehouse and Office Building

Althouh most of Wilmington's shop buildings were erected in the early part of this century, they are well constructed and are fully serviceable today. Housekeeping at this facility is good and the operation appears to be well managed.

* * *

6. INSPECTION, RUNNING MAINTENANCE AND TURNAROUND FACILITIES

Atlantic City

Maintenance Capability	Personnel
Monthly Inspections (MI's)	1 General Foreman
Running Maintenance	4 Machinists
Limited Heavy Maintenance	2 Electricians
24 Month FRA Test Work	1 Carpenter, Painter
Owned by: N.J. DOT	2 Car Inspectors
Operated by: Conrail	3 Car Repairmen
	13 Total

The Atlantic City facility performs all minor repairs to its fleet complement of ten RDC-1 Budd cars. Also, the 24 month FRA test work, minor truck work, and model 6-110 engine rebuilds are performed.

A foreman and nine journeymen work the first shift and three work on the second. There is no workforce during late night and early morning hours, making facility equipment and vehicles extremely vulnerable to theft and vandalism.

Two brick buildings are located at the Atlantic City rail passenger facility; one a comparatively small,but well built and well-equipped waiting room and ticket office, and the other, an obsolete railroad tower building currently being used as a train crew locker room and maintenance work shop. These two structures are independently heated; the station by a natural gas heater located in the roof section and the tower by a small oil-fired steam boiler at ground level.

Availiable work equipment is mostly old but useable. All required small tools, drill press, lift truck, chain falls, and engine test stand are available and serviceable.

* * *

6.2

Bay Head

Maintenance Capability	Personnel
Daily Locomotive Inspection	1 General Foreman
Servicing	5 Foremen
Car Inspection and Minor Maintenance	1 Machinist
Car Cleaning	4 Electricians
Owned N.J. DOT	17 Car Cleaners
Operated by Conrail	4 Car Inspectors
	3 Hostlers
	3 Hostler helpers
	38 Total

The Bay Head N.J. DOT commuter rail facility is located at the southern terminus of the North Jersey Coast Line. Its 15 track passenger train yard provides nightly layover for approximately 21 locomotives and 130 cars.

There are no permanent buildings at Bay Head terminal other than the railroad passenger station, This is located approximately 1/4 mile north of the yard. Old railroad cars are used for the mechanical department office and for train crew locker rooms.

Fueling and some sanding of locomotives is performed. Locomotives are "head pinned" and hostled to the north end of the yard where fuel is dispensed from three fuel tank cars via long hoses to the locomotive. An average of 5 locomotives are fueled nightly. Sanding of locomotives is done only on an as-needed basis. No sanding facility is available at Bay Head. Dry sand is delivered in 50 lb. bags with approximately 150 bags consumed per month.

Yard trackage is in poor condition and, in the northern section of yard, where locomotives layover and idle for many hours, the ground is saturated with oil. Neither a turntable nor "wye" is available at Bay Head facility; all incoming trains are run around a loop into the yard before train and engine crews go off duty.

* * *

County Yard

Maintenance Capability	Personnel
Daily Equipment Inspection	1 Mechanical Foreman
Car Cleaning	1 Cleaner Foreman
Owned by Amtrak	5 Car Inspectors
Operated by Conrail	10 Car Cleaners
	17 Total

County Yard is located adjacent to, and just north, of the Corridor main line south of New Brunswick. The work force performs only equipment inspection and cleaning. Approximately 28 Arrow III cars lay over nightly on three separate tracks and are readied for morning dispatchment from Jersey Avenue Station. No dumping of toilets is performed since the Arrow III cars are all equipped with retention toilets.

The Conrail maintenence of equipment personnel at County Yard are supervised by a foreman whose duty hours are 11 P.M. to 7 A.M. This foreman in charge reports directly to the general foreman at South Amboy. One car inspector works 7 A.M. to 3 P.M., two men are employed 3 P.M. to 11 P.M., and the remaining 13 employees work 11 P.M. to 7 A.M.

Two buildings are located in the passenger yard area. One is a reasonably well constructed yardmaster's and maintenance of equipment building located between the main line and #2 track; the other is a small and inadequate inspector's shanty approximately 50 yards northwest of the yard office.

No spare materials other than a few new brake shoes are kept at this facility. Defective cars requiring other than very minor repairs are serviced at Sunnyside (if cars are safe to run).

Tracks # 1, #2, and #3 in the passenger yard area are in fair to good condition.

* * *

6.4

Dover

Maintenance Capability	Personnel
Car Inspection	2 Car Inspectors
Car Cleaning	2 Electricians
Owned by N.J. DOT	3 Coach Cleaners
Operated by Conrail	
	7 Total

Dover is the terminus for fifteen Morristown and Boonton Line trains. The passenger yard accommodates the nightly layover of these trains on eight tracks. Seven trains are push-pull and eight are MU's. No electric stand-by is available in this yard. Consequently, the locomotives used in push-pull service must be kept running during layover. Equipment laying over each night in the area are:

7 locomotives
33 coaches
64 MU cars

Yard trackage is in fair or poor condition and paper debris clutters the entire yard area. A maintenance of equipment building is located south of and adjacent to the yard. It is of brick construction, neglected and in poor condition. Debris is scattered inside and around the building, presenting a potential fire hazard. Over-the-road truck fueling for the locomotives is accomplished on the south side spur track, and fuel spillage has badly contaminated the ground soil in the area.

No equipment maintenance is performed at the Dover facility

***

6.5 Harrison

Maintenance Capability		Personnel
Turnaround Cleaning of Coaches	1	General Foreman
Exterior Washing of Locomotives	1	Asst. Foreman
and Coaches	1	Painter
Minor Repairs to Locomotives	1	Carpenter
and Coaches	1	Welder
Owned by N.J. DOT	6	Car Repairmen
Operated by Conrail	8	Car Inspectors
	10	Electricians
	3	Pipe Fitters
	3	Machinists
	2	Carmen
	2	Laborers
	1	Hostler
	26	Coach Cleaners
	66	Total

Harrison Yard is located just north of Newark's Penn Station. It is used as a servicing, cleaning, and running repair facility for conventional and push-pull trains leaving Newark for Raritan, Phillipsburg, South Amboy, and Bay Head. Approximately 21 trains per day are dispatched from this 8 track yard. Only minor repairs are performed on equipment laying over during the day at Harrison while all periodic test work and heavy vehicle repairs are accomplished at Elizabethport. Extensive interior coach cleaning and exterior car washing is accomplished.

The size of Harrison Yard is only sufficient to accommodate the current equipment layover requirement, but it is a good yard and physically well planned. One stub end and two run-around tracks, in addition to the 8 run-through tracks, are available. No buildings exist other than several make-shift old converted railroad cars. The general foreman's trailer office is adequate and the converted cars are used as register and locker rooms.

Access to the yard is a crossing over the PATH main line. The crossing is heavily used and an accident potential exists 24 hours per day.

Noticeably lacking in the yard area are fuel and sanding facilities. All fueling and sanding of locomotives is performed at other line locations. The yard is equipped with electrical outlets for battery charging capability.

* * *

6.6 Hoboken (Inspection, Running Maintenance and Turn-around Facilities Only)

Maintenance Capability

Running Maintenance on MU's, Locomotives & Push-Pull Coaches

Diesel Sanding and Fueling

Monthly Inspections - MU Cars (DC)

Daily Inspections - Diesel Locomotives

Interior and Exterior Car Cleaning and Repainting

Owned by N.J. DOT

Operated by Conrail

Personnel

(Engine House)

6 Foremen

1 Chief Engine Dispatcher

9 Machinists

4 Machinist's Helpers

2 Pipe Fitters

6 Electricians

8 Laborers

36 Total

(Running Maintenance Facility)

1 General Foreman

13 Foremen

1 Electrical Supervisor

23 Special Trades

28 Electricians

8 Machinists

5 Pipe Fitters

4 Brake Testers

32 Car Inspectors

45 Coach Cleaners

6 Laborers

2 Apprentice Electricians

1 Chief Stockkeeper

1 Clerk - Typist

1 Counterman
1 Forklift Operator
172 Total

A general description of the Hoboken facility, and its heavy maintenance facilities, capabilities and personnel, was discussed in the previous section entitled "5. Heavy Maintenance Facilities." Yard trackage; office and maintenance buildings; and facility support equipment consisting of fuel and sanding station, turntable, heavy machinery etc. are generally in fair to poor condition. Servicing and medium to semi-heavy repairs are performed on 228 old DC MU cars and 150 push-pull coaches, while only servicing and minor repairs are made to the 33 GE Model U34CH diesel locomotives.

Monthly inspections, running maintenance and intermediate repairs on the old DC MU cars are carried out at the previously described MU shop. In September, 1978, there were 46 crippled DC MU cars, 21 of which were out of service because of defective traction motors. These GE #700 traction motors operate on a 3000 volt system and frequently fail.

Motor and air conditioning repairs, as well as air brake work, are accomplished in the Modoc Shop. This shop has a two-car long pit which is half in the building and half outdoors. Brake valve work is done in a portion of the adjacent stores building.

Diesel locomotive maintenance activities are presently confined to sanding, fueling, daily inspections and some running maintenance. This maintenance is performed in open yard areas adjacent to the MU shop. The existing facilities, which include an outdoor pit and a small, old building in poor condition containing offices and storage, are generally inadequate.
Monthly diesel locomotive inspections were recently transferred to Elizabethport because of the inadequate facilities at Hoboken. About 33 locomotives are dead-headed to Elizabethport each month for inspections and repairs. Such moves are extremely costly and, in addition, considerable delays are encountered on such moves while waiting for Conrail freight trains to clear.

Due to space limitations in the yard, running maintenance and intermediate repairs on the push-pull coaches is carried out at scattered outdoor locations, remote from the MU shop. Brake rigging, battery, spring, minor truck, and some accident repairs are performed on Tracks Nos. 95 and 96. Three (3) 25 ton portable jacks are frequently used in the performance of this work. A 150 ton standby wrecking crane is kept in this coach repair area on Track #94.

A drop table is located at the Cripple Track that can handle one wheel change at a time. This location provides a three (3) feet deep inspection pit and is approximately two (2) car lengths long. A stationary air compressor located at this Cripple Track provides compressed air for yard and building use. Interior and exterior car painting is performed at an adjacent track.

A Wheel True Shop is located adjacent to the Modoc Shop and houses a Stanray machine which is in poor condition. The machine is frequently used but winter working conditions are bad since the east end door must be left open for a vechicle to be positioned at the machine.
Exterior car washing is done at an outdoor car-wash facility in the yard. The entire Hoboken facility is in generally poor condition.

* * *

6.7 (7) Lindenwold

Maintenance Capability

Turnaround and Service Facility

Owned by DRPA

Operated by Conrail

Personnel

1 Machinist

1 Electrician

1 Car Inspector

2 Car Cleaners

5 Total

Lindenwold is the western terminus of the Atlantic City, Ocean City, and Cape May service. It is a turnaround and service facility for approximately eight RDC Budd cars. These vehicles lay over and are serviced during mid-day hours and are dispatched to the coastal points carrying commuters from Lindenwold and evening PATCO trains. Usually, one or two cars are stored over-night at Lindenwold. These cars represent service protection equipment.

The main and siding track at the facility dead-end and are located between the PATCO main and PATCO shop lead tracks. These two tracks are the only available tracks at the facility and they provide fueling and watering capability from twelve fuel and ten water outlets. An above ground 8000 gallon fuel tank feeds the twelve outlets. There is much evidence of both lube and fuel oil contamination of the road bed and in the small creek which runs adjacent to the siding track.

A 10'x30' sheet metal maintenance and parts storage building is located to the north and adjacent to the siding track. It is readily accessible from the dirt roadway and from the track area by a small footbridge which spans the creek.

The men are supervised by the general foreman at Atlantic City who is usually on duty at Lindenwold each afternoon. No personnel work during the night hours but there is no vandalism, (probably because of the tight security in the surrounding PATCO area).

The Lindenwold facility is somewhat make-shift in nature and has no practical potential capability for work or service expansion.

* * *

6.8 Paoli, Pa.

Maintenance Capability	Personnel	
Running Maintenance of MU Cars	58	Electricians
Milage Checks	49	Repairmen
Owned by SEPTA	11	Machinists
Operated by Conrail	11	Pipefitters
	4	Electrical Helpers
	1	Blacksmith
	1	Boilermaker
	135	Total

Paoli Shop is an MU car maintenance facility for SEPTA and New Jersey leased equipment. It is located on Route 252 in the center of town. Presently 16 of 18 - Model E6, N.J. DOT cars are in passenger revenue service. Two cars are out of service; #410 whose carbody is badly deteriorated, and #434 which has been greatly cannibalized.

The shop consists of four (4) tracks, three (3) of which are used for semi-heavy repairs. Normally only three (3) cars can be handled on each track, and only two (2) per track if a car is receiving a truck change. Running maintenance and all periodic test work up to and including the two year FRA test work are performed on the N.J. DOT vehicles.

The facility is self sustaining except for air brake cleaning, heavy electrical repair, and collision damage repair capability. Air brake cleaning for Paoli is performed at Wayne Junction, heavy motor work is farmed out to General Electric, and collision repairs are accomplished at the Wilmington Shop.

Paoli Shop is a reasonably well run facility but seemingly expensively operated. The facility appears over manpowered for its work responsibility. It does not have capability for increased work responsibility in its present form.

* * *

6.9 Pennsylvania Station, N.Y.

Maintenance Capability	Personnel
Running Maintenance and Turnaround Cleaning on MU's, coaches, and electric locomotives	3 Foreman
	2 Pipe Fitters
	1 Car Repairman
	4 Electricians
	30 Carmen
Owned by Amtrak	19 Cleaners
Operated by Amtrak/Conrail	59 Total
	(an additional 80 Cleaners are shared with Amtrak)

The Penn Station storage facility for N.J. DOT equipment is located on Eighth Avenue in New York City. There are two yards -- Erie Yard and "A" Yard -- and each has six tracks.

Running maintenance and car cleaning are the predominant maintenance functions performed with the monthly inspections of MU's performed at Sunnyside Yard.

* * *

6.10 Raritan

Maintenance Capability

Minor Repairs

Servicing

Owned by N.J. DOT

Operated by Conrail

Personnel

1	General Foreman
7	Foremen
6	Machinists
4	Electricians
12	Car Inspectors
6	Car Cleaners
1	Pipe Fitter
2	Hostlers
5	Laborers
44	Total

The Raritan facility is located near New Jersey Route 202 and Route 567 and is manned with three shifts per day, seven days per week. It is basically a service and running repair maintenance point where 12 locomotives and 50 to 55 cars lay over week nights. These are dispatched for morning commuter service to Newark. The general foreman at Harrison is in charge of equipment service at Raritan.

Only minor repairs are performed at the Raritan facility while major work on locomotives and coaches is done at Elizabethport. A minor painting program has recently been initiated, and to date, three locomotives and five coaches have been completed.

The facility is reasonably well equipped. A one-track repair shop, built in early 1971, is approximately 334 feet long and is well utilized. Most minor repairs, emergency repairs, and painting are accomplished within this well constructed building. An inspection pit, electrically controlled roll-up doors, pneumatic air-jacks, lube oil dispenser, low pressure steam heat system, and a most satisfactory lighting system all combine to rate this shop as the best low volume maintenance building on the N.J. DOT commuter rail system.

Fueling and sanding capability is provided in the adjacent shop area to the west on the incoming track. Four 20,000 gallon fuel tanks, series connected, constitute the fuel storage. Fuel is supplied to the tanks by over-the-road fuel truck delivery. The sanding facility is of Impco design and operates satisfactorily.

A small train and engine crew register building is located in the Yard Area, and two historic railroad cars have been improvised to house the maintenance of equipment office and locker space.

The passenger yard is of sufficient size to accommodate the current nightly layover vehicles. The yard trackage is in fair condition and housekeeping in the entire area, including the shop, is good.

A recently built 750,000 gallon waste oil holding tank is located approximately 75 yards south of the maintenance shop and is operating satisfactorily. An oil-water separator is to be constructed to meet more stringent effluent discharge standards.

***

6.11 South Amboy

Maintenance Capability	Personnel
Monthly, 3 Month, 6 Month & 12 Month Testing	1 General Foreman
Servicing 20 E8 Locomotives	4 Foremen
Servicing and Minor Repair to GG-1 Locomotives	6 Machinists
Cleaning, Servicing, Daily and Monthly Inspection of 46 MU Arrow III Cars	7 Electricians
	3 Pipe Fitters
	2 Laborers
	1 Clerk
	24 Total

Owned by N.J. DOT

Operated by Conrail

Trackage to the north of South Amboy is electrified, while south to Bay Head all trains are conventional diesel-powered. Approximately 22 MU cars lay over in the South Amboy passenger yard and are cleaned, daily tested, and inspected, and dispatched northbound every weekday morning. Southbound New York to Bay Head trains drop GG-1 electric locomotives at South Amboy and pick up diesel electric units. Northbound trains from Bay Head to New York drop diesel power and pick up GG-1 electric locomotives.

A small two track diesel locomotive shop is located at South Amboy. Two units can be worked on at a time. The building is in fair condition but is in need of repair. It is heated with unit space heaters which appear adequate. Separate stores, locker, and office rooms are small and electrically heated. Both shop tracks have satisfactory inspection pits for servicing traction motor and running gear, but these pits are poorly lighted.

Outside fueling and sanding facilities are available at the west end of the diesel shop. Three fuel supply tanks have a total capacity of 28,000 gallons. The ground in the fueling station area is saturated with fuel and a potential fire hazard exists.

An antiquated sanding facility is located immediately west of the shop. The sand storage tower is ancient, vulnerable to rain water leakage, and is currently unserviceable.

* * *

6.12 Sunnyside, N.Y.

Maintenance Capability	Personnel
Running Maintenance & Turnaround Cleaning on MU Cars	8 Foremen
Monthly Inspections on MU Cars	12 Pipe Fitters
Owned by Amtrak	24 Car Inspectors
Operated by Amtrak	20 Car Repairmen
	33 Electricians
	3 Machinists
	2 Electrician's Helpers
	57 Coach Cleaners
	159 Total

The Sunnyside Maintenance Facility is located in the Long Island City - Sunnyside section of the Borough of Queens, New York City. Sunnyside is a main storage and maintenance facility for trains operating into Penn Station, New York. Both Amtrak and N.J. DOT equipment use this facility.

The N.J. DOT fleet consists of MU cars, locomotives and coaches operating into New York from the Northeast Corridor Line and from South Amboy on the North Jersey Coast Line. Total fleet consists of 103 MU's, 81 coaches and 13 GG-1 locomotives.

Maintenance on N.J. DOT rolling stock includes running maintenance, turnaround cleaning, and six (6) monthly inspections each day on MU cars. Two monthly inspections per day are done at South Amboy.

For the GG-1 locomotives, monthly inspections and major maintenance is carried out at the Wilmington, Delaware shops. Wheel truing is done at Philadelphia. Vehicles are moved to Trenton in service, then dead-headed to Philadelphia's 30th Street facility.

The facility includes a recently constructed inspection shed (METRO building) with raised track for six cars, one toilet dump truck, two 35 ton jacks and one drop table.

* * *

6.13 Trenton

Maintenance Capability	Personnel
Daily Inspection	1 Foreman
Minor Repairs	8 Car Inspections
Light Cleaning	8 Car Cleaners
Owned by Amtrak	17 Total
Operated by Amtrak/Conrail	

The Trenton passenger station is the southwestern terminus for approximately 16 Penn Station outbound N.J. DOT MU trains on the Northeast Corridor Line. Approximately 28 Arrow III MU cars lay over nightly at a location adjacent to and directly north of the passenger station. The two layover yard tracks run parallel to and are adjacent to the corridor mainline tracks.

Only daily inspection, light cleaning, minor repairs, and running maintenance of equipment are accomplished at Trenton.

One small dilapidated office and spare parts building is located adjacent to and south of the passenger yard storage tracks. It appears worthless but is kept locked to prevent pilferage of its few contents.

The two yard storage tracks are in relatively poor condition, and several sections of humped rail sections and low points can be observed.

***

7. TRIP INSPECTION AND TURNAROUND CLEANING FACILITIES ONLY

7.1 Gladstone

Maintenance Capability
Minor Repairs
Owned by N.J. DOT
Operated by Conrail

Personnel
2 Car Inspectors

Gladstone is the western terminus of the Gladstone Branch electric passenger trains. Other than several turnaround trains at this location, six old green DC MU trains lay over each night. One train is stored at the freight house and another at the runaround track on the south side of the station building. The remaining four trains are left on the only four tracks in the passenger yard, located approximately 350 yards east of the station. Two of the yard tracks border the main to the south and two border it to the north.

Two maintenance of equipment car inspectors are employed at the Gladstone facility. One man is on duty from 3:00 p.m. to 11:00 p.m. while the other car inspector works 11:00 p.m. to 7:00 a.m. These men perform only minor repairs to the equipment as necessary to assure on time performance and safe operation of the morning dispatched trains.

A small concrete maintenance of equipment building located at the west end of the yard is used for some oil and tool storage. The building is in poor condition, cluttered with debris, and of little utility.

Main trackage is in fair to good condition while yard tracks are poor.

***

7.2 Morristown

Maintenance Capability	Personnel
Minor Repairs	1 Electrician
Car Cleaning	1 Car Cleaner
Number of Work Shifts - 1	2 Total
Owned by N.J. DOT	
Operated by Conrail	

Approximately 40 cars lay overnight at the Morristown passenger yard which is located approximately one mile northwest of the station facility. The passenger station, situated at end of Elm Street, is of brick construction. It is old but in good condition, and well maintained.

Five stub end tracks are located in the passenger train storage yard. There are no buildings or facilities in the yard area. The yard is located in a remote, inconspicuous area and its only access is a narrow dirt road through a wooded area originating at the Cory Road underpass.

Although vandalism of equipment in the yard is not a reported problem, the yard's remote location and the absence of protective personnel during nighttime hours jeopardizes the safety of the layover vehicles.

No form of equipment maintenance appears justified at Morristown now or in the future.

* * *

7.3

Phillipsburg

Maintenance Capability
Turnaround Cleaning and minor repairs to locomotives and coaches.
Owned by N.J. DOT
Operated by Conrail

Personnel
1 Car Inspector

The Phillipsburg facility is located near Route 22 in Phillipsburg, New Jersey. It has two tracks for overnight storage. The fleet that lays over at this facility consists of two diesel locomotives and 14 coaches.

Maintenance of equipment consists of turnaround cleaning and minor repairs.

* * *

7.4 Spring Valley, N.Y.

Maintenance Capability	Personnel
Turnaround Cleaning of Coaches	1 Engine Foreman
Shut Down and Start-Up of Locomotives	1 Engine Preparer
Owned by N.J. DOT	1 Coach Cleaner
Operated by Conrail	1 Engine Preparer & Coach Cleaner
	4 Total

The Spring Valley passenger yard is located near Route 59, immediately north of Maple Avenue. The yard has three storage tracks and is entirely fenced around its perimeter. Five push-pull trains lay overnight at this facility. An electrical 440 volts AC standby system permits either cooling or heating of the train with their GE U34CH locomotive engines shut down. Water outlets are available adjacent to trackage at several locations.

A small maintenance of equipment building and automobile parking lot for Conrail train crew and maintenance personnel is located just inside the entrance gate on Maple Avenue. Only light maintenance, servicing, and cleaning is performed on vehicle equipment during the nighttime hours. (5 locomotives and 29 coaches).

The general condition of the building and yard trackage is considered only fair but sufficient for the purpose which these facilities serve.

***

7.5 ## Suffern, N.Y.

Maintenance Capability

Turnaround Cleaning of Coaches

Shut-Down and Start-Up of Locomotives

Owned by N.J. DOT

Operated by Conrail

Personnel

1	Engine Foreman
1	Engine Preparer
1	Coach Cleaner
3	Total

Suffern Yard is located near Route 59 in Suffern. The New York State Thruway (Interstate 287) passes over the south end of the yard which is approximately one-third mile from the passenger station. It is the nightly layover facility for six push-pull trains powered by GE U34CH locomotives.

Yard trackage to the south of and paralleling Route 59 consists of one north and one southbound main, one extension and five storage tracks. The storage track area has several 440 volts AC electrical outlets permitting the layover equipment to be either cooled or heated with locomotive engines shut down.

Only servicing, cleaning, and minor repairs to the locomotives and push-pull coaches are performed.

Three small buildings are located on the south side of the yard, just north of the tower. They are used for train crew lockers, toilet facility, and signal department and mechanical department material storage. All three buildings are in poor condition and unsuitable for usage.

The main track is in good condition and storage tracks are fair.

***

7.6 Summit

Maintenance Capability
Turnaround Cleaning and
Minor Repairs to MU Cars
Owned by N.J. DOT
Operated by Conrail

Personnel
1 Car Inspector

Summit is at the junction of the Morristown Line and Gladstone Branch. There are three tracks in the passenger yard; namely, the Hill, Wall and Interchange tracks located approximately 150 yards east of the station and bordering the main track on the south. Three electric MU trains lay over in the yard nightly. There are no maintenance of equipment buildings in the Summit yard. One car inspector is on duty weekday nights. His duties include inspection of the 26 vehicles laying over, and perform any light repairs necessary for morning train dispatchment.

No equipment protection is afforded at Summit over week-end periods. Although there have been no serious instances of equipment vandalism at this location, a great potential does exist, and safety is jeopardized during the week-end layover.

The passenger station situated at Union Place is an old two story brick building in fair condition but lacks good housekeeping. Trackage in the area is good on main tracks, but poor in the passenger yard.

***

7.7 Waldwick

Maintenance Capability	Personnel
Turnaround Cleaning of Coaches	1 Gang Foreman
Shut Down and Start-Up Of Locomotives	2 Coach Cleaners
	1 Engine Preparer
Minor Repairs	4 Total
Owned by N.J. DOT	
Operated by Conrail	

The Waldwick passenger facility is located in Waldwick, New Jersey. It consists of a small but well constructed and maintained passenger station and four main and six passenger yard storage tracks. The yard is situated approximately 3/4 miles north of the station. At the latter end of the yard is a 10' x 10' maintenance building which is in very poor condition. The building is used to store tools and supplies.

Other than several off-peak turnaround passenger trains during daylight hours, Waldwick dispatches four push-pull trains to Hoboken every weekday morning.

A 440 volts AC electric system is available in the yard for power to accommodate nightly layover of the four GE U34CH locomotives and approximately seventeen coaches. The electric standby boxes were found to be unlocked in this yard during midday and no railroad personnel were on duty at the time of inspection. All trackage in the yard is in comparatively poor condition. Tracks Nos. 2 and 4 have been allowed to deteriorate to a point where use by U34CH locomotives should be restricted.

***

8. OTHER FACILITIES

8. OTHER FACILITIES

In addition to those facilities performing maintenance and car storage functions, there are two other sites that do not currently service equipment owned by N.J. DOT.

8.1 Port Jervis, N.Y.

At Port Jervis, New York, overnight storage facilties are used by N.J. DOT-owned trains serving the Mainline and Bergen County Line. Although running maintenance is performed at this facility, all N.J. DOT-owned equipment is serviced at Hoboken.

8.2 Secaucus

At Secaucus, New Jersey, major repairs are made on Conrail-owned freight locomotives. Prior to commencement of Conrail operations, this facility serviced N.J. DOT-owned passenger equipment. However, this work is now performed at Conrail's Elizabethport facilites. N.J. DOT-owned parts are stored at Secaucus in one third of two 60 by 40 feet buildings. There are seven people employed in the parts storage section.

9. EQUIPMENT LAYOVERS

Exhibit I-10 summarizes rolling stock layovers at the various facilities. Detailed information of layovers at each facility is graphically depicted in Appendix B.

Facility	Layover Period	Locomotives Diesels	Locomotives Electric	Coaches	MU'S	RDC'S
Atlantic City	6 PM - 8 AM	-	-	-	-	6
Bay Head	6 PM - 8 AM	21	-	130	-	-
County Yard	6 PM - 8 AM	-	-	-	28	-
Dover	6 PM - 8 AM	7	-	33	64	-
Gladstone	4 PM - 8 AM	-	-	-	46	-
Harrison	8 AM - 7 PM	11	-	107	-	-
Hoboken	(8 PM - 7 AM)	-	-	-	28	-
	(8 AM - 7 PM)	22	-	132	126	-
Lindenwold	7 AM - 5 PM	-	-	-	-	3
Morristown	6 PM - 8 AM	-	-	-	40	-
Phillipsburg	7 PM - 7 AM	2	-	15	-	-
Raritan	7 PM - 7 AM	12	-	50	-	-
South Amboy	5 PM - 8 AM	2	13	-	22	-
Spring Valley	6 PM - 8 AM	5	-	29	-	-
Suffern, N.Y.	7 PM - 8 AM	6	-	39	-	-
Summit	6 PM - 8 AM	-	-	-	26	-
Trenton	6 PM - 8 AM	-	-	-	28	-
Waldwick	7 PM - 7 AM	4	-	17	-	-

10. CURRENT EQUIPMENT MOVEMENTS FOR MAINTENANCE

Due to inadequate facilities at Hoboken, limited facilities at South Amboy and Raritan, and no facilities at other N.J. DOT terminating/originating terminals, most of the N.J. DOT passenger diesel locomotive units are moved to Conrail's Elizabethport (E'port) shops for monthly inspections and/or repairs. South Amboy performs monthly inspections on the EMD E8 locomotives, but the bi-annual inspections and/or repairs require that the units be sent to E'port. Occassionally, when the monthly inspection due date of a Raritan unit is over-due, the required inspection will be performed at the Raritan facility. Recently, the manpower assignment at Raritan was increased, permitting the performance of additional MI's. The GG-1 electric locomotive units (which operate between New York and South Amboy) receive monthly inspections and repairs at the Amtrak facility in Wilmington, Delaware.

This section will present the movement of equipment from the various terminals, the route used, the out-of service time, and the estimated annual operating costs incurred.

Two terms will be used in this discussion, and in order to eliminate confusion, are defined as follows:

- Deadhead Move - the moving of a train from one location to another (exclusive of movements within a yard) by a crew for other than revenue service.

- o Light Engine Move - also a deadhead move, but <u>only</u> the locomotive makes the trip.

In general, diesel locomotive units are moved to E'port as a light move. If a coach(s) requires attention, it is dispatched with the locomotive unit, as a drill train.

10.1 Hoboken to E'port

There are thirty-two (32) GE U34CH passenger locomotive units assigned to the Hoboken service.

- o Two (2) moves per day-- one to E'port and one from E'port each day.
- o A two (2) man crew, five (5) days per week is required.
- o The route from Hoboken to E'port is as follows:
  - Hoboken to Croxton Yard.
  - Croxton Yard to Marion Junction.
  - Move on the branch to Waverly #5 freight yard.
  - Waverly to E'port.
- o Minimum elapsed time for this light move is eight (8) hours. Frequently, delays occur due to freight train moves, and the crews are relieved due to the hours of service law (12 hours). It should be noted that a deadhead passenger diesel

locomotive has a lower priority than a freight train, and hence, must wait.

- o The estimated annual operating cost for light engine moves -- Hoboken to E'port -- is approximately $100,000. This includes crew costs, fringes, fuel, reasonable wear and tear, and contingencies such as overtime.
- o Minimum out of service time is three days.

10.2 South Amboy to E'port

There are twenty (20) EMD E8 passenger locomotive assigned to South Amboy.

- o An average of two (2) light moves per week which originate at E'port are made, and two return moves.
- o The route from E'port to South Amboy is via the Perth Amboy Branch.
- o The minimum out-of-service time is approximately five (5) days.
- o The estimated annual operating cost for these moves is $32,000.00.

10.3 Raritan to E'port

There are thirteen (13) EMD GP 40, and eight (8) EMD GP 7 passenger locomotives assigned here. Prior to August, 1979, Raritan handled only emergency MI's. Since then, seven (7) new journeyman positions have been transferred from E'port to Raritan, which now handles some monthly inspections.

- An average of two (2) light moves per week are made.
- The route from Raritan is via Cranford Junction and onto the Bayonne Branch to E'port.
- The minimum out-of-service time per unit is approximately five (5) days.
- The estimated annual operating cost for the light engine moves is $36,500.00

10.4 New York to Wilmington

There are thirteen (13) GG-1 electric locomotives which are shopped at Wilmington, Delaware. When MI's and/or repairs are needed, the GG-1 units are assigned to haul revenue train #219 to Philadelphia. From Race Street in Philadelphia, the unit is involved in a shop train move to Wilmington. On returning the unit to N.J. DOT service, the above move is performed in reverse.

10.5 Summary

N.J. DOT is incurring approximately $170,000 annually, in deadhead move costs. In addition, the location of E'port, coupled with the out-of-service time necessary to reach this facility, requires N.J. DOT to have additional reserve locomotives to meet scheduled train consists.

CHAPTER II

PROJECTED RAIL SERVICES AND EQUIPMENT NEEDS

CHAPTER II

PROJECTED RAIL SERVICES AND EQUIPMENT NEEDS

1. N.J. DOT STUDY - TASK TWO

The projections contained herein were extracted from a draft of a report prepared by the Bureau of Common Carrier Planning and the Bureau of Rail Equipment of the New Jersey Department of Transportation entitled "New Jersey Rail Equipment Maintenance Facility Study - Task Two - Projected Services and Associated Equipment Needs " dated March, 1978. The complete report is contained in Appendix C.

2. NORTHERN NEW JERSEY COMMUTER RAIL NETWORK 1979 - 2000

Exhibit II-1 illustrates Northern New Jersey's Commuter Rail Network as it presently exists. Exhibits II-2 and II-3 show the projected network for the years 1985 and 2000 respectively.

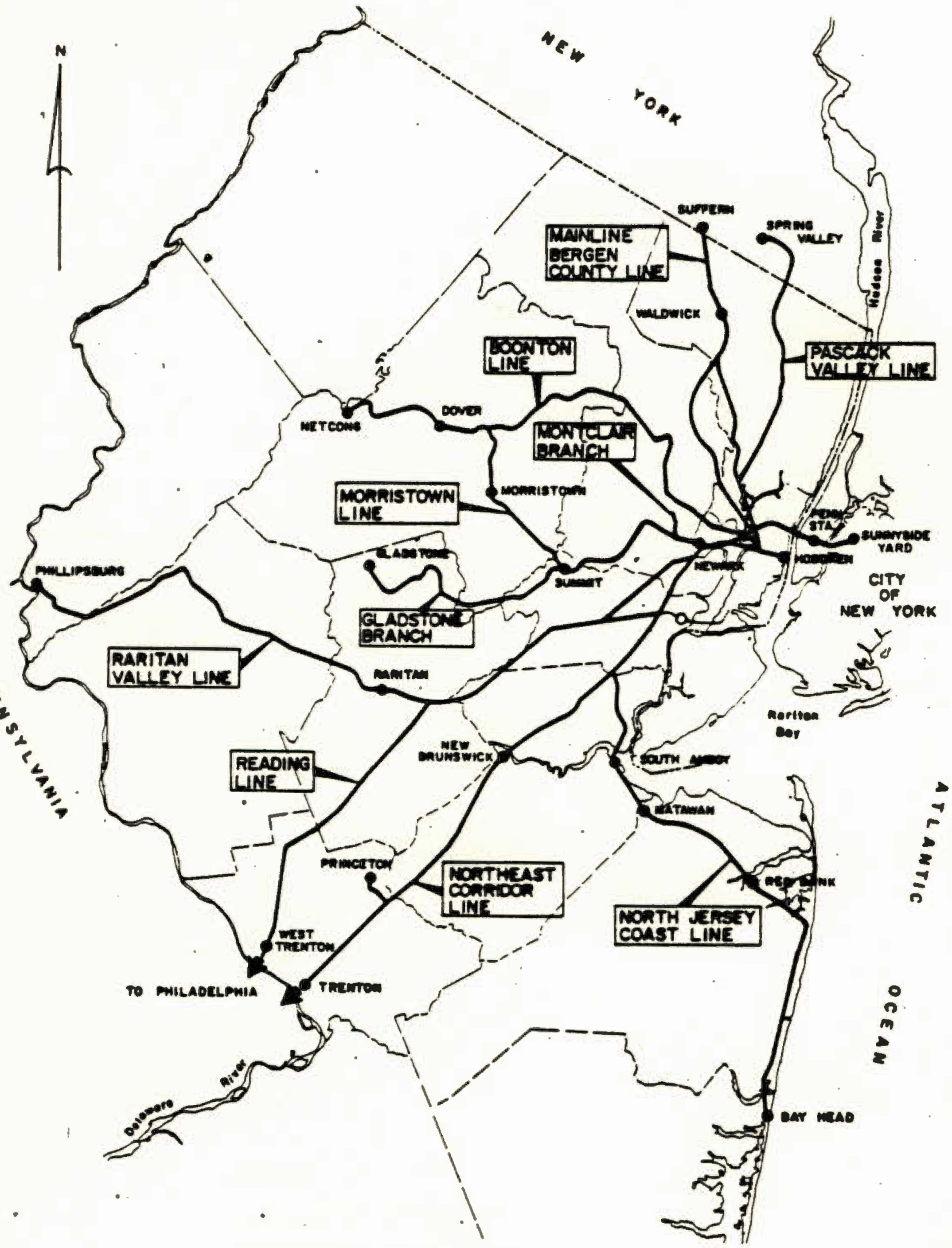
2.1 Mainline, Bergen County, Pascack Valley and Boonton (MBPB) Lines

The MBPB lines received a major equipment refurbishment by N.J. DOT between 1971 and 1974. As indicated in Chapter I, 32 new diesel locomotives and 150 new passenger cars were purchased during that period.

Ridership has remained high -- to the point where in 1977, all these passenger cars were used daily without any operational spares. Moreover, population is expected to increase appreciably particularly along the Boonton Line Corridor.

NORTHERN NEW JERSEY
COMMUTER RAIL NETWORK
1979

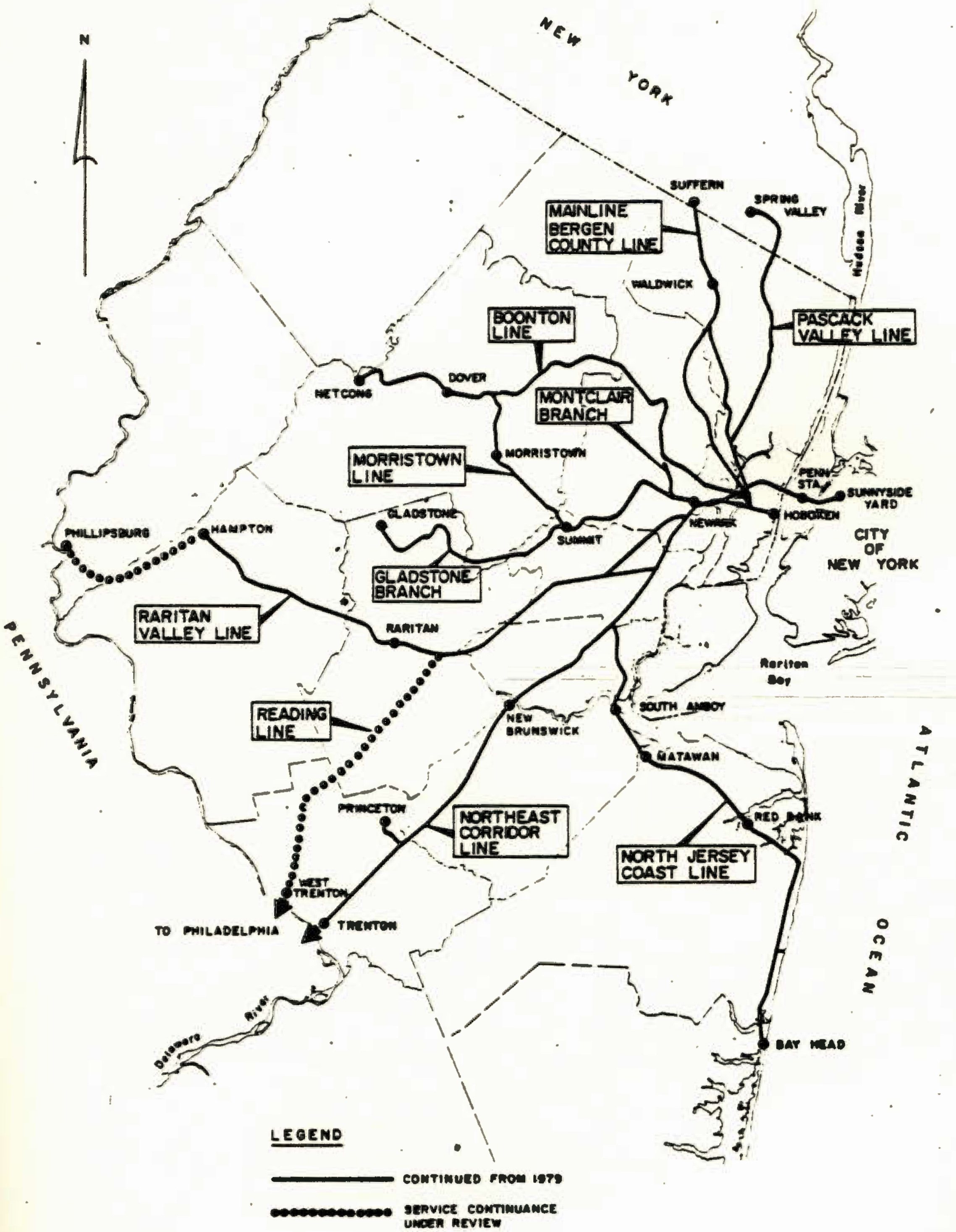
EXHIBIT II - I



TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES
Seelye Stevenson Value & Knecht
Engineers and Planners
SSV&K

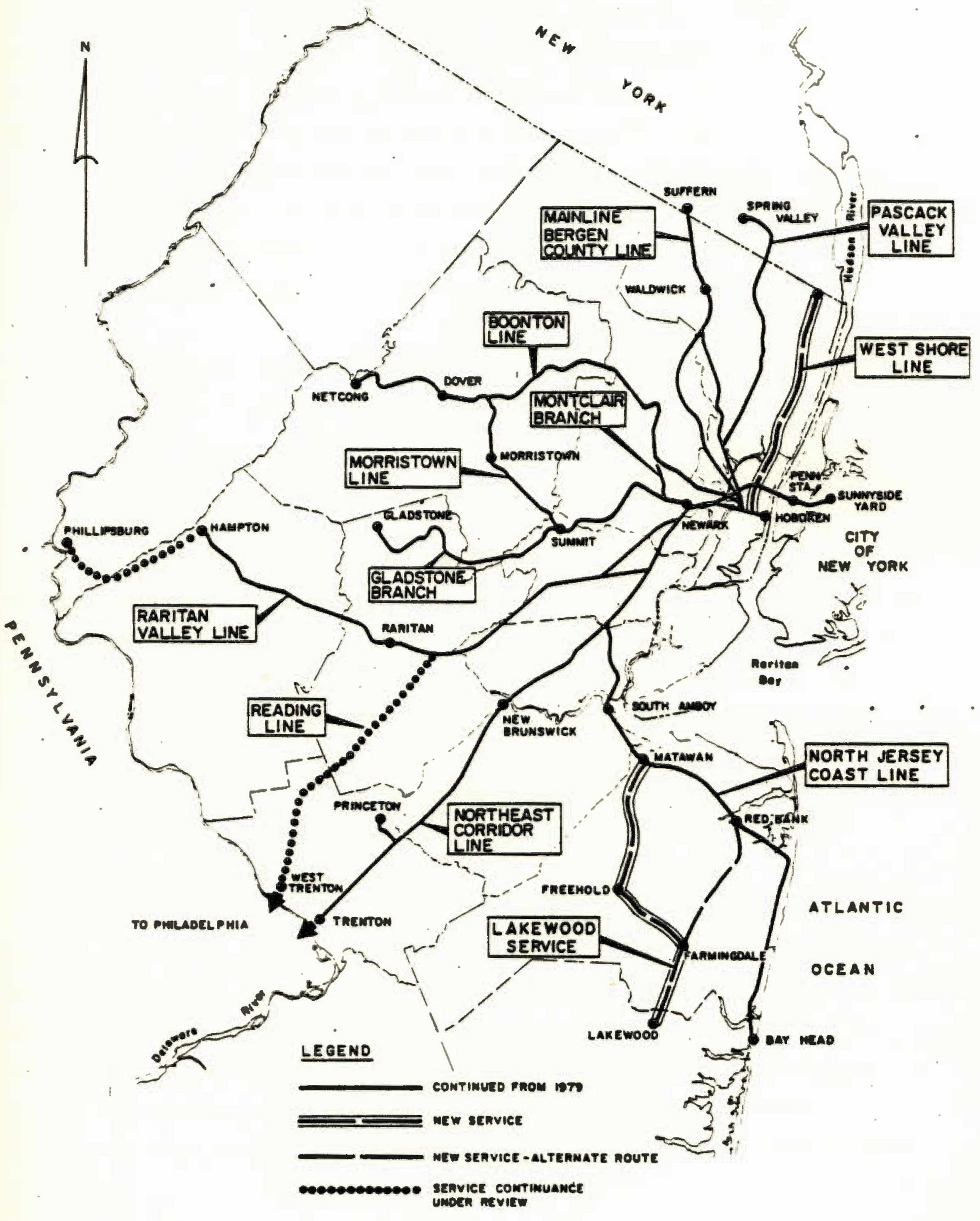
NORTHERN NEW JERSEY
COMMUTER RAIL NETWORK
1985

EXHIBIT II-2



NORTHERN NEW JERSEY
COMMUTER RAIL NETWORK
2000

EXHIBIT II-3



A N.J. DOT study is presently underway which will develop a low-cost short range improvement plan for all Hoboken Division diesel services except the Boonton Line. It is assumed however, that: 1) normal replacement and refurbishing of rolling stock will be made on these lines as the service life of existing equipment expires; 2) the fleet will be expanded as the patronage increases beyond the capabilities of the present fleet; 3) minor station and track improvements will be made; and 4) direct rail access to Manhattan will be unavailable.

The purchase of four coaches for push-pull service on the Pasack Valley Line is scheduled for 1982.

2.2 Morristown, Gladstone and Montclair (MGM) Lines

The Morristown, Gladstone and Montclair lines will be rehabilitated and converted from 3 kilovolts direct current to 25 kilovolts alternating current by 1982. As noted in Chapter I, 228 old MU cars will be retired and will be replaced with 180 new Arrow III MU cars by 1982.

Accompanying the purchase of new equipment will be complete conversion of the electrified lines to commercially available current.

Related to the foregoing is the Direct Rail Access Project (DRAP) Study. The DRAP Study is under review. Phase I of DRAP will establish a rail connection between the electrified Morristown Line and the Northeast Corridor Line, at Kearny, to permit direct operation to Penn Station, New York, of trains on the electrified MGM Lines.

2.3 Raritan Valley Line

In 1977, N.J. DOT and the Port Authority of New York and New Jersey (PANYNJ) participated in a federally funded study to examine public transportation alternatives west of Plainfield, N.J., in anticipation that PATH rapid transit service would be extended from its present terminus at Newark, N.J. to Plainfield. The study suggested that commuter rail service on the Raritan Valley Line should only be provided between Raritan and Plainfield, provided PATH is extended to Plainfield.

Subsequent to the study's completion, PANYNJ experienced certain legal complications regarding the financing of the PATH project. The proposed PATH extension has recently been offically dropped and has been replaced with the Raritan Valley Upgrade Project which is included as part of the Transpac Program. This project provides for the acquisition of ten diesel locomotives and 57 push-pull coaches by 1982. The equipment will replace all equipment currently in use on the line. The 10 Pullman-Standard 270 coaches will be put into NJCL service.

Ridership on the Raritan Valley service is expected to increase as the population of the area served increases. However, because of the low volume of ridership from Warren County, service continuation to Phillipsburg, for the long term, will be under review. If such service were to be terminated, Hampton would become the western terminus of the Raritan Valley operations again.

2.4 Northeast Corridor (NEC) Line

As Chapter I indicated, between 1966 and 1974, the State of New Jersey purchased a total of 103 MU cars which are still in use on the Northeast Corridor and South Amboy Branch. These cars have been complemented by a portion of the new Arrow III fleet on a temporary basis. The Arrow III MU cars will be transferred to the Morristown, Gladstone, Montclair, and North Jersey Coast Lines when their electrification/re-electrification projects are completed.

Ridership is expected to continue increasing along the Northeast Corridor in the future. Normal replacement/refurbishing of existing rolling stock will be made as the service life expires and/or patronage increases beyond the capabilities and capacities of the existing MU fleet.

2.5 Princeton Branch

The Princeton branch currently uses two Arrow I MU cars (one in service, one spare) to shuttle passengers between Princeton and the Amtrak NEC Mainline at Princeton Junction. In order to ensure continuation of passenger service, the entire line was purchased by the State of New Jersey in 1976. However, long term operating subsidies for this service by N.J. DOT will be under review.

2.6 North Jersey Coast Line (NJCL)

The North Jersey Coast Line has been allocated funds for a major improvement. Electrification will be extended from its present terminus at South Amboy to Matawan with electrification to the Red Bank/Long Branch area under review.

Diesel service from Bay Head will be continued, and diesel trains will continue to stop at selected stations in the electrified territory. It is assumed that New York-bound diesel-hauled consists will continue to change to electric locomotives at the southern terminus of the electrification.

As Chapter I indicated, 50 new Arrow III cars have been purchased for eventual use between Penn Station, N.Y. and the southern extension of the electrified territory.

In addition, 9 diesel locomotives and 10 electric locomotives are scheduled to be purchased in 1982. Rehabilitation of 117 coaches, including 10 presently in service on the Raritan Valley Line, is scheduled for the 1980's.

2.7 Reading Line

With the expiration of UMTA Section 17 funding, which is provided through the Southeastern Pennsylvania Transportation Authority (SEPTA), continuance of service from Philadelphia to Newark on the Reading line will be under review. Since the RDC's assigned to this service are owned by SEPTA, no equipment would be reallocated to other New Jersey services in the event of termination of this service.

2.8 Proposed New Service - West Shore Line

N.J. DOT is currently participating in an UMTA funded study being conducted to determine the feasibility of reinstating passenger service along the former Penn Central West Shore

Line in eastern Bergen County. Several major problems would have to be resolved regarding coordination of existing freight service with the proposed passenger service. If sufficient diesel rolling stock could be transferred from other rail services, this service could be implemented by 1990. It is likely that minimal diesel service designed for commuters could probably be implemented at the outset.

2.9 Proposed New Service - Lakewood

N.J. DOT is currently studying the feasibility of instituting passenger service to Lakewood in Ocean County.

N.J. DOT is evaluating two route alternatives as an addition to existing service on the North Jersey Coast Line. One route would originate in Lakewood on the Southern Division Main Line (M-L) and pass through Red Bank on the North Jersey Coast Line. The other route would follow the Southern Division M-L to Farmingdale, then utilize the Freehold Secondary track to Freehold and the Freehold Branch through Matawan to the North Jersey Coast Line. Service would extend to Newark and New York City via the North Jersey Coast Line.

The State of New Jersey has already purchased a portion of the Freehold Secondary Track and the entire Freehold Branch to ensure that passenger service can be implemented -- provided it is considered feasible.

Should this project prove feasible and receive funds for implementation, major rehabilitation of trackage, purchases of new rolling stock, and construction of stations and facilities will be required.

It is possible that this new service could be introduced between 1990 and 2000.

3. SEASHORE LINES COMMUTER RAIL NETWORK 1979 - 2000

Exhibit II-4 illustrates the Seashore Lines Commuter Rail Network as it presently exists. Exhibit II-5 shows the projected network for the years 1985 to 2000.

3.1 Atlantic City Line

If federal funds can be obtained subsequent to expiration of UMTA Section 17 funding, RDC service would probably continue. Ridership will have to increase significantly and a minimum of capital investment expended to justify extending service beyond 1985. The effect, if any, of casino gambling on mass transit facilities has yet to be determined.

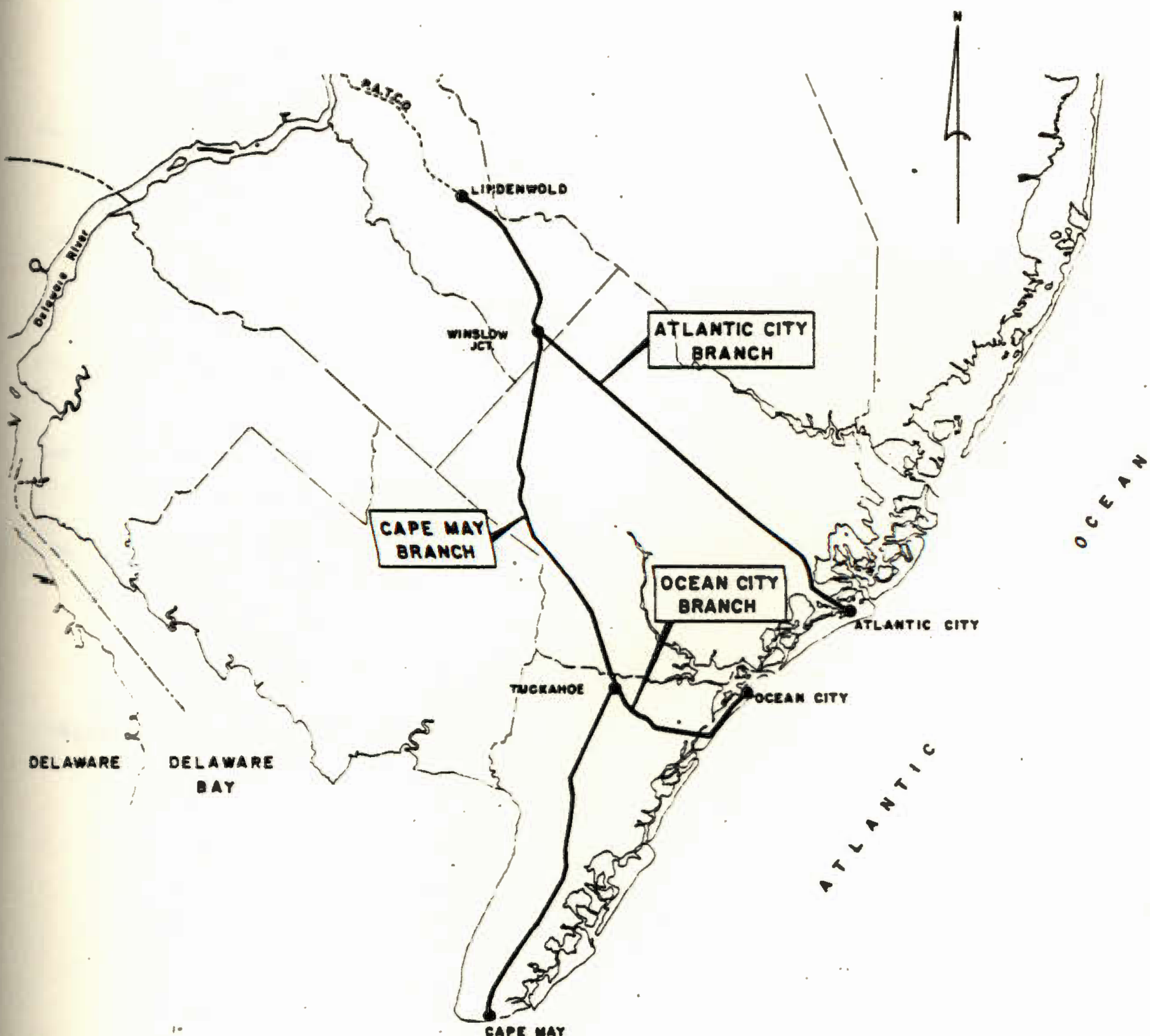
Future service is assumed herein to increase to eight round trips per weekday with three daily round trips on weekends, comparable to the System II service proposed in a Study conducted by the Delaware Valley Regional Planning Commission.

3.2 Cape May Line, Ocean City Branch

With the coming expiration of UMTA Section 17 funding, this service continuance is under review. Ridership is comparatively low and is steadily decreasing. Major capital investments and increased service would be required to attract ridership sufficient to approach the break even point. Should this service terminate, its RDC's could be reallocated to the Atlantic City service.

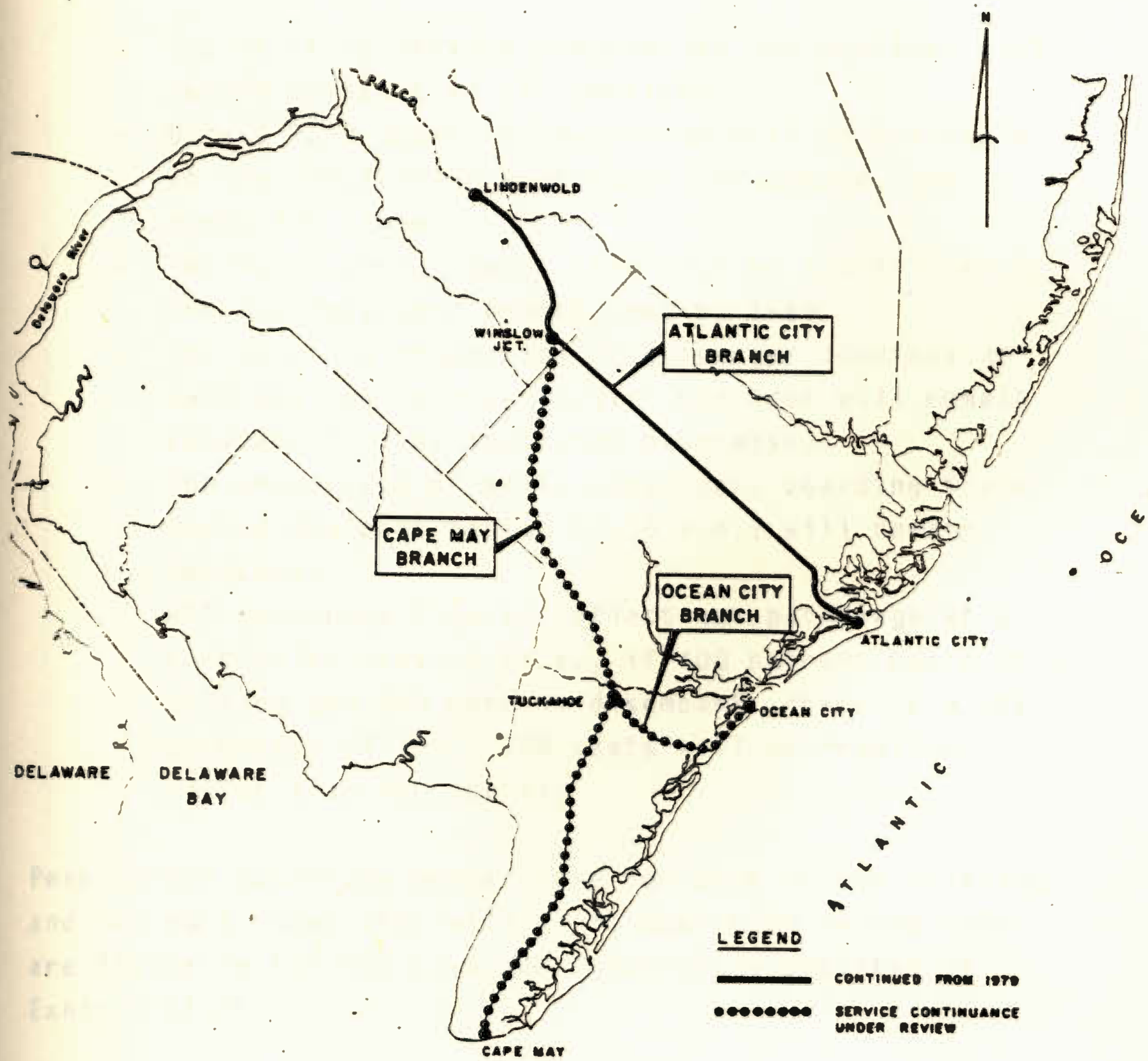
COMMUTER RAIL NETWORK
SEASHORE LINES
1979

EXHIBIT II - 4



COMMUTER RAIL NETWORK
SEASHORE LINES
1985-2000

EXHIBIT II-5



PEAK PERIOD PATRONAGE PROJECTIONS

The following assumptions were made concerning the service characteristics on each line. These assumptions are reflected in the patronage estimates.

- o The existing service frequencies and routings will remain constant on all services.
- o Direct rail access to Manhattan will be available to the electrified Morristown, Gladstone, and Montclair Lines.
- o The North Jersey Coast Line will be electrified to the Red Bank/Long Branch area by 1985.
- o The existing proportion of passenger loadings at each station in a particular corridor will remain constant (unless indicated otherwise).
- o The proportion of daily passengers boarding trains during the peak period (7-10 a.m.) will remain constant.
- o All patronage figures reflect net patronage at a particular station (i.e., if 400 patrons board at a station and 300 patrons disembark, there is a net patronage of 100. 100 seats will be required, rather than 400 seats).

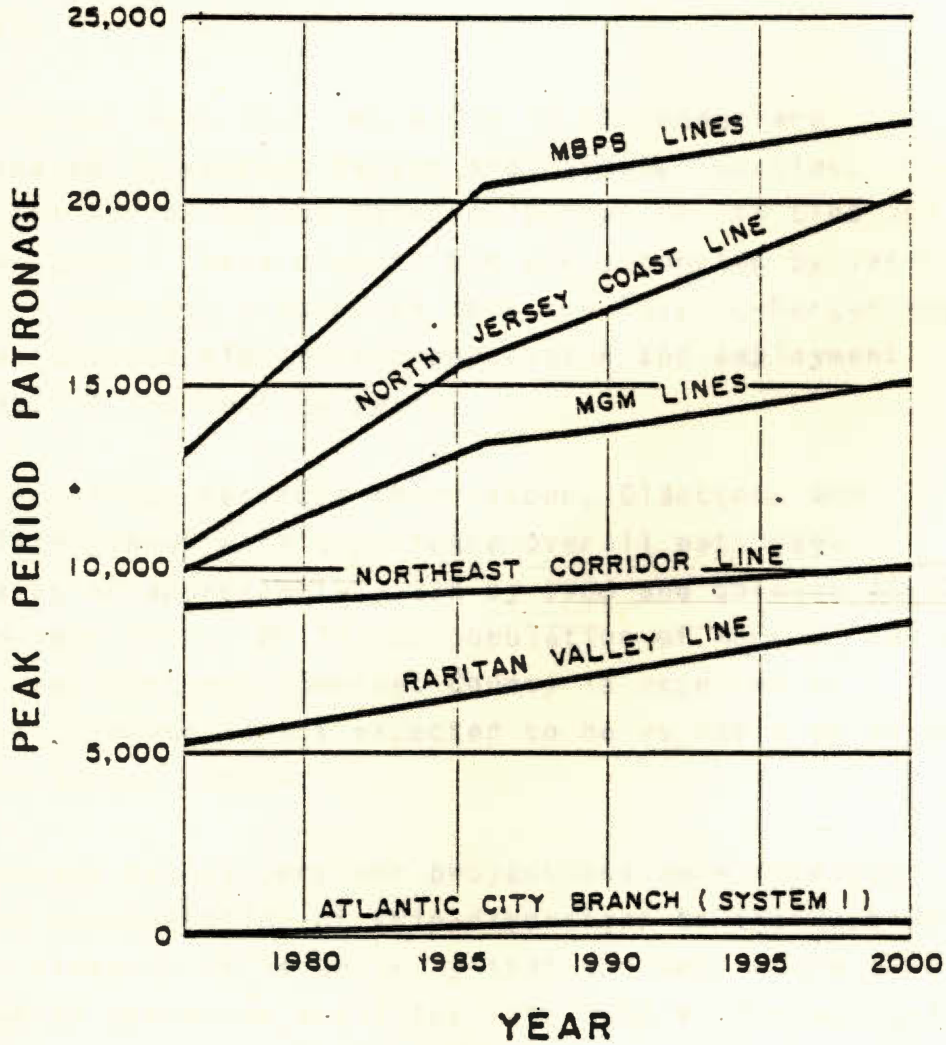
Peak period patronage projections for each of the existing and new rail lines that will be in operation beyond 1980 are listed in Exhibit II-6 and graphically depicted in Exhibit II-7.

.1 MBPB and Morristown, Gladstone and Montclair Lines

Projections were developed for 1980 and 1986 using

	1976	1980	1985*	1990	2000
MBPB Lines					
Mainline - Bergen Co. Line	7,177	8,626	10,800	11,053	11,686
Pascack Valley Line	2,872	3,323	4,000	4,094	4,330
Boonton Line	2,986	4,030	5,600	5,731	6,059
Sub-Totals	13,035	15,979	20,400	20,878	22,075
MGM Lines					
Morristown Line	7,554	8,572	10,098	10,459	11,360
Gladstone Line	2,233	2,533	2,983	3,093	3,356
Montclair Line	317	358	419	434	471
Sub-Totals	10,104	11,463	13,500	13,986	15,187
Raritan Valley Line	5,265	5,820	6,514	7,201	8,574
Northeast Corridor Line	8,952	9,146	9,390	9,630	10,114
North Jersey Coast Line	10,660	12,802	15,481	17,062	20,224
Seashore Lines (System 1)	119	220	346	378	397
Sub-Totals	24,996	27,988	31,731	34,271	39,309
GRAND TOTALS	48,135	55,430	65,631	69,135	76,571

* For MBPB and MGM Lines, actual projection year is 1986.


25,000
20,000
15,000
10,000
5,000
0
PEAK PERIOD PATRONAGE
MBPS LINES
NORTH JERSEY COAST LINE
MGM LINES
NORTHEAST CORRIDOR LINE
RARITAN VALLEY LINE
ATLANTIC CITY BRANCH (SYSTEM I)
1980
1985
1990
1995
2000
YEAR

patronage estimates completed by the Port Authority of New York and New Jersey (PANYNJ) in 1977.

1990 and 2000 patronage was derived from population estimates developed by the Bureau of Common Carrier Planning, based on population and work force projections made by the Tri-State Regional Planning Commission (TSRPC).

The greatest numerical increases in patronage are anticipated in western Bergen and Passaic Counties. These areas are served by the Mainline/Bergen County Line and Boonton Line. These projections are supported by various planning reports, predicting that the Passaic-Bergen region will experience significant population and employment increase in the next 20 years.

The electrified services (Morristown, Gladstone and Montclair Lines) will experience overall patronage increases of approximately 33% by 1986 and between 48-51% by the year 2000. While the population of Morris, western Essex, and northern Somerset County is expected to increase, growth is not expected to be as rapid as in the Passaic-Bergen region.

The Pascack Valley corridor projections were developed without consideration of trip diversions to the West Shore Line. Although it is unlikely that the West Shore service will be in operation until the late 1980's, Pascack Valley ridership may eventually be affected by reinstitution of West Shore service.

4.2 Raritan Valley Line

Raritan Valley Line projections were developed for 1980, 1985, 1990,and 2000, using selected population, employment and travel projections developed by Tri-State Regional Planning Commission (TSRPC).

4.3 Northeast Corridor (NEC) Line

Northeast Corridor patronage projections were developed for 1980, 1985, 1990, and 2000, using selected population, employment,and travel projections developed by TSRPC. Comparable trends were used to project patronage for that portion of the Corridor located in the Tri-State region.

Tri-State projections indicate that the population in the Northeast Corridor is expected to increase by 37% from 1970-2000. This figure correlates with the projected increase in eastbound transit trips of 36%.

4.4 North Jersey Coast Line (NJCL)

North Jersey Coast patronage projections for 1985 were obtained from a report prepared by Edwards and Kelcey, Inc. and Wyer Dick and Co. in 1977. Projections were developed for 1990 and 2000 using Tri-State Regional Planning Commission (TSRPC) report data.

Recent ridership trends on the North Jersey Coast Line indicate that patronage has been decreasing since 1970. Electrification, station improvements, and the purchase of new MU cars is expected to reverse this downward trend. Ridership in the year 2000 is expected to be 77.0% higher than 1970 ridership and 89.7% higher than the 1976 figure.

4.5 Seashore Lines

It is not yet apparent whether the Seashore Lines service will remain oriented toward westbound commuting. Neither N.J. DOT nor Atlantic City has developed any estimate of future eastbound rail ridership or modal splits which would be generated by casino-oriented travel.

N.J. DOT and Atlantic County officials are currently studying cost-effective methods to improve the rail terminal in Atlantic City to attract more ridership. However, N.J. DOT has predicted that at least for the short term, rail service from Atlantic City will remain commuter-oriented. Eastbound travelers to Atlantic City are expected to rely primarily on automobiles, express buses and air transportation.

The current schedules on the Seashore Lines make it very difficult for travelers from the greater Philadelphia region to commute to Atlantic City on a regular basis. Weekend service is not provided during the winter.

It is doubtful that this service will be continued beyond 1985 unless ridership increases appreciably.

The 1985 patronage projections used in this report were developed by the Delaware Valley Regional Planning Commission (DVRPC). These projections do not consider the effects, if any, of casino gambling. The 1990 and 2000 ridership was projected using population estimates developed by the Bureau of Common Carrier Planning.

The patronage estimates contained in Exhibit II-7 assume that the existing service frequency (three (3) weekday round trips, no weekend service) will remain in effect (System 1). If eight (8) weekday round trips and four (4) weekend round trips were to be provided, (System 2) peak patronage projections would only be expected to increase as follows assuming casino gambling has no effect on service:

	1980	1985	1990	2000
Additional Net Eastbound Patronage - System 2	+ 44	+ 98	+107	+113

These patronage estimates should be reviewed and revised as necessary after the effects, if any, of casino gambling on passenger rail service are actually observed.

5. PROJECTED ROLLING STOCK REQUIREMENTS

Chapter I presented a description of New Jersey's passenger rail fleet as it exists. This inventory was used to determine which portions of the passenger fleet can be expected to continue operating in the 1980-2000 period.

Rehabilitation and replacement schedules were developed based on the remaining service life of this equipment and on current N.J. DOT rehabilitiation and replacement plans as outlined in Chapter I, and earlier in this chapter.

A summary of projected fleet requirements for rolling stock is given in Exhibit II-8. Detailed requirements for each line are given in Appendix D.

PROJECTED FLEET REQUIREMENTS 1980 - 2000

EXHIBIT II - 8

LOCOMOTIVES

Service	1980			1985			1990			2000		
	Diesel	Electric	Dual Mode	Diesel	Electric	Dual Mode	Diesel	Electric	Dual Mode	Diesel	Electric	Dual Mode
MBPB Lines	32	-	-	32	-	-	34	-	-	40	-	
Raritan Valley Line	13	-	-	13	-	-	13	-	-	13	-	-
North Jersey Coast Line	28	13	-	15	-	12	15	-	12	19	-	12
N.J. Coast - Lakewood Line	-	-	-	-	-	-	-	-	-	-	-	10
Totals	73	13	-	60	-	12	62	-	12	72	-	22

COACHES

Service	1980			1985			1990			2000		
	Diesel Coach	MU	RDC	Diesel Coach	MU	RDC	Diesel Coach	MU	RDC	Diesel Coach	MU	RDC
MBPB Lines	158	-	-	194	-	-	197	-	-	208	-	-
MGM Lines	-	180	-	-	180	-	-	180	-	-	180	-
Raritan Valley Lines	68	-	10	53	-	10	59	-	-	66	-	-
Northeast Corridor Line	-	87	-	-	90	-	-	92	-	-	96	-
North Jersey Coast Line	117	72	-	105	86	-	113	97	-	139	109	-
Seashore Lines	-	-	10	-	-	10	-	-	10	-	-	10
West Shore	-	-	-	-	-	-	-	-	10	-	-	10
NJ Coast Lakewood Line	-	-	-	-	-	-	-	-	-	60	-	-
Totals	343	339	20	352	356	20	369	369	20	473	385	20

SOURCE: Task Two, Table 21 -- Projected Services and Associated Equipment Needs

6. EQUIPMENT FLEXIBILITY

By 1985, all equipment on the electrified commuter rail lines will be fully interchangeable. The North Jersey Coast Line, Northeast Corridor Line, and Morristown, Gladstone, and Montclair Lines will all use 25Kv 60 HZ electric power.

N.J. DOT will have completed the rehabilitation of Arrow I and Arrow II MU cars. Thus, MU cars can be reallocated on a temporary basis to lines experiencing unanticipated high patronage.

By the year 2000, additional Arrow III MU's will be needed for New Jersey service. Since the equipment will be needed on lines having fully interchangeable MU cars, it is logical to purchase equipment that can easily be added to the existing fleet.

On the other hand, N.J. DOT has recently had difficulty purchasing MU cars in smaller "lots". The sole remaining domestic MU car manufacturer is reluctant to bid for contracts requiring construction of less than 100 units; this reluctance is not shared by foreign MU car manufacturers, notably Canadian, Italian and Japanese firms, who have secured several smaller lot orders from U.S. purchasers in recent years. Thus, depending upon the nature of any "Buy America" legislation in effect at the time of purchase, N.J. DOT may have to resort to non-domestic supply in order to fulfill its future MU car requirements.

As a second choice, it may become necessary for N.J. DOT to purchase electric locomotives and push-pull coaches, if MU cars are unavailable. Existing diesel coaches would then be useable on electrified lines.

The Pullman-Standard Series 1500, 1600, and 1700 push-pull coaches, or equivalent, are recommended by the Bureau of Rail Equipment for use on all diesel services in the future. The cars can easily be added to the current MBPB diesel fleet and can be reallocated to electrified services if electric locomotives are purchased.
At the outset, some difficulty may be experienced in interchanging these cars on lines other than the MBPB lines. The majority of the obsolete coaches currently used on the North Jersey Coast Line and Raritan Valley Line are steam heated, whereas the Pullman-Standard coaches use electric heat. This means that train consists must use either all Pullman coaches or all obsolete coaches. As the older coaches are gradually phased out, this problem will be minimized.

The rail diesel cars (RDC's) currently used on the Seashore Lines theoretically can be used on both diesel and electric lines, (although they are diesel powered). They can be reallocated to any service in the State on a temporary basis. However, RDC's cannot be used for direct service into Manhattan because units powered by internal combustion are not permitted in the North River tunnel. For commuting purposes, their use should be limited to the Raritan Valley Line; MBPB lines; the West Shore service (if initiated); the Seashore Lines; and for eastbound trips on other lines that do not terminate in Manhattan.

RDC's of the type currently used on the Seashore Lines are no longer manufactured in this country. A substantial market does exist for remanufactured units. It should be noted that the Budd Company has recently introduced the SPV-2000, a self-propelled diesel MU car based on the Amfleet cars used by Amtrak in intercity service. Thirteen SPV-2000's have been delivered to the Connecticut Department of Transportation for Amtrak and New Haven Line service and ten more have been ordered by the New York State Metropolitan Transportation Authority for use on its Harlem and Hudson Lines. The SPV-2000 is being promoted as the present-day equivalent of the RDC. As such, it is being considered as an equipment alternative by the N.J. DOT.

7. SUMMARY

It must be understood that requirements change as technology advances, and operations, through subsequent planning, alter equipment needs in the future projections. However, recommended maintenance facilities will be applicable for the present, and for revised planning of projected equipment needs in the future.

CHAPTER III
MAINTENANCE REQUIREMENTS

CHAPTER III
MAINTENANCE REQUIREMENTS

1. INTRODUCTION

1.1 General

A maintenance program for commuter rail equipment includes the periodic testing, repair, and replacement of components of rolling stock as required to keep the equipment in its assigned service at maximum utilization, throughout its service life. Planned preventive maintenance is necessary to assure the reliability of the equipment and to minimize maintenance costs. Inspections must be performed on a regular basis to insure that the vehicles remain in safe and reliable operating condition. Inspection of a unit is made each time it is assigned for dispatchment, and at the time of scheduled periodic maintenance.

The numerous individual parts and major components of a rail vehicle have lives of varying length. Components may be replaced when experience suggests replacement, in accordance with replacement cycles recommended by the manufacturer, or when they fail. Simultaneous replacement of several major components and heavy repairs should be performed on a scheduled basis.

Locomotives, cab control coaches, and multiple operated electric units (MU's) are legally required to be periodically inspected and maintained under the regulations of the Federal Railroad Administration (FRA). For certain specified items, minimum inspection and maintenance frequencies are stipulated. Other mandated servicing is specified to be performed on an "as required" basis.

The function of the FRA regulations regarding inspection, maintenance, and servicing of equipment is to insure the safety of the public. To insure reliability and equipment availability to meet scheduled service needs, a preventive maintenance program is recommended. A high degree of system reliability can be economically achieved, in the long term, by means of a comprehensive program of preventive and systematic demand maintenance.

Therefore, all recommendations and concepts of this report are based on employing the philosophy of thorough surveillance and checking of all N.J. DOT rolling stock vehicles and their components at designated terminals in accordance with "Preventive Maintenance" and "Systematic Demand Maintenance" programs. The long term goal is high reliability and availability of all N.J. DOT rolling stock through minimal line-of-road or service failures and minimum out-of-service time.

1.2 Preventive Maintenance

Preventive maintenance is the development of service limits based on time, and in some cases on mileage, whichever comes first, to determine at what point a component or part requires a changeout for a new or rebuilt component or part. A practical, cost-controlled but effective preventive maintenance program is easily justified by service reliability.

1.3 Systematic Demand Maintenance

Systematic demand maintenance is controlled by stated and periodic inspections where remaining wear or life limits are determined by gauges (i.e., feeler, Go or No-Go, snap-on, etc.); electric and/or ultrasonic type diagnostic equipment, etc., to determine the components or parts requiring a corrective repair or replacement. Demand maintenance by visual inspection plays an important part in the design configuration of inspection pits, depressed floors, platforms, lighting, etc., of a service and inspection (S&I) shop. Since stated and periodic inspections require varied and experienced judgments by visual inspections to ascertain whether the component or part would have sufficient residual wear-life or capacity to last until the next inspection, the S&I shop plans require considerable planning in all aspects of the lay-out and work progression.

1.4 Failure Maintenance

Failure maintenance is also an alternative, but it is not recommended for New Jersey DOT commuter operations. Failures will occur but can be held to a minimum with a good preventive and systematic demand maintenance program.

1.5 Philosophy of a Good Maintenance Program

The philosophy of a good maintenance program for N.J. DOT equipment starts with four plateaus of maintenance activity and related sub-elements of work:

- o Heavy repairs/rebuilds
- o Stated and periodic inspections, and light and intermediate repairs attainable within a 72 hour out-of-service limit.
- o Daily inspection, equipment servicing, and light/ running repairs.
- o Turn-around cleaning, trip inspections and running repairs .

These maintenance activities should be performed at the type of shops and facilities described and recommended in Section 8 of this chapter.

2. STATED AND PERIODIC INSPECTIONS

2.1 General

Specific items of inspection and servicing, directly related to insuring the safety of the public, are mandated under the Code of Federal Regulations 49 CFR, Chapter II, Federal Railroad Administration (FRA), Department of Transportation. These items are discussed in this section. For the purpose of these discussions, a "locomotive" is defined as a self propelled unit of equipment designed for moving other equipment and includes a self-propelled unit designed to carry freight and for passenger traffic.

2.2 Trip or Daily Inspection

Each locomotive unit in service must be inspected at least once every 24 hours. Reports must be made on FRA Form No. 2-A for diesel and electric locomotives, and on Form No. 2-B for multiple operated electric units (MU's) and cab control coaches. What follows is Rule 203, which covers the daily inspection:

> "Each locomotive unit when used in road service shall be inspected at least once every 24 hours, except locomotive units operated on a through run exceeding 24 hours may be inspected at the next crew change point immediately beyond the point at which the 24-hour period expires. A report of the above inspection shall be made on an approved form to the proper representative of the railroad, whether such locomotive units need repairs or not.
>
> Any competent employee may be designated by the railroad to make the inspections required by this rule.
>
> Any official or responsible employee designated by the railroad may approve the inspection report. The unit may be used in further service without waiting for such approval, provided defects reported have been repaired as required by this rule.
>
> This rule prescribes the minimum number of inspections that are required to be made and is not intended to

prevent the railroad from making additional inspections."

Some of the "walk-around" exterior inspection items under Rule 203 are:

- Inspect condition of wheels
- Inspect structural integrity of trucks and spring suspension system
- Inspect coil, eliptical or air springs
- Inspect brake gear and for air leaks
- Inspect coupler system and jumper connections
- Inspect cut-out cocks
- Inspect all side and undercar equipment covers
- Inspect headlights, running lights and marker lights
- Inspect safety appliances
- Inspect car body features and trim

Some of the "on-board" and visual systems evaluation tasks are:

- Inspect braking system
- Inspect operating cab controls -- cab signals, etc.
- Inspect horn and whistle operation, also bell ringer
- Inspect windshield wipers
- Inspect all cabs to ascertain proper position for service: control switch, valves, high and low voltage switches, etc.
- Inspect floors, seats, handholds, handrails and stanchions
- Inspect buzzers, bells, radio, public address and intercom

- Inspect side doors and door signal system
- Inspect fire extinguishers
- Check for broken windows
- Check train and engine crew reports on: air conditioning, heating, acceleration, dynamic and air brake response
- Check inspection card dates for FRA compliance

Any defects which constitute a violation of the Locomotive Inspection Act or any FRA rule or regulation, must be repaired before the unit is again placed in service.

It must be known before each trip that the brakes are in safe and suitable condition for service; that the air compressors are in condition to provide an ample supply of air; that pressure regulating devices are properly performing their functions; that the brake valves work properly in all positions; that the water has been drained from the air brake system; and that all potential safety and fire hazards, such as oil leaks, are corrected.

2.3 Monthly Inspection*

Each locomotive unit is inspected at least once every 30 days to determine whether it meets the requirements of the

---

*As of July 1, 1980, has changed the inspection frequency requirements to a ninety-two (92) days cycle, instead of the previous thirty (30) days requirement. The analysis contained herein was predicated on the 30 days (monthly) inspection frequency. New Jersey Transit, the public corporation responsible for the public services, has indicated that for the present time, monthly (30 days) inspections will continue.

FRA rules and regluations and a report made on Form FRA F6180-49. Rule 331 covering monthly inspections read as follows:

> "not less than once every 30 days a report shall be made on Form 1-A, covering each locomotive unit in use, which shall show the condition of the unit as determined by an inspection made in accordance with the law and these rules and instructions. The railroad may perform the inspection required by this rule within the 5 days next following the expiration of the 30-day period, if conditions beyond the control of the railroad render such additional time necessary; and in that event proper notation shall be made on the reverse of the report on Form 1-A. The report shall be prepared, subscribed and sworn to before an officer authorized to administer oaths, by the inspectors who made the inspection, and by the officer in charge. A duplicate copy of this report shall be filed in the office of the mechanical officer having charge of the locomotive and within 10 days after each inspection one copy shall be transmitted to the United States District Inspector."

Some of the basic items that are inspected for necessary correction and repair are:

- o Trucks -- bolsters and frames; wheels, axles and roller bearings; springs; spring rigging; foundation brake rigging; liners and wear plates; hoses and piping; gear cases, etc.

- o Propulsion Equipment and Associated Components -- traction motors; TM resistors and connections; relays, contactors, line breakers, circuit breakers fuses, etc.; cables and wiring; motor generators; manual knife switches; pantographs; prime movers (leaks); turbos; etc.

- o Car Body -- Couplers and draft gears; doors; car interior and trim; batteries; safety appliances and equipment; safety hangers; car body lights; instruments and gauge lights; signal indicators; diaphragms; vents; AC and heating system; inter-car electrical and pneumatic jumpers and connectors; etc.

- o Brake System -- Functions and controls; safety and pressure limiting controls; pressure gages; deadman controls or alerters; indicating lights; automatic drains; hand brakes; air compressor; slack adjuster; etc.

2.4 Other Required Inspections

Under the Safety Appliance Acts, 45. U.S. Code, Section 1 to 16, power brakes and hand brakes; automatic couplers; grab irons or handholds; coupling and uncoupling devices; sill steps; etc., must be inspected.

The Signal Inspection Law, 49 U.S. Code, Section 26 requires inspection of on-board automatic train stop, train control, cab signal devices or other similar devices such as deadman controls.

Not less than once every three months, each steam generator used in connection with a locomotive unit must be inspected in accordance with the FRA rules and regulations and a report made on Form No. 1-B.

FRA regulations require that brake equipment on passenger train cars be cleaned, repaired, lubricated and tested as often as required to maintain it in a safe and suitable condition for service but not less frequently than as required by the Association of American Railroads (AAR) Code of Rules for Cars in Interchange.

Other periodic inspections for passenger cars are established by AAR rules for roller bearings; manufacturers' recommendations for air conditioning, heating, etc.; and trip inspections to comply with the FRA Safety Appliance Act.

3. RECOMMENDED INSPECTION AND MAINTENANCE PROCEDURES

3.1 General

Shop facilities must be equipped to allow inspection and maintenance procedures for various components and appurtenances. Efficient, safe, and attractive revenue service will be achieved using the following general procedures.

3.2 Interior Car Inspection and Refurbishing

The need for car refurbishing due to general wear and tear should be determined by semi-annual inspections. The items which are subjected to the greatest wear and tear and therefore are expected to require periodic replacement or repair are:

- Floors
- Seat covers and seat adjustment mechanism
- Entrance doors and areas
- Rest room facilities
- Windows
- Paneling
- Luggage racks
- Trim

During the interim between inspections, an excellent source of car interior conditions are the conductors' reports and cleaning crew foremen's report. These reports can be used by the inspector to help locate damages that occur during runs.

Major refurbishing of the car interior should be handled at the main shops. A walk-through inspection is recommended at the end of each run as well as a check of the conductor's and engineman's reports to determine the extent of conditions that may require attention. The daily inspection is more thorough, and any problem areas will be corrected at hand, or sent to the shop for proper repairs.

At monthly inspections (MI), the interior of the car is generally checked completely, and corrective action taken. The seat upholstering, covers, arm rests, foot rests, and adjustment mechanisms should be checked. The vestibules and doorways should be examined for damage. The operation of the folding steps and operator's console and seat should be tested. Also in the operator's cab, the defroster, horn, windshield wiper, and cab heater should be checked for proper operation.

The toilet rooms should be examined. This includes a test of hopper units and sinks for proper operation and a test of the toilet recirculation pumps.

Toilet recirculation pumps should be removed, cleaned and tested at MI. Aerators should be checked and refilled. Molding, molding tape and luggage racks should be inspected.

Outbound inspection should include checking the interior of the car for foreign objects.

3.3 Windows

Conductor reports and cleaning crew reports should be the basis for locating damaged windows. At the end of every operating day, cracked or severely scratched windows should be replaced. If the damage to a window during a run is serious enough to be a potential safety hazard, the car should be removed from service and repaired at the end of the run.

Window moldings should be inspected monthly and repaired or replaced as required. Windows which have become opaque due to wear and/or detergent use should be replaced.

3.4 Air Conditioning and/or Heating System

Conductor reports should be relied on to locate a car in which the air conditioning and/or heating system is not operating properly. If the system is able to maintain the temperature within $\pm$ five degrees of the thermostat setting, the system should be repaired at the end of the operating day. If the variation in temperature is greater than $\pm$ five degrees, the car should be removed from service at the end of the run and repaired. Every monthly inspection should include the examination of:

- Freon compressor, condensor, receiver, and associated piping.
- Blowers and motors
- Air conditioning control box
- Evaporator and filters
- Thermostat and control
- Ducts
- Heating filters
- Heating elements

Evaporators should be checked for noise and leaks. The freon compressor should be inspected for loose, burnt, missing, or damaged wiring, and a defective modulating switch. The air conditioning control box should be inspected for loose, burnt, missing or damaged relays, wiring, contacts, and interlocks. If any of these items is not operating properly, it should be repaired or replaced. All switches of the air conditioning control box should be disassembled and have the contacts dressed as necessary at MI. Dirty filters should be replaced on stated schedules. The entire system of the car should be overhauled yearly.

3.5 Communication System

The communication system consists of the radio, public address and intercom. The cab signal system and the door indicator light in the cab are also part of the communication system, but these will be discussed in other sections.

The radio, public address and intercom should be tested at the end of each run, daily, and at monthly inspections. If the radio in the lead car is not working properly at the end of a run, this car should be placed at another location in the train for the rest of the day, and a car with a properly operating radio should become the lead car. If the radio unit proves to be malfunctioning at daily or monthly inspection, the car should be repaired before being returned to use. The intercom and public address system should be handled the same way, since conductors must relay any necessary announcements; since the intercom and public address system are not as critical to a safe operation as is the radio, the car can remain in service but should be repaired at first opportunity.

3.6 Cab Signal System

The cab signal system should be checked and tested at the end of every run. There are seven basic components to the system:

- Receivers
- Equipment box
- Signal lights
- Audible indicators
- Acknowledging pedal
- Speed sensing device
- Brake valve

The receivers, equipment box, signal lights, audible indicators, and acknowledging pedal all can be tested when the train is not in motion, if the car is located on a cab signal test loop on a station track. A test "program" should be shot through the system, testing all the combinations of signals and therefore testing all these components.

If any component fails and cannot be repaired in the alloted turnaround time, the lead car should be removed from service or moved to another location in the train depending on the extent of the problem and on the availability of a replacement vehicle. The monthly inspection should encompass all of the procedures of the end-of-run inspection plus the checking of the pickup and decoding relays and any necessary cleaning of the nonsealed components inside and out. Air brake action should be observed for proper operation.

3.7 Doors and Door Operating Mechanism

Doors should be checked daily and monthly for physical damage. Damaged doors should be repaired or replaced. The operating mechanism should be tested daily and monthly. Any malfunctions should be corrected. Monthly inspection will consist of a thorough check of:

- Door circuits, switches, and motors
- Door tracks, track heaters, and hanger assemblies
- Possible panel and seal defects
- Blue light on the operators console (indicates when doors are opened)
- Door mechanical locks

All moving parts should be lubricated.

3.8 Interior Car Lighting

The lights of the car interior are:

- General overhead lighting
- Vestibule lights
- Individual reading lights
- Rest room lights

These lights may require replacement or repair from time to time due to:

- Burned out bulbs
- Broken covers
- Faulty switches
- Wiring problems

Inoperative aisle, vestibule, and rest room lights should be recorded on the conductor's report and the daily cleaning crew's report, and these lights should be serviced daily.

Individual reading lights should be inspected during the monthly inspection and serviced at that time. (If the conductor or cleaning crew reports one or more as being inoperative, they should be serviced on that day.) Lights should be serviced prior to car cleaning.

3.9 Traction Motors

Train crew reports should be relied upon on a daily basis to determine if a traction motor is malfunctioning. Uncommon noises, excessive vibration, and uneven acceleration require a more complete examination, therefore, cars should be removed from service for repair or adjustment when these problems are noted by the train crews.

Monthly inspection should include checks for:

- Chipped and excessively worn brushes
- Loose or broken string bands on armatures

- Other mechanical defects on armatures
- Defective or worn commutator
- Flashover and loose bars on commutator
- Tight brush holders
- Motor covers
- Air bellow wear and damage
- Air intake cleanliness
- Clean lines of commutator and field coils
- Chafing of motor leads and/or connections
- Clean brush holder insulators, flash ring-motor frame and armature insulator
- Motor bearing lubrication

The traction motor resistors and connectors should be checked for:

- Open circuits
- Shorted turns
- Execessive heating
- Cleanliness and tightness

3.10 Transformer

Transformer failure can be caused by four problems:

- The leads may separate from the terminals causing arcing.
- The oil, which serves as insulation and coolant, may be fouled by the presence of carbon, foreign matter, moisture, or acid; all of which can short the transformer.
- The transformer wire insulation may fail.
- Physical damage to transformer shell.

The leads should be inspected monthly to detect separation or losseness. If separation does occur, the leads should be tightened and the oil replaced, since arcing causes carbon to build up in the oil. The oil pump must be checked for leakage. Once a year the transformer should be "high potted". A 1-3/4 overload should be shot through the transformer to see if it can take a sudden overload. Then the oil should be sampled and tested for the presence of foreign matter, moisture, carbon, or acid. If the oil is fouled it should be replaced. The transformer coolant pump and fan should be checked and lubricated.

If the transformer shorts either during operation or during "high potting", the transformer is to be removed and rewound by an outside shop.

3.11 Motor Generators

At daily inspection, motor generators should be checked for:

- Air intake cleanliness
- Loose, missing or damaged parts and arcing
- Secure cover attachments

Monthly inspection should include checks for:

- Commutator defects --- wear, flashover and loose bars
- Armature defects -- loose or borken string bands and other defects

- Generator and motor brushes -- damage and excessive wear
- Generator and motor leads -- chafing, and security of connections
- Air intake cleanliness
- Air bellows -- wear and damage
- Brush holders -- tight connections
- Brush holder insulators -- flashover ring, and insulation on armature cleanliness
- Secure cover attachments
- Bearing lubrication

If the generator is defective, it should be repaired, adjusted, or replaced before the car is returned to service.

3.12 Electrical Components

Electrical components, such as braking grids, smoothing reactors, etc., should require end-of-run, daily, and monthly inspections for evidence of loose, burnt, damaged, or missing wiring or equipment.

Pot heads should require checks of the seal tight conduits into the terminal box. Relays, contactors, line breakers, circuit breakers, and fuses should be inspected for:

- Breakage, burring or misalignment of cabinets or boxes

- Cover alignment or evidence of flashovers
- Burned arc horns
- Spring tension of spring loaded armatures and contact fingers
- Loose connections, worn or burned contact or interlock contact tips for all protection and control items as well as auxiliary equipment
- Condition of traction motor resistor mounting insulator

Any necessary repairs should be completed before the car is returned to service.

3.13 Batteries

Monthly inspection will include a check of the battery system for:

- Electrolyte level
- Corrosion
- Cracks and leakage
- Voltage and charge
- Short circuit
- General deterioration
- Ground

Batteries should be replaced periodically based on predetermined life expectancy.

Should a battery system failure occur, the car should be removed from service until the repair is completed.

3.14 Pantograph

At end-of-run and daily inspections, the pantograph should be checked for contact shoe-wear and missing or broken parts. If the wear is too great, the shoes should be replaced. Any missing or broken parts should be replaced. There should be three phases to the monthly inspection. The first should be the inbound inspection. The operation of the pantograph from the cab and the operation by the hand pump should be checked. The second should be a full inspection and cleaning of the pantograph.

- The pantograph should be inspected for broken, worn, or missing parts, including the air cylinder, springs, stabilizing arms, latches, fittings, insulators, horn, contact shoes and danger signs.

- Insulators and danger signs should be cleaned.

- Ball bearings, rotating points, spring connections and stabilizing arms should be lubricated.

- The pantograph pole clamp and the pump should be lubricated.

- The springs should be checked for tension.

The third phase should be the outbound inspection. The pantograph should be checked to see that the pantograph pole is in place and secured properly.

The air cylinder should be disassembled and cleaned every twenty-four months. Any parts should be replaced.

3.15 Car Body Exterior

A brief inspection should be conducted at the end of every run to see if there are any loose panels, tears in the sheet metal due to accident, broken windows, etc., which may constitute safety hazards. If such defects are discovered, the car should be removed from service until repairs are completed. At the end of daily operations, the body of a car should be inspected more thoroughly. Any graffiti should be removed, and signs of corrosion should be noted. Necessary repairs should be made before the car is returned to service. At monthly inspection, the car body should be examined thoroughly. The underframe should be air and detergent cleaned. All cabinets and protective screening mounted on the underframe should be inspected for looseness and/or damage. A thorough check of the end doors, head end shell and "end frame" as well as windows, safety appliances, diaphragm, gate, air intake grilles, and the roof should be performed. The car body height must be checked to insure level height between cars, adjusting the spring rigging if necessary. Measurement should be made of the coupler height, height of equalizing springs, and lateral and side bearings clearances. The condition of vertical and lateral shock absorbers should be inspected and ball joints lubricated. All outside car lighting should be checked at the outbound inspections as should all covers, screens, arc chutes, and switch covers, to insure that they are in place. Snow screens should be in place in season, if required.

3.16 Compressors

At daily inspections, compressors should be checked for air and oil leaks, and for correct air and oil pressure. Air compressors should be either rotary or piston type. If the compressors are rotary, at monthly inspection they should be checked for:

- Vane wear
- Air and oil leaks
- Air and oil pressure
- Response
- Compressor motor condition and lubrication

If the compressors are of the piston variety, piston ring and bushing wear should be checked in place of vane wear. All necessary repairs or adjustments should be completed before the car is returned to service. Compressors should be stripped down and cleaned every two years.

3.17 Gears and Gear Cases

Gears should be examined at monthly inspection for:

- Wear
- Cracks
- Broken teeth
- Tightness
- Cleanliness and lubrication

Gears should be cleaned and relubed every six months. Any necessary repairs should be completed before the car is returned to service.

3.18 End Of Car/Locomotive Connections

Jumpers are the electric connections between self-powered cars and electric power train lines on conventional cars. They have to be visually inspected at the end of each run to insure the tightness of the connection. If the train crew reports indicate that a car has had electrical problems during the run, the jumper connections should be checked for signs of arcing and shorting, and for cleaniness.

At three months, the units should be cleaned with a degreaser and compressed air. Contacts should be cleaned and performance checked. If a jumper connection is defective, it should be repaired, adjusted, or replaced before the car is returned to service. If the cars are self powered, automatic couplers should be employed instead of jumpers. Maintenance and inspection procedures should be the same.

Air hoses should be checked at the end of every run, at daily inspection, and at monthly inspection to ensure that there are no leaks or twists, and that the hoses have not collapsed or chafed.

3.19 ## Coupler and Draft Gear

On the daily walk-around, the coupler system should be visually inspected. The housing, shank and yoke should be checked, and the coupler should be inspected for signs of cracking, binding, and adequate lubrication. Train crew reports on the smoothness of the ride should be used to determine the condition of the draft gear.

Monthly inspection should include checks for:

- Signs of binding
- Lubrication
- Wear tolerance limits
- Performance and condition of draft gear
- Cracks
- Condition of the housing, shank, and yoke

Any necessary repairs should be completed before the car can be returned to service.

3.20 ## Spring (Coil, Eliptical or Air):

Truck coil spring testing is essential to insure proper truck performance. Spring testing machines should be used to test springs at truck overhaul intervals. The procedure for testing should be:

- Measure the unloaded height of the spring
- Place spring in spring testing machine

- At load of one static weight, measure the height of the spring (loaded height)
- Continue pressure to one and one-half times the static weight
- Gradually remove the pressure
- At one static weight, measure the height of the spring
- When the pressure is removed the spring height is measured

The two unloaded heights are averaged, and the two loaded heights are averaged. If either of these average heights do not fall within predetermined limits of acceptance, the spring is scrapped. Springs should be checked at daily and end-of-run inspections for cracks and broken coils. Checks for rust and pitting should be done at monthly inspections. Since these conditions cause stress concentration, springs should be scrapped if rusting or pitting is extensive. At monthly inspection, spring height should be measured and checks should be made for cracks, broken coils, rusting and pitting.

Eliptical springs should be checked daily and monthly for loose leaves in bond, and for broken leaves. If the top leaf, two leaves in the top half of the spring or any three leaves are broken, the spring should be replaced before the car is returned to service.

Air springs should be checked for audible leaks at daily and monthly inspection. Air spring leveling valves should also be checked. All necessary repairs should be completed before the car is returned to service.

4. RECOMMENDED MAINTENANCE GUIDELINES

4.1 Introduction

The following maintenance guidelines have been prepared to form a basis for the recommended comprehensive maintenance program. These guidelines generally incorporate FRA requirements, manufacturers' recommendations and SSV&K's operating experience with regard to the effect of time, mileage and type of service on maintenance needs.

Preventive maintenance and systematic demand maintenance as recommended in this report are predicated on the basis that all inspection and maintenance be performed on time intervals. The realization that manufacturers recommend certain maintenance performance at mileage intervals, i.e. rebuilding trucks, reconditioning fuel pumps and motor fans, renewing low voltage wiring, is recognized; however, the realization that each vehicle's mileage record is difficult to maintain overshadows the use of miles as a criteria for maintenance in the preventive maintenance program, at this time. The difficulty of maintaining mileage records is one of the reasons the FRA requires inspections based on time.

Some operating properties schedule the general overhaul for their equipment in the fourth or fifth year -- based upon their experience. Other properties, usually high mileage operations, program the general overhaul using 400,000 or 500,000 miles <u>OR</u> four or five years, whichever come first.

In the case of New Jersey DOT, the recommended schedule is subject to revisions. Through experience, the State will be able to develop wear rates or reliability-in- failure rates. The recommended time interval of four years as stated in the guidelines could possibly change to five years, six years or even three years once these experiences are established. For the present, SSV&K recommends the four years (48 months) time interval be used.

Additionally, the FRA has approved the 92 days inspection in lieu of the 30 days inspection period, effective July 1, 1980. Thirty days inspection is still recommended for many items in terms of safety and rehabilitation inspection.

4.2 Frequencies of Inspections and Servicing

The FRA mandated inspection and servicing items for diesel and electric locomotives, steam generators, and multiple operated electric units (MU's), for which minimum frequencies are stipulated in the code, are summarized in Exhibits III-1, III-2, and III-3. Other inspection and servicing items, not listed herein, are specified in the code to be performed as required to maintain equipment in a safe and suitable condition for service.

DIESEL AND ELECTRIC LOCOMOTIVES AND CAB CONTROL COACHES

Description	Each Trip	Months 1	3	6	12	18	24
Brake Equipment							
Determine That Brakes Are in Safe and Suitable Condition for Service	X						
Main Reservoir Tests (Other Than Aluminum) - Unless Drilled							
*Hydrostatic Pressure Test						X	
*Hammar Test						X	
Main Reservoir Tests (Aluminum)							
*Clean-Visual Inspection							X
*Hydrostatic Pressure Test							X
Air Gauges - Test			X				
Clean, Repair or Replace Filtering Devices in Main Reservoir Supply Line to the Air Brake System			X				
Clean, Repair and Test Specified Valve Portions of Air Brake System					X		
Clean, Repair and Test All Other Valve Portions							X
Sanders - Test (1)	X						
Cab Signal System - Test	X						
Electrical Equipment							
Clean, Inspect and Test Cable Connections Between Units and Jumpers			X				
Voltmeters and Ammeters							
*Units with Outside Power Source - Test				X			
*Power Generated Within Units - Test					X		
Insulation							
*Dielectric Test					X		
Inspection		X					

*Record on Form FRA F6180-49 Locomotive Inspection and Repair Record

(1) With a cab control coach, sander control test is performed.

STEAM GENERATORS USED WITH DIESEL LOCOMOTIVES

Description	Each Trip	Months 1	3	6	12	18	24	48	60
Remove Fire Tubes, Clean & Inspect Inside of Boiler								X	
*Fusible Plug - Boiler, Remove & Refill					X				
*Fusible Plug - Low Water Alarm, Remove and Clean			X						
*Other Type Low Water Alarm, Inspect & Test			X						
All Other Alarms and Protective Devices			X						
Boiler Exteriors									
Remove Jacket and Lagging and Inspect Under Pressure									X
*After Repairs, Test Automatic Controls and Safety Devices									
Hydrostatic Pressure Test					X				
Fire Box Sheets - Inspect		X							
Pressure Gauges - Test			X						
Safety Valves - Test			X						
Water Glass & Gauge Cocks - Blowout Water-Glass and Test Gauge Cocks	X								
Feed-Water Appliances - Test	X								
Boiler Washing - Steam		X							
- Hot Water					X				
Feed-Water & Fuel Oil Reservoir Testing						X			

*Record on Form 1-B Quarterly Boiler Inspection & Repair Report

MULTIPLE OPERATED ELECTRIC UNITS (MU'S)

Description	Each Trip	Months 1	3	12	15	24
Air Brake System						
Determine That Brakes Are in Safe and Suitable Condition for Service	X					
Main Reservoir Tests						
*Hydrostatic Pressure Test						X
*Hammar Test						X
Air Gauges - Test			X			
Air Brake Equipment - Clean Oil and Test						
Types D-22, VE & PS						X
All Other Types					X	
Train Signal Equipment - Test	X					
Electrical Equipment						
Clean, Inspect, and Test Cable Connections Between Units and Jumpers			X			
*Insulation Dielectric Test				X		
Inspect Insulation and Electrical Connections		X				

*Record on Form FRA F6180-49 Locomotive Inspection and Repair Report

4.3 Maintenance Guidelines for Diesel Locomotives

Exhibits III-4 through III-10 inclusive contain the recommended maintenance guidelines for diesel locomotives and are tabulated under the following general component categories:

- o Engine
- o Electrical Equipment - High Voltage
- o Electrical Equipment - Low Voltage
- o Trucks
- o Cab
- o Car Body
- o Brakes
- o Lube Oil System
- o Fuel Oil System
- o Cooling System
- o Air System
- o Steam Generators
- o Miscellaneous Items

RECOMMENDED MAINTENANCE GUIDELINES– DIESEL LOCOMOTIVES

EXHIBIT III - 4

ENGINE	DAILY/ TRIP	Months					
		1	3	12	24	48	144
Check for Fuel and Lube Oil Leaks	X						
Test Low Oil and Water Shutdown Devices	X						
Check Level of Engine, Governor and Air Compressor Oil	X						
Check Operation of Engine Protector		X					
Change Engine Air Intake Filters			X				
Change Turbo Lube Pump Filter			X				
Inspect Top Deck with Engine Idling		X					
Crankcase with Engine Hot, Conn Rods			X				
Bearings and "P" Pipes			X				
Air Boxes for Water and Oil Leaks			X				
Pistons and Liners			X				
External Leakage	X						
Check Operation of Low Water and Crankcase Protector Devices. If not so Equipped, Check Operation of PG Low 0.1 Pressure Shutdown.		X					
Repair Leaks in Exhaust Manifold Gasket and Expansion Joints	X						
Test Lube Oil - Change if required		X					
Clean Eductor Tube			X				
Check Spark Arresstors			X				
Change Baggie Air Filters			X				
Measure Side Clearance on All Compressor Rings			X				
Air Test All Cylinders			X				
Remove and Clean Exhaust Manifold Parts Catcher				X			
Remove and Clean Oil Separator Screen				X			
Remove and Clean Inertial Air Filters				X			
Torque Stack Gaskets to 130 ft. lb.				X			
Check Overspeed trip RPM				X			
Examine Main Bearings			X				
Change Main Bearings						X	
Check Valve Timing and Set Injector Racks				X			
Inspect Conn Rod Bearings, Torque Conn Rod Baskets to 190 ft. lb.				X			
Retorque to Builders Specifications; Crab, Rocker, Liner and Injector Studs; Turbo to Aftercooler Cap Screws					X		
Change Governor					X		
Recondition Engine Protector					X		
Replace Cylinder Assemblies						X	
Replace Injectors						X	
Inspect and Qualify Connecting Rod Bearings						X	
Install New Thrust Collars						X	
Install New Lower Main Bearings						X	
Check Rocker Arms, Rocker Arm Bushings and Cam Followers						X	
Change Water Pump						X	
Replace Engine Blowers						X	
Replace Crankshaft Harmonic Balancer						X	
Replace Oil Pumps						X	
Replace Lower Liner Inserts						X	
Replace Engine							X

ELECTRICAL— HIGH VOLTAGE	Daily/trip	Months 1	3	6	12	48	144
Check Wheel Slip Indication Through Consist	X						
Inspect Traction Motors		X					
Inspect Slip Ring Brushes, Fuses, and Diodes Suppression Circuits and Clean Windows		X					
Visually Inspect HV Cabinet Equipment & Clean		X					
Check Operation of Ground and Wheel Slip Systems		X					
Lubricate Reverser Drum			X				
Clean Diode Air Box Heat Sinks and Slip Ring Area with Compressed Air					X		
Check Pickup, Dropout Values of Ground and Wheel slip Relays					X		
Check Condition of Main Generator Commutator				X			
Clean and Inspect All Electrical Equipment				X			
Change Electrical Cabinet Air Filter Elements					X		
Main Generator - Replace Collector Ring Brushes				X			
Traction Motors - Replace Support Bearing Wick Lubricators				X			
Recondition Traction Motors						X	
Main Generator - Remove rectifier assemblies from Air Box. Remove Fuses and Thoroughly Wash Heat Sink and Diodes						X	
Main Generator - Replace Bearings						X	
Replace Main Generator							X
Renew High Voltage Cabling							X

ELECTRICAL—LOW VOLTAGE	Daily/trip	Months 1	3	6	12	24	48
Inspect Headlights	X						
Check Spare Fuses, Lights and Ground Relay Seal	X						
Check Head End Power	X						
Check Throttle, Sequence Test and Battery Charging	X						
Check Alarm System Through Consist.	X						
Check Conditioning of Control Stands, Switches, M.U. Headlight Selectors on Intermediate and Trailing Units.	X						
Check Water Level in All Battery Cells, Fill as Necessary		X					
Check Brushes, Main and Auxiliary Generators, Fuel Pump, Turbo Lube Pump, Heaters and Defrosters		X					
Check for Low Voltage & AC Grounds, Making Necessary Repairs		X					
Check and Correct Operation of All Alarm Bells & Indicators		X					
Check for Proper Operation of Temperature Switches, Cooling Fans and Shutters		X					
Check Battery Electrolyte Level. Wash Battery Box and Grease Terminals			X				
Check Rotation of Filter Bin Blower, Cooling Fans, and Tractor Motor Blower Motors			X				
Clean and Inspect Load Regulator			X				
Make Thorough Electrical Inspection. Check 27 Point M.U. Receptacles			X				
Self-Test Modules per Locomotive Model Manual				X			
Load Test Unit							
Voltage Regulator (Where Used) -					X		
Check Auxiliary Generator Output Voltage			X				
Check Auxiliary Generator Reference Voltage			X				
Magnet Valves - Clean and Replace Seats					X		
Electric Cabinets							
Air Filter - Change Filter Element					X		
Door Seals - Check for Damage and Leakage. Replace if Necessary. Adjust Lock Keeper, If Required					X		
Contact Tips - Visually Inspect Tips of all Power Contactors, Reversers, and Brake Transfer Switches. Replace as Required			X				
- Check Timing of Time Delay Devices					X		
Auxiliary Generator - Inspect and Replace Brushes when Required			X				
Starting Motors - Disassemble, Clean and Lubricate						X	
- Inspect Brushes and Replace if Necessary			X				
Electrical Control Circuits - Check Settings and Operation of Non-Modular Protective and Regulating Devices and Circuits					X		
Recondition Fuel Pump and Motor Fans							X
Recondition Auxiliary Generator and Exciter							X
Recondition Cooling Fans							X
Renew Low Voltage Wiring							X

RECOMMENDED MAINTENANCE GUIDELINES - DIESEL LOCOMOTIVES

TRUCKS	DAILY/TRIP	Months 1	3	12	48
Inspect Wheels and Running Gear	X				
Check All Suspension Bearing Cupbolts for Tightness and Proper Wire Lace		X			
Drain Water, Replace Wicks and Fill Suspension Bearings		X			
Check Journal Box Oil Level and Cover Bolts		X			
Inspect Truck & Wheel, Pilot and Coupler		X			
Reapply or Replace Disconnected or Wornout Shock Absorbers			X		
Traction Motor Support Bearings - Check Lubricant Level		X			
Traction Motor Gear Case - Maintain Lubricant at Sufficient Level to Provide Full Gear Tooth Dip into Grease		X			
Truck Center Bearing - Add Two Quarts of Oil			X		
Rebuild Trucks					X

CAB	DAILY/TRIP	Months 1	3
Check Operation of Cab Heaters and Defrosters	X		
Check for Proper Operation of Hot Water and/or Electric Cab Heaters		X	
Check Operation of Speed Indicator and Recorder		X	
Lubricate Cab Seats and Cab Doors			X

CAR BODY	DAILY/TRIP	Months I	3	12	48
Inspect Draft Gears and Couplers	X				
Change Carbody Impingement Filters			X		
Clean Out Main Generator and Flywheel Pit		X			
Check and Clean Inertial Air Compartments & Replace Missing Firewalls			X		
Check GP Units for Loose Engine Hoods & Roofs			X		
Examine Drawbars, Pins, Bushings and Retaining Keys and Stencil Date of Inspection on Pin and Key				X	
Clean and Paint Battery Boxes					X
Check Door Latches to Engine Compartment		X			

RECOMMENDED MAINTENANCE GUIDELINES - DIESEL LOCOMOTIVES

EXHIBIT III - 8

BRAKES	DAILY TRIP	MONTHS 1	3	6	12	24
Test Air Brakes, Air Compressor Controls	X					
Test Main Reservoir Safety Valve		X				
Test for Brake Pipe Leakage	X					
Check Operation of Automatic Drain Valves and Timers		X				
Check for Leakage From Main Reservoir and Related Piping			X			
Check for Brake Cylinder Leakage			X			
Check for Leakage From Control Air Reservoir Related Piping and Pneumatically Operated Control			X			
Test Operation of Main Reservoir Check Valve and Equalizing Main Reservoir Check Valve			X			
Test All Air Gauges			X			
Clean All Filters				X		
Clear, Inspect and Test M.U. Jumpers and Connections			X			
Clean and Inspect Compressor Discharge and Intake Valves and Heads			X			
Lubricate Hand Brake				X		
Tighten All Compressor Head and Anchor Bolts			X			
Clean and Test Compressor Unloader Control Switches and Magnet Valves						X
Clean, Inspect and Test Sanding Control Relays, Magnets,	X					
Bleed Check Valves and Orifice Blocks				X		
Inspect Air Brake System Hoses on Both Ends of Locomotives				X		
Clean, Repair and Test FRA - Specified Valve Portions					X	
Clean, Repair and Test All Valve Portions						X
Brake Slack Adjuster Screws - Coat Threads Using Graphite Grease			X			

LUBE OIL SYSTEM	MONTHS 1	3	12	24
Change Lube Oil Filter	X			
Remove and Clean Lube Oil Suction Strainers and Scavenging Oil Screen		X		
Remove and Clean Michiana Filter Relief Valve				X
Check Lube Oil Cooler for Temperature Differential			X	
Take Sample of Lube Oil for Analysis - Change if necessary	X			
Clean Lube Oil Cooler				X
Change Hot Oil Detector: Remove and Check for Operation at Proper Temperature				X

FUEL OIL SYSTEM	DAILY/ TRIP	Months			
		1	3	12	24
Check Level of Fuel Supply	X				
Check Operation of Emergency Fuel Trips (Mech. or Elec.)			X		
Inspect All Fuel Heat Exchangers			X		
Change Fuel Filters		X			
Drain Condensate From Fuel Tank		X			
Clean Fuel Oil Sight Glasses			X		
Remove and Clean Fuel Return Sight Glasses				X	
Fuel Pump and Motor - Replace Coupling Spider					X

COOLING SYSTEM	DAILY/ TRIP	Months			
		1	3	12	48
Check Level of Cooling Water and Inhibitor Concentration	X				
Check Condition of Flexible Pipe Couplings		X			
Inspect for Leaking Radiators		X			
Check Shutter Operation			X		
Blow Radiators with Cooling Fans Running			X		
Check for Proper Operation and Setting of Cooling Fans and Engine Temperature Switches			X		
Replace Flexible Coupling Seals					X
Shutter Air Cylinders - Replace Piston, Piston Rod and Cylinder Seals					X

AIR SYSTEM	DAILY/ TRIP	Months				
		1	3	6	12	48
Test Horn, Bell, Air Signal and Sanders	X					
Take Compressor Oil Sample and Check Lube Oil Pressure		X				
Remove, Clean and Inspect Horn Diaphragms			X			
Change Oil in Compressor, Clean Sump and Screen				X		
Change Out Compressor Filter Element Located in Fan Compartment on GE Locomotives				X		
Change Oil				X		
Clean and Repair Automatic Main Reservoir Drain Valves					X	
Air Compressor - Recondition						X
- Recondition Drive Coupling						X
Main Reservoir System - Clean System and Recondition Check Valves						X

STEAM GENERATORS	DAILY/ TRIP	Months			
		1	3	6	12
Test Gauge Cocks and Feed-Water Appliances	X				
Check Operation With Orifice Test	X				
Wash Coils and Blow Soot From Coils		X			
Change Fuel Spray Nozzle Tip		X			
Test Steam Temperature Limit Control		X			
Test Out-Fire Relay Timing and Operation		X			
Check Condition of Motor and Brushes		X			
Remove & Clean Strainer Screen at Steam Trap (Y Strainer), Water Strainer (Where Used) & Water Return Sight Glass		X			
Check for Electrical Grounds		X			
Remove & Clean Fill Test Valve		X			
Clean Fuel Filters			X		
Test Operation of Separator Blowdown Timer		X			
Check Motor & Pump Speeds		X			
Acid Wash Coils		X			
Test Safety Valves for Proper Setting			X		
Review Servo & Water Bypass Diaphragms					X
Test Steam Gauges With Test Gauge			X		
Renew Water Pump Packing & Change Oil					X
Drain & Wash Tanks				X	
Clean Blower and Inspect Blower Fan Bearings					X
Hydro-Test Generator 25% Over Working Steam Pressure					X
Megger Test Solenoids, Relay Coils & Ignition Transformer, Clear All Grounds		X			
Renew Steam Temperature Limit Switch			X		
Replace Stack Switch, Out Fire Relay, Atomizing Air Pressure Switch, and Coil Blowdown Switch			X		

MISCELLANEOUS	DAILY/ TRIP	Months	
		1	3
Check Fire Extinguishers	X		
Drain, Refill and Service Toilet		X	
Inspect and Lubricate Flexible Couplings			X
Check Belt Drives for Tension and Condition			X
Door Hardware - Lubricate Hinges, Latches & Linkage			X
Check Inspection Card Dates for FRA Compliance	X		

4.4 Maintenance Guidelines for Multiple Operated Electric Units (MU'S)

Exhibits III-11 through III-13, inclusive, contain the recommended maintenance guidelines for multiple operated electric units tabulated under the following general categories:

- o Mechanical
- o Electrical
- o Lubrication

RECOMMENDED MAINTENANCE GUIDELINES MU'S

EXHIBIT III-11

MECHANICAL	DAILY/TRIP	Months 1	Months 6
Check Inspection Cards Dates For FRA Compliance	X		
Inspect Running Gear, Wheels, Gear Cases, Axle Caps, etc.	X		
Test Air Brake & Air Signal Equipment	X		
Test Safety Control Devices	X		
Test Horn, Bell & Windshield Wiper	X		
Check Manual & Automatic Drain Valves	X		
Drain Air Reservoir, Intercooler, & Dirt Collector Condensate	X		
Check Air Compressor Oil Level - Bring Level to Full Mark	X		
Inspect All Fire Extinguishers	X		
Inspect Draft Gear & Safety Appliances - Gauge Coupler	X		
Clean Drinking Water Cooler & Check Operation	X		
Inspect Cab Seats & Mounting Appurtenances	X		
Clean Toilets & Check Operation	X		
Clean Floors, & Windows	X		
Check Seals on Cutout Cocks & other Devices	X		
Check Operation of Sanders	X		
Check for Grounds-Protect Solid State Equipment	X		
Test Headlight, Marker Lights, Panel and Carbody Lights	X		
Check Operation Heaters	X		
Talk-Test Radio	X		
Test Cab Signal and Speed Control, Equipment	X		
Power Test, Foward and Reverse	X		
Coupler, Inspect Gauge & Test		X	
Pantograph Pump		X	
Air Brake Apparatus - Inspect		X	
Air Brake & Leakage Test		X	
Drain Main Reservoirs		X	
Window Wipers & Defrosters		X	
Test Main Reservoir Safety Value Setting		X	
Compressor Governor Setting		X	
Make Compressor Orifice Test			X
Hand Brake - Inspect & Test			X
Truck & Brake Rigging Inspection		X	
Car Body Platform & Interior		X	
Blower Intake Box & Louvers		X	
Motor Mounts & Couplings		X	
Wheel Inspection & Record		X	
Lubricate Hand Brake		X	
Inspect Brake Rigging & Repair as necessary		X	
Inspect Trucks & Repair as necessary		X	

ELECTRICAL	Months			
	1	3	6	12
Generator Voltage - Test	X			
Voltage Regulator - Test	X			
Headlights. Marker Lights - Test Voltage	X			
Body. Vestibule & Saloon Lights Test Voltage	X			
Car Heaters. - Operation. All Heat Points	X			
Car Heaters & Switches	X			
Body Fans - Operation & Lube Date	X			
Clean Electrical Cabinets & Apparatus	X			
Clear Grounds - All Circuits	X			
Annual Dielectric Test				X
High Tension Cable	X			
#1 Traction Motor	X			
#2 Traction Motor	X			
#3 Traction Motor	X			
#4 Traction Motor	X			
Pantograph & Apparatus on Roof: Tension	X			
Control Battery-Flush & Test	X			
Danger Signs	X			
Cab Signals & Battery Charger or M.G.	X			
Clean Pantograph Insulators		X		
Clean Lightning Arrester Porcelain			X	
Gauge Pantograph Magnet Valve				X
Annual-Paint Batteries & Boxes				X
Annual, Clean & Paint Traction Motor Leads, Tighten Connections in Junction Box.	X			
Main Auxiliary & Control Wiring	X			
Sequence Operation, Test	X			
Pantograph Lowering Relay	X			
Relay Cabinets & Included Apparatus	X			
Sequence Switch Overload & Ground Relays	X			
Lightning Arrestor or Spark Gap	X			
Switchboard Apparatus & Slip Relay	X			
Master Controller	X			
Main Switches & Reverser (SW. Group)	X			
Brake Valve - Electric Portion	X			
Bell & Horns	X			

ELECTRICAL (CONT'D)	Months 1	3	6	12
Communicating Whistle	X			
Wire Terminals & Visible Insulation	X			
Jumpers - Make Multiple Test & Date		X		
Insulation & Connections on Front, Top & Back of Switchboard			X	
Reverser & Sequence Switch Drums Remove to clean & Inspect			X	
Switch Operating Cams & Followers			X	
Relay & Switch Cabinet Covers Gaskets & Latches			X	
Gauge Compressor Switch Magnet Valve			X	
Gauge Main & Top Switches Magnet Valve			X	
Gauge Communicating Whistle & Bell Magnet Valves			X	
Lubricate Piston Leathers on Main & Tap Switches			X	
Lubricate Piston Leathers on Reverser & Sequence Switch			X	
Lubricate Piston Leathers on Pantograph				X
Clean & Date Centrifugal Dirt Collectors				X
Jumpers & Receptacles	X			
Motor Generator & Cont actors	X			
Blower Motors & Contactors	X			
Compressor Motors & Contactors	X			
Transformers - Main & Lighting	X			
Reactor Coils & Grids	X			
Pantograph Pole	X			
Dielectric Test				X
General Tightening of All Connections at Main Control Group, Auxiliary Group, Rectifier Control Group, Switchboard and Air Conditioning Compartments.				X
Measure Voltages at Firing Panel				X
Lubricate Reverser Air Engine.				X
Measure and Adjust Spring Tension, Oil Drum Switch Fingers				X
Wipe Through all Interlock Contact Surfaces with Crocus Cloth.				X
Remove Recirculating Air Grills From Car and Clean Thoroughly.				X
Thoroughly Clean Car Battery and Battery Box.				X
Lubricate Bearings on All Rotating Equipment.				X

ELECTRICAL (CONT'D)	Months 12	Months 24
Change out Pantograph Down Cylinder and Latch Cylinder.		X
Renew Pantograph Piston Rubber Dust Bellows.		X
Inspect Air Ground Brushes.		X
Remove Outside Layer of Tape From H.T. Lead on Roof. Apply one Layer New Tape, (Scotch 70)		X
Di-Electric Test	X	
Lubricate Reverser	X	
Tighten All Connections in Main Group	X	
Tighten All Connections in Auxiliary Group	X	
Tighten All Connections in Rectifier Group	X	
Tighten All Connections in Cam Group	X	
Tighten All Connections in Air Cond. Group	X	
Tighten All Connections on Main Transformer	X	
Check MA. DEB & SEB Brusholder Clearance	X	
Clean Battery Box & Tighten All Connections	X	
Inspect & Rebrush Cam Motor (3/8"min.)	X	
Inspect & Rebrush Door Motors (3/8" min.)	X	
Check All Electronic Card Panel Connections	X	
Lubricate MA, DEB & SEB Motors	X	
Tighten Dynamic Resistor Connections (Roof)	X	
Tighten Fresh Air Intake Screens on Roof	X	
Lubricate the Cam Controller & Felt Pads		X
Clean & Lub Pantograph Down Cylinder		X
Change Dust Bellows on Down Cylinder		X
Inspect Hi-tension Lead Insulation & Tape		X
Lubricate the "A" Contactor Cylinders		X
Lubricate the Transf. Cooling Fans		X

LUBRICATION	Months			
	1	3	6	12
Brake Rigging - Grease Fitting Only	X			
Side Bearings	X			
Buffers & Stems	X			
Friction Journals	X			
Check Date Grease Roller Bearing Journals	X			
Compressor Crankcase	X			
Axle Caps	X			
Traction Motor Gears	X			
Traction Motor Bearings		X		
Motor Generator Bearings		X		
Blower Motor Bearings		X		
Compressor Motor Bearings		X		
Grease Type Roller Bearings			X	
Body Fans E.E. 105				X
Gear Case E.6 Cars				X
Repack Axle Cap Bearings				X
Pantograph Bearings, Joint and Latch				X

NOTE: This lube program is for the old EL MU's and the MP 54 E6 cars which are still in service and which are to be replaced by the Arrows.

4.5 Maintenance Guidelines for Cab Control Coaches

A cab control coach is a standard rail passenger vehicle which has been so modified as to provide the required control capability at one end of a push/pull passenger commuter train, and to remotely operate a motive power unit which is at the other end of that train. The power control section of the cab control coach is conventionally located at the free end of the train, while the larger remaining section of the vehicle is equipped for passenger seating.

Since the FRA requires this cab control coach to undergo specified inspection and safety checks, these were previously noted in Exhibit III-1. The recommended guidelines for Cab Control Coaches are presented in Exhibits III-14 to III-18, tabulated under the following general categories:

- o Mechanical
- o Electrical
- o Trucks
- o Cab
- o Car Body
- o Brakes
- o Lubrication
- o Air System
- o Miscellaneous Items

MECHANICAL	DAILY/ TRIP	Months 1	3	6	12	24
Check Inspection Cards Dates for FRA Compliance	X					
Test Safety Control Devices	X					
Test Panel & Carbody Lights	X					
Car Body Platform & Interior		X				
Wheel Inspection & Record		X				
Lubricate Hand Brake		X				
Brake Rigging Repairs		X				
Truck Repairs as required		X				
Inspection & Renewal of Brake Shoes		X				
Inspect Body Fans					X	
Remove & Clean Airbrake Dirt Collectors				X		
Air Gauges- Clean & Test			X			
Renew Leveling Valves & Turnbuckle Assemblies					X	
Completely Strip Air Brake Equipment for Cleaning and Lubrication. This includes Air Compressor and Automatic Coupling Equipment						X
Hammer & Hydrostatic Test Main Reservoirs (if not drilled)						X
Clean and Lubricate Pantograph Hand Pump						X
Renew all Air Springs						X
Renew Bolster Anchor Pads						X
Check Truck Shocks for Leaks and Tighten					X	
Change-Out the Leveling Valves					X	
Renew the Bolster Anchor Pads						X
Renew all Auxiliary Motor Resilient Mounts						X
Remove & Clean all Package Brake Units						X

RECOMMENDED MAINTENANCE GUIDELINES CAB CONTROL COACHES

EXHIBIT III-15

ELECTRICAL	DAILY/ TRIP	Months					
		1	3	6	12	24	48
Inspect Headlights	X						
Check Spare Fuses, Lights	X						
Check Head End Power & Equipment Operation	X						
Check Throttle and Sequence Test	X						
Check Wheel Slip Indication through consist	X						
Check Condition of Control Stands, Switches, M.U. Headlight Selectros	X						
Check Operation of Heating and Air-Conditioning	X						
Test, Forward & Reverse Circuits	X						
Visually Inspect Cabinet Equipment		X					
Check Operation of Ground and Wheel Slip Systems		X					
Headlights, Marker Lights - Test Voltage		X					
Body : Vestibule & Saloon Lights - Test Voltage		X					
Body Fans - Operation & Lube Date		X					
Clean Electrical Cabinets & Apparatus		X					
Clear Grounds - All Circuits		X					
Inspect Main Auxiliary & Control Wiring		X					
Test Sequence Operation		X					
Inspect Master Controller		X					
Bell and Horns		X					
Communicating Whistle		X					
Wire Terminals & Visible Insulation		X					
Inspect Jumpers & Receptacles		X					

ELECTRICAL (CON'D)	DAILY/ TRIP	Months 1	3	6	12	24	48
Blower Motors and Contactors		X					
Lighting Transformers		X					
Check for Low Voltage Grounds, making necessary Repairs		X					
Check and Correct Operation of All Alarm Bells and Indicators		X					
Jumpers - make Multiple Test and Date			X				
Insulation & Connections on Front, Top & Back of Switchboard				X			
Lubricate Reverser Drum				X			
Clean and Inspect all Electrical Equipment				X			
Lubricate Reverser					X		
Wipe through all Interlock Contact Surfaces with Crocus Cloth					X		
Remove Recirculating Air Grills from Car and Clean thoroughly					X		
Lubricate Bearings on all Rotating Equipment					X		
Magnet Valves - Clean and Replace Seats					X		
Electric Cabinets:							
Air Filter - Change Filter Element					X		
Door Seals - Check for Damage and Leakage. Replace if necessary. Adjust Lock Keeper, if required					X		
Contact Tips - Visually Inspect Tips of all Contactors, Reversers, and Brake Transfer Switches. Replace as required					X		
- Check Timing of Time Delay Devices					X		
Tighten all Connections in Air Cond. Circuit					X		
Tighten Fresh Air Intake Screens on Roof					X		
Electrical Control Circuits - Check Settings & Operation of Non-Modular Protective and Regulating Devices and Circuits						X	
Renew Low Voltage Wiring							X

TRUCKS	DAILY/ TRIP	Months			
		1	3	12	48
Inspect Wheels and Running Gear	X				
Check Journal Box Oil Level and Cover Bolts		X			
Gauge Wheels, Pilots and Couplers		X			
Reapply or Replace Disconnected or Wornout Shock Absorbers				X	
Truck Center Bearing - Add Two Quarts of Oil				X	
Rebuild Trucks					X

CAB	DAILY/ TRIP	Months	
		1	3
Check Operation of Cab Heaters and Defrosters	X		
Check Inspection Card Dates for FRA Compliance	X		
Test Horn, Bell & Windshield Wiper	X		
Inspect Cab Seats & Mounting Appurtenances	X		
Talk Test Radio	X		
Check Operation of Speed Indicator and Recorder		X	
Lubricate Cab Seats and Cab Doors			X

CAR BODY	DAILY/ TRIP	Months		
		1	6	12
Inspect Draft Gears and Couplers	X			
Clean Passenger Area	X			
"E" Clean Entire Passenger Area			X	
Examine Drawbars, Pins, Bushings and Retaining Keys and Stencil Date of Inspection on Pin and Key				X

BRAKES	Each Trip	Months 1	3	12	24
Test Air Brakes, Air Compressor Controls	X				
Test Main Reservoir Safety Valve		X			
Test for Brake Pipe Leakage	X				
Check Operation of Automatic Drain Valves and Timers		X			
Check for Leakage From Main Reservoir and Related Piping			X		
Check for Brake Cylinder Leakage			X		
Check for Leakage From Control Air Reservoir Related Piping and Pneumatically Operated Control			X		
Test Operation of Main Reservoir Check Valve and Equalizing Main Reservoir Check Valve			X		
Test All Air Gauges			X		
Clean All Filters			X		
Clean, Inspect and Test M.U. Jumpers and Connections			X		
Lubricate Hand Brake				X	
Clean, Inspect and Test Sanding Control Relays, Magnets, Bleed Check Valves				X	
Inspect Air Brake System Hoses on Both Ends of Locomotives				X	
Clean, Repair and Test FRA - Specified Valve Portions				X	
Clean, Repair and Test All Valve Portions					X
Brake Slack Adjuster Screws - Coat Threads Using Graphite Grease				X	

LUBRICATION	Months 1	3	6	12
Brake Rigging - Grease Fitting Only	X			
Side Bearings	X			
Buffers & Stems	X			
Check Date Grease Roller Bearing Journals	X			
Grease Roller Bearings			X	
Body Fans				X

AIR SYSTEM	Each Trip	Months 1	3	6	12	48
Test Horn, Bell, Air Signal and Sanders	X					
Test Operation of Windshield Wipers	X					
Remove, Clean and Inspect Horn Diaphramgs			X			
Clean and Repair Automatic Main Reservoir Drain Valves				X		
Main Reservoir System - Clean System and Recondition Check Valves						X

MISCELLANEOUS	Each Trip	Months 1	3
Check Fire Extinguishers	X		
Service Toilet as required		X	
Door Hardware - Lubricate Hinges, Latches & Linkage			X

.6 Maintenance Guidelines for Standard Commuter Coaches

When making an inspection and performing necessary maintenance work all established safety precautions must be strictly followed.

.6.1 Daily and/or Trip Requirements

- o Check all items reported by the members of the train crew that failed or that they felt required attention during their last trip.

- o Air brake inspection and maintenance:
  - Perform single car test with Standard Passenger Car Testing Device. Test for brake pipe and reservoir leakage. Perform graduated release test, application test, release test and emergency test. Follow instructions outlined in the latest AAR Instruction Pamphlet No. 5039-4-Sup 1 covering 26 C Passenger Car Equipment. Make certain that the testing device is maintained as outlined in this instruction manual.
  - Check and properly adjust piston travel of truck mounted brake cylinders, if car is so equipped.
  - Check C O T & S (clean, oil, test and stencil) date on car. The date stencilled on the equipment with 26 C brake valves must not be over 36 months old. If the date is expired the air brake equipment must be given "periodic

attention" as outlined in the current AAR Field Manual (Passenger Car Rule 2).
- Check train air signal equipment.

o Trucks and brake rigging inspection and maintenance:
  - Inspect all brake rigging on trucks and car body such as pins, bushings, cotter keys, brake beams, brake beam hangers, brake shoes, levers, rods, and brake lining of disc brakes, and make any necessary corrections.
  - Check roller bearing lubrication date. Bearings must be lubricated if date on car is 92 days or older. If date is expired all work per Passenger Car Rule 9 of the current AAR Field Manual must be performed. It is recommended that work be handled at the expiration of 85 days.
  - Observe condition of all wheels. Gauge as shown in AAR Freight Rule 41 Section A should be available for use in determining condition. It is recommended that wheels be removed when rim thickness becomes less than 1/16" measured as shown in Freight Rule 41.
  - Check for proper side bearing clearance.
  - Observe swing hangers for proper securement and excessive wear.
  - Observe centerplate condition.

o Electrical equipment inspection and maintenance:
  - Make certain that all electrical equipment is shut off during layover.

- Check all lights, both fluorescent and incandescent, and make necessary corrections. This includes marker lights, emergency lights, vestibule lights, step and sign lights, etc..
- Check battery charger.
- Check that the ventilating, heating and/or air conditioning equipment is functioning properly. Follow the equipment manufacturer's recommendations for inspection and maintenance.

o Couplers, buffers, etc., inspection and maintenance:
  - Height must be maintained (nominally 34-1/2" with a maximum of 35" and a minimum of 34"). Buffer height should be held at 16" from the center line of the coupler knuckle to the top of the buffer plate. 1/4" variation is allowed.

o Safety appliances inspection and maintenance:
  - All grab irons, hand rails, steps and similar items must comply with FRA regulations. An inspection of all items must be made and corrective action taken when discrepancies are found.

o Wash rooms inspection and maintenance:
  - Check water supply
  - Check water cooler
  - Clean out retention tanks

- o Car inspection and maintenance:
  - Completely clean the interior of the car. Wash floors and windows.
  - Wash exterior of the car unless the temperature makes this impractical.

6.2 Monthly Requirements

- o Air brake inspection and maintenance:
  - Same as daily requirements

- o Truck and brake rigging inspection and maintenance:
  - Same as daily requirements

- o Electrical equipment inspection and maintenance:
  - Handle all trip requirements
  - Inspect all electrical connections at switches, circuit breakers and battery grounds
  - Inspect switches and circuit breakers for proper mechanical operation
  - Inspect battery leads for corrosion, loose connections and grounds
  - Add distilled water to low level cells
  - Check battery's specific gravity
  - Inspect train line and battery charger receptacles

- o Couplers, buffers, etc.; safety appliances; wash rooms; and car inspection and maintenance:
  - Same as daily requirements

4.6.3 Semi-annual Requirements

- o Air brake inspection and maintenance:
  - Same as daily and monthly requirements

- o Truck and brake rigging inspection and maintenance:
  - Same as daily and monthly requirements

- o Electrical equipment inspection and maintenance:
  - Handle all trip and monthly requirements
  - Check battery boxes and batteries carefully; remove all corrosion, and torque all bolts.
  - Blow off dirt and dust from battery charger
  - Inspect circuit breaker panels for loose wires and hardware
  - Inspect electrical connections for tightness
  - Blow out dust and dirt from all electrical boxes

- o Car inspection and maintenance:
  - Inspect floors, seats, windows, fire extinguishers, trap door, etc., repair as necessary.

4.6.4 Annual Requirements

- o Air brake inspection and maintenance:
  - Same as daily, monthly and semi-annual requirements

- o Truck and brake rigging inspection and maintenance:
  - Same as daily, monthly and semi-annual requirements

- o Electrical equipment inspection and maintenance:

- Handle all daily, monthly and semi-annual requirements
- Inspect all circuit breaker panels and connections for dirty or corroded contacts
- Blow out dirt from circuit breaker panels
- Inspect all electrical components for broken, discolored or over-heated parts

o Couplers, buffers, etc.; safety appliances; wash rooms; and car inspection and maintenance:
- Same as daily, monthly and semi-annual requirements

4.7 Maintenance Guidelines for Car Cleaning

Maintenance to provide for the physical comfort and well being of the passengers is generally referred to as the "housekeeping" function. It encompasses the cleaning of the passenger area, replenishing of service supplies and the inspection of lighting, heating, ventilating and air conditioning systems on turnaround, layover (daily), and extended period bases.

Short turnaround car cleaning should be performed at the end of the trip and when at least thirty minutes are available. If less than thirty minutes are available, as many of the cleaning tasks should be performed as are possible: The following tasks should be completed during turnaround cleaning:

o Clean, disinfect, and restock toilets rooms
o Pick up debris -- newspapers, cups, etc.

o Sweep entire floor area (if tiled), or vacuum (if carpeted)

Layover or daily cleaning should be handled at terminating/orginating terminals when equipment is turned or when layover periods of at least three hours are available. A guideline for daily car cleaning items is presented in Exhibit III-19.

The daily car cleaning function, however, is not adequate for maintaining proper car cleanliness over an extended period of time. A periodic extraordinary ("E") cleaning should be performed to clean the cars in a more thorough manner than can be accomplished during the limited turnaround periods.

The recommended quideline for "E" cleaning of MU's, RDC's and coaches is given in Exhibit III-20. It is recommended that "E" cleaning be accomplished at intervals not exceeding 6 months.

4.8 Maintenance Guidelines for Vehicle Component Cleaning

Miscellaneous car and locomotive parts should be given a special cleaning to limit corrosion, to assist in keeping shops clean, and to facilitate inspections. All locomotive underframes and running gear should be cleaned, preferably through the use of a blow pit, at the time of monthly inspections. Coach and locomotive trucks should be cleaned, preferably through the use of a cleaning shed or booth, whenever major repairs or rebuilds are to be

DAILY CAR CLEANING GUIDELINES

INTERIOR

- o General
  - Wall shall be free of smudges, marks and graffiti.
  - Panels and bulkheads shall be clean with all possible marks removed.
- o Pipe guards shall be clean and have a polished appearance.
- o Waste Containers and Astrays
  - Must be empty, clean and free of matter.
- o Floors
  - No debris, newspapers, gum or foreign matter on floors.
- o Seats
  - Seats shall be turned, if necesary/possible.
  - Seats shall be free of tears, marks or stains over one inch.
  - Arms and headrests shall be damp-wiped.
- o Windows
  - Permit clear view for passengers and engineman.
  - Free of dust, smudges and streaks
  - Sills, to have polished look with no dirt buildup in corner.
- o Lavatories and toilets
  - No undesireable odors
  - Wash basins and hardware shall be free of stains and have a bright appearance.
  - Toilet bowls shall be bright and disinfected
  - Areas around and behind wash basin and toilet shall have no dirt buildup, or soap marks
  - Mirrors must be clean and clear, free of streaks and stains.
- o Vestibules
  - Panels, steps, doors, handholds, platforms, and related parts must be free of oil, ice, dirt or foreign matter.
- o Supplies
  - Ample stock of paper towels, cups, toilet paper and soap
  - All tanks in every car shall be watered to capacity prior to dispatching.
- o WASH FLOOR and/or VACUUM DURING MIDDAY LAYOVER

EXTERIOR

- Run equipment through an enclosed washing facility, if available

EXTRAORDINARY "E" CLEANING GUIDELINES

INTERIOR

- o Wash evaporator and check evaporator drain.
- o Blow interior of car, including ducts, grill work, anemostats, and electric and equipment lockers.
  - Partially turn seats to blow between frame and wall.
  - Lift seats and blow seats frames.
  - Blow under heat and water pipe guards.
  - Remove gum and adhesive from seats and tile.
- o Fumigate car entirely; apply roach treatment
- o Scrub and wipe ceilings, walls, bulkheads, seat frames and sides, steam pipe guards, window sills, and light fixtures.
- o Clean window frames; clean both sides of curtains, if equipped.
- o Scrub and wipe toilet rooms with disinfectant cleaner, including ceiling, wash basins, enclosed area under wash basins, toilet and trash receptacles. Polish brightly all hardware and basins.
- o Refill deoderizers.
- o Mop all tiled floors with approved cleaner shampoo carpets.
- o Clean all glass work, windows, mirrors and dividers.
- o Scrub and clean vestibule and blind end of car including doors, appliances and steps with an approved exterior cleaner.
- o Touch up paint to cover marks that will not wash off; paint metal housing on toilet bowls so equipped.
- o Drain and flush water coolers and storage tanks.
- o Check that all hardware and safety appliances are in proper position and function correctly (door knobs, air door, locks).
- o Wash condensor.
- o Blow out generator, condensor fan motor, and control boxes.
- o Flush and wash batteries.
- o Replace lamps.
- o Replenish train supplies.
- o Shampoo upholstery

EXTERIOR

- o Clean exterior of car to remove any trace of rust, or grease or foreign buildup. Also scrub car ends.
- o Clean fecal residue off truck and disinfect.
- o Make proper entries on car maintenance record.

performed. The cleaning should occur prior to dismantling of the trucks. Wheel and axle assemblies should be passed through a cleaning shed prior to inspections to determine salvageability. Many other assemblies and parts (e.g. roller bearings) should be cleaned prior to major repair/rebuild.

4.9 Summary

The recommended maintenance program which is presented on the preceding pages will insure maximum availability of clean revenue cars to meet scheduled service with a high degree of reliability. However, one major caution must be emphasized. Prior to the institution of this comprehensive preventive maintenance program, those pieces of equipment which have incurred deferred maintenance, must undergo an overhaul to correct any existing deficiencies.

The preventive maintenance program can be implemented on those vehicles which were not subjected to deferred maintenance. Vehicles on which maintenance was deferred will require scheduling and coordination of repairs in order to minimize the effect on total fleet availability. In many instances, this equipment will have to receive service comparable to that which is performed at 48 months as proposed in the recommended guidelines. In other cases, a six year rebuild might be required in order to bring the equipment up to standard.

5. RECOMMENDED SCOPE OF INSPECTIONS

5.1 Inspection and Maintenance Specifications

The preceding guidelines are recommended as the basis for a "Preventive and Systematic Demand Maintenance Program". In order to accomplish this, specific plateaus of inspection and maintenance are recommended. Exhibits III-21, III-22, III-23, III-24, and III-25 are typical of the procedures and flow encompassed by such plateaus. These exhibits represent a majority, but not necessarily all areas, of inspection and maintenance work. It should be noted that a distinction has been made between trip and/or turnaround inspections, and the daily inspection.

6. PROJECTED MAINTENANCE REQUIREMENTS

6.1 Equipment Assumptions

Assumptions were made on rolling stock specifications and configurations on a long term basis. The philosophy of maintenance can be improved if adjusted to technological improvements as rolling stock is replaced with new, or rebuilt and/or retrofit with improvement modifications. It is assumed that N.J. DOT locomotives, MU cars and coaches will on a long term (year 2000) basis have the following:

- Interfacing of MU cars, locomotives, and coaches to permit pooling and cycling of like equipment for control inspection, maintenance, modifications, cleaning, component repair, and spare parts.
- Standard couplers, trainline functions and controls.

EXHIBIT III - 21

TRIP AND/OR TURNAROUND INSPECTION

BY: KNOWLEDGEABLE AND RESPONSIBLE PERSON THROUGH VISUAL INSPECTION TO ASCERTAIN THAT NO DEFECT EXISTS OF SUFFICIENT MAGNITUDE TO JEOPARDIZE THE SAFE AND RELIABLE OPERATION OF THE EQUIPMENT

"FINDERS"

"WALK-AROUND" EXTERIOR INSPECTION

- O INSPECT CONDITION OF WHEELS (FLAT SPOTS - FLANGES OUT OF GAUGE - WHEEL CRACKS - LOOSE WHEELS - EXCESSIVE WORN TREADS)
- O INSPECT STRUCTURAL INTEGRITY OF THE TRUCKS AND SPRING SUSPENSION SYSTEM
- O INSPECT ALL SPRINGS
- O INSPECT RUNNING BRAKE SYSTEM
- O INSPECT COUPLER SYSTEM AND RELATED AND ATTACHED FEATURES
- O INSPECT CUT-OUT COCKS
- O INSPECT FOR AIR SYSTEM LEAKS
- O INSPECT ALL SIDE AND UNDERCAR EQUIPMENT COVERS
- O INSPECT ALIGNMENTS OF DRAWBAR CUT-OUT DRUM SWITCHES
- O INSPECT HEADLIGHTS - RUNNING LIGHTS - MARKER LIGHTS
- O INSPECT ALL SAFETY DEVICES TO INSURE HAND CLEARANCES AND PROPER FASTENING
- O INSPECT EXTERNAL CAR BODY FEATURES AND TRIM TO ASSURE THAT THEY ARE IN GOOD CONDITION AND PROPERLY FASTENED

"ON BOARD" AND VISUAL EVALUATION OF SYSTEMS

- O CHECK FRA CAB CARDS & DATES FOR COMPLIANCE
- O CHECK ENGINEER'S REPORT AND MAKE CORRECTIONS AS NECESSARY
- O INSPECT BRAKING SYSTEM
- O INSPECT OPERATING CAB CONTROLS (CAB SIGNALS, ETC.)
- O INSPECT HORN AND WHISTLE OPERATION
- O INSPECT WINDSHIELD WIPER OPERATION
- O INSPECT ALL CABS TO ASCERTAIN PROPER POSITION FOR SERVICE: CONTROL SWITCHES, VALVES, LOW & HIGH VOLTAGE SWITCHES
- O INSPECT FLOORS, SEATS, HANDHOLDS HANDRAILS & STANCHIONS
- O INSPECT BUZZERS, BELL, RADIO, PUBLIC ADDRESS & INTERCOM
- O INSPECT SIDE DOORS & DOOR SIGNAL SYSTEM
- O INSPECT FIRE EXTINGUISHERS
- O INSPECT FOR BROKEN WINDOWS
- O CHECK TRAIN CREW REPORT ON:
  AIR CONDITIONING
  HEATING
  ACCELERATION
  DYNAMIC BRAKE RESPONSE
  BRAKING

"FIXERS"

ADJUSTING
TIGHTENING
MINOR COMPONENT
CHANGE OUT SUCH AS
BRAKE SHOE

ADJUSTING
TIGHTENING
MINOR COMPONENT
CHANGE OUT SUCH AS
WINDSHIELD WIPER

DAILY INSPECTIONS
(Include all items under trip inspection)

DIESEL-ELECTRIC LOCOMOTIVES

- Determine that brakes are in safe and suitable condition for service.
- Sanders - test
- Cab signal system - test
- Check for Fuel and Lube Oil Leaks
- Test Low Oil and Water Shutdown Devices
- Check Level of Engine, Governor and Air Compressor Oil
- Check Wheel Slip Indication Through Consist
- Inspect Headlights
- Check Spare Fuses, Light, & Ground Relay Seal
- Check Head End Power
- Check Throttle, Sequence Test & Battery Charging
- Check Alarm System Through Consist
- Check Conditioning of Control Stands, Switches, MU
- Headlight Selectors on Intermediate and Trailing Units
- Inspect Wheels and Running Gear
- Check Operation of Cab Heaters & Defrosters
- Inspect Draft Gears and Couplers
- Test Air Brakes & Air Compressor Controls
- Test for Brake Pipe Leakage
- Check Level of Fuel Supply
- Check Level of Cooling Water and Inhibitor Concentration
- Test Horn, Bell, Air Signal

STEAM GENERATORS

- Water Glass & Guage Cocks - Blowout Water Glass & Test Gauge Cocks
- Feed - Water Appliances - test
- Check Operation with Orifice Test

MISCELLANEOUS

- Check Inspection Card Dates for FRA Compliance
- Check Fire Extinguishers
- Check Engineer's Report and make corrections and repairs.

MULTIPLE UNITS (MU's)

- Check Inspection Card Dates for FRA Compliance
- Inspect Running Gear, Wheels, Gear Cases, Axle Cap, Etc.
- Test Air Brake & Air Signal Equipment
- Test Safety Control Devices
- Test Horn, Bell & Windshield Wiper
- Check Manual & Automatic Drain Valves
- Drain Air Reservoir, Intercooler, & Dirt Collecter Condensate
- Check Air Compressor Oil Level - Bring Level to Full Mark
- Inspect all Fire Extinguishers
- Inspect Draft Gear & Safety Appliances - Gauge Coupler
- Clean Drinking Water Cooler & Check Operation
- Inspect Cab Seat & Mounting Appurtenances
- Clean toilets & Check operation
- Clean Floor & Windows
- Check Seals on Cutout Cocks & other Devices
- Check for Grounds - Protect Solid State Equipment
- Test Headlight (front & back), Oscillating Warning Light, Panel Car body Lights
- Check Operation of Heaters
- Talk - Test Radio
- Test Cab Signal & Speed Control Equipment
- Power Test - Forward & Reverse

CAB CONTROL COACHES

- Check Inspection Card Dates for FRA Compliance
- Test Safety Control Devices
- Test Panel & Car Body Lights
- Inspect Headlights
- Check Spare Fuses, Lights
- Check Head End Power & Equipment Operation
- Check Throttle & Sequence Test
- Check Wheel Slip Indication Through Consist
- Check Condition of Control Stands, Switches, Headlight Selectors
- Check Operation of Heating & Air Conditioning
- Test Forward & Reverse Circuits
- Inspect Wheels and Running Gear
- Check Operation of Cab Heaters & Defrosters
- Test Horn, Bell & Windshield Wipers
- Inspect Draft Gear & Couplers
- Clean Passenger Area
- Test Air Brakes, Air Compressor Controls
- Test for Brake Pipe Leakage
- Test Air Signal & Sander Control
- Check Fire Extinguishers

COACHES

- Inspect Wheels & Running Gear
- Inspect Draft Gear & Couplers
- Check Operation of Heaters and Air Conditioning

EXHIBIT III - 22

DIAGNOSTIC TESTING

Verify that unit performs to specifications and that the wing and components are within tolerance using a tape-controlled digital analyzer specifically developed to quickly, simply and reliably test locomotive units. Each unit must have a test harness permanently installed with quick connections. The harness brings all necessary test points in the unit out to a connector panel. Harnesses contain shorting bar assemblies to allow isolation of negative returns and components, thus can troubleshoot faults such as grounds, and control unit circuits for functional testing.

Basically, the diagnostic tester is a special purpose computer which will make a series of measurements in an order determined by the program tape developed for each type unit. The test limits are pre-programmed on the tape. The tests are arranged in two categories:

1. COLD TESTS or all circuits de-energized.

The fundamental purpose of the cold test is to eliminate all trouble causes which could appear repetitively in succeeding function tests. Typical cold tests include continuity of wires, detection and correction of grounds, component tests, normally closed interlock checks, and MU coupler checkout.

2. HOT TESTS or all circuits energized.

The hot tests simulate road operations, every major function is tested, both at its input and output, intermediate test points are also employed to help spot developing trouble. The emphasis is put on test point selection to maximize ability to automatically define defects down to easily replaceable assemblies. As an example, test points have been selected to test the following functions and sub-function on an existing unit or units.

MAIN POWER SYSTEM

- Secondary of main transformer power rectifiers
- Dynamic braking resistor
- Motor fields
- Associated motor contactors

3-PHASE POWER SYSTEM

- Power distribution motors via power contactors

PROPULSION CONTROL

- Motor controls
- Reversers and interlocks
- Field shunting controls
- Brake controls
- Slip-slid controls
- Master controller

AUXILIARY POWER SYSTEM

- Circuit breakers, 220/440 power distribution heaters

BATTERY CHARGING

- Battery supply distribution (Regulated & Unregulated)

LIGHTING

TIME SEQUENCE CONTROLS

AIR COMPRESSOR CONTROLS

MU LINES & COUPLER

ELECTRONICS

HEATER CONTROL RELAYS & CONTACTORS

TRACTION MOTORS

Chipped and excessively worn brushes
Loose or broken string bands on armatures
Other mechanical defects on armatures
Defects and wear commutator
Flashover due to loose bars on commutator
Tight brush holders
Motor covers
Air bellows wear and damage
Air intake cleanliness
Clean commutator and field coils
Chafing of motor leads and/or connections
Clean brush holder insulators, also flash ring-motor frame and insulator on armature

TM RESISTORS AND CONNECTIONS

Open circuits
Shorted turns
Excessive heating
Cleanliness and tightness

RELAYS-CONTACTORS-LINE BREAKERS-CIRCUIT BREAKERS-FUSES

Breakage-burning or misalignment of cabinets or boxes
Cover alignment or evidence of flashovers
Burned arc horns
Spring tensions of spring loaded armatures and contact fingers
Loose connections, worn or burned contact or interlock contact tips for all protection and control items as well as auxiliary equipment
Condition of traction motor resistor mounting insulator

MOTOR GENERATORS

Commutator defects-wear, flashover and loose bars
Armature defects-loose or broken string bands and other defects
Generator and motor brushes-damage and excessive wear
Generator and motor leads-chafing and security of connections
Air intake-cleanliness
Air bellows-wear and damage
Brush holders-tight connections
Brush holder insulator-flashover ring and insulation on armature cleanliness
Secure cover attachments

CABLES-WIRING AND KNIFE SWITCHES

Check compartments for flashing, burning, and deteriorated insulation and chafing of wires
On cable, check for evidence of chafing, also secure attachments and terminal connections
Check knife switches for free movement of blade-tight blade at pivot-solid contact and service terminals

PANTOGRAPHS

Check functions for service when energized and deenergized
Check latching and unlatching
Check air system for improper resonance
Check condition of shoe and horn
Check circuit transfer switch and emergency switch

BRAKE SYSTEM

Check all brake valves as to proper operating requirements
Check all brake system pressures and other regulating devices
Check all filter cleaning devices and automatic drain valves
Check dynamic braking operating control and application
Check friction braking system to insure maintenance of effective braking capability for at least five minutes
Check effectiveness of dead-man control
Check trip cocks and switches for intended brake function
Check pressure reading instruments and condition of glass
Check safety or pressure limiting devices
Check cab indicator devices for braking
Check all exposed brake rigging including alignment of brake shoes
Check wear of brake shoes
Check hand brakes for application and release
Check air compressor
Check emergency brake when pipe is opened at the master controller, passenger emergency valve or signal system magnet valve
If provided, check velocity control programmer for propulsion and brake control
Check engine crew reports of alleged malfunction or abnormal delay of function

CAR BODY

COUPLERS AND DRAFT GEARS

Visual for binding and lubricatons
Check for wear tolerance limits
Check for circuit continuity
Check for ground and shorts
Check cable and airline connections
Check for excessive wear and deformity account run-in and other slack action, also loose connections

BATTERIES

Check water level
Check terminals
Check enclosure for deterioration
Check enclosure doors
Ventilation and drainage openings to be cleared
Check for cracks

OTHER

Check all car body safety hangers
Check all gauge and instrument lights
Check windshield wiper mechanism
Check horn and bell
Check intercom
Check radio or radio phone
Check signal indicators
Check car heating
Check comfort indicators and control sensors
Check headlights and dimmers
Check running lights and marker lights
Check high voltage cabinets and cabinet stenciling
Check emergency evaluation system
Check AC filter for changeout
Check train crew report

(Following are additional items for electric self-propelled multiple unit equipment only)

END AND SIDE DOORS

Check operation and door signal lights of side doors
Check locks and dogging arms of end doors
Check door closer mechanism
Check diaphragms, safety chain, gates and all other between car mechanisms
Check anti-slip plates, thresholds, door seals, engine-man or operator's seat mechanism
Check cab or vestibule windows for cracks and discoloration

CAR INTERIOR AND TRIM

Check for excessive wear and hazardous footing
Check seats for safe condition
Check for cracked windows or loose windows
Check lighting
Check AC inlets and outlets
Check fire extinguishers
Check handholds
Check end door closers
Check loose paneling and possible roof leaking

TRUCKS AND RUNNING GEAR

BOLSTERS AND FRAMES

Broken or cracked side frames
Broken-loose or missing safety hangers
Missing or broken hanger bolts
Loose pedestal tie bars
Cracked and broken truck bolster
Excessively worn bolster stops
Cracked or missing pedestal liners
Broken or defective motor suspension lugs-bolts-brackets or hangers
Broken or loose journal bearing attachments
Broken or cracked journal bearing liners
Cracked or broken center bearing casting
Loose or broken side bearings
Check level of bolster and truck frame
Check truck grounding

WHEELS AND AXLES (RECONTOURED OR REPLACED)

Slid flats
Cracks in plate
Sharp and/or High Flanges
Flanges with flat vertical surface
Burnt rim
Spread rim
Shattered rim
Shelled tread
Sub-surface defect
Loose wheel
Out of gauge
Thin rim thickness
Ultrasonic test of axle
Visual inspection for deleterious defects

SPRINGS

Audible leakage of air spring
Air spring leveling valves defective
Broken coil or spiral springs
Broken-cracked or badly worn equalizer-hanger bolt-jib or pin
Top leaf or two leaves in top half or any 3 leaves broken in elliptic spring
Loose leaves in bond of elliptic springs

SPRING AND BRAKE RIGGING

Broken-cracked or bent levers and beams
Loose or broken bushings
Missing-bent or loose pins
Missing brackets or supports
Worn or missing brake shoes
Missing brake shoe keys
Excessive piston travel

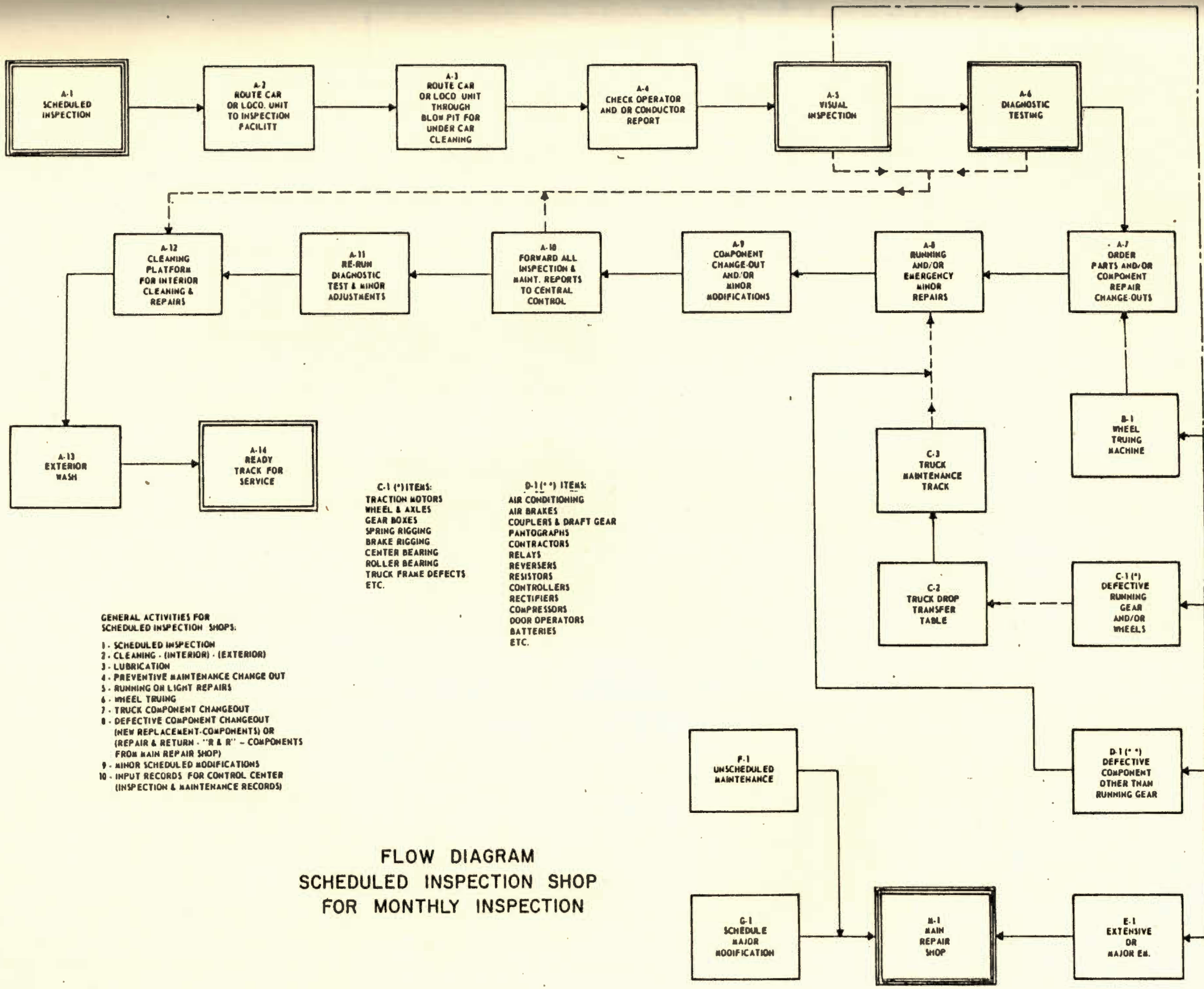
HOSES AND PIPING

Hoses twisted-collapsed-chafed-flat or leaking
Piping secured not corroded or abraded

GEAR CASES

Oil leakage
Misalignment

MONTHLY INSPECTIONS



C-1 (*) ITEMS:
TRACTION MOTORS
WHEEL & AXLES
GEAR BOXES
SPRING RIGGING
BRAKE RIGGING
CENTER BEARING
ROLLER BEARING
TRUCK FRAME DEFECTS
ETC.

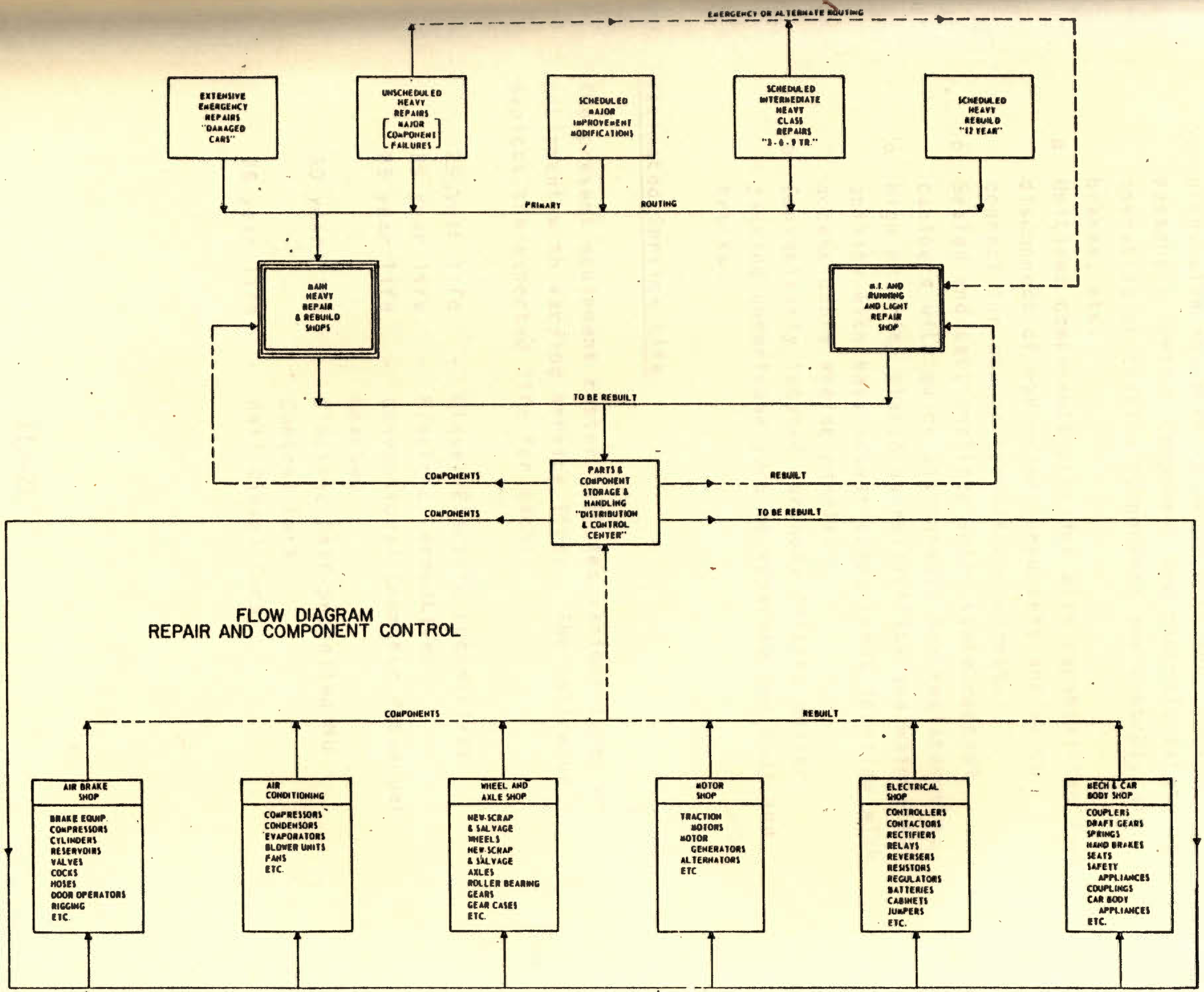
D-1 (**) ITEMS:
AIR CONDITIONING
AIR BRAKES
COUPLERS & DRAFT GEAR
PANTOGRAPHS
CONTRACTORS
RELAYS
REVERSERS
RESISTORS
CONTROLLERS
RECTIFIERS
COMPRESSORS
DOOR OPERATORS
BATTERIES
ETC.

GENERAL ACTIVITIES FOR
SCHEDULED INSPECTION SHOPS:

1 - SCHEDULED INSPECTION
2 - CLEANING - (INTERIOR) - (EXTERIOR)
3 - LUBRICATION
4 - PREVENTIVE MAINTENANCE CHANGE OUT
5 - RUNNING OR LIGHT REPAIRS
6 - WHEEL TRUING
7 - TRUCK COMPONENT CHANGEOUT
8 - DEFECTIVE COMPONENT CHANGEOUT (NEW REPLACEMENT-COMPONENTS) OR (REPAIR & RETURN - "R & R" - COMPONENTS FROM MAIN REPAIR SHOP)
9 - MINOR SCHEDULED MODIFICATIONS
10 - INPUT RECORDS FOR CONTROL CENTER (INSPECTION & MAINTENANCE RECORDS)

FLOW DIAGRAM
SCHEDULED INSPECTION SHOP
FOR MONTHLY INSPECTION

EXHIBIT III-25



FLOW DIAGRAM
REPAIR AND COMPONENT CONTROL

- o Quick coupling and uncoupling capabilities for electronic diagnostic testing of car body wiring, propulsion and braking components and control, passenger comfort component and control, safety and operating protection components and control, air brakes, etc.
- o Unitized components provided with capabilities for disconnect of bad order components and quick connect for new or rebuilt components.
- o Sealed and sectionalized solid state control cabinets with quick disconnects for replacements.
- o High priority placed on reliability and maintainability with easy access compartment location with access doors and/or panels.
- o Conveniently located car body lifting and/or jacking underframe pads to separate car body and trucks.

6.2 Estimated Service Life

The present equipment roster includes various types of equipment with varying service lives. The following depicts the expected life for each:

25 year life	-	Diesel-Electric Locomotives
25 year life	-	Electric Locomotives
25 year life	-	Conventional Commuter Passenger Coaches
30 year life	-	Electric Self-propelled MU Control Cars
25 year life	-	Rail Diesel Cars

The economics of new rolling stock versus a second rebuild with major modification and retrofit for a new service life must be analysed, and a policy determined. The estimated life cycle of a second rebuild is estimated to be approximately 75 to 80 percent of the first life cycle.

6.3 Projected Inspections

As noted in an earlier section of this chapter, diesel and electric locomotives, multiple unit electric cars, and cab control coaches must be inspected at least once every thirty days to determine whether they meet the FRA rules and regulations.

Exhibit III-26 was developed using the present and projected N.J. DOT commuter rail fleet. It presents the projected monthly inspections that must be performed each day. For each service, the MI's required are depicted on a per day basis. Also shown are the types of equipment which must be inspected--diesel and electric locomotives, multiple unit cars, and cab control coaches.

In developing this exhibit, certain assumptions were used. Each unit will undergo an inspection an average of thirteen (13) times per year. The second assumption used was that there are 240 work days per year on which inspections can be performed.

PROJECTED MI's PER DAY 1980 - 2000

EXHIBIT III - 26

LOCOMOTIVES

ice	1980		1985		1990		2000	
	Diesel and RDC	Electric	Diesel and RDC	Electric	Diesel and RDC	Electric	Diesel and RDC	Electric
Lines	1.73	—	1.73	—	1.84	—	2.17	—
tan Valley	0.70	—	0.54	—	0.54	—	0.54	—
h Jersey st Line	1.52	0.70	1.25	0.54	0.81	0.65	1.03	0.65
. Coast - ewood Line	—	—	—	—	—	—	0.54	—
LS	3.95	0.70	3.52	0.54	3.19	0.65	4.28	0.65

MU'S

vice	1980	1985	1990	2000
Lines	9.75	9.75	9.75	9.75
theast rridor Line	4.71	4.88	4.98	5.20
th Jersey ast Line	3.9	3.90	3.90	3.90
OTALS	18.36	18.53	18.63	18.85

CAB CONTROL CARS

vice	1980	1985	1990	2000
B Lines	1.79	2.28	2.28	2.44

STANDARD COMMUTER COACHES

vice	1980	1985	1990	2000
B Lines	8.56	10.51	10.67	11.27
itan Valley Lines	4.82	2.87	3.20	3.58
th Jersey Coast Line	7.96	6.77	7.20	7.53
ewood	—	—	—	3.25
ALS	21.34	20.15	21.07	25.62

The rationale for using thirteen inspections per unit, per year is based on the FRA requirement* that an inspection must be performed at least once every thirty days. The thirty day period is a calendar period. Normally, a unit is not pulled from the fleet exactly thirty days from its last inspection for a new inspection. The period can vary up to one week prior to the expiration date. Therefore, it is most likely that a unit will experience thirteen MI's per year. The base work year of 240 days excludes weekends and holidays.

Therefore, the formula that was developed to depict the projected requirements is:

$$MI = \frac{n \times 13}{240}$$

Where: MI = Monthly Inspections per day
n = Fleet size requiring inspection
13 = Inspections per vehicle per year
240 = Number of work days per year

7. GENERAL CRITERIA FOR FACILITIES

Properly designed shops must accommodate all scheduled and unscheduled servicing, inspection, maintenance and repair activities and expediently return all equipment to revenue service. The primary functions are as follows:

---

*As of July 1, 1980, FRA requirement was changed to 92 days.

- Scheduled routine inspections of all mechanical and electrical systems and components of locomotives and cars.
- Scheduled operational checking and diagnostic testing of all systems including automatic train control, mechanical, electrical, traction power, communications and environmental systems and controls.
- Scheduled heavy repairs, rebuilds and major modifications.
- Unscheduled heavy repairs and rebuilds due to failure and/or damage.
- Modifications and retrofit of proven technological developments.
- Scheduled intermediate repair and minor modifications.
- Unscheduled intermediate repairs.
- Scheduled light or running repairs.
- Component replacement when judged to be more expedient than repairing on-car.
- Lubrication and all related work.
- Wheel truing--on-car or off-car when recontouring wheels in conjunction with truck repair.
- Exterior washing.
- Interior cleaning.
- Servicing --fuel oil, sand, water, lube oil and lubricants, etc.).

8. FOUR RECOMMENDED PLATEAUS OF MAINTENANCE FACILITIES

8.1 Introduction

Maintenance of equipment is required at certain time frequencies and activity levels, as previously discussed. In the case of the N.J. DOT fleet, four basic types of maintenance facilities are recommended to provide such maintenance expeditiously and efficiently. Each designated type serves specific functions of rail equipment maintenance. These are presented in ascending order with respect to maintenance time required and functions performed.

The facility types recommended are as follows:

- o Layover/Turnaround Facility
- o Light Running Repair Facility
- o Service and Inspection (S&I) Facility
- o Major Repair/Rebuild (MR/R) Facility

These facilities are recommended for an economical, yet effective, procedure for making federal tests and for performing the preventive maintenance necessary to maximize locomotive, MU, and coach availability and reliability. Nonproductive time should be reduced as the coach, MU and locomotive units are brought to well-tooled stations where specialists can make necessary inspections, adjustments and repairs. Portions of the vehicles worked at each track should be carefully assigned to minimize interference between the various craftsmen.

Facilities with external methods for appraising electrical conditions such as spectrographic analysis and automatic circuit testing, along with a growing background of wear rates and economical service limits, make it possible to change many inspection procedures. Where equipment checks formerly would require extensive disassembly to reach the affected parts, these parts should now be appraised in place, making it unnecessary for locomotives to be held for indefinite periods. A production inspection and maintenance track operated on an around-the-clock basis should provide a six (6) hour limit for electric locomotives; six (6) hour limit for electric self-propelled multiple-unit equipment; eight (8) hour limit for diesel-electric locomotives; four (4) hour limit for cab control coaches; and two (2) hour limit for standard commuter coaches.

With respect to the S&I facility, the maintenance on the monthly inspection track should be held to intermediate repairs, minor component change-out and/or minor modification. All repairs of major proportions, whether scheduled or emergency, should be transferred to the heavy repair shop rather than hold-up, or drastically slow down the monthly inspection track.

In the sections which follow, each of these facility types will be defined, typical repairs performed will be delineated, and the shopping time limits established. Exhibit III-27 summarizes this information.

MAINTENANCE FACILITIES BY FUNCTION

ITEM	LAYOVER/TURNAROUND FACILITIES	LIGHT/RUNNING REPAIR FACILITIES
Normal Shopping Limit	≤ 4 hours	≤ 8 hours
Functions	o Inspections -- Daily,trips, end of run o Internal car cleaning & rubbish removal o Inspect lighting, heating, A/C systems o Minor/emergency repairs -- wiper blades, brake shoes, tighten loose nuts	o Light/running repairs -- fix seats, minor component change out, lubrication and truck work. o Emergency repairs o Minor internal car cleaning o Fueling and sanding of locomotives o Replenishment of service supplies o Inspection and correction of lighting and air circulation o Functions of Layover/Turnaround facilities

ITEM	SERVICE & INSPECTION FACILITIES	MAJOR REPAIR/REBUILD FACILITIES
Normal Shopping Limit	≤ 72 hours	≤ 720 hours
Functions	o Monthly Inspection of Locomotives, MU cars, cab control coaches - scheduled routine inspection of all mechanical and electrical systems and components - scheduled operation, checking, and diagnostic testing o Scheduled intermediate repair and minor modifications o Component change outs -- traction motors, wheel sets, draft gear, o Scheduled light/running repairs -- seat replacement, lubrication and truck work, minor component change outs o Unscheduled or emergency work -- door repair, window replacement o Wheel truing -- on or off-car when recontouring wheels in conjunction with truck repair o Functions of light/running repair and layover/turnaround faciltes	o 48 months inspections o Scheduled major improvements and modifications to locomotives & MU o Scheduled heavy repairs o Unscheduled heavy repairs o Repair &/or rebuild components or assemblies o Repair &/or rebuild on-board items of body, underframe, and car body o Handling, cleaning, and maintenance of trucks and running gear o Interim and major overhaul of equipment o Wheel shop o Air brake shop o Motor generator, alternator & electric component shop o Air condition shop o Paint Shop o Parts cleaning room o Storage rooms -- battery,grease, and lubricating oil o Functions of Service and Inspection, light/running repair, and layover/turnaround facilities

8.2 Layover/Turnaround Facilities

Layover/Turnaround Facilities provide train storage tracks and are usually located at the western terminals of the N.J. DOT rail lines. These facilities are primarily used for overnight train storage.

Maintenance performed at these facilities should be kept to a minimum. The following activities are recommended for these facilities:

- o Trip inspections
- o Internal car cleaning and rubbish removal
- o Inspection of lighting, heating, ventilating and air-conditioning systems
- o Minor running and emergency repairs
- o End of run inspection

Minor running repairs are defined as those repairs necessary to conform to safety appliance standards and include replacing or changing windshield wiper blades, brake shoes, loose or missing pins or nuts, bent or loose handholds, etc. In all cases, the repair shopping limit is not to exceed four hours. If any necessary safety related repairs are deemed to exceed the four hour limit, the train or unit should be deadheaded to the Service and Inspection Facility or to the Major Repair/Rebuild Facility, as appropriate, for servicing, repair, or both.

In a like manner, any defects or deficiencies reported by the operating crew at the completion of a run, or noted at the "end of run inspection" should be corrected. The end of run servicing includes a detailed inspection to insure against mechanical defects that would prevent the vehicle from making its scheduled run safely and on time. Correction of defects should be limited to the time available before departure, or four hours, whichever is less. Defects which require more time and effort should be handled at a Service and Inspection Facility or Major Repair/Rebuild Facility, as appropriate. In that event, the MU car or the locomotive would be removed from service, and deadheaded to the appropriate shop.

It is recommended that only limited or emergency fueling or sanding of locomotives take place at the Layover/Turnaround Facilities. It should also be noted that shops are not required at these facilities since maintenance requirements and performances are kept to a minimum. The nature of the repairs required can be performed with minimal tools, and outdoors.

The major components and equipment requirements of the Layover/Turnaround Facilities are as follows:

- Track storage sufficient to handle layover stock with sufficient support track for maneuverability, if cut and coupling is required, to meet scheduled train consists.
- Layover servicing facilities or support arrangements for fuel, oil, sand, water, and lubricants and layover outlets for precooling or preheating.
- Sufficient lighting for daily or trip inspections.
- Small hand tools and testing devices.
- Protected storage for small supply of materials and parts.

- Personnel welfare facilities (if off-rail vehicles are used for several terminals, facilities required at home terminal only).

8.3 Light/Running Repair Facilities

Light/Running Repair Facilities are defined as those facilities which have the manpower, access to stores, and capabilities to perform repairs of a light, running, or emergency nature. In addition, they should handle the maintenance functions, inspections, and minor running repairs that a Layover/Turnaround Facility performs.

The following activities are recommended at this type of facility:

- Light/running and emergency repairs; no one repair to exceed 30 minutes
- Internal car cleaning
- Daily (or trip) inspection
- Fueling and sanding of locomotives
- Replenishment of service supplies
- Inspection and correction of lighting and air circulation
- End of run inspection

The repairs accomplished here would entail such activities as hand brake adjustment/repair; replacement of windows, brake shoes, filters, and windshield wipers; or repairs to doors, air hoses, toilets, etc.

Repair shopping limit is not to exceed eight hours. If any repairs are expected to exceed this eight hour limit, the unit should be sent to the Service and Inspection Facility or to the Major Repair/Rebuild Facility as appropriate.

The major components and equipment requirements of the Light/Running Repair Facilities are as follows:

- Sufficient track space to perform FRA-required daily safety inspections.
- Jacks, fork lifts, hoists, and portable hand tools and equipment.
- Diesel locomotive and MU car servicing accessories and facilities; i.e. fuel storage and pumping apparatus, sand, water, lubricants, toilet dump and purge, and oil leak cleanup capabilities.
- Air, water, and electrical connections.

3.4 Service and Inspection (S&I) Facilities

Service and Inspection (S&I) Facilities are defined as facilities which have the manpower, stores, equipment, etc. to perform periodic inspections, scheduled and emergency minor repairs due to component failures, and scheduled minor modifications. The Service & Inspection Facilities also handle the maintenance functions and inspections of the two preceding categories.

Maintenance performed at Service and Inspection Facilities should not exceed 72 hours. The facility must accommodate all scheduled and unscheduled servicing, inspections, maintenance and repair activities. The primary functions of S&I facilities are as follows:

- o Scheduled routine inspection of all mechanical and electrical systems and components of locomotives, MU cars, and cab control and standard commuter coaches.
- o Scheduled operation, checking and diagnostic testing of all systems including automatic train control, mechanical, electrical, traction power, communications and environmental systems and controls.
- o Handling of locomotives and MU's as either single units or as coupled units.
- o Scheduled intermediate repair and minor modification or changeout to such components as traction motors, wheels sets, draft gear and/or couplers, major electrical controls, air conditioning and assemblies, etc., or anything short of major disassembly which could be classified as heavy or major rebuild.
- o Unscheduled intermediate repairs.
- o Scheduled light or running repairs; such as seat which in the judgment of the shop supervisor are within the scope of the shop capability.
- o Component replacement when judged to be more expedient than repairing on-car.
- o Lubrication.
- o Wheel truing; on-car or off-car when recontouring wheels in conjunction with truck repair.

- o Exterior washing.
- o Servicing -- fuel oil, sand, water, lube oil and lubricants, etc.

It should be noted that the main objectives of a Service and Inspection Facility for the N.J. DOT rail fleet are toward scheduled routine inspections, component replacemnts, and minor repairs. Reducing vehicle out-of-service time is the major goal of this type of facility. Rather than wait for a component to be repaired or rebuilt, spare components should be available to replace the failed component. This will not only save shop time, but also permit the equipment to be returned to revenue service expeditiously.

To properly carry out the recommended functions of an S&I Facility, the following facility components and equipment are required:

- o Sufficient track space to conduct periodic inspections.
- o Storage tracks for service trains, spare rolling stock, and inbound rolling stock.
- o Ready tracks for testing of on-board signals of outbound rolling stock.
- o Material car tracks.
- o Run-around and maneuvering tracks.
- o Portable hand tools and some machine tools, testing equipment, and work benches.
- o A small work support area (majority of work will be on-car).

- Major support equipment required are a wheel truing machine, jacks, lifts and pendant control hoists or bridge cranes.
- Track-mobile or on-off track vehicle to move rolling stock in and out, through tracks in the shop.
- Running gear blow-pit and steam cleaning facilities for inspections and shop cleanliness.
- Open inspection pits, depressed floors with ramps, and elevated platforms at levels for safe and easy access to rolling stock on through tracks.
- Material and parts storage of small items, new components and parts of sub-assemblies, and repair and return components enroute to and from major repair shop or contractors.
- Mezzanine for supervisory and clerical personnel, comprising locker, lunch, toilet and rest areas, locomotive and car data storage, and a training and meeting area.

8.5 Major Repair/Rebuild Facilities

Major Repair/Rebuild Facilities are defined as facilities which have the manpower, stores, equipment, component shops etc. to perform major repairs and rebuilds of the rail fleet. Although these types of facilities can perform the functions of the preceeding three, the emphasis is on component repairs, repair and replacement of worn and defective parts, interim and major overhaul of equipment, extensive emergency repairs (damaged equipment), scheduled and unscheduled repairs, and scheduled major improvements and modifications to the equipment.

Maintenance performed at a Major Repair/Rebuild Facility normally exceeds 72 hours and usually has 30 days as the normal shopping limit. The facility's maintenance functions include the following:

- o Scheduled major improvements and modifications to locomotives and MU's (all are handled as single units).
- o Unscheduled heavy repairs due to major component failure or because of collision damage.
- o Disassembly and repair of major components and/or assemblies.
- o Necessary repairs and/or rebuilds of car body, on-board items of body, and underframe.
- o Diagnostic testing.
- o Major truck and running gear handling, cleaning and maintenance.
- o Preparation of unit parts and/or components for movement to specialized contractor or manufacturer shops.
- o Cleaning of trucks, wheels, and axles and parts.
- o Interim and major overhaul of equipment.
- o Computer control of maintenance records, e.g., service life, failures, warranties, vehicle miles, etc.

8.5.1 Component Shops

The Major Repair/Rebuild Facility contains various work areas and component shops for the specialized work noted above. These include:

- o Wheel shop -- specialized with equipment and facilities for exacting control of quality work on wheels, axles, bearings, gears, and gear cases.
- o Air brake shop -- specialized with equipment and facilities for exacting control of quality work on pneumatic and electropneumatic components, including air compressors and hand brakes.
- o Electric component shop -- specialized with equipment and facilities for exacting control of quality work on propulsion equipment and associated electrical components such as motors, generators, alternators, relays, contactors, knife switches, circuit breakers, etc.
- o Air condition shop -- specialized with equipment and facilities for exacting control of quality work on all air conditioner components.
- o Signal and Communication shop -- specialized with equipment and facilities for exacting control of work on right-of-way signals and communications, train control, cab signals, train stop, radio, crossing protection, etc.
- o Paint shop -- specialized with equipment and facilities to paint, stencil, letter, stripe and perform any required locomotive and car painting and touchup with adequate ventilation and environmental controls.

- o Body shop -- specialized in equipment and facilities for quality work requiring fabrication (sheet metal and tin shop), and also includes blacksmithing and welding capabilities.
- o Internal cleaning shop -- self enclosed shop area equipped with water, air, vacuum cleaning, and trash disposal accessory attachments and portable cleaning equipment. Responsible for upholstery repair, glass replacement, floor repairs, trim repairs, etc.
- o Blow pit -- self-enclosed shop area with air, steam, and detergent attachments for cleaning rolling stock running gear prior to inspection and repair.
- o Electronics shop -- specialized air conditioned room with equipment and facilities for exacting control of work on circuit boards and panels.

8.5.2 Shop Support Areas

In addition to the component shops described, the MR/R Facility should be provided with the following indoor facilities and equipment:

- o Battery room for storage and recharging.
- o Lubricating oil and grease storage room.
- o Component and parts cleaning room.
- o Electrical equipment room (control room for all shop electric power).
- o Mechanical room containing shop heating plant, air compressors, shop pumps and related equipment.

(Consideration of solar energy use should be made. The shop roof lends itself to this application.)

- Mezzanine containing supervision and clerical personnel toilet, locker, lunch and rest areas, locomotive and car data storage, meeting and instruction room(s), and small item and supply storage (locked room for limited access)
- Large storehouse area for components, parts, and material in general, with highway vehicle and freight car access.
- Receiving and dispatching area for repair and return or unit exchange components.
- Basement area for access to all hoisting equipment and bulk storage lubricating oil tanks.
- Bridge cranes, hoists, fork lifts, drop tables, transfer tables, on-off track vehicles, and power machine tools and equipment, etc.

The MR/R Facility requires adequate planning so that all areas are related and located, which will reduce material and supply handling and employee travel time.

.5.3 Shop Yard Support

Outside the shop, track support must include bad order and await repair storage tracks, sufficient shop leads, ready tracks and test tracks.

.5.4 Alternatives to Component Shops

Major rebuild of rolling stock components, primarily major locomotive and car components for warranty, can be handled via two additional alternative approaches in lieu of in-house main repair component shops and offer versatility in case of work overload or emergency. These approaches are described as follows:

- o Utilize manufacturer or specialized contractor for a "Unit Exchange", "Repair & Return", or "Sell & Buy Back" transaction. (Any advantages of the latter plan are doubtful for N.J. DOT. Under "Unit Exchange" there is prompt acquisition of a rebuilt component (at an average or nominal charge), with a subsequent billing, debit or credit, when the N.J. DOT component is rebuilt. With "Repair and Return" the bad order component is forwarded for repair/rebuild and the same component is returned.
- o Arrange for, and shop to the nearest "Conrail" or "Amtrak" repair facility on a repair and return basis.

The advantage of the first approach is inherent in the warranty that the manufacturer or specialized contractor can provide and in the prompt rebuilt acquisition of such items as motors, generators, turbos, transformers, injectors, air compressors, fuel and lube pumps, air conditioning assemblies, etc. However, union agreements may require periodic negotiating to employ this approach.

The second approach could entail a reciprocal agreement to handle each other's component rebuilds in cases of work overload or emergency.

8.5.5 Computer Control

Under the "Preventive and Systematic Demand Maintenance Program", SSV&K recommends the use of a computer control system. It is recommended that the computer facilities and activities be located at MR/R Facility, or a computer terminal from existing N.J. DOT computer facilities be located in the facility. The use of computers for maintenance control offers management an opportunity to realize savings in maintenance costs. Some of the areas of viable computer application are as follows:

- Mileage Tabulation. The mileage of each unit may printed out each month. This information may be used to compile shopping lists, trigger component change-out, special inspections, etc.

- Material Inventory and Availability Control. A railroad operator stocks many thousands of inventory items. The only practical way to properly control this volume is with a computer.

- Trigger Warranty Claims. Manual methods lose a good deal of money because warranty situations usually go unnoticed. This can be minimized with computer control.

- Control Labor and Material Expenditures. The computer is the only way to give management a fast response for controlling expenditures. It is of litle value to know a month later that your budget is overrun. A computer can give a day-to-day accounting of expenditures, and you can work currently on a "real time" basis.

- Determine the Life of Components. Such items as traction motors can be analyzed for the type of failure or average life, and various vendors' products can be compared.

- Determine the Cost of Components. Accurate "make-or-buy" decisions can be made on fact--not opinion. By using cost and life values together, a value analysis can be conducted to determine if it is worthwhile to pay a little extra for a "deluxe" component.

- Programmed Instruction. Employee training can be effectively aided with programmed instruction utilizing computerized approaches.

- Deterination of Total Locomotive, MU, and Coach Cost Levels. The decision to keep certain units and retire others can be made, and even the decision as to which new equipment should be acquired can be made on the basis of accurate cost data furnished by the computer.

- Industrial Engineering Standards and Work Measurement. These functions can be programmed to determine the efficiency of various facilitites and functions.

- Maintenance and Project Control. All levels of maintenance, including required and routine FRA inspections, modification projects, regular maintenance, heavy repair, etc. can be placed under computer control and the job can be done more accurately. Thus, when a unit arrives at a repair facility for work, all of the necessary work can be listed and forms can be printed out in advance.

While the computer cannot inspect the equipment and determine what is actually required (with some exceptions in the field of taped program testing of electrical components), it can call attention to the need of inspection, modification, replacement, etc. With computer techniques it is quite possible that repair cycles closer to optimum can be ascertained for a given piece of equipment based on historical data in the computer.

- <u>Equipment Failure and Out-of-Service Analysis.</u> Management can pinpoint important trouble areas and utilize its "power" more effectively when trouble is properly analyzed.

- <u>Spectrographic Control</u>. This item can be automated to a large degree using computer control. Absolute limits and rate-of-change limits can be programmed the same as in a manual system.

All of the items listed above and many more can be performed with a computer. They can also be done manually, but few operators would have enough men or want to have enough men to do all of the jobs that can be done with a computer. A word of caution should be noted, a computer is only as good as the data fed into it. An axiom of computer people is GIGO--Garbage In = Garbage Out. In addition, computer should not be used as a giant electronic filing cabinet. It must be programmed to do something, or the filing cabinet becomes a far cheaper solution.

CHAPTER IV

INSTITUTIONAL ALTERNATIVES

CHAPTER IV
INSTITUTIONAL ALTERNATIVES

1. INTRODUCTION

For the purposes of this report, an institution can be defined as an agency, an authority, an organization, or a group or combination thereof, which is responsible for owning and/or leasing the rail equipment maintenance facilities which service N.J. DOT-owned rail equipment. Included within its jurisdiction, and implicit in the institutional alternative is the management and operation of the facilities, and any and all maintenance functions occuring within the facilities. The institutional alternatives for this study are: the State of New Jersey, a "new" agency/authority/corporation under state jurisdiction (i.e., N.J. Transit), Conrail, Amtrak, Port Authority of New York and New Jersey, or a private firm.

In evaluating the institutional alternatives, certain aspects were addressed. These include ownership, operations, labor, legal, and financial. Although each aspect is independent, an interdependency exists among them. Because of the interrelationships among these various aspects, the complexity of choosing a "candidate" institutional alternative for implementation is not clear cut and easily defined. The interaction of the various aspects overshadows the independency of each aspect while strengthening the "gray area".

Various hypotheses are presented and discussed. Solutions are problematic and difficult to define. Hopefully, the following will alleviate some of the confusion and allow for amelioration to the problem.

1.1 Ownership

Defined as proprietorship, having legal title to the facilities, or the controlling role. Included also within the definition is leasehold, and the leasee has all benefits of ownership.

As noted above, ownership incorporates two separate components -- owner and/or leasee. Under each component, full responsibility and control rests; although contractual agreements could remove some control from a leasee.

Concerning ownership, there are six institutions considered. They are 1) State of New Jersey, 2) a "new" authority/agency/corporation, 3) Conrail, 4) Amtrak, 5) Port Authority of New York and New Jersey, and 6) a private firm.

1.2 Operational

Defined as pertaining to the performance of an assigned task or tasks. Within the context of institutional alternatives for the N.J. DOT study, the operational aspect includes two distinct areas:

- o Maintenance facility operations
- o Maintenance performance

Maintenance facility operations require the assumption of responsibility for controlling day to day activities which occur within the facility while insuring that it is operated in an efficient, cost effective, and timely manner. Similarly, the maintenance performance operational aspect requires that the performance of maintenance on the rolling stock must be overseen, adherence to federal and state regulations for the performance of maintenance functions and requirements is complete, and the maintenance of equipment is performed in an efficient, cost effective, and timely manner. For the operational aspect, there are six candidates under consideration: 1) State of New Jersey, 2) a "new" authority/agency/corporation, 3) Conrail, 4) Amtrak, 5) Port Authority of New York and New Jersey, and 6) subcontracting to another by the owner.

1.3 Labor

Defined as the work force, with the kinds and quantity of employees necessary to maintain and operate the facilities, and the rail equipment in an efficient manner.

With respect to labor, certain considerations must be recognized. These are existing labor agreements, craft distinctions, and work rules which are binding on existing operating properties. Some of these work rules not only hamper efficiency, but entail higher operating costs.

Section 13C of the Urban Mass Transportation Act of 1964 must also be considered in any implementation plan. Section 13C requires an assurance that an employee's position will not worsen when an agency receives federal money.

There are two distinct categories to consider: 1) utilizing existing operators and 2) new operators. Under category 1, Conrail, Amtrak, and the Port Authority are considered; category 2, examines a "new" authority/agency/corporation, the State of New Jersey, or subcontracting to a private entity.

1.4 Legal

Defined as pertaining to or according to law, and created or permitted by law. Under the legal aspect, legislation, whether federal or state, was also included, as were existing contracts.

The legal legislative matters that must be addressed cover the ownership, operational, and labor aspects and the interrelationships involved. Within the context of this aspect also fall the Environmental Policy Act of 1969, Urban Mass Transportation Act of 1964, and the appropriate sections of Title 49 -- Code of Federal Regulations. State of New Jersey legislative acts and contractual agreements presently in force are also included.

Again, the candidate institutional alternatives are the same as under the ownership, operational, and labor aspects.

1.5 Financial

Defined as pertaining to finance; fiscal, monetary and/or pecuniary. Included within the financial aspect is both capital and operating expenditures and funding sources and capabilities.

When dealing with the financial aspect, what is financially feasible is sometimes not fiscally possible. The financial resources to buy, develop, design and construct are not always available. The candidate alternatives include the State of New Jersey, a "new" authority/agency/corporation, Conrail, Amtrak, the Port Authority, or a private concern.

2. METHODOLOGY

In the discussions which follow, the issues associated with each aspect are presented. These discussions will put forth advantages and disadvantages which can be used as bases in addressing the problem. The discussions are intended to facilitate understanding of the problems associated with institutional alternative selection while highlighting a possible solution and course of action. Since each of the five aspects is common to each alternative, the discussion will detail all aspects within the context of each institutional alternative. Implications, which appear relevant, will also be identified.

It should be noted that interrelationships among the alternatives do not lend themselves to a cut and dry discussion. It is also premature to directly apply the alternatives to site specific locations although much of the discussions appear applicable to each site.

3. EVALUATION

3.1 State of New Jersey

The first question that must be raised concerns the aspect of ownership. Can the State of New Jersey legally own the land, tracks and appurtenances, buildings, etc. associated with maintenance on its commuter rail fleet?

Acquisition of property for transportation related purposes lies within the realm of state authority. Precedents exist. The highway system and its respective support facilities required land purchases. With regard to rail transportation facilities, the State of New Jersey recently purchased railroad rights-of-way on which passenger service is offered. Other capital expenditures include the purchase of the Hoboken terminal, and stations along the existing commuter lines.

Since precedents have established a basis for ownership by the State of New Jersey, the state could purchase land for the building of rail maintenance facilities. New Jersey has a huge investment in rolling stock. The future fleet is estimated at approximately 1,000 vehicles, and at an estimated conservative replacement cost of $500,000 per vehicle, New Jersey's fleet will have a value of one half billion dollars.

With purchase and subsequent ownership by the State, certain problems could develop. Local jurisdictions would incur a tax loss, and New Jersey might have to consider some alternative type of payment in lieu of taxes. Should the State be unable to purchase the property required, it could use its power of eminent domain to secure the land.

However, a court challenge could develop, and a long litigation process ensue.

Other challenges which could develop center on compatibility with surrounding land uses (zoning), and environmental objectives. (This factor will apply under all six alternatives.)

The second aspect addressed is operational. Does the State of New Jersey have the manpower, capability, and the expertise to perform the operational role in both facility operations and maintenance performance for their rail fleet?

In order to discuss this aspect, what "is" must first be delimited. Conrail presently has the N.J. DOT passenger train operation responsibility and authority. Conrail also performs the maintenance on the rolling stock and operates many of the maintenance facilities.

It appears that the State does not presently have the manpower, capability, or expertise to operate commuter rail maintenance facilities and perform maintenance on the equipment. It would be highly problematical for New Jersey to operate the maintenance facilities when it does not have passenger train operation responsibility and authority. The dichotomy which would evolve presents the train operating property without necessary control over equipment availability, but responsible for providing passenger services.

The State of New Jersey does not have a history of operating a commuter rail service or commuter rail maintenance facility. To attempt to project any possible cost benefits from a New Jersey takeover of commuter rail maintenance functions would be pure speculation at this time. What appears necessary is as follows: The State of New Jersey should develop and establish an authoritative means to oversee and control the maintenance performed by Conrail. Since New Jersey has a multi-million dollar investment in equipment it should institute measures to verify that maintenance of equipment is performed in a comprehensive, efficient, cost effective, and timely manner.

Additionally, there are three other options available to the State under the operational aspect. The first is "do nothing". Allow the status quo to continue, with the State of New Jersey contracting with Conrail for the performance of maintenance services. The second option would require the State of New Jersey to purchase the operations from Conrail. The third option entails a transition or slow "integration" of employees of the State of New Jersey into the maintenance work force positions through attrition of Conrail personnel and new hirings.

The first option is self explantory. If this is the selected option and the State continues its contract with Conrail, it should also initiate a comprehensive check and verification system.

With the second option, the State could assume responsibility for maintenance performance on the N.J. DOT fleet. Since it does not have the manpower and expertise, it would "purchase" the present Conrail labor force. With such a course of action, the State would also have to assume the shopcraft agreements and be bound by present contract work rules. Under this type of arrangement, the work force would be employees of the State of New Jersey. Although the State could exercise jurisdiction and control over this labor group, implementation of any and all changes would probabaly have to be negotiated.

The third option would require a gradual assimilation of the maintenance operations and performance by the State of New Jersey. As previously discussed, the State does not, at present, have the where-with-all and expertise to run and perform maintenance at a facility. The approach used in this option is one of staging. In order to gain this expertise and knowledge, any new positions which developed would be classified as a State of New Jersey position. All persons who applied for these positions and were hired, would be employees of the State. In a similar fashion, when a Conrail employee leaves, retires, or dies, his job would be filled by a new N.J. employee. In this manner, all the people performing maintenance would eventually be on the New Jersey payroll and subject to the rules and regulations established by the State.

When we consider the labor aspect, the first area of discussion is work force. Where will the employees come from?. A number of options are available. The State could establish its own categories of labor classes and advertise for employees at prevalent wage rates, or could purchase existing employees from other rail properties through lump sum payments to those employees, or through the transition process previously discussed. Each of these options has its own merits and drawbacks.

The railroad labor force is protected under various federal laws and regulations. The state would have to accept and honor existing protective agreements in order to insure access to federal funding. This implies that the rail labor organizations will have a major input into the development of the institutional alternative.

There are precedents which demonstrate that the assimilation process is possible through cooperative efforts of management, labor, and government. Examples are the PATH system and Amtrak.

In discussing the legal aspect, the interrelationships among the five aspects permeates the discussion. Under the three preceding aspects, legal aspects appeared -- legal right to own, legal and legislative right to operate, and the legal rights of existing rail employees. Under the financial aspect, legislative requirements mandate adherence to law in order to receive both capital and operating assistance.

A number of other issues must also be considered when determining the legal aspect. These include:

- o The effects of the Regional Rail Reorganization Act on the alternative with respect to funding.
- o Is the State of New Jersey presently empowered to own, operate and manage rail maintenance facilities?
- o The effects, if any, on the institutional alternative by the regulations of the Interstate Commerce Commission, Federal Railroad Administration, etc.
- o The effects of the Railway Labor Act on the State of New Jersey.
- o The question of liability to taxation.
- o The question of public accountability, and its effect on operations.

The last of the aspects to be discussed is the financial aspect. It is interrelated with the other aspects. The question of financial resources for design, construction and operation of maintenance facilities poses numerous problems. With the State as the institutional alternative, access to federal grants for purchase, facility design, and construction of facilities would be possible.

- o Could the State pay indemnification costs (if it assumed the labor force), and from whence would the money come?
- o Could the State pay facility operating costs from the general fund, or from instituting a special tax?
- o From what resources would funds for capital costs come -- general taxes, a special tax, etc?

Should the State of New Jersey be the selected institutional alternative, mechanisms would be required to meet the financial aspect requirements. The primary areas of concern deal with operating costs, labor costs, and funding sources.

3.2 Public Corporation

The second institutional alternative involves the creation of a "new" agency/authority/public corporation. The State of New Jersey has created such a corporation, New Jersey Transit, to manage its commuter rail and bus operations. The enabling legislation was shaped to meet the following "ideal criteria":

- o Assure ability to increase ridership and re-shape service to meet public goals of mobility, air quality, energy conservation, and urban revitalization.
- o Provide quality service in a cost effective manner.
- o Assure opportunity for intermodal coordination and service rationalization.
- o Provide public control over personnel, equipment, and facilities at a level commensurate with the degree of public financial involvement.
- o Assure responsiveness to the Governor's policy direction and foster close interaction with the other state agencies.
- o Recognize and include local and regional interests in the transportation decision-making process.
- o Assure ability to attract and keep a highly competant professional staff to be responsible for day-to-day operational decisions.

The question of ownership of maintenance facilities by the transit corporation is the first aspect considered. Two approaches to this aspect are direct ownership, or the transit corporation as the leasee having all benefits of ownership.

Since the public corporation is an agency of the state, created by the legislature, ownership of maintenance facilities is within it realm: The corporation (New Jersey Transit) is a vehicle of the State with the express intent of providing public control over personnel. equipment, and facilities at a level commensurate with the degree of public financial involvement. It has already been established that the State of New Jersey (through the Department of Transportation) owns rail equipment and terminal facilities, and thus, an agency (public corporation) of the State could own rail maintenance facilities.

The other approach to ownership is one in which the transit corporation is leasee of maintenance facilities, (from the State), but possesses all benefits of ownership. This approach eliminates the legal entanglements that could develop if the approach above (direct ownershop) is employed. Under this concept, the corporation would lease the facilities from the State which has the power to own, should there be a question of the public corporation's right to own.

Under the operational aspect, the discussion contains those same elements which were discussed under the State of New Jersey alternative, which included manpower, capability, and expertise. However, the transit corporation recently purchased two major bus companies, Transport of New Jersey and Maplewood Equipment Company, from the Public Service Electric and Gas Company. As of October 14, 1980, TNJ and MEC, which retained their respective equipment fleets, facilities and operating rights, became subsidiaries of New Jersey Transit. Implicit in the transit corporation's position as a holding company is the fact that its subsidiaries employ the drivers, mechanics and other personnel associated with bus operations and maintenance. This may have established a precedent for similar action concerning commuter rail operations.

The labor aspect is the third area to be considered. As noted above, precedent could exist for such a takeover by the transit corporation. As discussed earlier under the State alternative, two other approaches are also possible. The first, maintain the "status quo", would have the corporation continue to purchase services from Conrail, while the third would have the transit corporation gradually assimilate the work force through attrition and new hirings. Each approach can be justified, but the final decision will depend upon the policy established by the new corporation.

Under the legal aspect, the issues addressed under the alternative dealing with the State of New Jersey are the same for the public transit coporation. These include the effects of the Regional Rail Reorganization Act, the regulations of the ICC, FRA, etc., and the question of liability to taxation.

The financial aspect of this alternative is not clearly defined. It appears that the transit corporation, as an agency of the State of New Jersey, is empowered to seek funds for capital and operating assistance from the federal government, and matching funds would be appropriated from its operating budget. Its dealing in this regard would probably parallel other state agencies such as the Department of Transportation. Monies allocated in the transportation bond issue which were earmarked for public transportation would probably be placed under the public corporation's control.

3.3 <u>Conrail</u>

As with the State of New Jersey and the public corporation, this alternative also contains the five aspects. With respect to ownership, Conrail presently holds title to rail maintenance facilities. Therefore, it seems unlikely that any new impediments exist which would preclude Conrail ownership.

In addressing the operational aspect, Conrail has experience and expertise as a rail maintenance facility operator. It is presently operating many of the facilities which perform maintenance on the New Jersey rail fleet. It also employs the personnel who perform the maintenance. Again, it appears that few difficulties would be encountered if Conrail were to operate the facilites and perform the maintenance.

The labor aspect of the Conrail institutional alternative is the third area. Reinforcing the previous two aspects, Conrail has the existing labor force and shopcraft agreements.

The legal and financial aspects of this institutional alternative are so interrelated that they are considered together.

Having the necessary capital to meet the operating and capital expenditures necessary for maintaining a commuter rail fleet is a problem common to all transit carriers.

Conrail is not in a financial position to assume the responsibility for maintenance. First, it does not own the rolling stock; second, Conrail does not have the financial resources to build new facilities; and third, Conrail was formed with the express purpose of developing and maintaining freight activities and making a profit.

At the present time Conrail provides passenger service and performs maintenance on the rail commuter equipment under contract with the State of New Jersey. Articles V and VI of the contract deal with "Equipment" and "Maintenance", and defines other responsibilities of each party. Therefore, the institutional alternative, Conrail, is comparable to a "maintain the status quo" alternative. It eliminates the possibility of major changes in the maintenance program without the mutual consent of both parties. Therefore, the area that must be investigated and a decision reached, is "should New Jersey continue this arrangement?"

3.4 Amtrak

The fourth institutional alternative under consideration is Amtrak. Amtrak was created to provide intercity rail passenger service. It has its own facilities and performs maintenance on equipment. Like Conrail, it has the operational expertise. It has the labor force and respective shopcraft agreements. Obviously, Amtrak could be a viable alternative in this regard.

The sources of funds for Amtrak come from passenger revenues, federal appropriations, and federally-guaranteed loans. Whether Amtrak could assume the N.J. DOT fleet maintenance as well as operations of facilities is problematical. Contractual agreements could be developed which would allow this option. The question of federal regulations allowing a complete and comprehensive assumption of the N.J. DOT rail fleet maintenance would necessitate a detailed legal search. Are all N.J. DOT train operations "intercity" passenger services as defined by the federal legislation which created Amtrak? Does Federal law allow Amtrak to own such facilities (for performance of maintenance on a state's fleet)?

3.5 Port Authority of New York and New Jersey

The fifth institutional alternative is the Port Authority of New York and New Jersey. The Port Authority presently owns and, through its subsidiary, the Port Authority Trans-Hudson (PATH) Corporation, operates a commuter rail transportation system. It has the requisite expertise and experience in operating a maintenance facility and performing rail vehicle maintenance.

Under existing bi-state legislation, the Port Authority cannot become further involved with deficit-producing rail passenger operations without first satisfying the contractual requirements of covenants with its bond holders. If these restrictive convenants were removed or otherwise satisfied, maintenance of the New Jersey commuter rail fleet by the Port Authority could become a viable alternative.

3.6 Private Firm

The last institutional alternative under consideration proposes a private firm be responsible for the operations and performance of maintenance at any proposed facilities. It is highly unlikely that a private firm would be able to build facilities using its own capital. The realization that the return on its investment would not materialize were such a venture undertaken would preclude a private firm's involvement. If the State were to build, and then have a private firm manage and operate the facilities under contract, what benefits would the State derive?

With respect to the labor aspect, a private firm would be in a similar position as the other institutional alternatives. Most likely, it would be required to absorb the present work force, the shop craft agreements, etc. Therefore, it appears unlikely that a private firm would be a good candidate as an institutional alternative.

4. SUMMARY

Each of the institutional alternatives discussed above has its own pro's and con's requiring further analysis in the context of the overall institutional arrangements for the future management, operations, and maintenance of New Jersey's commuter rail network. Inasmuch as N.J. DOT has undertaken a comprehensive analysis of institutional alternatives to its present arrangements, known as the "Conrail Alternatives Study", the selection of a preferred insitutional alternative for rolling stock maintenance is not appropriate for inclusion in this report.

CHAPTER V

ALTERNATIVES ANALYSIS

CHAPTER V

CHAPTER V

ALTERNATIVES ANALYSIS

1. FACILITY CONSOLIDATION/CENTRALIZATION VERSUS DECENTRALIZATION

1.1 Introduction

No magic formula exists for the selection of the best maintenance plan for a commuter rail operation. Prior to the development of a maintenance plan, several factors common to all maintenance functions must be reviewed and understood. These include the following areas:

- o Organization Plan,
- o Maintenance Practices,
- o Cost Assignment,
- o Accounting Procedures,
- o Material Requisitioning, and
- o Training Programs.

1.1.1 Organization Plan

The type of organizational structure should be charted, and the respective responsibilities of each group displayed. By charting each of the work efforts, details of flaws in the existing decentralized structure will be disclosed. These flaws include the overlapping of responsibilities, variations in the number of men assigned to each supervisor or foreman for specific functions, and work performance. The development and utilization of a comprehensive organization plan will therefore maximize efficiency, eliminate duplication of efforts, enhance work schedules, and allow for a smoother maintenance operation.

1.1.2 Maintenance Practices

The present maintenance practices should be reviewed. Is the work performed not only meeting Federal and other regulatory agency requirements, but minimizing equipment down time? Are preventive maintenance practices being employed? Are the time deliveries of materials inhibiting repair and rebuild work? Are personnel being utilized in the most efficient and effective manner? Are standards for maintenance activities established?

1.1.3 Cost Assignment

An analysis of the maintenance should be performed to determine what items and costs are chargeable to capital expenditures and what items are operating expenditures. The utilization of "unit exchange" with component contractors, described in Chapter III, is an example of a cost chargeable to operating expense.

There is also a "sell and buy" transaction, which, if circumstances permit, can be a capital account charge. This occurs where a defective or worn out major component is sold to a contractor or a salvaging rebuild company and a new or rebuilt unit is purchased.

It should be noted that with the "unit exchange" or "sell" and buy" transaction, the major advantage is the warranty provided by the rebuild manufacturer or contractor.

Generally, the volume of rebuild work is an important factor in sizing a facility as is the availability of technical and qualified shop craft personnel. Usually the technology and development in component improvements make it difficult to keep a rebuilding facility updated in machinery and techniques unless there is reasonable volume. The company or manufacturer is a specialist, who has the volume, and can more readily handle the requirements of rebuild improvements.

1.1.4 Accounting Procedures

The accumulation and distribution of maintenance charges are critical in the evaluation and determination of improvement areas. Improvements and potential improvements must constantly be investigated since maintenance costs are seldom satisfactory. Admittedly, it is difficult to achieve a balance between costs and service. Each is attainable, but usually at the expense of the other. Service can always be improved if costs are ignored. Conversely, lower costs can be obtained if service is minimized. The key is often the type of maintenance facilities and organizational plan developed. Well defined accounting procedures "red flag" problem areas before these areas become unmanageable. Therefore, more consideration must be given to the accounting procedures which influence the selection process, as well as a particular plan's advantages and disadvantages. Without well developed accounting practices and procedures, pinpointing areas for improvement not only become difficult, but almost impossible.

1.1.5 Training Program

A comprehensive training program must be developed, instituted, and adhered to in order to maximize the efficiency of the maintenance operations. Standards should be established which govern work performances and will minimize equipment down time.

1.1.6 Material Requisitioning

How are materials requested from stores? How are they requested and ordered from outside suppliers? What controls are in effect? Are control sheets used to assist in material inventory? What other controls are in effect and utilized?

1.1.7 Summary

After a review of these six (6) factors and what each encompasses, it is apparent that a maintenance policy and comprehensive plan must be developed. The locations of the facilities selected for the implementation of this plan could exhibit various degrees of consolidation or decentralization. The following sections examine the benefits and disadvantages of each philosophy.

1.2 Consolidating Maintenance Activities

Consolidating maintenance activities, according to levels of maintenance, in one, or as few locations as possible, has certain benefits. These include speed, manpower availability, flexibility, better control and staffing, reduced overall material inventory, a more efficient and effective use of equipment as well as various cost savings.

1.2.1 Speed

The in-shop function of inspection and repair can normally be accomplished faster in a centralized facility. A consolidated facility affords designated, well tooled positions, with increased availability of highly skilled craftsman to work on a piece of equipment or component.

1.2.2 Flexibility

A properly designed, consolidated facility allows maximum flexibility within the assigned work areas. Inspection and repair positions can be utilized for various equipment types, craftsmen assigned, and work performed.

1.2.3 Reduced Material Inventory

Replacement components and parts play an important part in a maintenance program. With a consolidated facility, the systemwide materials inventory can be reduced, since all repair work is performed at one location.

1.2.4 Capital Cost Savings

With a consolidated facility, certain capital cost savings can accure.

- o Less costs are incurred for tooling and shop machinery. Since duplicate facilities are not needed, duplicate tools and machinery are not required.
- o The cost of installing utilities at one site is less than the cost of bringing service to many sites.

- The cost for one large consolidated facility is less than the costs for many smaller decentralized facilities.
- With respect to land costs, savings should be experienced since there are reduced overall acreage requirements (depending on location(s) selected).
- Costs for environmental controls are reduced since one system at one site is involved.
- Savings are incurred with respect to running, yard and storage tracks.
- Savings are experienced with regard to electrification of yard and storage areas.

1.2.5 Operating Cost Savings

Operating cost savings can be attained with a centralized maintenance facility.

- Reduction in the maintenance of facility (physical plant) cost since one facility, versus many facilities, has to be maintained.
- Administration costs are less since administration is centralized at one location.
- Since one stores area is required, overall parts and component inventory activities are reduced, thus a savings is realized.
- Costs for site security are reduced since one, versus many, sites are involved.
- Costs for supervision are less.

- o If the consolidated facility is dedicated to servicing the passenger fleet and excludes freight vehicle maintenance, savings can usually be achieved.

1.2.6 Manpower Benefits

Maintenance of equipment requires the utilization of a highly specialized labor force. With a consolidated facility, certain benefits can be realized.

- o Highly specialized labor and shop craft personnel can be justified and maintained because of the high volumes of inspection and repair work.
- o Better supervision and supervisory control.
- o Better personnel control in terms of job performance, workmanship, etc.
- o Better utilization of manpower.
- o Single responsibility for reliability and utilization.
- o Central responsibility for all repair work.

1.2.7 Other Advantages

In addition to the advantages cited above, other advantages which are realized with a consolidated facility include:

- o Better utilization of manpower, repair equipment, machinery, tools, etc.
- o Higher utilization of floor space.

- o Better control of "repair and return" components and/or assemblies.
- o One stores point is required.

1.3 Decentralizing Maintenance Activities

There are a number of benefits which can be associated with a decentralized maintenance operation. With this concept, maintenance facilities and activities are located throughout the system. Benefits include less deadheading of equipment, reduced out-of-service time, easier equipment storage, and alternate maintenance sites in case of emergencies.

1.3.1 Less Deadheading

Since maintenance facilities are located throughout a system, equipment which requires inspection and/or repair has fewer deadhead miles to travel. Hence, operating cost savings (in terms of crew requirements, fuel consumed, and general equipment wear-n-tear) can be achieved.

1.3.2 Reduced Out-of-Service Time

With decentralized facilities, equipment can be shopped almost immediately if a problem develops. The aspect of deadheading and the time necessary for this move to the shop is reduced.

1.3.3 Easier Equipment Storage

Since facilities are decentralized, smaller numbers of equipment are handled at any one facility. This allows for easier storage and separation of layover equipment versus bad order equipment, since space requirements are less.

1.3.4 Alternate Maintenance Sites

Should an emergency develop, decentralized facilities afford the use of alternate maintenance sites. The equipment in need of repair can be shopped at any number of locations.

1.4 Summary

The various factors and benefits associated with a centralized facility and with decentralized facilities have been presented. Prior to developing a recommendation for the N.J. DOT rail fleet, the existing and future operations of the rail passenger system must be examined, on a subregional as well as as system wide basis.

2. OPERATIONAL MAINTENANCE ALTERNATIVES

2.1 Service Areas

In order to comprehensively address the maintenance alternatives, the present passenger services were divided into four service areas. These areas were designated as follows:

- o Hoboken Terminus
- o Penn Station, New York, Terminus
- o Newark Terminus
- o Atlantic City Operations

The rationale for these designations are predicated on existing operations of N.J. DOT passenger rail service as well as being reflective of the former railroads' operation.

2.1.1 Hoboken, New Jersey

The first designated service area is Hoboken Terminus. This service area is reflective of the former Erie-Lackawanna services. The originating/ terminating terminal is Hoboken. MU cars (DC), cab control coaches, and locomotive hauled coaches are maintained at Hoboken terminal. Diesel locomotives are presently deadheaded to Elizabethport for monthly inspections.

2.1.2 Penn Station, New York

This service area reflects all commuter rail services which terminate at Penn Station, New York, and consists of multiple-unit cars, and electric locomotives and electric locomotive hauled coaches. North Jersey Coast Line and Northeast Corridor Line Services, originating at Bay Head, South Amboy, Jersey Avenue, and Trenton, offer direct service into Manhattan's Penn Station. The MU monthly inspections are performed at Sunnyside Yard in Queens. The GG-1 electric locomotives receive their monthly inspections at Wilmington.

2.1.3 Newark, New Jersey

This service area entails former Central of New Jersey services which terminate at Newark, with train storage in Harrison. Push-pull trains, locomotive hauled coaches, and rail diesel cars (RDC's) are used on this service. Periodic maintenance is performed at Elizabethport.

2.1.4 Atlantic City, New Jersey

The fourth area which will be discussed is the Atlantic City operation. This service which uses rail diesel cars (RDC's) exclusively, operates in the southern portion of the state and is virtually isolated from other N.J. DOT passenger rail lines. It was formerly known as the Pennsylvania-Reading Seashore Lines. Monthly inspections of RDC's are performed at Atlantic City.

2.1.5 Summary

Within each of these service areas were developed various alternatives for maintenance performance. Alternatives were selected to represent all reasonable degrees and combinations of consolidated and decentralized facilities. The alternatives for each terminus will be presented, the respective pro's and con's set forth, and a recommended alternative will be stated.

The alternatives selected dealt with the major tiers of the four recommended types of maintenance facilities. Therefore an incomplete picture of the total maintenance plant of each service area is presented. It was determined that recommendations for these remaining facilities would entail utilization of most of the existing facilities, with some minor modifications, and would thus not require the type of analysis presented herein. Many of these recommendations are independent of the decisions reached for the major facilities. The final recommendations for these lower activity level facilities are described in the next chapter.

2.2 Hoboken Terminus Facility Alternatives Analysis

At the present time, there are over 400 units of equipment invoved in the operations of this service area. This fleet consists of diesel locomotives, DC MU cars, coaches, and cab control coaches which are used in conjunction with push-pull services.

In addition, when the former Erie-Lackawanna rail lines are re-electrified, AC MU cars will replace the present DC fleet. In order to maintain and service the present and future equipment on a regular basis, a Service and Inspection Facility as described in Chapter III is needed. This type of facility would perform monthly inspections of all units, scheduled intermediate repairs and minor modifications, component changeouts, emergency work, as well as the functions of Light/Running Repair and Turnaround Facilities. These maintenance functions convert into shop and track space to perform diagnostic testing, wheel truing, diesel-electric locomotive inspection and repair, MU inspection and repair, cab control and coach inspection and repair, small parts and component storage, and work areas equipped with machines and tools to perform this work.

The Hoboken terminus fleet also requires the services which are performed in a Major Repair/Rebuild Facility. These include tracks and shop space for scheduled heavy repairs, rebuilding and/or repairing components and assemblies, and interim and major overhaul of equipment.

For the Hoboken terminus, five maintenance alternatives were considered. These are:

<u>Alternative 1:</u> Continue the maintenance of equipment operations as they presently exist.

<u>Alternative 2:</u> Upgrade the existing facilities at both Hoboken and Elizabethport.

<u>Alternative 3:</u> Build a new Service and Inspection Facility at the existing Hoboken terminal area and:
a) maintain E'port in its present status;
b) upgrade Elizabethport so that it can continue to handle major repair and rebuild work; or
c) build a new Major Repair/Rebuild Facility elsewhere.

<u>Alternative 4:</u> Build a new centralized and consolidated facility for S & I work and heavy repair work.

<u>Alternative 5:</u> Build a new S&I Facility and a new MR/R Facility.

2.2.1 Alternative 1: Null or Do Nothing

The hypothesis presented in the first alternative proposes the do nothing alternative -- continue the servicing and maintaining of equipment at all present locations which now perform maintenance. In order for this alternative to be viable, the existing maintenance operations must be examined. The primary areas which must be addressed are:

- o Are the present facilities adequately meeting the present maintenance requirements?
- o Are the present maintenance operations performed in an efficient and effective manner?
- o Can these existing facilities accomodate future maintenance needs?

The Hoboken maintenance facility presently performs heavy maintenance and monthly inspections on the MU cars in a three-track stub-ended MU shop. The shop is described in Chapter I. Simply stated, the MU facility requires extensive rehabilitation.

The Mainline, Bergen County, Pascack Valley and Boonton (MBPB) lines have diesel powered push-pull service. The diesel locomotives undergo monthly inspections and repairs at Elizabethport because the existing facilities at Hoboken are inadequate for this type of work. The cost of locomotive movements between the two shops approximates $100,000 annually. Only sanding, fueling, daily inspections and some running maintenance are performed on the diesel equipment at Hoboken; these activities are performed in open yard areas adjacent to the MU shop. These existing facilities at Hoboken can generally be classified as inadequate.

Due to space limitations in the yard, running maintenance and intermediate repairs on the push-pull coach fleet is performed at scattered outdoor locations. Brake rigging, battery, spring, minor truck and some accident repairs are accomplished frequently with the use of three 25 ton portable jacks. Heavy coach repairs are sent to E'port.

There is a drop table that can handle one wheel change at a time. This location also provides a three feet deep inspection pit which can handle approximately two cars. The wheel truing machine is in poor condition. Its location requires the east end door to be left open when a vehicle is positioned at the machine. Car washing is performed at the outdoor car-wash facility in the yard.

As noted above, the Hoboken diesel locomotives are maintained at Elizabethport. E'port is approximately a three hour deadhead move from Hoboken. Within the Elizabethport maintenance complex are two main buildings which are used for locomotive and car repairs, both passengers and freight. Further description is contained in Chapter I.

Within both the car shop building and the locomotive shop building are two tracks dedicated for N.J. DOT car repairs. Both of these shops can be classified as in generally poor condition, with the roofs requiring major repairs. Shop machinery is antiquated.

Heavy engine overhaul, major generator and motor work, and rebuilding of steam generators are not performed in-house, but usually shipped to a subcontractor. An air brake cleaning and repair room is proposed, but presently, brake equipment cleaning and test work is done in Altoona.

"Are the present facilities adequately meeting the present maintenance requirements?" was the first question raised. The preceding review of the existing maintenance operations and conditions at the various facilities indicates that maintenance performance can and should be improved. Buildings are generally in a fair to poor state, and various maintenance functions are performed outdoors, exposed to the elements. Therefore, the first alternative -- a do nothing hypothesis -- has questionable viability since various problems are present.

"Are the present maintenance operations performed in an efficient and effective manner?" The answer to this question is virtually impossible to ascertain. Given the existing conditions at many of the facilities which maintain N.J. DOT equipment -- buildings in fair to poor condition, maintenance equipment and tooling which are old and not designed to handle modern rail equipment -- improvements could enhance maintenance operations and performance.

The third question concerned the ability of the existing facilities to handle anticipated maintenance demands. Space for inclusion of additional work at the Hoboken facility is at best marginal. The existing stub-ended MU shed would probably have problems accomodating the Arrow cars when the former Erie-Lackawanna electrified territory is converted to AC electrical power. As noted earlier, the spacing between shop track centers is approximately seventeen feet. Recently designed maintenance shops recommend twenty five feet, allowing easier movement and greater flexibility around the cars.

Elizabethport presents a different problem. The existing locomotive and car shops could be expanded and improvements made, but facilities are not available for MU cars. In addition, its location is not well suited for N.J. DOT fleet maintenance. As noted earlier, E'Port is not in the immediate proximity of existing N.J. DOT commuter lines and requires deadhead moves of equipment.

2.2.2 Alternative 2: Upgrade E'port & Hoboken

In addressing this alternative, upgrading the Hoboken facility will be discussed first. The present maintenance functions have been described in detail in other portions of this report. The existing facility's conditions have also been delineated. A brief summary of those conditions follows:

- The MU shop is in need of extensive rehabilitation -- shop lighting, roof, insulation, etc.
- Within the shop, track spacing is 17 feet from center.
- Tracks stub-end within the shop.
- Yard storage space is at a premium.
- Existing locomotive fueling area has a ground saturation problem.
- Motor, air conditioning repairs, and air brake work are performed in the Modoc Shop (two-car length pit; half indoors, half out).
- Locomotive running maintenance is performed in open yard areas.
- Facility lacks modern tools and machinery for the performance of vehicle maintenance.
- Work areas are constrained.

The viability of a major upgrade of existing Hoboken facilities has been the subject of a number of reports. The Gibbs & Hill Final Report -- a Conceptual Design of Maintenance Facilities at Hoboken, New Jersey for the Jersey Arrow III's -- dated August 3, 1977 stated:

"This Report presents a conceptual design of facilties at Hoboken, New Jersey, for the maintenance of electric multiple-unit (MU) coaches, being acquired for service on the former Erie-Lackawanna electrified commuter lines. According to the terms of reference established by N.J. DOT, this design was to be based on the best usage of facilities already existing at Hoboken which limited the design to adaptation of the existing MU shed and the former Railway Express Agency (REA) building, both these buildings being located west of and near the Hoboken passenger terminal.

As this Report shows, a number of practical difficulties would attend the adaption of the REA building to the purposes of maintaining a large MU fleet and, therefore, this alternative was discarded early in the analysis. Cost estimates, building layouts, schematic plans and other information of a detailed nature are accordingly, presented only for the alternative based on the adaptation and enlargement of the existing MU shed..."

The renovation and expansion of the existing MU shed in Hoboken could be accomplished, but it is questionable whether adequate space would be available to perform all inspection and service functions of a Service and Inspection Shop as presented in Chapter III, since the shop would be stub-ended, space constrained, and existing storage yard area would be reduced. In addition, any type of major improvements which were to be undertaken at the existing Hoboken maintenance facilities would impede and hinder present commuter operations. As presented in other parts of this report, daytime layovers utilize virtually all available tracks (and yard space). Coupled with the maintenance activities which are presently performed outdoors, (and which would be displaced were major improvements undertaken), any additional space for expansion is almost non-existant.

Since the first premise of this alternative is not implementable in desirable terms, the alternative for upgrading Elizabethport will not be discussed within the context of Alternative 2, but will be discussed under the next alternative.

2.2.3 Alternative 3: New Hoboken S&I with a) E'port Null, b) E'port Upgrade, or c) New MR/R

The idea for a new Service and Inspection Facility at the existing Hoboken terminal area has been the topic of much discussion. Rather than approach this alternative from a purely theoretical standpoint, a practical, rational approach will be used.

Based upon the N.J. DOT fleet size, SSV&K developed a space requirement of approximately 200,000 sq. ft. for a S&I shop handling MU's, locomotives, and coaches which would adequately meet the N.J. DOT fleet needs for a comprehensive preventive maintenance program. A site plan for such a facility on the existing Hoboken terminal property was developed to determine the merit of this alternative. This facility would create interference with existing train operations. The existing MU shed would be demolished to make room for relocated storage tracks. Some of the existing maintenance facilities, such as the outdoor pits and fueling area, would have to be removed and relocated in order to provide space for the new S&I shop since space limitations exist.

Another problem that could develop concerns a lack of facilities to maintain the existing MU fleet during the demolition/construction period. At the present time, there are no facilities of sufficient size, and with adequate manpower to service and inspect the existing fleet elsewhere in the State of New Jersey. The existing facilities at Sunnyside would not be able to accommodate additional work loads of nine to ten monthly inspections per day. (This work load assumes the AC Arrow cars to be in service on the former Erie-Lackawanna electrified operations.) Therefore, the first premise of this alternative was not considered very promising.

Sub-alternative a proposed the continued use of Elizabethport for heavy repairs. With a new S&I shop at the existing Hoboken facilities area, monthly inspections of locomotives would be performed there, thus eliminating the excessive time and costs presently expended for light and deadhead moves (see Chapter I). E'port would still be utilized for heavy repairs of locomotives. However, heavy repairs to MU cars would present a problem. E'port is not presently equipped to handle MU repairs. Therefore, the null Elizabethport alternative was discarded from futher consideration.

Sub-alternative b proposed an upgrade of Elizabethport in conjunction with a new S&I facility at existing Hoboken. E'port shop improvements and expansion are highly possible. Space is not at a premium. However, the location is not well-suited for maintenance of the fleet of this service area. It is not in the immediate proximity of the commuter lines and requires light and/or deadhead equipment moves. Another problem with this sub-alternative is that MU cars would have to be locomotive hauled to E'port (even if E'port were upgraded to handle MU cars). The costs of these new deadhead moves would be quite significant, judging from the estimates of current costs presented in Chapter I. This sub-alternative was discarded as economically non-feasible.

Under sub-alternative c, a new facility for heavy repairs would be built elsewhere, more conveniently located to/from Hoboken. This consideration has merit. A new main repair facility could handle all locomotive and MU work of a heavy nature. Although this sub-alternative is viable, when it is coupled with using the existing Hoboken terminal area for a new S&I shop, it is an alternative of low priority.

2.2.4 Alternative 4: New Centralized & Consolidate Facility

Arguments have been presented which depicted the benefits associated with decentralization or consolidation of maintenance facilities. The implications that evolved suggest the hypothesis that the N.J. DOT fleet should be maintained at a centralized facility, having both service and inspection, and major repair/rebuild capabilities. The inadequacy of existing facilities lends credence to the idea of a new facility. Such a facility appears viable for this service area on the basis of the potential for improved control of personnel and for various capital and operating cost savings, as discussed previously in this chapter. Further refinement of this consolidated facility concept is discussed in the remainder of this section.

In the performance of scheduled maintenance functions, such as monthly inspection, there are certain parameters which are utilized. These parameters are employed to determine when scheduled inspections are performed, and at what locations.

If the statement -- efficient operation of an inter-city rail commuter service requires the availability of a completely reliable service fleet of clean revenue cars sufficient to maintain advertised schedule service, while minimizing the total number of cars required -- is used as a base for vehicle requirements, then scheduled maintenance of equipment must be performed during periods that the equipment is not in use. N.J. DOT equipment is available for scheduled maintenance during layover periods -- midday, after the A.M. peak period and before the P.M. peak, or overnight. Therefore, in order to minimize equipment requirements, scheduled maintenance should be handled during these time periods when the cars and locomotives are not required to provide revenue service.

A second parameter utilized requires that the scheduled maintenance service be performed within the immediate proximity of the terminating/originating terminal. The rationale for this guideline is the reduction in deadhead and light moves.

A third parameter requires the location of the maintenance service facility in the proximity of the train storage yard. As in the previous guideline, this minimizes deadhead and light moves.

Two additional parameters which influence the location of the maintenance facility are the proximity to mainline tracks, and to existing electrification power sources. Close proximity affords better access to a facility and eliminates the need for extensive electrification and new track construction.

The N.J. DOT fleet is stored at sixteen different locations for nighttime layovers. The State would incur heavy operating costs for deadheading the equipment to a central facility for scheduled maintenance during the overnight layover period. Obviously, scheduled maintenance, such as monthly inspections, should not be performed during the nighttime layovers if extensive deadhead moves are required. Equally obvious, due to the amount of capital expenditures involved, is the absurdity of constructing S&I and heavy repair/rebuild facilities at each of the overnight layover sites.

The remaining implication, when the present N.J. DOT rail passenger operations are reviewed, suggests that schedule maintenance be performed during the midday layover period at a location reasonably near the layover site, Hoboken in this case, and in proximity to mainline tracks and existing utilities. An operating plan, which includes the cycling of equipment for maintenance, should be developed and implemented.

2.2.5 Alternative 5: Separate New S&I and MR/R Facilities

Each of the new facilities proposed under this alternative would be independent of one another. This proposed alternative is also extremely viable for the same reasons cited under Alternative 4. This alternative is considered inferior to Alternative 4 should space for a consolidated facility be available. This decision is due to the advantages of consolidating facilities, as previously discussed.

2.2.6 Summary

Exhibit V-1 recaps the evident benefits and disadvantages associated with each of the alternatives evaluated. Based on a comparison of these items, it was determined that Alternative 4 presents the best opportunity for the State with regard to maintenance performance for this service area. Since existing facilities are inadequate or difficult to upgraae, it appears that the best direction is a new facility, consolidated at one location. This will provide the most benefit and, although most costly, will not meet the problems anticipated under the other alternatives. Alternative 5 is recommended should a site to accommodate the entire consolidated facility not be available.

2.3 Penn Station, N.Y. Terminus Facility Alternative Analysis

Major inhibiting factors on the operations of this service area are the availability of Hudson River tunnels and of platform space at Penn Station. The

HOBOKEN TERMINUS ANALYSIS SUMMARY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 "Null" or or Do Nothing	No capital expense. Minimal deadheading for daily and monthly MU and coach maintenance	Existing shops generally inadequate; need extensive rehabilitation. Some activities performed outdoors. Inefficient shop track spacing. Stub-end operation. Poor control of manpower. Lack of MU heavy repair facility. Limited storage tracks. Antiquated tools and machinery. Continued costly light movements. Inability to handle future needs
2 Upgrade Existing @ E'port	Makes maximum utilization of existing capital investments; less costly than constructing completely new facility. Minimal deadheading for daily and monthly MU and coach maintenance Improved efficiency through use of modern tools & machinery. Provides facility for MU heavy repairs.	Extensive renovation required. Interference to existing yard revenue operations: need to remove/relocate some existing facilities. Complicated construction phasing plan required. Continued costly light movements. Stub-end operation. Limited storage tracks. Need to locomotive-haul MU's from Hoboken to E'port.
3 New S&I at Hoboken with a) E'port "Null" b) Upgrade E'port c) New MR/R	Minimal deadheading for all but heavy repair functions; elimination of current deadhead movements. Improved efficiency through better shop layout and use of modern tools & machinery. Potential reduction of fleet requirement due to theoretical decrease of out-of-service time.	Interference to existing yard and revenue operations; need to remove/relocate many existing facilities. Complicated construction phasing plan required. Continued light movements for heavy repairs. Limited storage tracks. ALSO Under sub-alternative 3a Lack of MU heavy repair facility. Under sub-alternative 3b Need to locomotive-haul MU cars from Hoboken to E'port.

HOBOKEN TERMINUS ANALYSIS SUMMARY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
4 New Centralized & Consolidated Facility	Minimal deadheading for all maintenance functions (depending on location); possible resultant reduction of equipment requirements. Provides facility for MU heavy repairs. Improved efficiency through better shop layout, use of modern tool & machinery better control of manpower. Pull-through operation possible. No interference to current operations during construction. Allows rearrangement/modification of existing yard and service facilities. Potential reduction of fleet requirements due to theoretical decrease of out-of-service time.	Expensive.
5 New S&I & New MR/R (not Consolidated)	Same as Alternative 4.	Expensive. Slightly less efficient than Alternative 4 due to some duplication of items decreased control of manpower, increased overall spare parts requirements etc.

station is relatively close to some New Jersey maintenance facilities, although easy and direct access to all of these is not available at the present time. Although some running maintenance and cleaning is conducted at Penn Station, the nature of the present operation requires the use of Sunnyside Yard in Queens, via deadhead moves, for the performance of all monthly inspections and most light running repairs on MU's and locomotive hauled coaches. The present commuter rail maintenance facilities in New Jersey cannot handle the monthly inspections of all the Arrow cars.

The facilities at Wilmington, South Amboy, Bay Head, Trenton, and County Yard support the balance of maintenance activities required for this service area. N.J. DOT equipment presently shares the use of the METRO shed at Sunnyside with Amtrak. N.J. DOT equipment has the use of this facility for approximately twelve hours per day. Monthly inspections of the MU cars are handled in this shared facility. A recommended maintenance program was presented in Chapter III and given the size constraints of the existing facility and the shared time constraints, this program would be extremely difficult to implement, if at all possible. The N.J. DOT Penn Station fleet requires shop track space that can accommodate at least ten MU cars for inspection during one trick, and a repair area that can accommodate four units.

Ideally, these inspections should be performed during layover periods and the equipment should be availale for dispatch to meet service requirement.

There are various alternative maintenance possibilities which can be evaluated for the Penn Station terminus fleet. These range from the null alternative, to an integrated Amtrak/N.J. DOT facility at Sunnyside, to the performance of all rail equipment maintenance in New Jersey. Five alternatives were selected for consideration. The respective pro's and con's will be presented, and a determination made as to which would best serve the N.J. DOT fleet in an efficient and cost effective manner through the year 2000. The alternatives are:

Alternative 1: The null or do nothing alternative. Continue maintenance operations as they presently exist.

Alternative 2: Upgrade the existing facilities at Sunnyside Yard.

Alternative 3: Enter into an agreement with Amtrak and FRA for the development of an integrated Amtrak/N.J. DOT rail equipment facility at the Sunnyside complex.

Alternative 4: Discontinue all maintenance of the N.J. DOT fleet at Sunnyside Yard, and deadhead the equipment to other existing facilities located in New Jersey.

Alternative 5: Design, develop and build a new facility in either New York or New Jersey for exclusive N.J. DOT use.

None of these alternatives consider the provision of heavy repair facilities at Sunnyside Yard. It was determined that the Penn Station service area fleet should be accommodated at the MR/R Facility recommended for the Hoboken service area, thus eliminating duplication of significant capital expenditures for new facilities. Aside from this cost factor, new MR/R Facilities are precluded under most of the alternatives by non-availability of land. Access to the MR/R Facility would have to be provided through construction of a track connection. One such MR/R connection is discussed under the Newark terminus analysis.

2.3.1 Alternative 1: Null or Do Nothing

The "Northeast Corridor Maintenance of Equipment Service Facility Concept - New York" by RNC-8 Operations Staff, Northeast Corridor Project, Federal Railroad Administration, dated August, 1979, presents maintenance of equipment facility design criteria for Amtrak services in the New York Region. The following is an excerpt from this report:

> "Facilities for other users (commuter agencies and Conrail) will not be funded by NECIP. Joint-use facilities will be considered but should not delay or impair the functioning of NECIP-funded facilities. NECIP will not displace existing users or remove existing facilities without providing like or better facilities at a site approved by NECIP and those users."

This project policy guideline can impact the N.J. DOT fleet which is presently maintained at Sunnyside.

Also within this NECIP report is a Facility Concept Plan which proposes new shops on the vacant existing yard area. The N.J. DOT presently shares the existing METRO shed with Amtrak. The content of the report implies that under the proposed NECIP plan, Amtrak vehicles will be serviced in a new facility and that the METRO shed will no longer be utilized for Amtrak purposes.

Alternative 1, continue the status quo, cannot be accomplished. Since Amtrak plans to develop and construct new facilities at the existing Sunnyside site, the null alternative is void. Additionally, any increase in service on the part of N.J. DOT, and the subsequent increase in equipment required, would also present a problem with respect to the METRO shed capacity. Future maintenance needs could not be adequately handled by the existing facility. The outdoor repair area is not conducive to timely and exacting repair of equipment. Adequate material storage and welfare facilities are also lacking. Therefore, N.J. DOT must look toward other alternatives to meet its service and inspection requirements. From this null alternative, two other Sunnyside alternatives evolved. The first of these is to upgrade the existing facilities to meet present and future requirments, while the second is to join Amtrak in a new integrated facility at Sunnyside.

2.3.2 Alternative 2: Upgrade Sunnyside

Given the hypotheses contained in the NECIP report identified under Alternative 1, the prospects for the maintenance of the N.J. DOT commuter rail fleet serving Penn Station become promising. The existing METRO shed could be utilized exclusively by the N.J. DOT fleet consisting of Jersey Arrow cars and electric locomotives when the existing GG-1's are retired. N.J. DOT could enter into an agreement with Amtrak for the use of this shed. Maintenance work would continue to be performed by Amtrak personnel under existing contract provisions. Some improvements would be required if this were to occur. Welfare facilities (lavatory, lockers, lunch room), stores area, and supervisory space would have to be developed. (Several existing facilities in the shed area could be eventually put to this use). Additionally, the shed would have to be expanded to provide more inspection spots and several spots for light repair work.

N.J. DOT could incur the initial capital cost for these modifications, with a provision that should N.J. DOT not require these facilities at some future date, Amtrak would purchase them at fair market value. A preliminary estimate of these capital costs is $3.6 million.

The advantages of this alternative are:

- o Improved control and utilization of manpower;
- o Separate and distinct N.J. DOT maintenance facility, dedicated to N.J. DOT requirements;
- o Since all work efforts would be consolidated at one location, a reassignment of manpower appears likely;
- o Improved maintenance quality control;
- o Improved control of material storage and costs;
- o Facility construction would have little or no effect on-going operations of Amtrak and N.J. DOT;
- o Relatively low capital costs; and
- o Early potential completion date (estimated late 1982).

Another benefit of this alternative is that it allows for the continuation of a pull-through operation at Penn Station. Additionally, the necessary storage tracks, test tracks, etc., are presently in place. Because of the proximity to Penn Station, monthly inspections can be performed during the midday layover period between rush hours. Also, movements would not be constrained by the two tracks under the Hudson River.

The biggest disadvantage of this alternative lies in the fact that money would be invested and jobs provided outside the State of New Jersey.

2.3.3 Alternative 3: Integrated Amtrak/N.J. DOT Facility

As previously indicated, Amtrak maintenance facilities are scheduled for improvements in conjunction with the Northeast Corridor Improvement Program. Thus, an integrated Amtrak/N.J. DOT facility at Sunnyside Yard was selected for analysis.

There are a number of advantages and benefits associated with an integrated Amtrak/ N.J. DOT maintenance facility. One advantage is the proposed site. As presented earlier, Sunnyside affords an excellent locational alternative for maintenance of the Penn Station terminus trains for a number of reasons. Another positive factor is that New Jersey would have designated tracks and space within such a facility for its MI requirements. Separate stores areas and separate work areas could also be designated. N.J. DOT could purchase wheel truing on an "as needed" basis, and not have to purchase any of the machinery necessary. New Jersey would not have to incur the total cost of the locomotive servicing area, but instead could share that capital expense with Amtrak. The component truck removal release track and diagnostic testing equipment costs could be shared. It should be noted that FRA has indicated that the costs of yard support tracks and catenaries would not have to be borne by N.J. DOT. N.J. DOT would continue to utilize the existing coach storage and servicing tracks. An integrated facility would allow flexibility in the assignment of personnel both in normal and emergency conditions. Finally, it is possible to contruct this facility with little or no disruption to on-going operations.

There are certain disadvantages that are incurred with an integrated facility. For one, the State of New Jersey will be making a substantive capital investment in another state and will be providing jobs there as well, similar to the preceding alternative.

Under both this alternative and Alternative 2, manpower would be supplied by Amtrak and be only indirectly controlled by N.J. DOT. However, the monitoring of work on N.J. DOT equipment would be more difficult under the integrated facility concept due to the interchangeable nature of the Amtrak and N.J. DOT fleet personnel assignments. Finally, indications are that the primary function of the proposed Amtrak facility, if integrated, would be to maintain the Amtrak fleet, and that any N.J. DOT functions would be ancillary. For instance, the proposed S&I track space designated for N.J. DOT use will likely be needed by Amtrak by 1990, suggesting potential conflicts during parts of the day. It is possible that Amtrak could exercise a priority on the facilities, rather than construct new facilities.

NECIP, through the efforts of DeLeuw, Cather/Parsons, Amtrak, FRA, and Bechtel, has produced preliminary cost estimates and facility layouts for both the proposed Amtrak facility and a potential integrated Amtrak/N.J. DOT facility. The N.J. DOT maintenance functions would require that one 1,200 foot track and 30,000 sq. ft. of floor space be added to the basic S&I shop and that four vehicle spots (18,000 sq. ft.) be added to the running maintenance/repair shop. Thus, the integrated facility would entail 48,000 sq. ft. of space (for N.J. DOT use), compared to the 39,900 sq. ft. total requirement of Alternative 2. These additions were estimated to cost about $4.24 million, or $640,000 more than the modified METRO shed, both costs exclusive of land lease or purchase costs. The estimated date of completion of construction of the integrated facility is near the end of 1982.

2.3.4 Alternative 4: Discontinue Maintenance at Sunnyside

The fourth alternative under consideration suggests that the N.J. DOT fleet be maintained in New Jersey, at existing maintenance facilities. At first glance, this alternative appears reasonable. Maintain New Jersey rail vehicles in New Jersey. Upon closer inspection, problems materialize. How is the Hudson River tunnel problem overcome? Where can the additional platform space in Penn Station (which would be required because of the stub-ended operation) be acquired? Where would additional midday storage tracks be located? Can the equipment which is inspected and/or repaired be returned to Penn Station in time for the evening rush? Finally, there are no existing N.J. DOT maintenance facilities that could handle the additional work load (MI's, running/light repairs) on the Arrow cars. This last factor eliminated further consideration of this alternative.

2.3.5 Alternative 5: Build a New Facility

Under the fifth proposed alternative, a new N.J. DOT maintenance facility would be designed and built in either New York or New Jersey. This could correspond to the consolidated maintenance facility previously recommended for the Hoboken terminus service area. As in Alternative 4, deadheading the equipment to the New Jersey side of the Hudson River presents numerous operational problems.

The reason the N.J. DOT rail passenger cars are presently maintained at Sunnyside and not deadheaded back to the New Jersey side of the river is to utilize a "pull-through" operation at Penn Station, rather than a "stub-end" operation. With the pull-through operation, the train arrives, passengers disembark, and the train continues to Sunnyside for storage, MI's and/or repairs. With a stub-end operation, certain time-consuming functions and inspections are performed. The train arrives at the station, passengers disembark, and then the following takes place. The engine crew must reverse ends, i.e. go from the front of the train to the back of the train, and prepare to operate the train from that end. A brake test must be performed. A car inspection might also be required. Additionally, the platform is not available for use during this period of time while the ends are reversed, equipment inspected, and brakes tested.

Another disadvantage associated with the New Jersey locations concerns the performance of MI's during the midday layover period. Since there are four tracks under the East River, access to Sunnyside is preferable to trying to use one of the two tracks under the Hudson River for a return to a New Jersey maintenance facility for similar servicing. The tunnel under the Hudson River is a constraining factor. At the present time, MI's are performed and the equipment is returned to service from Sunnyside in time for the evening rush period.

Depending on the location selected, new electrified track connections and access and layover tracks would be required on the New Jersey side of the Hudson River if the equipment were deadheaded back to New Jersey. In contrast, present midday storage tracks for the N.J. DOT fleet are convenient and adequate at Sunnyside and within the Penn Station complex.

The next question that must be addressed for a New Jersey site concerns the hypothesis of storing trains at Sunnyside, and deadheading the units for MI's to New Jersey. Although this is possible, the vehicles which are due for the monthly inspections might require the breaking of consists, and the formation of a new consist of units to be inspected. This consist would then be deadheaded through the East River tunnels, Penn Station, and Hudson River tunnels to New Jersey and on to a maintenance facility. The associated down time, coupled with the deadhead moves would preclude having the train inspected and returned to Penn Station in time for an evening rush hour departure. The consist formation and the deadhead moves would also incur additional operating costs. This option would require having additional (excess) vehicles to meet established service requirements -- an additional capital investment.

The construction of a new facility in New Jersey could probably not be accomplished as fast as the modifications to the METRO shed area discussed under Alternative 2, since this would require a site selection process, land acquisition, possibly an environmental assessment, cost analysis, track connections, and detailed design and construction.

It is concluded that relocation of the present Sunnyside Yard maintenance functions to a new facility in New Jersey would have many associated problems, some significant, but all which could be overcome to varying degrees through the use of computer scheduling techniques, facility consolidation efforts, optimal site selection, and other planning actions.

The prospects for a new facility located in New York do not indicate an easy accomplishment. The major constraints are land availability and location. Even if adequate land were available, the property purchase (or lease) costs and facility contruction expenses would undoubtedly be greater than the costs assocciated with Alternative 2 (which makes maximum use of existing adequate facilities) or with Alternative 3 (which entails the sharing of costs for many major equipment items and the incurring of facility costs on an incremental basis).

2.3.6 Summary

The positive and negative characteristics of each alternative are summarized in Exhibit V-2. After a review of the five alternatives, it is evident that Alternative 2 presents the best opportunity for satisfactory maintenance program conditions while limiting implementation drawbacks. The utilization of the existing METRO shed, coupled with the proposed improvements, would allow the N.J. DOT fleet to be inspected and maintained in an efficient and cost effective manner, while major repair work would be shipped to the consolidated facility recommended in the Hoboken terminus alternative analysis.

Alternative 5 (with a facility in New Jersey) was found to be a viable option worthy of additional future consideration. However, the time, and possibly the costs, associated with overcoming its problems, coupled with the apparent more favorable aspects of Alternative 2, indicate this alternative to be less suitable for immediate/short term N.J. DOT maintenance needs.

2.4 Newark Terminus Facility Alternatives Analysis

The third area under discussion concerns the services termed Newark terminus. They encompass operations of the former Central of New Jersey and Reading railroads which terminate in Newark, New Jersey. Midday storage of these trains is accomplished in Harrison Yard.

PENN STATION TERMINUS ANALYSIS SUMMARY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 "Null or Do Nothing	No capital expense	Existing facility inadequate for short-term future inspection needs. Lack of adequate light repair facility. Poor control/monitoring of manpower. Inadequate parts storage facilities Inadequate welfare and supervisory facilities.
2 Upgrade Existing at Sunnyside	Improved control of manpower. Possible reduction of manpower. Separation of N.J. DOT and AMTRAK maintenance facilities/operations. Improved quality control Improved control of parts storage & costs. Little or no interference to existing operations during construction. Provision of adequate light/running repair facility. Relatively low capital cost; optimal use of existing capital investments. Early potential completion date. Continued pull-through operation at Penn Station and Sunnyside Yard. Improved welfare & supervisory facilities.	Continued discharge of cars onto congested inbound motor track. Significant investment outside State of New Jersey. Slight duplication of proposed AMTRAK facility.
3 Amtrak N.J. DOT Integrated	Capital investments incurred on incremental cost basis. Provision of adequate light repair facility. Little or no interference to existing operations during construction. Continued pull-through operation at Penn Station and Sunnyside Yard	More expensive than most other alternatives Use of one long track would be less efficient than two shorter tracks of Alternative 2. Continued poor monitoring of manpower. Current uncertain ability of AMTRAK to obtain funds for proposed facility. Potential for future conflicts on facility priority Later estimated completion date. Significant investment outside State of New Jersey.

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
3(continued)	Flexibility in manpower assignment. Improved storage and welfare facilities. Designation of tracks & work areas for N.J. DOT use	
4 Deadhead to N.J. & Existing Facilities	No capital expense for maintenance	Existing facilities are inadequate to handle the demand. Need to construct adequate track connection(s) Inadequate existing storage tracks. Inefficient stub-end operation at Penn Station platform space. Hudson River tunnels constrain movements
5 Design & Build New	Capital investments incurred on incremental cost basis (if designed as part of proposed Hoboken terminus facility). Provision of adequate light repair facility.	Electrified track connection and access tracks required (depending on location). New storage tracks required. Inefficient stub-end operation at Penn Station: inadequate availability of Penn Station platform space. Hudson River tunnels constrain movements. Difficulty in completing inspections during midday layover period. Probable late completion date relative to other alternatives. Non-availability of suitable land at reasonable cost (if located in New York).

The diesel locomotives receive their monthly inspections at Elizabethport. Running maintenance, minor repairs, and turnaround cleaning are performed in the Harrison Yard. With respect to this terminus opreation, there are three alternatives.

Alternative 1: The null or do nothing alternative -- continue maintenance of equipment at E'port and other existing facilities.

Alternative 2: Upgrade the E'port facilities.

Alternative 3: Build new facilities or service and maintain equipment at the proposed consolidated maintenance facility (identified in the Hoboken terminus analysis).

2.4.1 Alternative 1: Null or Do Nothing

Under Alternative 1, some inspection work would be continued at other facilities, i.e. South Amboy, Raritan when necessary, etc. Monthly inspections of locomotives and heavy repairs to locomotives and coaches would continue to be performed at E'port. This is a no capital cost option.

Since maintenance of equipment would be dispersed at a number of facilities, there is always a question of quality control, stores availability, and adequate tooling to perform proper maintenance.

2.4.2 Alternative 2: Upgrade E'port

As with the Hoboken terminus operations, deadhead moves are required to bring the equipment to E'port for servicing. Also, it has previously been noted that E'port is in need of repairs. An additional consideration is that E'port is a a shared facility, i.e., it handles commuter locomotives and coaches as well as freight locomotives and freight cars. Although this is a workable alternative, it is not highly promising.

2.4.3 Alternative 3: Build New or Send to Consolidated Facility

The third alternative considers building new facilities for equipment maintenance. Given the volume of pieces of equipment to be maintained, it appears reasonable to send the equipment to the proposed new consolidated facility as recommended in the Hoboken terminus analysis. In order to facilitate access to this consolidated facility, a track connection would have to be developed between the "Mail track (which connects from the NEC main line at Harrison and enters Meadows Yard) and the MGM line which terminates in Hoboken. Once access to Hoboken is provided, the Newark terminus consists could then be routed to whichever site evolves as the best candidate location for the consolidated facility.

NEWARK TERMINUS ANALYSIS SUMMARY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 "Null" or Do Nothing	No Capital cost. Minimal deadheading for daily activities.	Poor control of manpower and work quality: wide dispersion of maintenance activities. Some activities performed outdoors Continued light moves for inspections. Some duplication of parts inventory.
2 Upgrade E'port	Optimal use of existing capital investments. Minimal deadheading for daily activities.	Continued wide dispersion of maintenance activities. Some activities performed outdoors. Continued light moves for inspections. Some duplication of parts inventory.
3 Build New or to Recommended Consolidated Facility	Capital investments incurred on incremental cost basis. Reduced light movements. Improved quality control and control of manpower. Reduced overall parts inventory needs.. Potential reduction of fleet requirements due to theoretical decrease of out-of-service time.	Construction of track connection required. Some overall increase in deadhead moves

2.4.4 Summary

Exhibit V-3 presents and compares the good and bad points of each alternative. Alternative 3, utilizing the recommended consolidated facility of the Hoboken Terminus discussion, is considered the best candidate alternative. It exhibits far fewer negative aspects and helps to further justify the need for the consolidated facility and its component shops.

2.5 Atlantic City Operations Facility Alternatives Analysis

The fourth area under consideration concerns the rail passenger operations serving the southern portion of the state. The location for maintenance services and the types of maintenance to be performed must be defined.

Rail diesel cars (RDC's) are used to provide service in this part of the state. At the present time, monthly inspections, running maintenance, limited heavy maintenance and the 24 month FRA test work are performed by two work shifts. All work is performed outdoors. The present maintenance facility cannot readily, and should not, accommodate any additional work load.

There are a number of alternative maintenance strategies that were developed for the Atlantic City, Ocean City and Cape May operations. These are:

Alternative 1: The null or do nothing alternative -- continue the maintenance of equipment operations as they presently exist.

Alternative 2: Discontinue all maintenance operation and deadhead equipment:

a) To some other facility for maintenance services, or

b) Contract with a transit agency, or a private firm, to perform maintenance on the equipment.

Alternative 3: Build a new facility to maintain and service the equipment.

2.5.1 Alternative 1: Null or Do Nothing

Although this alternative is a no cost option, it appears to have little merit. As there is no maintenance facility, repairs are performed outdoors, subject to the elements. This in itself has a debilitating effect on the men and maintenance performance. An added problem is that no additional maintenance can be performed should the service experience any growth. Given these two constraints, Alternative 1 should be eliminated from further consideration.

2.5.2 Alternative 2: Discontinue Maintenance at Atlantic City

Under sub-alternative 2a, maintenance of equipment could be performed at any of the other facilities now servicing the N.J. DOT fleet. These include E'port, Hoboken and South Amboy. All equipment would require deadhead moves to reach any of these facilities. The respective deadhead moves would increase the vehicle down time, increase costs, and possibly require additional equipment to compensate for the equipment which is scheduled for and in maintenance. The maintenance personnel would also have to be relocated. This alternative does not appear viable in terms of the deadheading required, the additional operating costs that would be incurred, the manpower relocations that would be required, and the additional equipment that might be required to meet scheduled service.

Sub-alternative 2b proposes contracting with a transit agency or a private firm to perform the maintenance on the equipment. Indications are that SEPTA and PATCO would not be interested in maintaining the RDC fleet for N.J. DOT. The possibility of contracting with a private firm for maintenance services is plausible. With either case, deadheading of equipment would be required, and again, the question of what happens with the existing manpower develops. As in sub-alternative 2a, additional operating costs would be incurred, deadhead mileage would increase, and equipment availability would deminish. Although increased work loads could likely be handled with each sub-alternative, these options should be removed from further consideration since it appears that the negative aspects outweigh the positive ones.

2.5.3 Alternative 3: Build New Facility

Because the routes of this service area are isolated from the other passenger service in the state, and since Alternatives 1 and 2 are not very viable, due to the problems that they would create, the design and development of a new facility would be the best approach for meeting the equipment service needs. Ideally, the facility would be a "step-down" from a Major Repair/Rebuild Facility and a "step-up" from a Service and Inspection Facility.

This specialized type of facility would accommodate monthly inspections, minor and major running repairs, and major component changeouts. Heavy repairs would not be performed at the facility, but would be shipped to either a manufacturer or the Major Repair/Rebuild Facility recommended in the Hoboken terminus analysis. In a like manner, the major components which were replaced would also be sent out for repairs and rebuilding. The nature and size of the Atlantic City operation would require a two unit shop with adequate component stores area, shop equipment and facilities for component removal and replacement, equipment inspection, etc.

The development of a new facility to replace the present maintenance operation has two primary locational possibilities -- Atlantic City and Lindenwold. Since the existing operation is located at Atlantic City, and since the majority of the RDC's are stored and layover in Atlantic City, this site was selected for investigation. It is centrally located within the service area. If a facility were located in the vicinity of the existing maintenance operations, deadhead mileage would be minimal. In addition, no new operating costs would be incurred in bringing the equipment to the proposed maintenance facility. The location has adequate land to accommodate the new construction without interfering with present operations. The availability of this land is not known.

Equipment in service lays over during midday at Lindenwold. There are some obvious constraints at this location. Space requirements for a shop and storage tracks appear inadequate. The effects of relocation of personnel might also present some problems.

2.5.4 Summary

The advantages and disadvantages of each alternative are presented in Exhibit V-4. Atlantic City is the prime candidate location for a recommended new two unit shop to service and maintain the fleet which will

ATLANTIC CITY OPERATIONS ANALYSIS SUMMARY

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 "Null or Do Nothing"	No capital cost. Minimal deadhead mileage	Work performed outdoors.
2 Discontinue, Perform at a) Other N.J. DOT Facilities	No capital cost.	Significant increase in deadhead movements. Potential increase in fleet requirements, due to theoretical increae of out-of-service time. Relocation of manpower.
b) Contract with Others		Signigicant increase in deadhead movements. Potential increase in fleet requirements due to theoretical increase of out-of-service time. Little indication of willingness by PATCO or SEPTA to provide service.
3	Improved working conditions, machinery, equipment, etc. Minimal deadhead mileage.	Expensive

operate in the southern portion of the state (Alternative 3). Repair work which exceeds the shop's capabilities should be handled in the proposed consolidated facility as recommended in the Hoboken Terminus Alternatives analysis. This alternative will modernize the tooling, equipment, and machinery provisions while providing indoor working conditions conducive to quality work.

2.6 Recommended Alternatives (Summary)

As presented in the preceeding sections, four service areas were identified. Within each of these service areas, an array of alternatives were evaluated. The end results of these evaluations were:

- o Centralize and consolidate maintenance operations (to a major extent);
- o Improve and modify Sunnyside as a separate inspection facility;
- o Develop new facilities at Atlantic City for scheduled inspections and repair work.

2.7 Site Analysis

The findings from the Hoboken terminus alternative analysis recommend the development of a Major Repair/Rebuild Facility. Such a facility would accommodate this work function from all four service areas. The recommended S&I Facility would handle all scheduled inspections from the Hoboken and Newark terminus operations. Specific sites were considered which could accommodate either shop or a consolidated S&I and MR/R Facility. The analysis of these sites are presented in this section. The selection of facility sites for the Penn Station terminus was inherent in the facility alternatives analysis of that service area. Site analysis for the recommended Atlantic City Operations facility was straightforward and was included as part of the facility alternatives analysis of that service area.

2.7.1 Criteria

Criteria are yardsticks which measure the relative merit of any site. In order to evaluate the potential sites, criteria were developed which provided assistance in site selection. The criteria employed included consideration of the following:

- Deadheading and/or light moves from the station/terminal
- Layover period
- Access to existing utilities
- Expansion potential to meet existing and future requirements
- Storage space
- Facility capability
- Facility capacity

- o Environmental concerns
- o Operational problems and/or conflicts
- o Manpower adequacy and availability of labor force
- o Maximum vehicle availability

In utilizing these considerations, the sketch planning technique of "fatal flaw" was employed. Under this technique, if a fatal flow develops, it becomes justification for discarding the site. Feasibility plays an important part in this segment of the analysis, as does physical constraints. An example of this technique follows:

> A site that was considered was the Monmouth Street yard area in Jersey City which was owned by the Erie-Lackawanna trustees. This yard is under the N.J. Turnpike and Routes 1&9 ramps from the Holland Tunnel. Easements had been granted. Because of the ramps, height clearances for a maintenance shop were inadequate. This inadequate height clearance was a fatal flaw, and therefore, this site was discarded from further considerations.

2.7.2 Matrix

In conjunction with the fatal flaw technique, a site selection matrix was developed which would place the respective sites in order of "best potential location". The matrix employed four key requirements for site consideration. These were:

- Adequacy of land
- Land availability
- Suitability for construction/improvements
- System accessibility

Within each of these key requirements were three criteria for consideration. Each of these was evaluated on a one (1) to five (5) scale and graded. Each of the criteria, or subgroups, were then summed to arrive at a value for each key requirement (maximum value - 15). The key requirement values were then summed. The higher the total value, the better the site. The highest possible score was 60. (It should also be noted that existing maintenance facilities were included in this matrix).

In evaluating adequacy of land, the subgroups that were selected included space for shop areas, for storage tracks, and for support facilities (power plant, treatment plant, etc.). If the space was inadequate, a zero was assigned. A zero in this requirement removed the potential site from further consideration. As an example, the space available at the existing Hoboken maintenance facilities was inadequate to accomodate both a Service and Inspection Facility with a Major Repair/Rebuild Shop. Therefore, for the column titled "Both" a zero value is shown for all requirements.

The aspects of ownership potential, zoning and compatibility with existing land use, and whether the property was vacant or developed, influenced the evaluation of land availability.

Site conditions, foundation and soil conditions, and the availability of utilities provided the bases for value assignment for suitability for construction improvement.

System accessibility was viewed from the standpoint of access and proximity to existing commuter rail lines and terminals, operational feasibilities and constraints, and vehicular access, parking, etc.

2.7.3 Sites Considered

Fifteen sites were considered. The criteria previously identified influenced the choices of the potential sites which were evaluated in the site selection matrix. The sites, and the rationale for their inclusion in the site selection matrix, are presented below. Also depicted are the major disadvantages that each site possessed.

- Croxton (existing yard) -- located in the immediate proximity of Hoboken operations, Newark operations, and Penn Station operations. It is presently a rail freight yard and has access to existing Hoboken terminal. Its disadvantages include no electrification and limited space for storage and support facilities.

- Elizabethport -- has existing facilities handling locomotives and coaches, has expansion potential, and land availability. Access problems, no electrification, and not being within immediate proximity of existing commuter lines are some of its short comings.

- Hoboken (upgrade existing) -- originating/terminating point of present service. Inadequate space for a consolidated facility, and the fact that an expansion of any type would conflict with existing operations, as well as remove storage tracks, are its disadvantages.

- Hoboken/Jersey City: South of Canal -- located in immediate proximity of existing Hoboken operation; freight yard adjacent to Hoboken Terminal; 104 mostly vacant acres, offered for sale by the Erie-Lackawanna trustees. The area was recently rezoned for residential use.

- Jersey City: West of Croxton -- located in the immediate proximity of Hoboken, Newark and Penn Station operations, and vacant. Disadvantages include accessibility for employees, marshland, and accessibility problems for other than Hoboken terminus trains.

- Jersey City: Pavonia Avenue -- existing rail freight yard in proximity of existing Hoboken terminal. The site is isolated from existing commuter services and is presently under consideration for development by private developer.

- Harrison Yard -- existing storage yard and running maintenance facility in proximity of Hoboken, Penn Station and Newark operations. Inadequate size for a consolidated facility, located between eastbound and westbound PATH tracks, this site could accommodate either an S&I Shop or a MR/R Facility.

- Kearny/Harrison (Rte. 280 and N.J. Turnpike) -- area in proximity of rail lines, and vacant. This land is approximately 80 feet above existing grades and access for rail equipment would be almost impossible.

- Kearny: Koppers Coke -- proximity to Hoboken terminal operations, Newark and Penn Station operations, partially vacant and for sale. Although this site offers excellent potential, upgraded utility services would have to be provided, as well track connections for access.

- Meadow Shop in Kearny -- formerly a maintenance facility, and in proximity to existing operations. The disadvantages include land inadequacy for a consolidated facility, constrained facility layout, and poor access for other services.

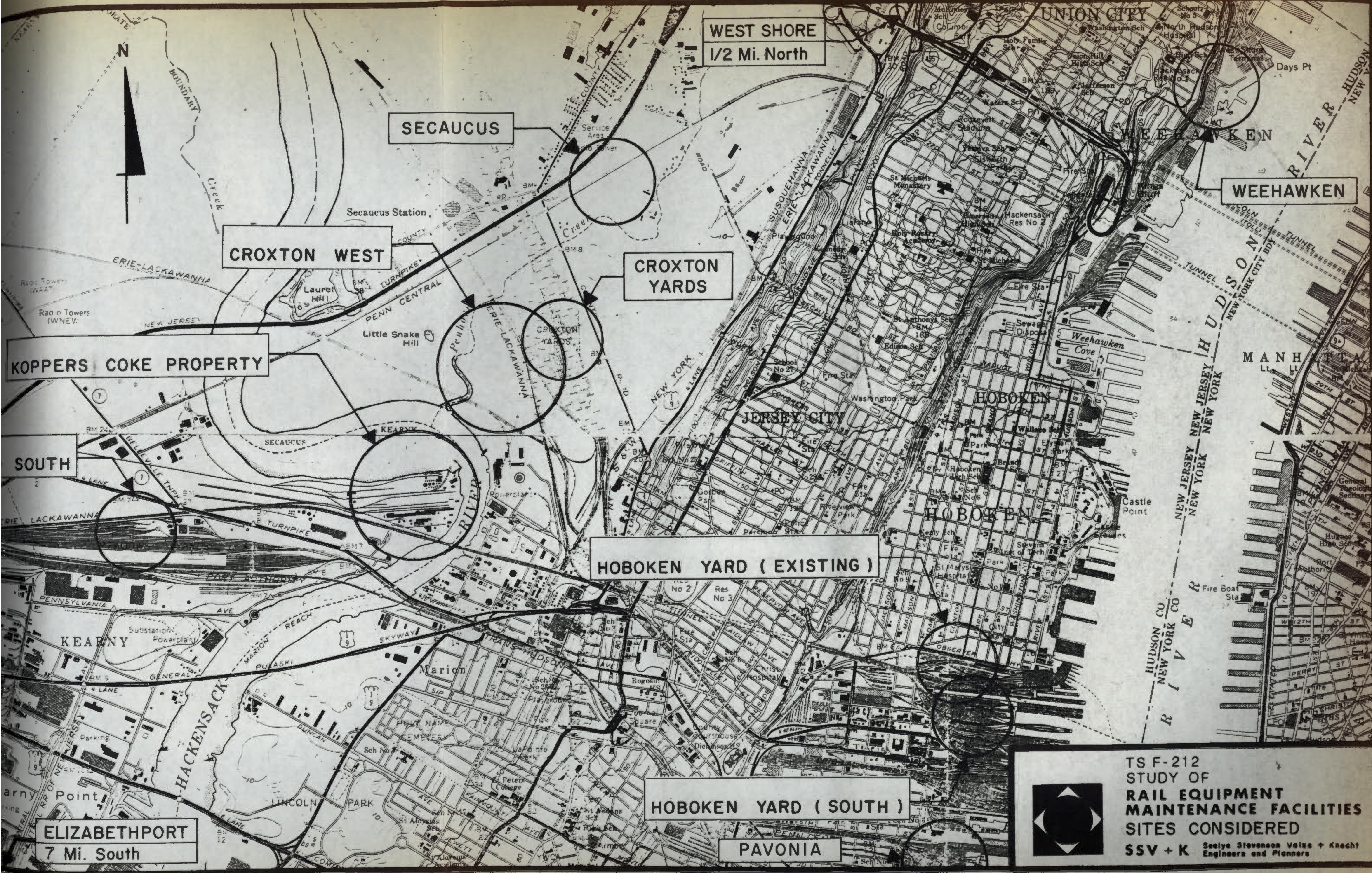
- North Bergen (West Shore) -- former yard and in proximity of existing Hoboken, Newark, and Penn Station operations. No electrification, and an accessibility problem from existing commuter lines are some disadvantages associated with this site.

- Secaucus -- vacant land in Meadowlands, considered as potential storage facility in previous studies. Soil conditions, access problems for equipment and employees, and high land costs are its disadvantages.

- Sunnyside, N.Y. -- existing facility handling M.U.'s and coaches; considered for Penn Station terminus trains only, since diesel locomotives cannot use tunnels. This site was included to see how it would fare in comparison to other potential S&I Shop sites considered.

- Weehawken -- existing freight yard. Poor access, no electrification, and off-the-beaten-path are some of the drawbacks of this location.

HARRISON - SOUTH EXPANSION
KEARNY/HARRISON
MEADOWS YARD SOUTH
KOPPERS COKE PROPERTY
CROXTON WEST
ELIZABETHPORT
7 Mi. South
N
NEWARK
KEARNY
HARRISON
BERGEN CO
HUDSON CO
ESSEX CO
PASSAIC RIVER
HACKENSACK
Secaucus Station
Little Snake Hill
Laurel Hill
Kearny Point
LINCOLN PARK
ERIE-LACKAWANNA
PENN CENTRAL
PENNSYLVANIA
HARRISON REACH
Project Depth 20 Feet


WEST SHORE
1/2 Mi. North
SECAUCUS
CROXTON WEST
CROXTON YARDS
KOPPERS COKE PROPERTY
SOUTH
HOBOKEN YARD (EXISTING)
HOBOKEN YARD (SOUTH)
PAVONIA
ELIZABETHPORT
7 Mi. South
WEEHAWKEN
UNION CITY
JERSEY CITY
HOBOKEN
KEARNY
HACKENSACK
HUDSON RIVER
Secaucus Station
Little Snake Hill
Laurel Hill
Castle Point
Days Pt
Washington Park
TS F-212
STUDY OF
RAIL EQUIPMENT
MAINTENANCE FACILITIES
SITES CONSIDERED
SSV + K Seelye Stevenson Value + Knecht Engineers and Planners

2.7.4 Site Evaluation

Exhibit V-6 presents the matrix of the fifteen sites and respective point totals. Although sixty was the maximum number of points attainable, no site achieved this total. Hoboken/Jersey City - South of the Canal ranked highest with a total point value of 52 for a consolidated facility.

In considering the adequacy of land for the necessary facility components, a point value of five was assigned if the land was completely adequate, three if fairly adequate, and one, if constrained. Depending upon the shape of the potential site, the Service and Inspection Facility required approximately 29 acres, while a consolidated facility incorporating both a MR/R and S&I required approximately 41 acres with a constrained layout, and approximately 55 acres for an "ideal" layout. Three examples are given below.

Croxton (existing yard) was the first site considered under adequacy of land. For a consolidated facility, it received a total point value of ten. Even with the existing freight operation at this location, securing space for shops is possible, although the best possible layout might not be attainable. This subgroup received a point value of four. With the utilization of available space for the shop area, the extra space needed for storage, ready and run-around tracks diminishes, and therefore that subgroup received a point value of three. Space for additional support facilities was limited and this was assigned a three.

The Hoboken/Jersey City - South of Canal site received fifteen out of a possible fifteen points in the key requirement of adequacy of land. The site covers approximately 104 acres, 65 of which are upland. The land is more than adequate in size to handle the shop area required (five points), the storage tracks, etc. (five points) and the necessary support facilities (five points).

The Koppers Coke site received fifteen points also. In terms of land adequacy, there are approximately 145+ acres at this site, which are more than adequate for the consolidated facility, storage tracks, and support services.

Continuing with these three example sites, the next key requirement evaluated was land availability. Since the existing Croxton Yard is presently used for freight, and most of the land is in use, a value of two was assigned in the subgroup of vacancy. The possibility of buying the yard is questionable since Conrail does have plans for its use (upgrading and major distribution point). In terms of zoning, a point value of five was assigned. Total point value under this requirement was nine.

The Hoboken/Jersey City - South of Canal site received five points under the vacancy subgroup, and four under ownership potential. Although the land is available and for sale, there are others interested in it. Under zoning, this site received a three. The property was formerly a rail freight yard, and there is presently some freight activity, but the city of Jersey City has recently rezoned the land for residential use and has a number of private developers interested in this parcel. Thus, the total point value for this site in this key requirement was twelve.

Koppers Coke scored thirteen in this category. Under the vacancy subgroup, the site received four points. Zoning scored five points, while ownership potential was four, since the owners were actively involved in negotiations for the sale of the property.

The third key requirement was suitability for construction/improvements. The marsh conditions in and around Croxton and poor sub-surface conditions for foundations contributed to its nine rating. Hoboken/Jersey City - South of the Canal received twelve. Koppers Coke also received a point value of twelve since track connections requiring a graduated

SITE SELECTION MATRIX

1 of 2

SITE	Adequacy of Land			Land Availability			Suitability for Construction/ Improvement			System Accessibility			TOTAL		
	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH
CROXTON (Existing Yard)	10			9			9			9			37		
		10			9			9			9			37	
			10			9			9			9			37
ELIZABETHPORT	15			11			12			8			46		
		15			11			12			8			46	
			15			11			12			8			46
HOBOKEN - Upgrade Exist.	5			12			12			11			40		
		5			12			12			11			40	
			A			A			A			A			A
HOBOKEN/JERSEY CITY SOUTH OF CANAL	15			12			12			13			52		
		15			12			12			13			52	
			15			12			12			13			52
JERSEY CITY West of Croxton	15			11			11			11			48		
		15			11			11			11			48	
			13			11			11			11			48
JERSEY CITY Monmouth St.	B			—			—			—			B		
		B			—			—			—			B	
			B			—			—			—			B
Jersey City Pavonia	15			12			11			10			48		
		15			12			11			10			48	
			13			12			11			10			46
HARRISON YARD	10			13			13			11			47		
		9			13			13			11			46	
			A			—			—			—			A

NOTES:

M R/R Major Repair/ Rebuild Facility

S & I Service and Inspection Facility

Both M R/R & S & I

A) Property size is inadequate, Removed from further consideration in this category.

B) Inadequate height clearance

C) Evaluated for Penn Station trains only; diesels can not use tunnels.

SITE SELECTION MATRIX															2 of 2
	Adequacy of Land			Land Availability			Suitability for Construction Improvement			System Accessibility			TOTAL		
SITE	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH	M R/R	S & I	BOTH
KEARNY/HARRISON RTE 280 & NJ Tpke	12			11			7			5			35		
		12			11			7			5			35	
			8			9			7			5			29
KEARNY - Koppers Coke	15			13			12			10			50		
		15			13			12			10			50	
			15			13			12			10			50
MEADOW SHOP (Kearny)	10			10			10			10			40		
		8			10			10			9			37	
			A			—			—			—			A
NORTH BERGEN (West Shore)	12			12			10			6			40		
		12			12			10			6			40	
			4			12			10			6			32
SECAUCUS	10			12			10			9			41		
		10			12			10			9			41	
			8			12			10			9			39
SUNNYSIDE N.Y.	C			—			—			—			C		
		15			12			14			13			54	
			C			—			—			—			C
WEEHAWKEN	13			11			9			5			38		
		13			11			9			5			38	
			11			11			9			5			36

NOTES: Same as Page 1

embankment and upgraded utility service would have to be provided.

Finally, under system accessibility, Croxton (existing yard) scored nine points while the Hoboken/Jersey City - South of Canal site scored thirteen. Under the access/proximity subgroup, both of these sites scored four points. Each is readily accessible from existing Hoboken terminal. Under operational constraints, Croxton received two, while the Hoboken/Jersey City site received four. Since Croxton is an active freight yard, there would be numerous conflicts. In addition, electrification would be required to reach this site. In the case of the Hoboken terminal, the train would stop at Grove Street, the ends would be reversed, and then it would pull into the site. The Hoboken/Jersey City - South of Canal site received five while Croxton had three in the vehicular access/parking subgroup. Koppers Coke received a total of ten points in this category. The deadhead moves required to access this site as well as reverse signaling of the MGM line between Newark and Hoboken contributed to this score.

2.7.5 Site Recommendation

Based upon the matrix results, the findings in the alternatives analysis, and based upon the arguments for consolidating and centralizing maintenance facilities, Hoboken/Jersey City - South of Canal is the "best candidate location". However, recent developments which occurred between August and November, 1980, preclude this site from receiving the recommendation. Therefore, it is recommended that the State of New Jersey build a consolidated maintenance facility at the former Koppers Coke site in Kearny, New Jersey since this location received the second highest score in the matrix evaluation. Among the specific advantages of this site are the following:

- Proximity to a major terminal (Hoboken) handling approximately 132 daily dispatches, or 29% of all N.J. DOT dispatches.

- Operationally accessible from most other N.J. DOT terminals with some new track connections.

- Easy access for personnel (by auto or rail, assuming a new employee-only stop on selected trains) and materials/ supplies deliveries by highway or rail.

- Environmentally acceptable.

- Zoned industrial.

- Sufficient space for yard support and storage tracks.

- Will permit construction without conflicts to present revenue and maintenance operations.

- Close proximity to existing power source.

- Experienced work force available as nucleus of total force.

- Minimal site preparation (the area is a former industrial site used for coal storage and shipping.)

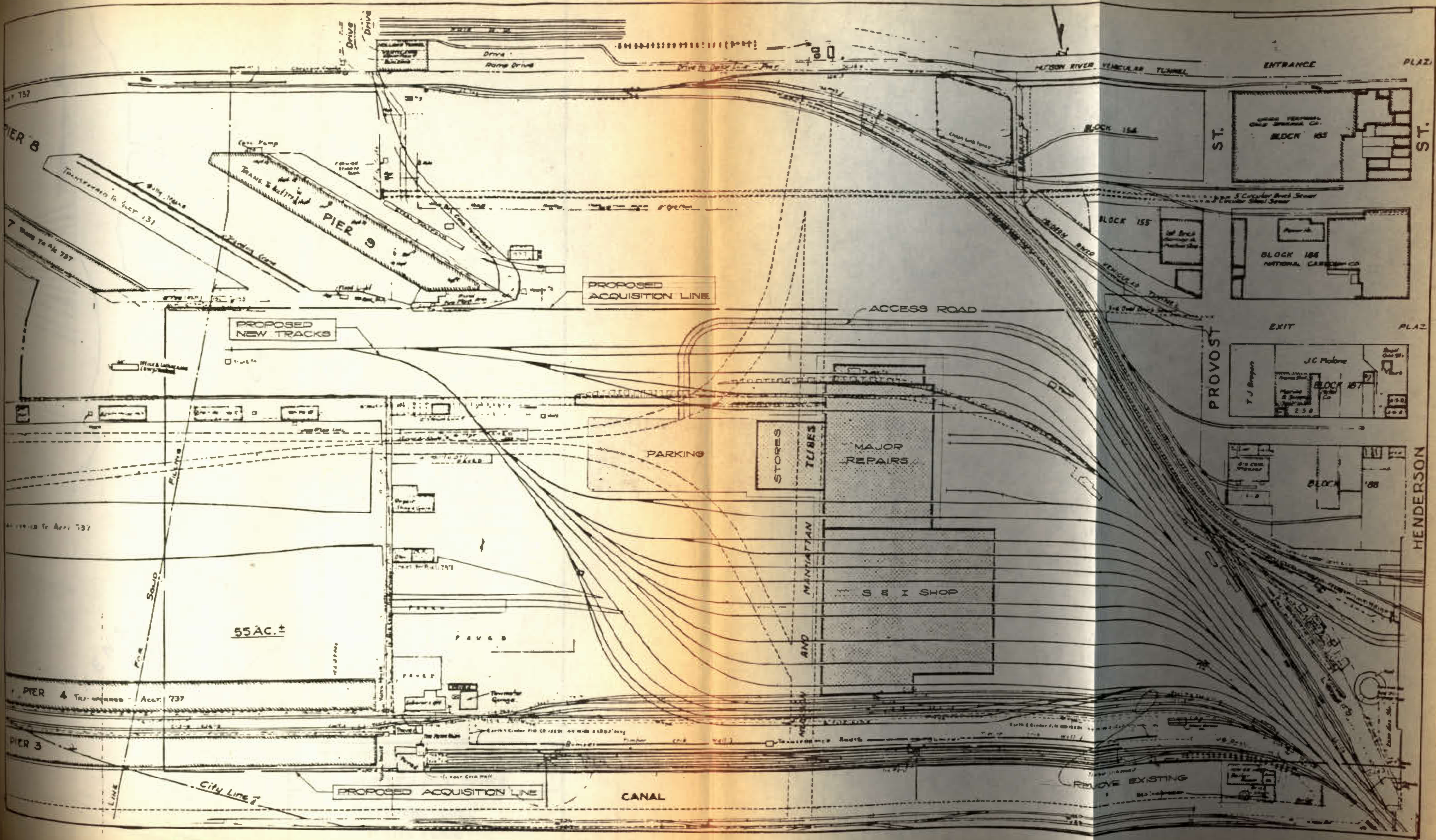
Although Hoboken/Jersey City - South of Canal attained the highest point value of all sites under consideration, it did not receive the recommendation for a centralized, consolidated rail maintenance facility because of recent developments. The master plan of the City of Jersey City in conjunction with the development plans of Herbert Glimecher Co. propose to transform the northern Jersey City waterfront into a ratable-rich asset which will contribute more than $100 million of new revenue annually into the city treasury. The proposed $1 to $2 billion development plan, which includes the area from Sixth and Henderson Streets in Jersey City to the Hoboken city line, includes housing, motels, a convention center and recreation. Both the Hoboken/Jersey City - South of Canal, and the Pavonia sites fall within this development area. Hoboken/Jersey City ranked number 1 in the matrix while Pavonia tied with Elizabethport in fourth.

Given the information presented above, the question that can be asked is "why were these two sites not rejected in the early analysis stage of the matrix evaluation?" For the past fifteen years, the waterfront area of Jersey City has been the subject of numerous plans and proposals. Virtually none of these passed the planning stage and reached fruition, Liberty State Park being the exception. Additionally, the Hoboken/Jersey City site has been owned and utilized by the railroads for railroad related activities for over 100 years. At the present time, it still serves some freight activity, and N.J. DOT (which owns a portion of the property) stores Arrow MU cars at this location. Therefore, based on historical precedents of railroad ownership and use, and on the lack of the past proposed development plans being implemented, these sites could not be rejected. However, the "new" proposed development plans cannot now be ignored. Newspaper reports indicate that Glimecher Co. has offered the City of Jersey City a $500,000 "performance bond" if it is given exclusive development rights for this area, and it will forfeit this bond if it does not begin development within eighteen months. Indications are that the Jersey City City Council will approve this agreement. (The Jersey City Redevelopment Agency has recommended the acceptance of the Glimecher offer.)

Exhibit V-7 is a plan view of the Hoboken/Jersey City - South of Canal site which, is discussed above, received the highest point value of all sites considered but was withdrawn from further consideration because of its identification of its land-use development potential for more far-reaching public purposes. Exhibit VI-8 is a plan view of the Koppers Coke site in Kearny, which

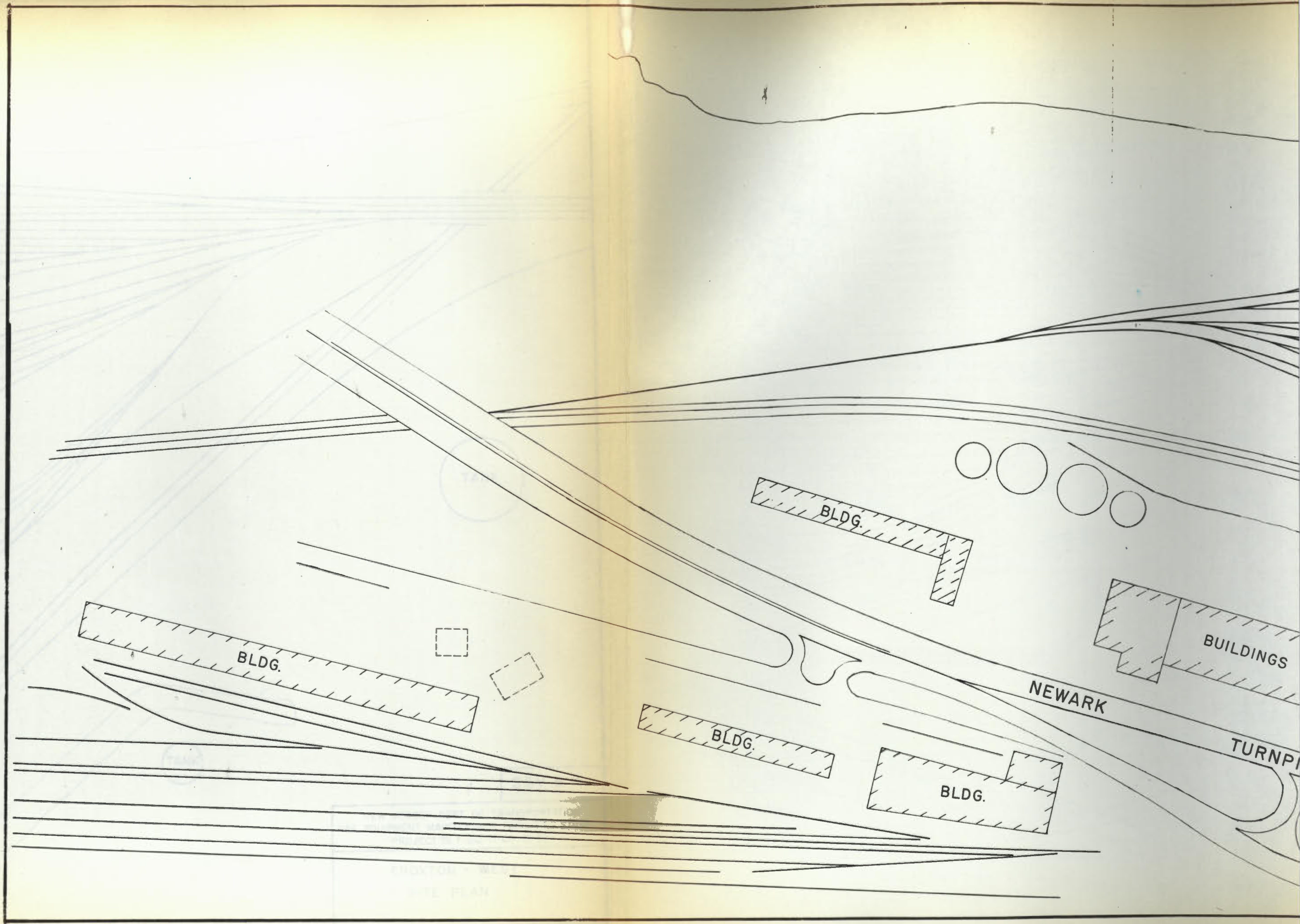
HOBOKEN / JERSEY CITY
SOUTH OF CANAL

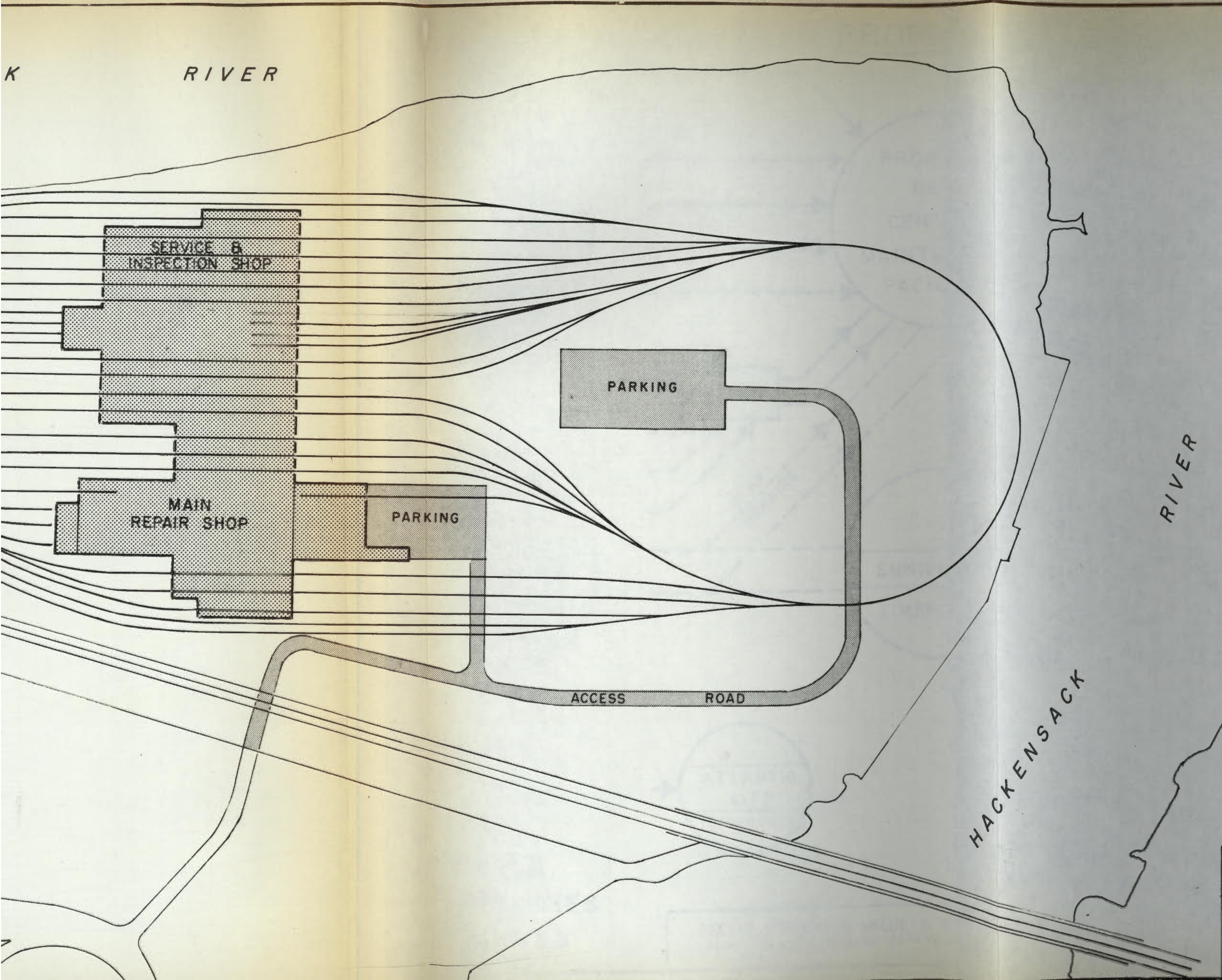
EXHIBIT V -7



SSV & K

EXHIBIT IV-9





NEW JERSEY DEPT. OF TRANSPORTATION
RAIL EQUIPMENT MAINTENANCE FACILITIES STUDY
PROJECT TS F-212 IT-09-0058

KOPPERS COKE
SITE PLAN

received the second highest point value and remains for sale for industrial-type land-use development purposes. Exhibit VI-9 is a plan view of the Jersey City - West of Croxton (Croxton - West) site, which received the third highest point value but is no longer available because of its recent sale to the Public Service Electric and Gas Company for energy-related land-use development purposes.

In summary, the Hoboken/Jersey City - South of Canal site (No. 1), Jersey City - West of Croxton (Croxton - West (n (No. 3) and the Pavonia site (No. 4) are no longer available for consideration. Therefore, the Koppers Coke site in Kearny, the second highest rated site for a consolidated facility, is the recommended location.

3. RECOMMENDED MAINTENANCE FUNCTION LOCATIONS

This section repeats the maintenance guidelines recommended in Chapter III and indicates where, among the recommended facilities of this chapter, those activities should be performed. This information is presented by type of equipment.

3.1 Diesel-Electric Locomotives

- o Daily or Trip Inspections and Servicing (fuel, water, sand, etc.) -- All terminating/originating terminals
- o Monthly Inspection (3-6-9 months) - Koppers Coke S&I Shop
- o Annual Inspections -- Koppers Coke S&I Shop
- o Three (3) Year Inspections -- Koppers Coke S&I Shop and/or Main Repair/Rebuild Facility

- o Five (5) Year Inspections & Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility
- o Nine (9) Year Inspections & Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility
- o Twelve (12) Year Inspections & Rebuild (New Service Life) -- Koppers Coke Main Repair/Rebuild Facility

3.2 Electric Locomotives (All functions to GG-1's, except daily inspections and servicing, will be performed at Wilmington.)

- o Daily or Trip Inspections and Servicing (sand, water, etc.) -- All terminating/originating terminals
- o Monthly Inspections (3-6-9 months)-- Koppers Coke & Sunnyside S&I Shops
- o Annual Inspections -- Koppers Coke S&I Shop
- o Three (3) Year Inspections -- Koppers Coke S&I Shop and/or Main Repair/Rebuild Facility
- o Six (6) Year Inspections and Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility
- o Nine (9) Year Inspections and Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility

- o Twelve (12) Year Inspections and Rehabilitation - (Koppers Coke Main Repair Shop)
- o Fifteen (15) Year Inspections and Rebuild (New Service Life) -- Koppers Coke Main Repair/Rebuild Facility

3.3 Conventional Commuter Passenger Coaches

- o Trip Inspections -- All terminating/originating terminals)
- o Turnaround and Layover Cleaning -- All terminating/originating terminals
- o Monthly Inspections and Maintenance -- Koppers Coke and Sunnyside S&I Shops
- o Six (6) Month "E" Cleaning -- Koppers Coke S&I Shop
- o Suppliers Recommended Inspection and Maintenance of Components (such as Air Conditioning) -- Koppers Coke and Sunnyside S&I Shops
- o Six (6) Year Inspections and Interior Refurbishing -- Koppers Coke Main Repair/ Rebuild Facility
- o Twelve (12) Year Inspections and Interior Rehabilitation, also Car Body and Running Gear Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility

- o Eighteen (18) Year Inspections and Interior Refurbishing -- Koppers Coke Main Repair/ Rebuild Facility
- o Twenty-five (25) Year Rebuild (New Service Life -- Koppers Coke Main Repair/Rebuild Facility.

3.4 Electric Self-Propelled Multiple-Unit Cars

- o Daily or Trip Inspection -- All terminating/orginating terminals
- o Turnaround and Layover Cleaning -- All terminating/originating terminals)
- o Monthly Inspections -- Koppers Coke and Sunnyside S&I Shops
- o Six (6) Month "E" Cleaning -- Koppers Coke S&I Shop
- o Suppliers Recommended Inspection and Maintenance of Component (such as Air Conditioning) -- Koppers Coke & Sunnyside S&I Shops
- o Annual Inspections -- Hoboken and Sunnyside S&I Shops
- o Three (3) Year Inspections and Interior Refurbishing) -- Koppers Coke S&I Shop
- o Five (5) Year Inspections and Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility

- Seven (7) Year Inspections and Interior Refurbishing -- Koppers Coke Main Repair/ Rebuild Facility
- Ten (10) Year Inspections and Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility
- Fifteen (15) Year Inspections and Rebuilds -- Koppers Coke Main Repair/Rebuild Facility

3.5 Rail Diesel Cars

- Daily or Trip Inspections -- All terminating/originating terminals)
- Turnaround and Layover Cleaning -- All terminating/originating terminals
- Monthly Inspections (3-6-9 months)-- Atlantic City Shop
- Six-month "E" Cleaning -- Atlantic City Shop
- Annual Inspections and Maintenance -- Atlantic City Shop
- Suppliers Recommended Inspection and Maintenance of Components (such as Air Conditioning) -- Atlantic City Shop
- Three (3) Year Inspections and Interior Refurbishing -- Atlantic City Shop
- Six (6) Year Inspections and Rehabilitation -- Koppers Coke Main Repair/Rebuild Facility
- Nine (9) Year Inspections and Interior Refurbishing -- Atlantic City Shop
- Twelve (12) Year Inspections and Rebuild (New Service Life) -- Koppers Coke Main Repair/Rebuild Facility

CHAPTER VI

RECOMMENDATIONS

CHAPTER VI

RECOMMENDATIONS

CONCEPTUAL DESIGN

In short summary, it has been recommended that a program of "Preventive and Systematic Demand Maintenance" be implemented, and established as was described in Chapter III. This program should be conducted on four activity levels, corresponding to the following four types of recommended facilities:

- o Major Repair/Rebuild Shop (MR/R)
- o Service and Inspection Facility (S&I)
- o Light/Running Repair Facility (L/RR)
- o Layover/Turnaround Facility (L/T)

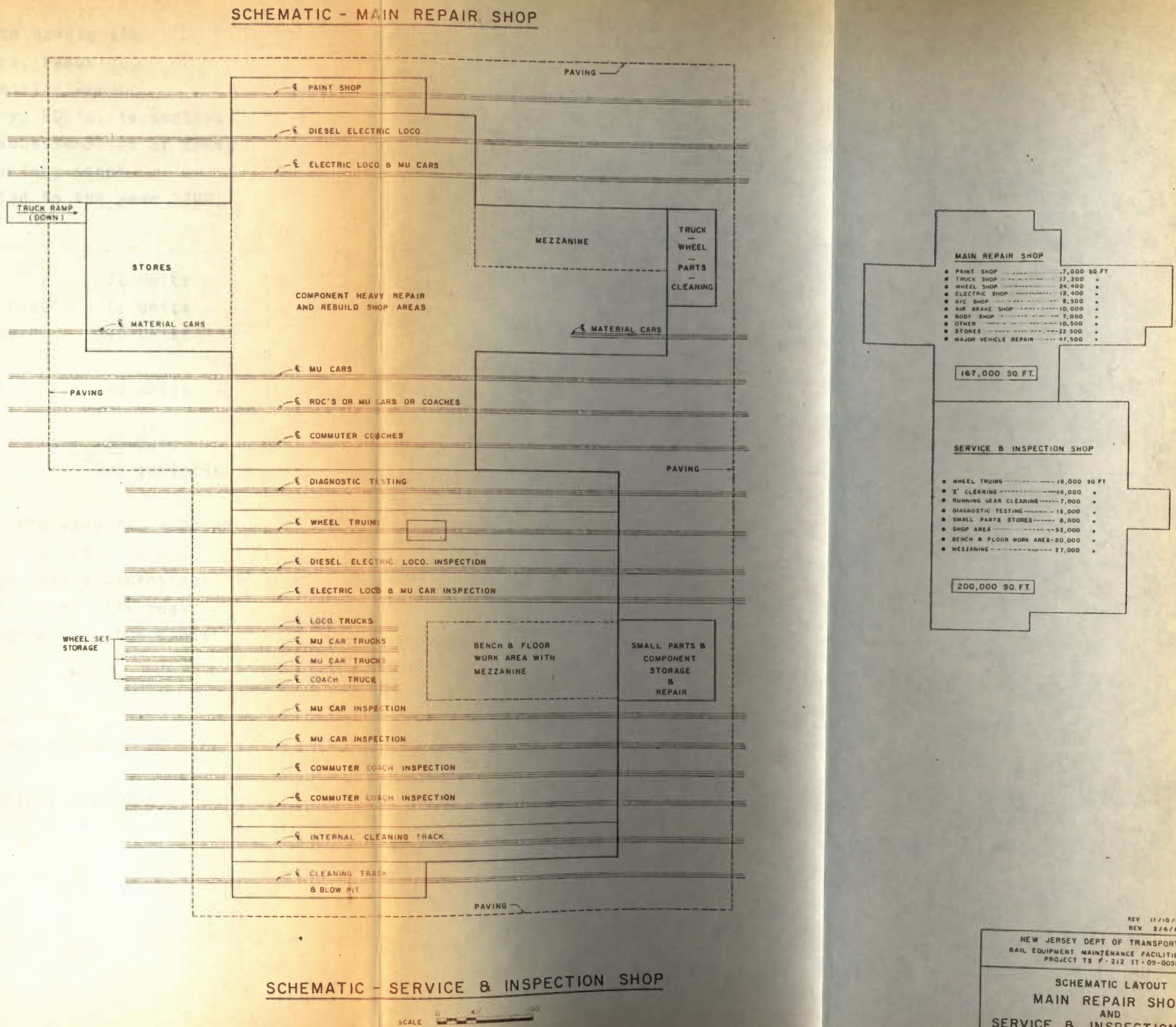
Final recommendations for specific (both existing and new) within each of these four categories are presented in this chapter, along with cost estimates and conceptual details concerning sites and preliminary configuration plans, personnel availability, equipment and tooling, fleet responsibilities, access, and other improvements.

Major Repair/Rebuild Shop

A new MR/R Shop is recommended for construction at the Koopers Coke Site. The existing E'port facilities will no longer be used for N.J. DOT work, due to the availability of the new Kearny facility. The Amtrak facility at Wilmington will continue to be used for major work on the N.J. DOT GG-1's for as long as they remain in service. No facility changes are recommended for Wilmington.

The new MR/R Shop should be built in consolidation with the new S&I Facility which is also recommended at this site. These two facilities will be divided by a common wall and both will be self-sustaining units, should circumstances force a staged construction. In that event, the MR/R Facility be given construction priority. Should funding not be immediately available to construct the recommended facility complex, the Main Repair/Rebuild Facility should be constructed first. As presented in Chapter III, this type of facility can accomplish the maintenance activities and functions of the lower order facility types. Thus, the MR/R Shop has the capabilities to perform monthly inspections, light/running repairs, as well as component changeouts, rebuilds, etc. In addition, priority for construction for the MR/R Facility is further reiterated by the age and condition of the Arrow fleet. The N.J. DOT equipment has incurred deferred maintenance (due in part to the absence of a main repair facility to accomplish such work) and, as such, four year rehabilitation/rebuild work will be required to bring this equipment "up to standard". Additionally, it is again emphasized that the maintenance program recommended in Chapter III can only be accomplished IF the equipment is "up to standard". A suggested schematic layout of the recommended consolidated facility is presented in Exhibit VI-1.

EXHIBIT VI-1



REV 11/10/80
REV 2/6/80

NEW JERSEY DEPT OF TRANSPORTATION
RAIL EQUIPMENT MAINTENANCE FACILITIES STUDY
PROJECT TS P-212 17-09-0058

SCHEMATIC LAYOUT
MAIN REPAIR SHOP
AND
SERVICE & INSPECTION SHOP
AT:
KOPPERS COKE / KEARNY, NEW JERSEY

SCALE	DESIGN BY	DRAWN BY	DATE	SHEET
1" = 40	FISHER	SP	9/21/79	1 OF 1

Seelye Stevenson Value & Knecht Inc — Engineers & Planners

The new MR/R Shop should be designed to handle all scheduled and unscheduled heavy repairs, rebuilds, retrofits, and/or modifications to diesel-electric locomotives, electric locomotives, MU's, RDC's, locomotive hauled coaches, and major components/subassemblies of these equipment types. Specifically, the rolling stock responsibilities of this shop, projected to the year 2000, are as follows:

Diesel-Electric Locomotives	72	Units
Electric Locomotives and/or Dual Mode	22	Units
Electric Self-Propelled MU Commuter Cars	393	Units
Locomotive Hauled Standard Commuter Cars	473	Units
Rail Diesel Cars	20	Cars
Total Commuter Rolling Stock	980	Vehicles

The suggested general configuration of the shop is based on a two-vehicle length for the major vehicle repair area. This section of the shop would have cumulative dimensions of approximately 250' x 250' and would contain six run-through tracks with the following assigned work functions:

- One track - Paint Shop
- One track - Diesel-electric locomotives
- One track - Electric locomotives and MU cars
- One track - MU cars
- One track - RDC cars and other vehicle overflow
- One track - Commuter coaches

The shop would also include a paint shop and track (7,000 sq. ft.), a stores area (22,500 sq. ft), and a support area for component and subassembly repair/rebuild work with the following assigned work areas:

Truck Shop	17,200 sq. ft.
Wheel Shop	24,400 sq. ft.
Electric Shop	12,400 sq. ft.
Air Brake Shop	10,000 sq. ft.
Air Conditioning Shop	8,500 sq. ft.
Body Shop	7,000 sq. ft.
Other (Office, locker room, lunch room, signals and communications, etc.)	10,500 sq. ft.
Total Support Area	90,000 sq. ft.
Total Heavy Repair Complex	167,000 sq. ft.

The proposed facility layout indicates that an internal cleaning shop would form part of the S&I Facility, and not a formal part of the MR/R Shop, a small discrepancy from the general MR/R shop requirements identified in Chapter III. This modification was made for reasons of optimal space utilization and improved flow of maintenance functions.

Personnel availability (for peak activity levels) at the proposed MR/R Shop is estimated as follows:

	1st Trick	2nd Trick	3rd Trick	Total
Supervision	10	4	2	16
Clerical	6	1	1	8
Shopcraft Personnel				
Safety Supervisors	2	-	-	2
Shop Engineering	3	-	-	3
Hostlers	2	1	1	4
Motive Power Dispatchers	2	1	1	4
Stockmen	3	1	-	4
Facility Maintainers	4	1	-	5
Shopcraft Personnel				
Journeyman	75	15	5	95
Helpers	6	2	-	8
Apprentices	8	-	-	8
Crane and Equipment Operators	4	1	1	6
Facility Maintenance	4	1	-	5
Laborers	8	2	1	11
Totals*	137	30	12	179

*Includes personnel shared with the S&I Facility on the basis of work load requirements.

The personnel estimate is based on consultant experience and review of main repair shops of other operations. It is obvious, for this facility as well as others, that categories and numbers of employees cannot be determined in accurate numbers until specific maintenance requirements and N.J. DOT policies are firmly established.

The major responsibilities of each of the shops of the MR/R Shop are described in the sections that follow. Also included is identification of tool, machinery, and equipment requirements and, in some instances, typical shop layouts and/or work flow diagrams are presented. The recommended machinery, equipment and tooling are general in nature and represent normal basic industry requirements.

1.1 Body Shop

Responsible for the heavy maintenance work on locomotives and cars such as repairing side swipes or fire damage and replacing bad or worn-out floors, sash doors, windows, seats, seat frames, complete side or front body panels, underframing, bolsters and equipment boxes. This shop is also responsible for repair of vandalism to interior trim, stanchions, seat frames, glass doors, seats, seat backs, and flooring.

Responsible for crating material and equipment to be shipped to a speciality shop or manufacturer for repair or rebuild.

Responsible for certain amount of building maintenance such as fabricating special benches, cabinets, etc.

Responsible for all the repair work of carpets, seats, seat backs, destination signs, slip covers for seats, and car cleaning waste sacks, covers, tarpaulins or bags that may be required over the entire system.

Responsible for cutting and grinding glass to various sizes and shapes to fit cars when sized glass is not available.

Tools, machinery and equipment:

- Roll former (hand operated)
- Hand brake box
- Power shear
- Power press brake
- Floor mounted metal drill press
- 10" grinder
- Wood band saw
- Metal band saw with saw blade cutter, welder and grinder
- Bench grinder
- Buffer
- Spot welder
- Cutter, notcher and bender
- Trackmobile
- Car pusher
- Sheet metal benches
- Small hand tools
- Sewing machines, cutter and tables for upholstery maintenance
- Glass finisher and grinder

1.2 Electric Shop

Responsible for all electric component heavy repair and rebuild work in connection with locomotives, MU cars, coaches, and RDC's.

Responsible for repair and recharging of batteries.

Responsible for fork and lift truck batteries and motors and all other batteries for maintenance-of-way equipment.

Responsible for equipment armature work and for whatever A.C. or D.C. work is required on the N.J. DOT commuter system (including work for the roadway and signal departments).

Responsible for the major repairs of all control equipment for locomotive and car equipment, including air conditioning, electrical controls, and electrical equipment for buildings, roadway and signal departments.

Tools, machinery and equipment:

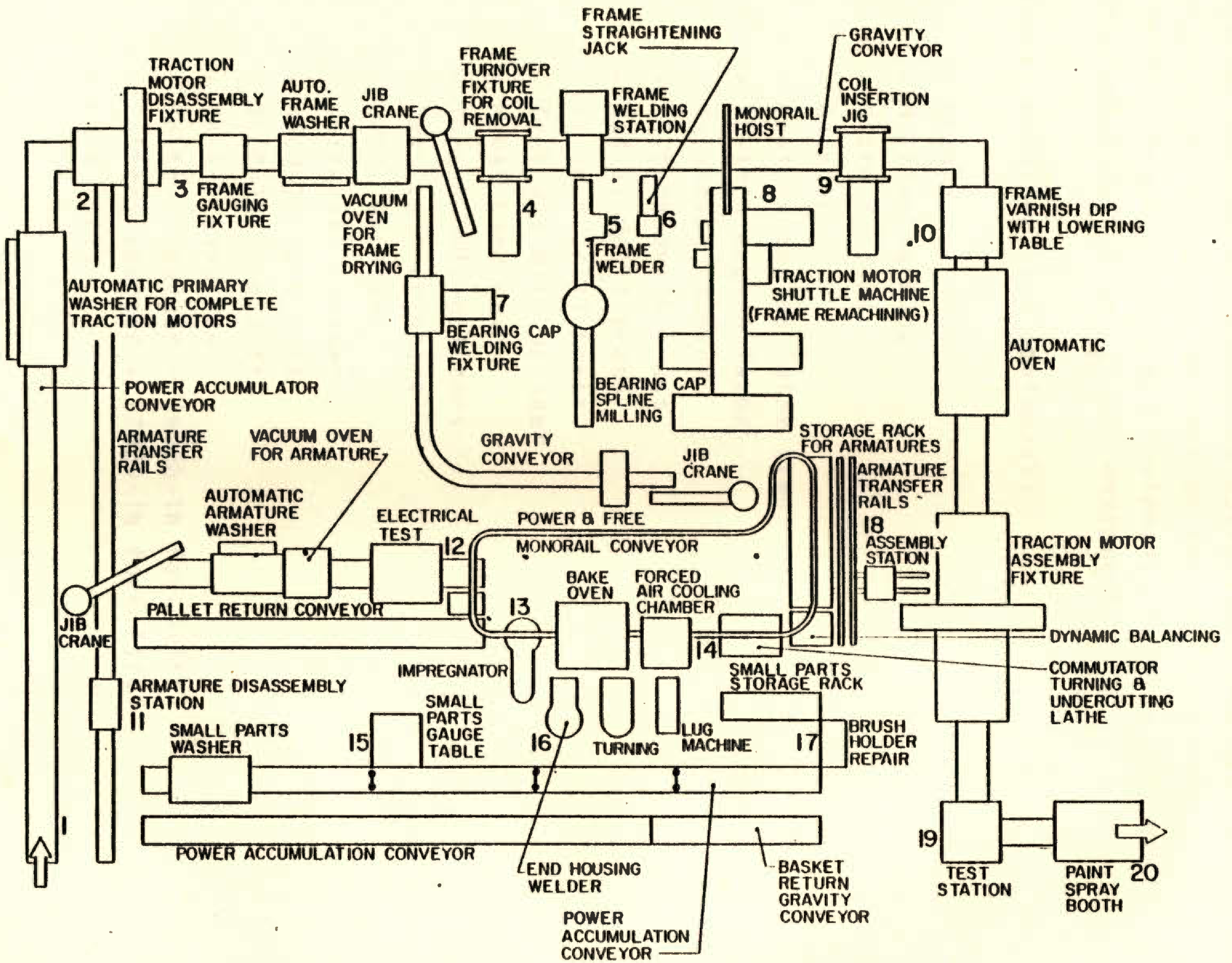
- Bearing oven
- Floor mounted drill press
- 6-inch pedestal grinder
- Battery chargers
- Hypots
- Blow out booth
- Hydraulic presses
- Fork lift trucks
- Test racks

- Armature lathe (with Mica undercutter attached)
- Impregnator
- Small electric oven
- Deep freeze
- Refrigerator
- Insulation cutter
- Insulation cutting table
- Tig welder
- Small lathe and undercutter
- Vacuum cleaner
- Pellet blaster
- Line breaker tester
- Jig saw
- Drill press
- Dynamic Balancer
- Buffing wheel
- Bench grinder
- D.C. supply 0-32 V
- D.C. supply 600 V
- Hand tools

Attached Exhibit VI-2 represents a typical layout for a traction motor overhaul line which would be part of the Electric Shop.

EXHIBIT VI-2

PRELIMINARY LAYOUT FOR A TRACTION MOTOR OVERHAUL LINE



SSV & K

.3 Machine Shop

Responsible for all machining operations required for all locomotives and cars, as well as for building hoists, cranes, shop machinery and equipment, roadway equipment, and communication and signal equipment.

Tools, machinery and equipment:

- Shaper
- Milling machine
- Micro finisher
- Grinder
- 16-inch engine lathe (two)
- 20-inch engine lathe
- Balancing machine
- 15-inch drill press
- Radial drill press
- 21-inch drill press
- Tool and mill grinder
- Metal band saw
- Thread bolt grinders
- Twin tool grinders
- Drill Grinder
- Universal Grinder
- 6000-lb fork lift
- 2000-lb fork lift
- Do-All band saw
- Battery charger - (6000-lb fork lift)
- Battery charger - (2000-lb fork lift)
- Hand tools

1.1.4 Air Brake and Air Conditioning Shop

Responsible for all air brake system equipment.

Responsible for all brake compressors.

Responsible for air conditioning compressors.

Responsible for recharging of Freon gas.

Tools, machinery and equipment:

- 2000-lb fork lift
- Pipe threaders
- Lap master
- Equipment test stands
- Surface grinder
- Rivet lathe
- Drill press
- Air conditioning tester
- Hand tools

Exhibit VI-3 represents a typical layout for an air brake overhaul line which is a requirement for any commuter equipment main repair shop.

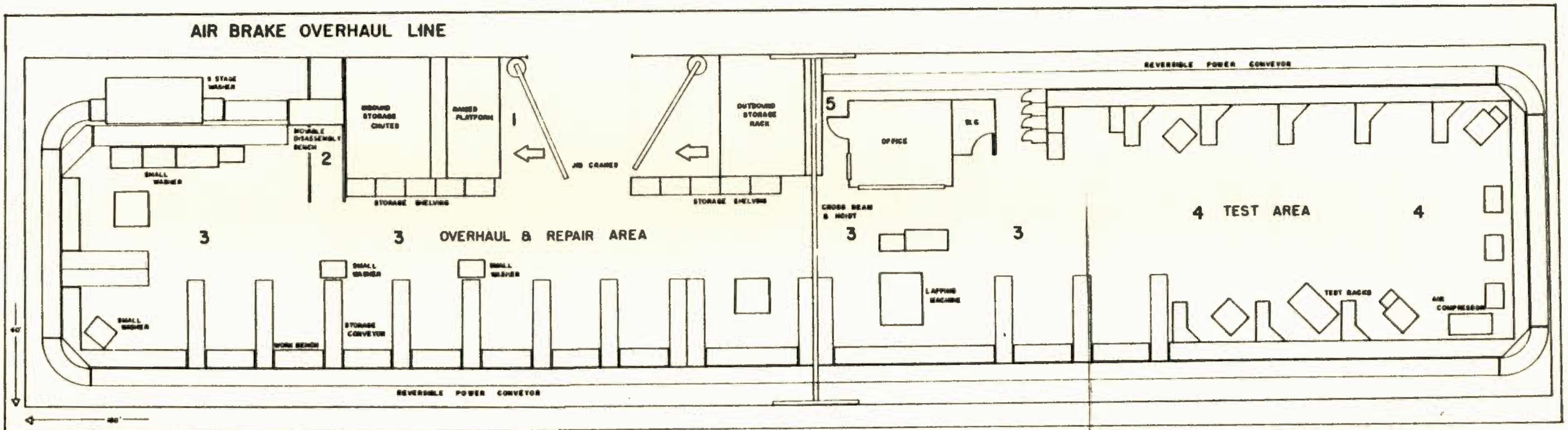

AIR BRAKE OVERHAUL LINE
5 STAGE WASHER
MOVABLE DISASSEMBLY BENCH
2
INBOUND STORAGE CHUTES
RAISED PLATFORM
1
JIB CRANES
OUTBOUND STORAGE RACK
5
OFFICE
REVERSIBLE POWER CONVEYOR
SMALL WASHER
STORAGE SHELVING
STORAGE SHELVING
CROSS BEAM & HOIST
3
3 OVERHAUL & REPAIR AREA
3
3
4 TEST AREA 4
SMALL WASHER
SMALL WASHER
LAPPING MACHINE
TEST RACKS
AIR COMPRESSOR
SMALL WASHER
STORAGE CONVEYOR
WORK BENCH
REVERSIBLE POWER CONVEYOR

EXHIBIT VI-3

1.1.5 Welding and Blacksmith Shop

Responsible for all acetylene or gas welding, arc welding, heli-arc welding, spot welding and new shop welding for stainless steel.

Responsible for repairs and reclaiming all forgings and fabrications which are damaged or excessively worn, but reclaimable.

Responsible to manufacture forgings and fabrications to expedite maintenance.

Tools, machinery and equipment:

- Midget aluminum welding gun
- Gas forge gun
- Electric furnace
- Annealing furnace
- Shear
- 30-ton air press
- Hand bending machine
- Grinder
- Electrode ovens
- Acetylene welders
- Electric welders (8 to 10 units)
- Electric heater oven
- Heli-arc welder
- Face plates - welding (3 to 4)
- Face plates - welding (4 to 5)
- Water tank
- Oil tank
- Exhaust fans (5 to 6)
- Furnace exhaust fan
- Iron rack
- Tool Rack

- Die rack
- Welding wire rack
- Anvils
- Welder exhauster
- Hand tools

1.1.6 Truck Repair Area

Responsible for all truck maintenance and repair from disassembly to reassembly, including visual and magnaflux inspection for damage, wear and cracks.

Tools, machinery and equipment:

- Pallets, tote boxes, wagons to handle material from disassembly
- Truck cleaning booth (automatic and fully enclosed, with a rolling door at each end).
- Fork lifts (2)
- Drill press (2)
- Sand Blaster
- Magnaflux and gray powder (castings and forgings)
- Magnaflux and red powder (machine surface)
- Air oil drum pump
- Emery wheel grinder
- Belt sander/exhaust
- Power cell (ram)
- Floor drill press
- Battery chargers for fork lifts

- Cut-off saw
- Impact wrenches
- Torque wrenches and torsion bars
- Vapor degreaser
- Parts cleaners
- Steam, detergent, hot water, and air connections

1.1.7 Wheel and Axle Shop Area

The Association of American Railroads (AAR) Wheel and Axle Manual has been prepared and revised annually and/or semi-annually to cover the best availale practices in the field of wheel, axle and bearing maintenance. There are methods of performing certain areas of work other than those described in the manual, but the experiences of many qualified people and railroad practices were assembled and made available through the manual.

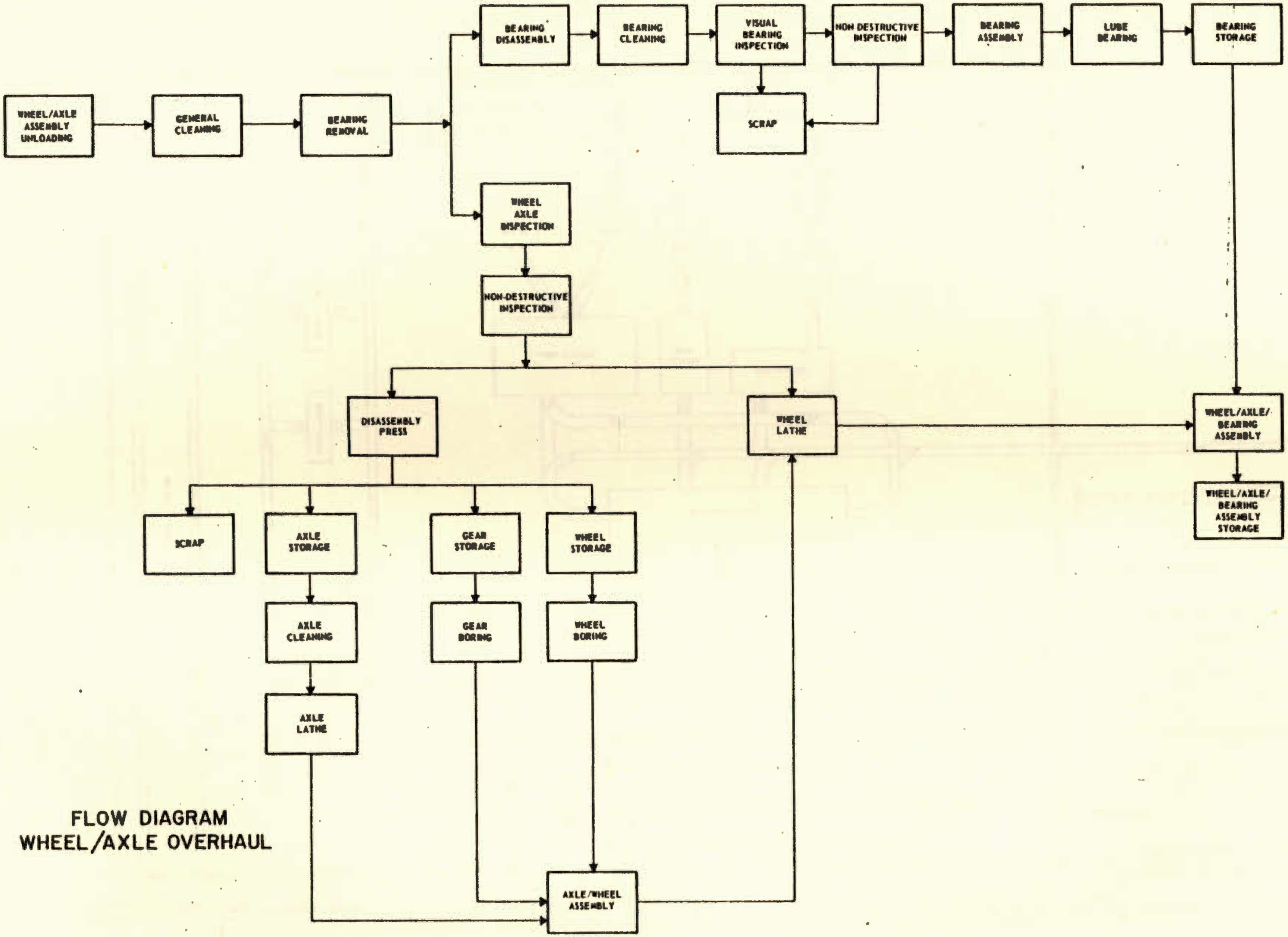
The section of the manual governing wheel shop practices has been adopted as standard and is made mandatory in interchange rule 69 and passenger car rule 7 and must be followed for all cars in interchange. The interchange rules are basically to protect the owner of the car and locomotive equipment during the time the equipment is operating on another railroad and to protect the using railroad when cars are received at interchange. The real primary factor is safe rail operations. For this latter reason, it is recommended that the minimum safety requirements for wheels, axles and bearings regarding defects, as outlined in AAR rules 41 and PC-10 and FRA rule

227 of the rules for Inspection of Locomotives, be a part of the maintenance functions and facilities for the N.J. DOT. All other rules, or sections thereof, by AAR and FRA for wheels, axles and bearings should also be part of the maintenance plans.

Wheel-axle-bearing and gear work is one of the most important equipment maintenance functions to be performed for safe high-speed operations. The purchase of wheels, axles, bearings, and gears and the labor to inspect, clean, store, machine. assemble and maintain them require very large annual expenditures. These expenditures justify special efforts to establish a facility for good workmanship and maintain the best practices which are currently available.

The wheel shop should be of sufficient size and arrangement to facilitate the storing of loose wheels, axles, bearings and gears, as well as mounted sets, in the sizes and types required and all under protective cover.

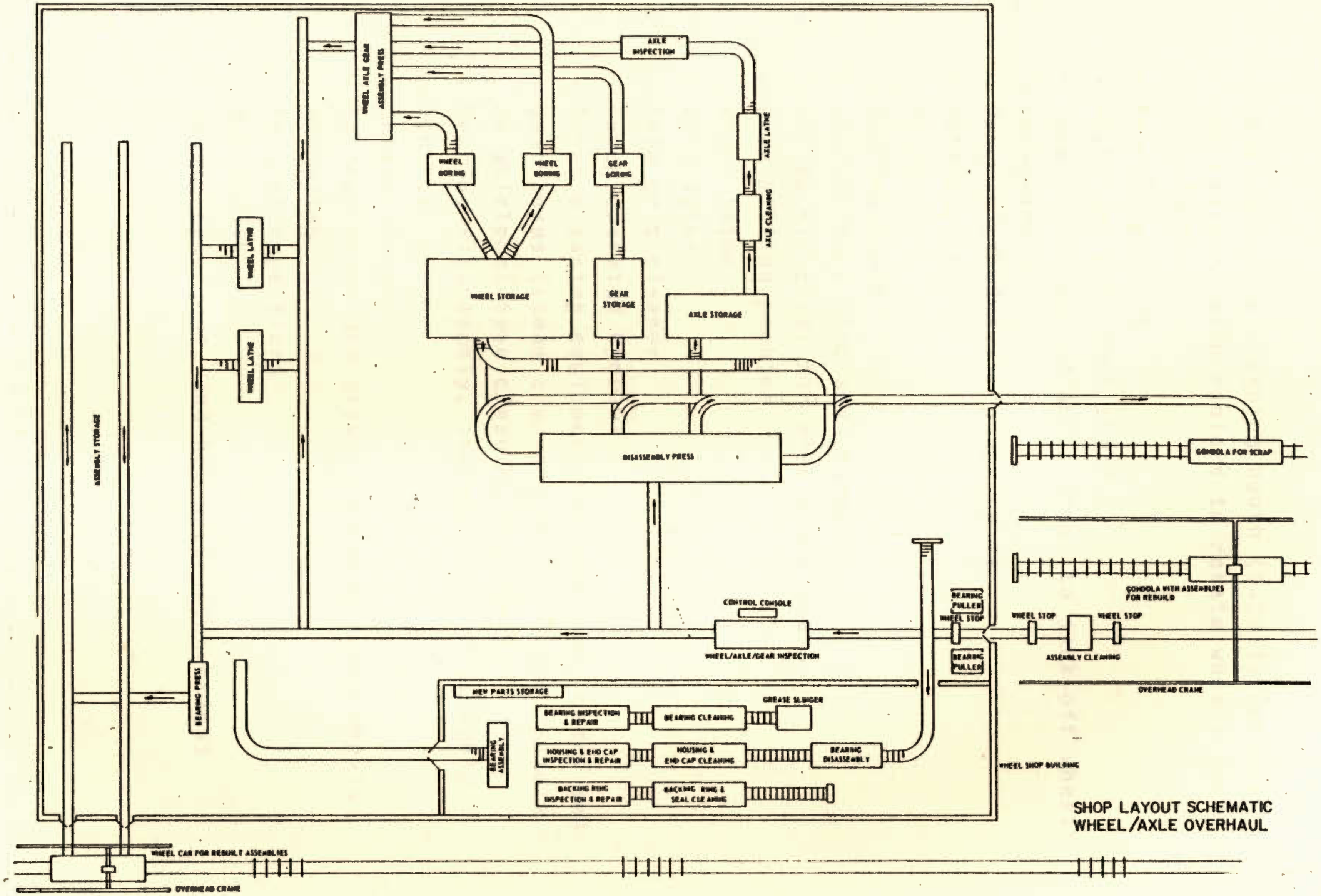
The shop machinery should be arranged for the most efficient progression of visual inspection, cleaning, disassembling, nondestrictive inspection, machining, assembling, etc. The flow diagram of Exhibit VI-4 shows a flow or progression of the approximate 23 work steps. A typical wheel/axle overhaul shop layout is presented in Exhibit VI-5.



FLOW DIAGRAM
WHEEL/AXLE OVERHAUL

EXHIBIT VI-4

EXHIBIT VI-5



SHOP LAYOUT SCHEMATIC
WHEEL/AXLE OVERHAUL

Tools, machinery and equipment:

- Wheel assembly cleaning booth (totally enclosed and equipped with roolers to rotate wheels during cleaning)
- Bearing pullers
- Wheel and axle test stand
- Power-operated hydraulic press to jack-off wheels and gears
- Pneumatic/hydraulic power cells
- Reflectoscope
- Maganfluc
- Onatona stand
- 2000-lb fork lift and charger
- Boring mills (3) for wheels and gears
- Gear milling machine
- Wheel lathe
- Axle lathe
- Axle grit cleaner
- Power-operated hydraulic
- Parts cleaning equipment for bearings, gears and gear boxes (steam cleaning booths and/or ajadip or whirlpool-type cleaning equipment)
- Bearing disassembly, inspection, and assembly benches
- Grease slinger
- Various power and gravity conveyors for wheels and axles
- Axle storage tiers
- Hand tools
- Steam, detergent, and hot water connections

.1.8 Signal and Communication Area

The signal and communication shop will service, maintain and repair equipment for locomotive and car on-board radio, intercom, cab signalling and automatic train control equipment.

The signal and communication shop could also be responsible for equipment involving wayside signals, interlocking equipment (such as switch machines, mobile radio equipment and base stations), and road crossing protection equipment.

All work benches and test benches should be equipped with built-in small test apparatus and be complete with all high and low AC and DC voltage outputs. The benches should also be equipped with accessible small parts cabinets and upper shelves.

All material and equipment for signals and communication that are valuable should be stored in enclosed areas that will be accessible only to responsible people.

Lighting should be optimal with a minimum of shadow and glare, especially in the area of the oscilloscopes.

Centrally located power distribution panels should be easily accessible for normal and emergency conditions.

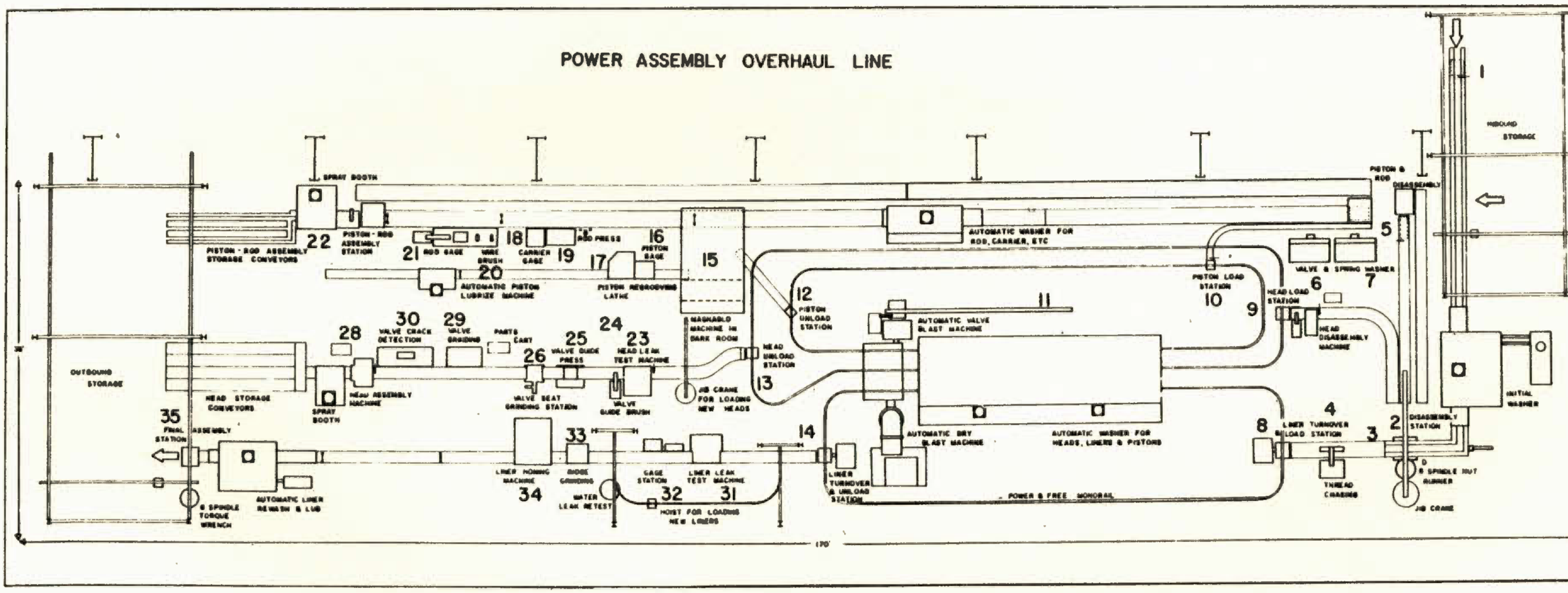
Tools, machinery and equipment:

- Ground ohmmeter
- Various voltmeters, ohmmeters, and ammeters
- Wheatstone bridge
- Condensor tester
- Oscilloscope
- Electronic counter
- Power supplies at benches for various voltages
- Oscillator
- Test jigs
- Code test sets
- Diode test sets
- Electric Welder
- Drill press
- Lathe
- Signal generator
- Digital circuit tester
- Good supply of spare units
- Small hand tools
- Small fork lifts and other material-handling buggies

.1.9 Diesel Engine Repair Area

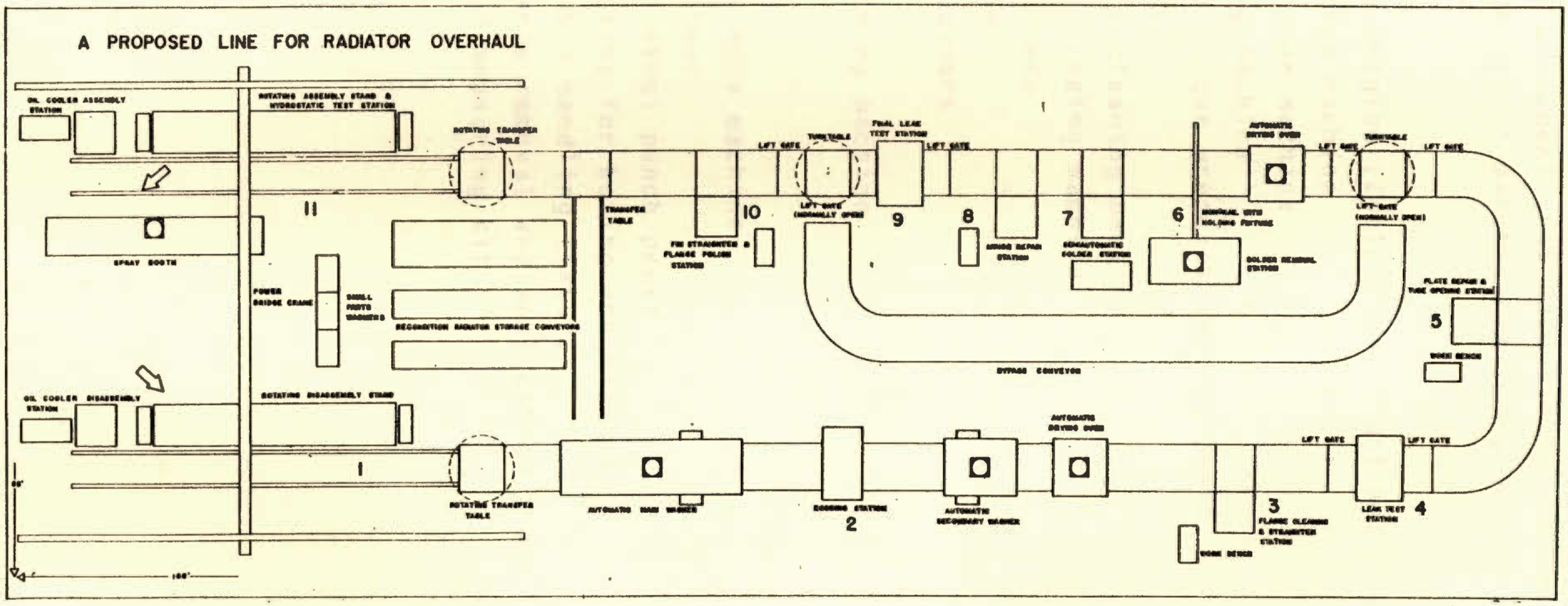
Major properties establish production lines for power assemblies repair, with supplemental component (e.g. radiators) repair areas. Exhibits VI-6 and VI-7 indicate a typical power assembly overhaul line and a typical radiator overhaul line respectively.

EXHIBIT VI-6



POWER ASSEMBLY OVERHAUL LINE
INBOUND STORAGE
PISTON & ROD DISASSEMBLY
AUTOMATIC WASHER FOR ROD, CARRIER, ETC
SPRAY BOOTH
PISTON-ROD ASSEMBLY STATION
PISTON-ROD ASSEMBLY STORAGE CONVEYORS
ROD GAGE
WIRE BRUSH
CARRIER GAGE
ROD PRESS
PISTON GAGE
AUTOMATIC PISTON LUBRIZE MACHINE
PISTON REGROOVING LATHE
MAGNAGLO MACHINE IN DARK ROOM
PISTON UNLOAD STATION
PISTON LOAD STATION
VALVE & SPRING WASHER
HEAD LOAD STATION
HEAD DISASSEMBLY MACHINE
AUTOMATIC VALVE BLAST MACHINE
HEAD UNLOAD STATION
JIB CRANE FOR LOADING NEW HEADS
VALVE CRACK DETECTION
VALVE GRINDING
PARTS CART
VALVE GUIDE PRESS
HEAD LEAK TEST MACHINE
VALVE SEAT GRINDING STATION
VALVE GUIDE BRUSH
HEAD ASSEMBLY MACHINE
HEAD STORAGE CONVEYORS
OUTBOUND STORAGE
FINAL ASSEMBLY STATION
8 SPINDLE TORQUE WRENCH
AUTOMATIC LINER REWASH & LUB
LINER HONING MACHINE
RIDGE GRINDING
WATER LEAK RETEST
GAGE STATION
LINER LEAK TEST MACHINE
HOIST FOR LOADING NEW LINERS
LINER TURNOVER & UNLOAD STATION
AUTOMATIC DRY BLAST MACHINE
AUTOMATIC WASHER FOR HEADS, LINERS & PISTONS
POWER & FREE MONORAIL
LINER TURNOVER & LOAD STATION
THREAD CHASING
DISASSEMBLY STATION
8 SPINDLE NUT RUNNER
JIB CRANE
INITIAL WASHER
170'

EXHIBIT VI-7


A PROPOSED LINE FOR RADIATOR OVERHAUL
OIL COOLER ASSEMBLY STATION
ROTATING ASSEMBLY STAND & HYDROSTATIC TEST STATION
ROTATING TRANSFER TABLE
SPRAY BOOTH
11
POWER BRIDGE CRANE
SMALL PARTS WASHERS
RECONDITION RADIATOR STORAGE CONVEYORS
TRANSFER TABLE
OIL COOLER DISASSEMBLY STATION
ROTATING DISASSEMBLY STAND
1
ROTATING TRANSFER TABLE
AUTOMATIC MAIN WASHER
RODDING STATION
2
AUTOMATIC SECONDARY WASHER
AUTOMATIC DRYING OVEN
3
FLANGE CLEANING & STRAIGHTEN STATION
WORK BENCH
LIFT GATE
LEAK TEST STATION
4
PLATE REPAIR & TUBE OPENING STATION
5
WORK BENCH
BYPASS CONVEYOR
LIFT GATE
TURNTABLE
LIFT GATE (NORMALLY OPEN)
AUTOMATIC DRYING OVEN
6
SOLDER REMOVAL STATION
7
SEMIAUTOMATIC SOLDER STATION
8
FINAL LEAK TEST STATION
9
LIFT GATE
TURNTABLE
LIFT GATE (NORMALLY OPEN)
10
FIN STRAIGHTEN & FLANGE POLISH STATION
100'

Tools, machinery, and equipment (not necessarily complete due to constant technological maintenance improvements and techniques):

- Magnaflux/magnaglow (Zyglo black light machine)
- Piston lubrize machine
- Piston regroove machine
- Liner honing machine
- Spindle and torque wrenches and equipment
- Ridge grinder
- Wheelabrator cleaning machine
- Value seat grinding machine
- Value seat press
- Value grinder
- Automatic washers
- Job cranes
- Value repairing machine
- Power tools
- Hand tools
- Multiple spindle machine
- Impact wrenches
- Numerical control punch press
- Shuttle machine for boxing and milling
- Power assembly handling fixtures
- Power assembly removal and application tools
- Engine speed measuring kit

- Load box
- Degreasing, decarbonization and dieseling
- Main bearing wrench
- Automatic glass bead blast machine

1.1.10 Paint Shop

Responsible for preparing and painting of vehicles and components. The shop will be divided into five areas two major and three minor. The major areas consist of a vehicle preparation booth, and a paint spray booth, and work benches. An environmental control system will be utilized to handle the sanding and chemical stripping in the preparation areas, as well as the paint spray emissions. A fire wall and doors between the two major areas will be provided. Total car painting and/or components will be accomplished in this shop.

1.2 Service and Inspection Facilities

It is recommended that new S&I facilities be constructed at the Koppers Coke site and at Atlantic City and that the existing facilities at Sunnyside Yard be expanded. The new Sunnyside Yard facilities would also include a Light/ Running Repair Facility. All of these facilities are described individually herein. The existing S&I facilities at South Amboy would no longer be used for that purpose.

1.2.1 Koppers Coke

The Koppers Coke facility should be designed to handle the following functions:

- o Scheduled periodic inspections as requied by Federal Safety Regulations and established in-house operational and preventive maintenance inspections.
- o Running gear blowing and cleaning prior to all MI's and other major shopping.
- o Additional wheel truing (30th Street - Philadelphia presently supplements wheel truing at Hoboken).
- o Internal major cleaning, servicing and maintenance.
- o All running, light and medium repairs requiring less than 72 hours.
- o Minor retrofit or modifications
- o Component and sub-assembly change-out and/or repairs requiring less than 72 hours.
- o Appraising electrical conditions with automatic circuit testing or diagnostic tester, spectographic analysis, magnet and/or ultrasonic testing, etc.
- o Storing repaired or rebuilt components as well as working stock materials.
- o Training apprentices as well as other designated personnel.
- o Administrative and welfare functions

These functions would apply to the following fleet of equipment, projected to the year 2000:

Diesel Electric Locomotive	72 Units
Electric Locomotives (Excluding GG-1's)	22 Units
MU Commuter Cars	227 Cars
Locomotive Hauled Commuter Cars	342 Cars
Total	663 Vehicles

As previously noted, the S&I Facility should be built in conjunction with the new MR/R Shop. The suggested configuration is shown in Exhibit VI-1. The S&I facility would encompass 200,000 sq. ft., apportioned to major functional areas as follows:

Main inspection area and tracks (including truck repair and component changeout area)	92,000 sq. ft.
Small parts and components storage	8,000 sq. ft.
Wheel truing area and track	16,000 sq. ft.
"E" cleaning area and track	14,000 sq. ft.
Mezzanine, including a bench and floor work area	47,000 sq. ft.
Diagnostic test area and track	16,000 sq. ft.
Running gear cleaning area, blow pit, and track	7,000 sq. ft.

The inspection tracks (6) should accommodate four vehicles and be equipped with inspection pits between rails, built at a depth of 4'8" from the top-of-rail. The facility should contain platforms between tracks at vehicle floor height. The three tracks designated for MU and electric locomotive inspection should be equipped with roof-level platforms for inspection and maintenance of pantographs. The consolidated MR/R and S&I Shops should also be supported by an appropriate network of receiving, read, storage, test, running, ladder, and shop lead tracks and by miscellaneous facilities such as a power plant, roadways, and a parking area.

Personnel availablity (for peak activity levels) at the proposed S&I Facility estimated on the basis of consultant experience and review of service and inspection shops of other railroad operations, are as follows:

	1st Trick	2nd Trick	3rd Trick	Total
Supervision	10	4	2	16
Clerical	6	1	1	8
Safety Supervisors	2	-	-	2
Shop Engineering	3	-	-	3
Hostlers	2	1	1	4
Motive Power Dispatchers	2	1	1	4
Stockmen	3	1	-	4
Facility Maintainers	4	1	-	5
Shopcraft Personnel				
Journeymen	66	20	10	96
Helpers	8	-	-	8
Apprentices	8	-	-	8
Crane and Equipment Operators	4	1	1	6
Car Cleaners	3	3	-	6
Laborers	8	2	1	11
Total*	129	35	17	181

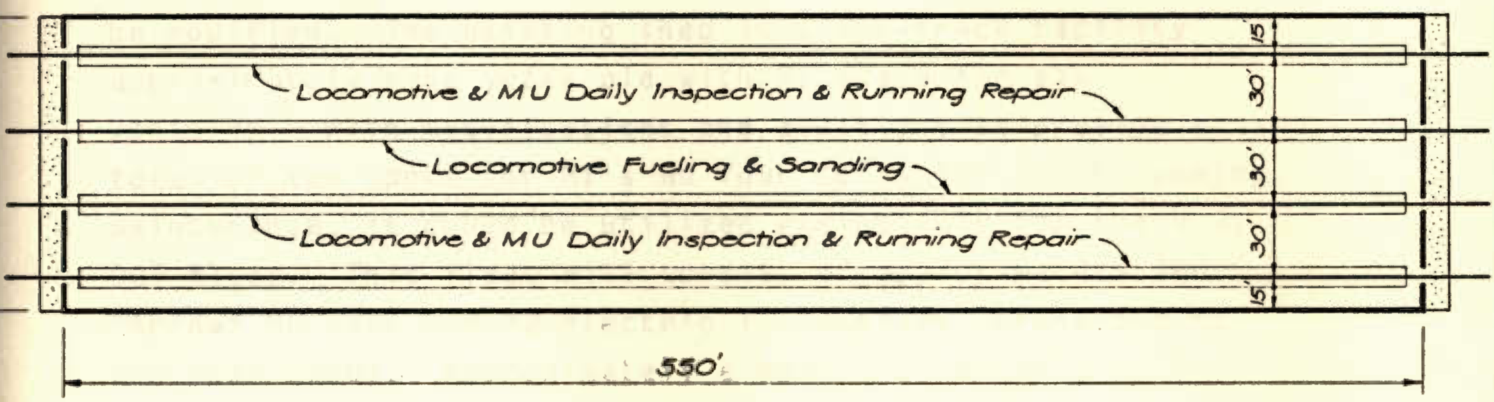
*Includes personnel shared with the MR/R Shop on the basis of work load requirements.

After both new Koppers Coke shops are completed, the existing MU car shop facilities and Modoc shop facilities with support facilities can be abandoned and retired for demolition.

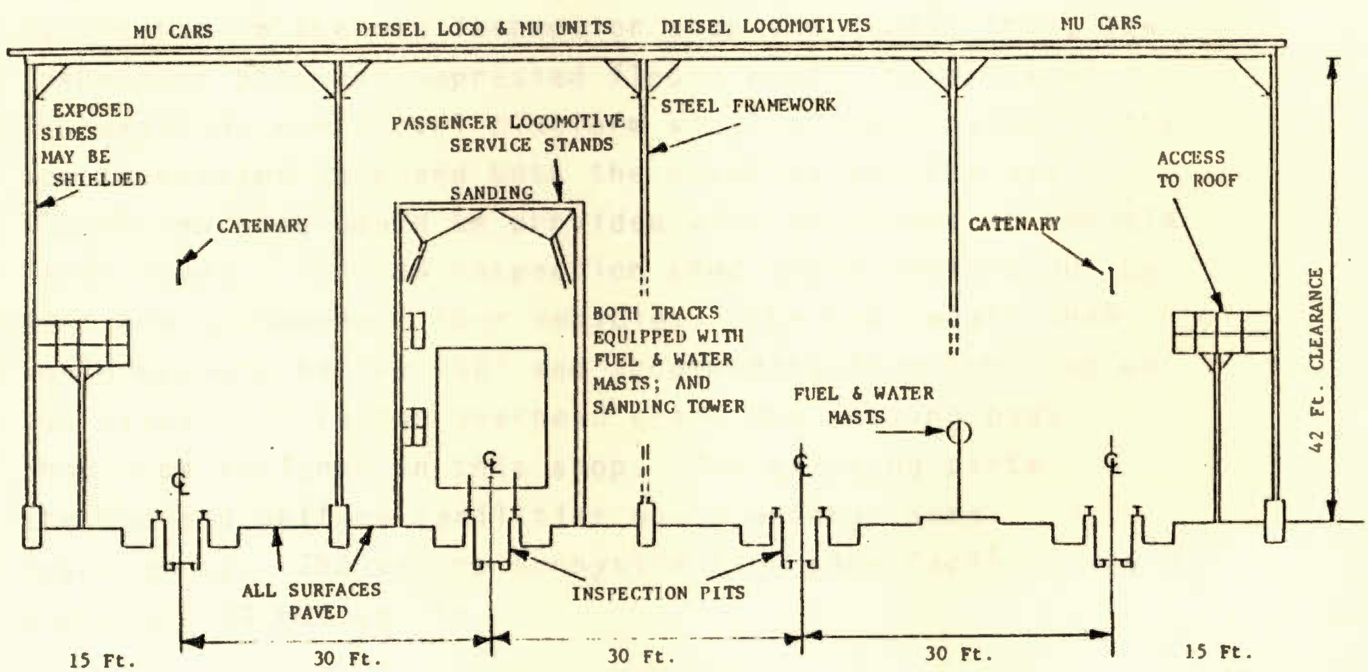
The present MU car shop site can be converted to a locomotive and MU servicing and daily inspection facility with through tracks and the yard area presently used for modoc facilities can be converted to additional yard tracks. In general, the Hoboken Terminal Yard can be converted to a true operating yard for terminating and orginating requirements and storage for lay over and spare equipment. Exhibit VI-8 presents a plan and a section view of the locomotive service and inspection facility recommended. The yard conversion work would also include modifications to the washing facility, power plant, tower, and other existing buildings.

HOBOKEN OPERATING YARD
DAILY INSPECTION & SERVICE TRACKS

EXHIBIT VI-8



PLAN



TYPICAL SECTION

ALL OF AREA DRAINS TO WASTE WATER TREATMENT

TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES

Seelye Stevenson Value & Knecht
Engineers and Planners
SSV&K

1.2.2 Sunnyside Yard

SSV&K recommends that the N.J. DOT commuter rail fleet serving Penn Station, New York be serviced and inspected at Sunnyside Yard, New York, and that the existing METRO shed be modified. The existing shed is a one-track facility approximately nine years old with MI space for six vehicles. With modifications and additions to provide a total of ten spots for MI's nd four sptos for light/running maintenance, it could be utilized exclusively for the N.J. DOT fleet. This fleet will consist of approximately 180 "Arrow" MU cars and 22 electric locomotives (projected to the year 2000). Approximately eleven (11) monthly inspections should be performed daily. This facility would assume the MI work currently conducted at South Amboy.

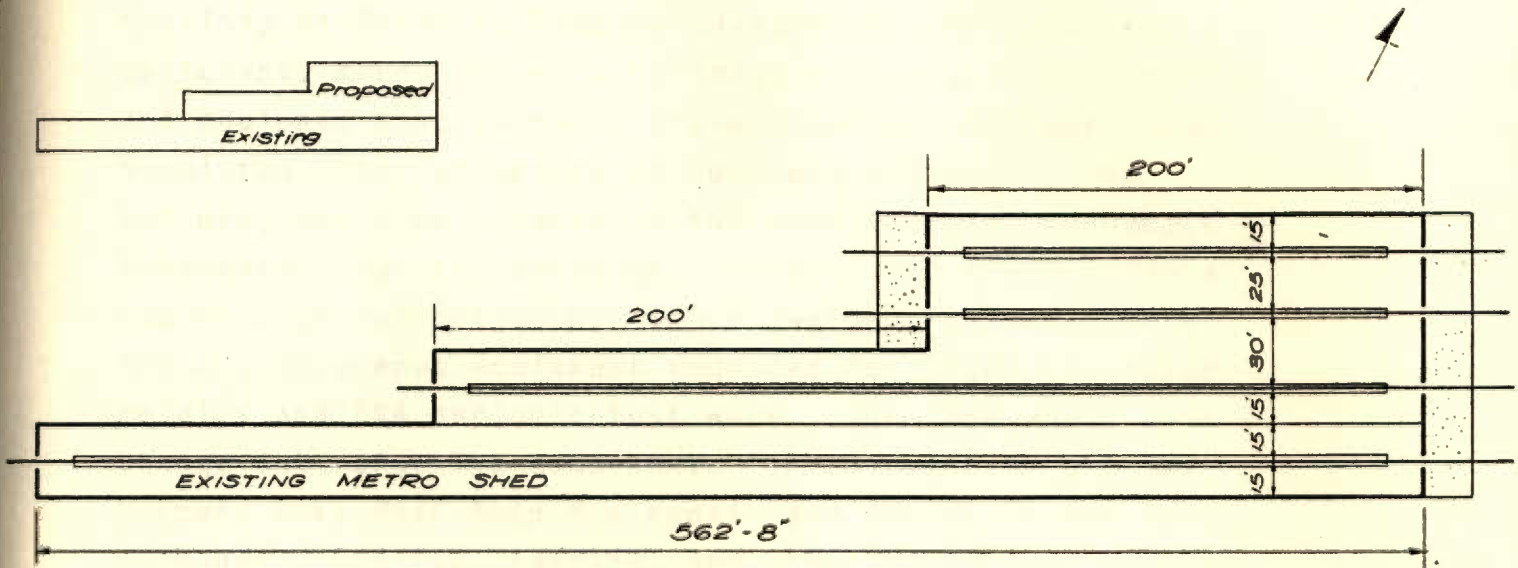
A plan and typical section of the proposed facility modifications and additions are presented in Exhibit VI-9 The track facilities of the existing shop would be duplicated in the new inspection shop and repair shop, new inspection pits and depressed floors would be provided. The existing roof-level platform would be duplicated in the new inspection shop and both the existing and the new inspection shop would be provided with platforms at vehicle floor level. The new inspection shed would measure 30' by 400' and accommodate four vehicles. The new repair shop would measure 55' by 200' and accommodate four vehicles on two tracks. A 15-ton overhead crane and jacking pads should be included in this shop. The existing parts storage and welfare facilities would undergo some improvement. The entire Sunnyside Yard shop facility would encompass 39,800 sq. ft.

Support tracks for the facility would need to be modified and/or constructed and a blow pit should be constructed in the support area. Track construction should include catenaries. Wheel truing would be accomplished at the proposed Amtrak facility on a negotiated user-charge basis.

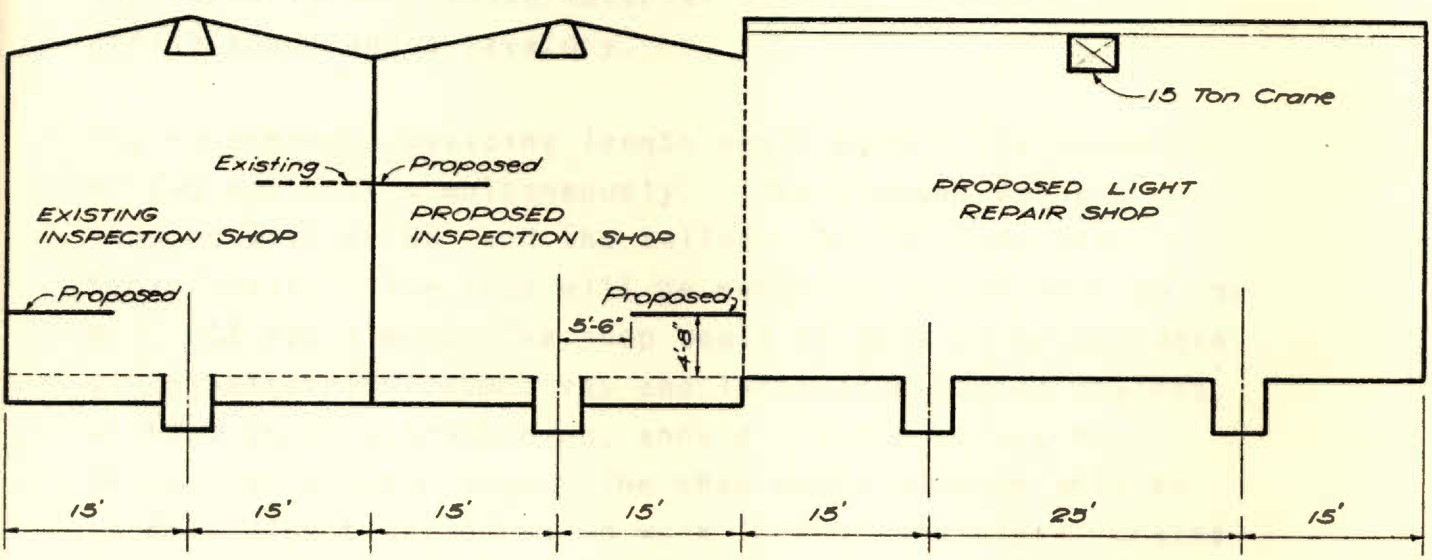
Yard storage, cleaning, and servicing functions would continue to be handled by Amtrak personnel in the present manner. Maintenance work would also continue to be handled by Amtrak personnel, guided by N.J. DOT work specifications. The required work force is estimated to be 109 persons.

SUNNYSIDE YARD FACILITIES MODIFICATIONS

EXHIBIT VI-9



PLAN



TYPICAL SECTION

TS F 212
Study of
RAIL EQUIPMENT
MAINTENANCE FACILITIES
Seelye Stevenson Value & Knecht Engineers and Planners SSV&K

.2.3 Atlantic City

SSV&K recommends tht the present maintenance of equipment facility at Atlantic City be upgraded by replacing the deficient, makeshift work building with a well constructed and equipped single-track, pre-engineered, prefabricated, insulated metal structure on concrete footings. The building would be located in the area south of Bacharack Boulevard near the passenger station, and would house a run-through inspection pit track (welded rail on H-beam) and miscellaneous equipment required for light to medium repairs and FRA periodic test work. The shop would also change out defective components for shipment to the new Koppers Coke MR/R Shop for repair and return or for unit exchange. Fueling, sanding, and other servicing functions are also recommended for this location.

Recommended is a 25' by 200' main building, with an attached 15' by 120' lean-to structure, which should be partioned to accomodate material storage, a repair shop, office space and a lavatory.

The recommended building length would permit the shopping of two vehicles simultaneously. (The longest vehicle shopped will be 86' and the tallest 15' 10" from the top-of-rail). The shop will be responsible for work on the N.J. DOT RDC fleet. The shop would be able to accommodate diesel-electric locomotives and locomotive hauled coaches, without shop restructuring, should train consists be changed at a later date. The shop would also be able to readily accept an increased work load if additional trains were to be scheduled. Only increased manpower would be required.

The main structure would have 15' wide electrically-powered rolling doors at both ends and a 95' lighted inspection pit, complete with four jacking pads to permit the lifting of RDC bodies. The pit would be provided with a drainage system. Water, air and electrical outlets would be installed at four convenient building wall locations.

The design and construction of the shop should be economical, and it should operate in a cost-efficient manner. It should be durable and able to withstand rigorous shop activities. Facilities (sanitary, etc.) for the work force should be incorporated, as should an office of approximately 180 sq. ft. for a shop manager. The employee facilities should be separated from the noise and fumes of the work area. Shop safety equipment, fire hose stations, sprinkler system, smoke evaculation fans, etc. must be provided as required by city building codes, state law and OSHA. Adequate drinking and other water must be provided, as well as 110/220/440 volt electric service (for lighting, power jacks, welding, water and lube oil heating etc.). The building should be provided with a steam heat boiler system to minimize heat losses as equipment is shunted in and out of shop as well as force hot air heaters at the track doors. The shop should also be equipped with the following service and service-related equipment: a 750 gallon lube oil storage tank for servicing equipment, and a 20,000 gallon supply tank for #2 diesel fueling of RDC cars at a pad outside the building. The tank would have a pump system for unloading and dispensing, consisting of a ticketed meter, Houston automatic shut off nozzle and fire extinguisher provision.

Two cranes should be provided: one 10 ton bridge crane running the full length of the track (21' 4" clearance must be provided from top of rail to crane hook), and a two ton monorail crane for store room material handling. The inspection pit should be 4' 8" below the top of rail, and must comply with all OSHA standards. Depressed concrete flooring (two feet deep) should be provided adjacent to the inspection pit. The electric doors should have a manual operation capability. The power roof vents with electric push button control and pilot light indicators should also be provided, along with adequate shop interior (including pit) lighting. The employee facilities (offices, etc.) should be air conditioned.

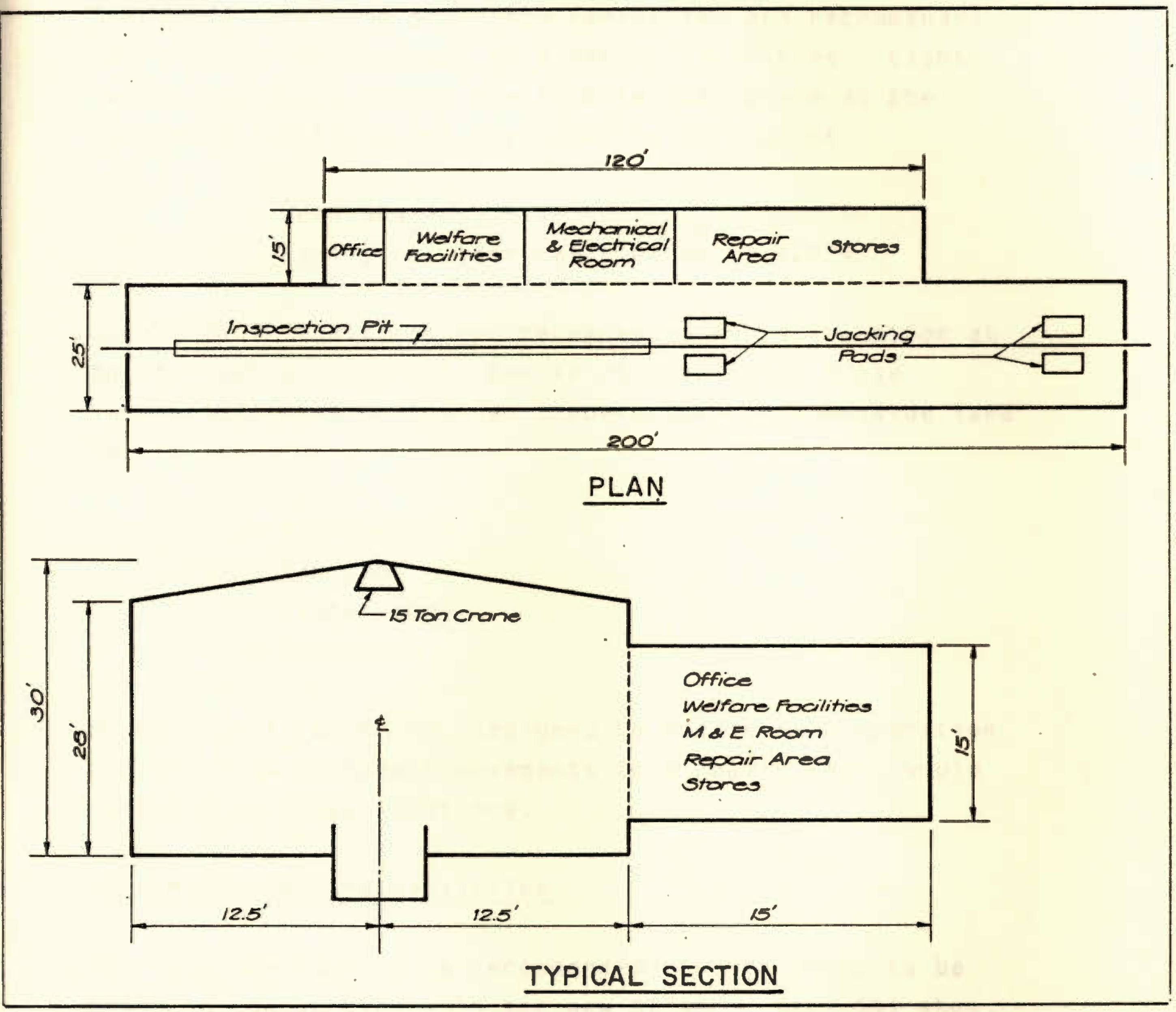
Adequate sanitary facilities (sewer, plus grease traps, oil separator and holding tank) must be provided, as well as a 1000 gallon waste oil storage tank with an oil separator and oil collector pans at the fueling pad. There should also be an Impco or equivalent sanding system at the fuel pad.

A stationary motor-driven air compressor should be located outside and adjacent to the shop building. Its supply would be used to satisfy shop maintenance requirements. Four portable jacking units would be required at the non-pit end of the facility. The heaviest vehicle will weigh 325,000 lb. and the maximum vehicle weight less trucks will be 220,000 lb. Thus, each unit must be capable of supporting 450,000 lb.

Adequate flood lighting should be provided in the fuel service area, the parking lot and outside the shop area, to increase security. A Kerrick cleaner wall unit or its equivalent should be provided for exterior car cleaning.

It is recommended that the new maintenance building be erected at a location that would be ~~easily accessible.~~ A vehicle should be able to enter the shop at the entrance end, receive the required maintenance, leave through the opposite end and then switch and reverse move onto a shop runaround track, returning to the main track for continued revenue service. Exhibit VI-10 shows a plan and typical section view of the recommended Atlantic City facility.

ATLANTIC CITY
RECOMMENDED FACILITY



1.3 <u>Light/Running Repair Facilities</u>

As previously noted, a new Light/Running Repair Facility is recommended for incorporation in the facilities at Sunnyside Yard. No other new facilities are recommended, nor are any improvements to existing facilities. Light repair functions should continue to take place at the following locations not discussed to this point:

- o Penn Station, N.Y.
- o Paoli, PA. (for cars loaned to SEPTA)

Light repair functions are recommended for elimination at the following locations, due to relocation of those responsibilities to the new Koppers Coke or Sunnyside Yard facilities:

- o Harrison
- o Raritan
- o South Amboy
- o Trenton

Minor repair functions, designed to assure safe operation and/or allow equipment movements to a repair shop, would continue at these locations.

1.4 <u>Layover/Turnaround Facilities</u>

The only new facilities recommended concern those to be built in conjunction with the new Atlantic City S&I shop. Storage yard and servicing facility improvements recommended for the existing Hoboken site have already been described in this chapter (Section 1.2.1). In addition, a 480-volt electric standby system should be installed. Such a system would permit the preheating or precooling of standard coaches and would allow diesel locomotives to be shut down overnight or during other long layover periods.

Miscellaneous modifications are recommended at other existing facilities, including other installation of the standby system described for Hoboken. Several of the facilities exhibit a lack of security; unauthorized access was found to be easily attainable. Improved security measures (primarily the installation of fencing) are recommended at these sites. Some site require yard storage track rehabilitation. Finally, some inefficient fueling and sanding functions could be eliminated and performed instead at the modified Hoboken (or Atlantic City) yard upon completion of the yard improvements and construction of necessary track connections. Recommended facility modifications by site, along with recommended personnel assignments, are as follows:

<u>Bay Head</u>

Rehabilitate yard storage tracks using fit rail.
Eliminate fueling and sanding functions; relocate to Hoboken
Manpower requirment: 28

<u>Gladstone, Morristown and Summit</u>

Rehabilitate yard storage tracks using fit rail.
Improve equipment and facility security.
Manpower requirement: 2 (Gladstone)
2 (Morristown)
1 (Summit)

Lindenwold

Eliminate fueling and sanding functions; relocate to Atlantic City.

Manpower requirement: 2

Dover

Rehabilitate yard storage tracks using fit rail

Install 440-V standby system.

Eliminate fueling and sanding functions, relocate to Hoboken

Manpower requirement: 7

Princeton

Improve equipment and facility security.

Manpower requirement: None

Raritan

Install 440-V standby system.

Eliminate fueling and sanding functions; relocate to Hoboken.

Manpower requirement: 28

South Amboy

Eliminate fueling and sanding functions; relocate to Hoboken.

Manpower requirement: 20

Waldick

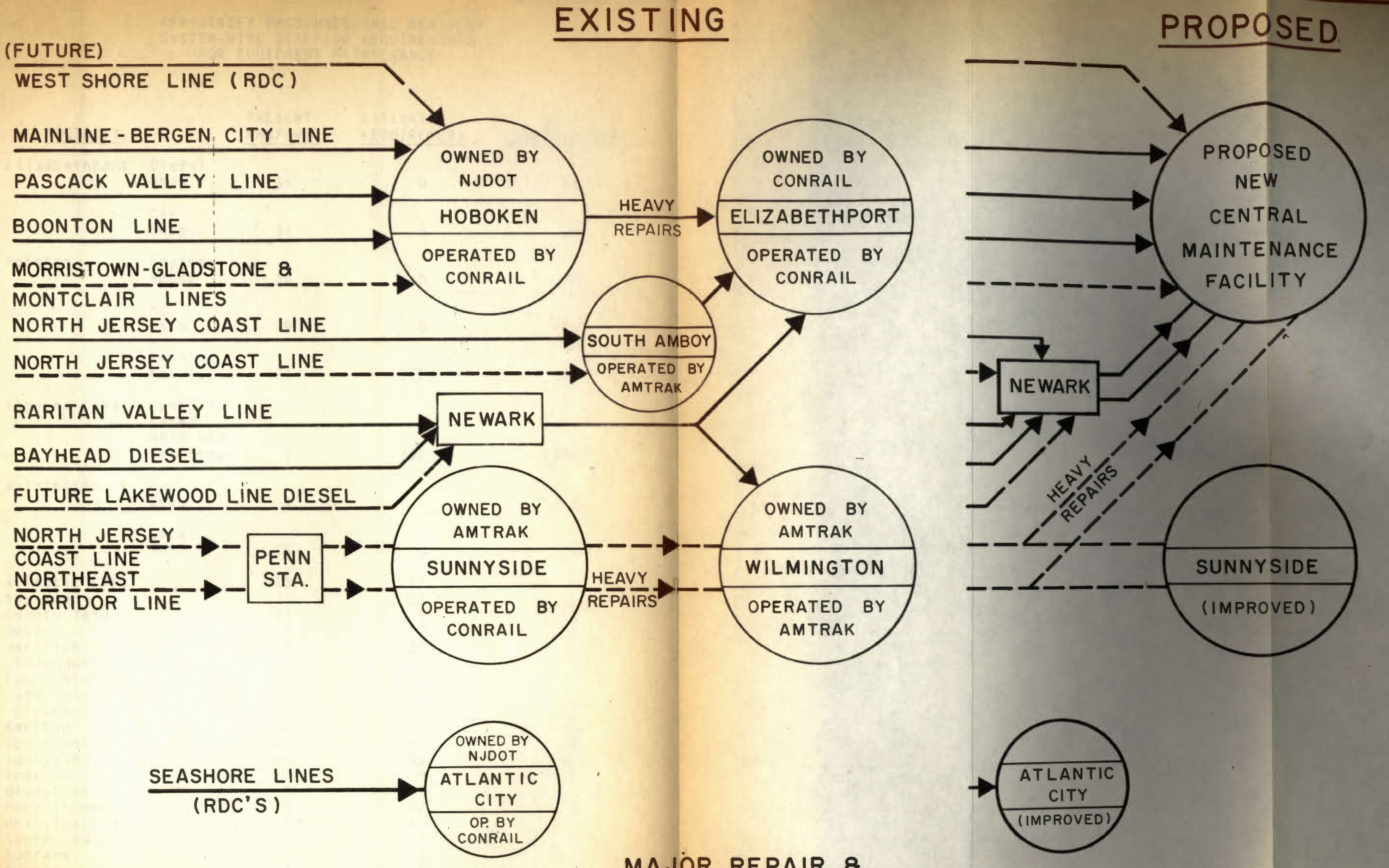
Rehabilitate yard storage tracks using fit rail.

Manpower requirement: 4

Facilities at other sites not mentioned to this point would remain unchanged.

1.5 Summary

Exhibit VI-11 shows schematically the major repair and inspection facilities which service each of the rail line services in New Jersey, both at present and as recommended in the future. As a result of the proposed reduction or elimination of work functions at various facilities, subsequent labor force reductions can be realized. Exhibit VI-12 presents the existing and proposed maintenance force requirements by facility and indicates individual and net total staffing changes that would result after the implementation of all recommendations. In addition, Exhibit VI-13 presents the proposed staffing by crafts for the consolidated facility at Koppers Coke, and the personnel requirements for the Hoboken Terminal and yard operations, while Exhibit VI-14 suggests the staffing for Sunnyside.



MAJOR REPAIR & INSPECTION FACILITIES AND LINES SERVED

SEELYE STEVENSON VALUE & KNECHT INC.
ENGINEERS AND PLANNERS · 99 PARK AVENUE, N.Y. 10016

EXHIBIT VI-13

MANPOWER ALLOCATION BY CRAFT BETWEEN THE PROPOSED KOPPERS COKE CONSOLIDATED MAJOR REPAIR/REBUILD (MR/R) SHOP AND SERVICE AND INSPECTION (S&I) FACILITY AND THE HOBOKEN TERMINAL AND STORAGE YARD

	Koppers Coke			Hoboken	Koppers Coke
Craft	MR/R	S&I	Consolidated	Terminal and Yard	Hoboken Complex
General Supt.	-	-	1	-	1
Asst. General Supt.	-	-	1	-	1
General Foremen	-	-	3	2	5
Foremen	7	7	14	8	22
Asst. Foremen	4	4	8	3	11
Clerks	-	-	8	2	10
Safety Supervisors	-	-	2	-	2
Shop Engineer	-	-	1	-	1
Draftmen/Technicians	-	-	2	-	2
Carmen	14	8	22	6	28
Electricians	30	16	46	12	58
Machinists	26	16	42	6	48
Upholsterers	2	-	2	-	2
Sheet Metal Workers	4	-	4	-	4
Tinsmiths	3	-	3	-	3
Pipe Fitters	3	-	3	1	4
Blacksmiths	2	-	2	-	2
Welders	2	-	2	-	2
Carpenters	2	-	2	-	2
Painters	6	-	6	-	6
Holsters	-	-	4	4	8
Helpers	4	4	8	-	8
Apprentices	8	-	8	-	8
Crane & Equip. Operators	5	1	6	1	7
Car Cleaners	-	6	6	40	46
Laborers	4	7	11	12	23
Motive Power Dispatchers	4	-	4	-	4
Stockmen	3	1	4	-	4
Facility Maintainers	-	-	5	-	5
Air Brake Inspectors	-	-	-	6	6
Car Inspectors	-	-	-	20	20
Totals	137	70	230*	123	353*

*Includes 23 positions listed above responsible for administrative and support activities for the entire Koppers Coke/Hoboken complex. The people filling these positions will be assigned working space in the office area at Koppers Coke and therefore are included in its manpower allocation total.

EXHIBIT VI-14

MANPOWER ALLOCATION BY CRAFT
FOR SUNNYSIDE FACILITY

Craft	Present Manpower	Estimated Requirement	# of Reassignments
Foremen	8	8	-
Machinist	3	3	-
Electrician	33	25	8
Electrican Helper	2	2	-
Pipefitters	12	4	8
Carmen	20	12	8
Cleaners	57	40	17
Car Inspectors	24	15	9
TOTALS	159	109	50

2. COST ESTIMATES

2.1 Capital Costs

The capital costs presented here are exclusive of any properly acquisition and/or lease costs. The estimated costs for the construction of the recommended MR/R shop at Koppers Coke total nearly $22.4 million. Details of this estimate are as follows:

Major Vehicle Repair	47,500 sq.ft.	@ $120	$ 5,700,000
Support Shop	90,000 sq.ft.	@ $100	9,000,000
Stores Building	22,500 sq.ft.	@ $ 80	1,800,000
Paint Shop	7,000 sq.ft.	@ $120	840,000
Support Tracks	14,000 lin.ft.	@ $ 80	1,120,000
Site Grading	20,000 cu.yds.	@ $ 10	200,000
Site Drainage			100,000
Site Utilities			150,000
Roads, Paving & Parking Area	11,700 sq.yds.	@ $ 8	93,600
Pollution Control			50,000
Turn-outs	11 @ $23,000		253,000
Other Yard Requirements			150,000
Sub-Total			$19,456,600
15% Contingencies			2,918,490
Total			$22,375,090

Construction of the new S&I Facility at Koppers Coke would require an estimated $28.8 million, broke down as follows:

Service and Inspection Vehicle Area		
	- 119,000 sq. ft. @ $120	$14,280,000
Stores Covered Storage Area		
	- 8,000 sq. ft. @ $ 80	640,000
Wheel Truing Shop		
	- 16,000 sq. ft. @ $ 90	1,440,000
Extraordinary Interior Cleaning Area		
	- 14,000 sq. ft. @ $100	1,400,000
Running Gear Cleaning Area		
	- 7,000 sq. ft. @ $120	840,000
Diagnostic Testing Track		
	- 16,000 sq. ft. @ $100	1,600,000
Running Gear Cleaning Area		
	- 7,000 sq. ft. @ $120	$ 840,000
Diagnostic Testing Track		
	- 16,000 sq. ft. @ $100	$ 1,600,000
Support Tracks	- 30,000 lin. ft. @ $80	$ 2,400,000
Site Grading	- 27,000 cu. yds. @ $10	270,000
Site Drainage	-	200,000
Site Utilities	-	225,000
Roads and Paving	- 10,300 sq. yds. @ $8	82,400
Pollution Control		750,000
Turn-outs	- 25 @ 23,000	575,000
Other Yard Requirements		300,000
Sub-Total		$25,002,400
15% Contingencies		3,750,360
Total		$28,752,760

The machinery, tools, and equipment that were recommended for the two new Koppers Coke shops would require an estimated two million dolalrs for acquisition and installation. Additonally, a power plant, tower, and other required facilities are estimated at $3 million.

The modifications/additions that were recommended for the Hoboken Terminal Yard would require an estimated $3.3 million, including costs for machinery and tools. A breakdown of this cost estimate is as follows:

Demolition of existing MU Car Shop and preparation of site	$ 250,000
Construction of Daily Inspection and servicing shed 120 ft. wide x 550 ft. long - 4 tracks on 30 ft. centers - inspection pits 4'8" deep depressed floors 2'6" deep - fuel & water masts for locomotives - Sanding facilities for locomotives	1,250,000
Rebuild and enclose existing locomotive and car washer facilities	850,000
Modify existing wheel truing facility	150,000
Demolition of Modoc car facilities and preparation of site	150,000
Provide additional rolling stock storage tracks at Modoc site and locomotive ready tracks adjacent to new inspection & servicing shed.	650,000
Total	$3,300,000

The modifications/additions that were recommended for the Sunnyside Yard METRO shed area would require an estimated $3.6 million, including costs for machinery and tools. A breakdown of this cost estimate follows:

METRO shed modifications	$ 167,000
Additional S&I Shop (12,000 sq. ft)	
Running Repair Shop (11,000 Sq. ft)	2,760,000
Track changes and catenaries	300,000
Contingency	370,000
Total	$ 3,597,000

A summary of the total capital cost is presented in Exhibit VI-15. Such costs would reach a grand total of $69.3 million.

EXHIBIT VI-15

SUMMARY OF CAPITAL COSTS FOR PROPOSED NJDOT MAINTENANCE FACILITIES

1.	Koppers Coke Main Repair/Rebuild Shop	$22.4 Million
2.	Koppers Coke S&I Facility	28.8 Million
3.	Ancillary Facilities at Koppers Coke	3.0 Million
4.	Shop Machinery & Tooling For Koppers Coke Shops	2.0 Million
5.	Modify and Improve Shop Facilities at Sunnyside	3.6 Million
6.	Modify and Improve Terminal Rolling Stock Facilities at Hoboken Terminal Yard.	3.3 Million
7.	Construct New Shop Facilities at Atlantic City	0.8 Million
8.	Modify and Improve Layover Terminal Facilities Where Rolling Stock Terminate/Originate	3.0 Million
9.	Engineering design services and construction contract administration	3.5 Million
	TOTAL	$ 69.3 Million

2.2 Operating Cost

Exact current operating costs were unavailable during the course of this study. Therefore, we have estimated current and anticipated operating costs presented in this section using standard procedures and experience-based formula commonly employed in the railroad industry. The following estimates, it should be noted, are based on October 1979 dollars and therefore are subject to escalation for subsequent inflation.

The proposed Main Repair/Rebuild (MR/R) Shop at the recommended Koppers Coke Consolidated Shops would require the following estimated annual operating budget:

Manpower (152 @ $17,500)*		$ 2,660,000
Fringe Benefits @ 40% of Manpower		1,064,000
Shop Expense @ 60% of Manpower		1,596,000
Materials Expense @ 65% of Manpower		1,729,000
Stores Expense @ 10% of Materials		172,900
Sub-Total		$ 7,221,900
15% Contingency		1,083,285
Total		$ 8,305,185
	Say	$ 8,305,000

*152 developed from 137 by direct assignment (see Exhibit VI-13) plus allocation of 15 administrative and support personnel.

The proposed Service and Inspection (S&I) Facility at the recommended Koppers Coke Consolidated Shops would require the following estimated annual operating budget:

Manpower (78 @ $17,500)*	$	1,365,000
Fringe Benefits @ 40% of Manpower		546,000
Shop Expense @ 60% of Manpower		819,000
Materials Expense @ 50% of Manpower		682,500
Stores Expense @ 10% of Materials		68,250
Sub-Total	$	3,480,750
15% Contingency		522,113
Total	$	4,002,863
Say	$	4,003,000

*78 developed from 70 by direct assignment (see Exhibit VI-13) plus allocation of 8 administrative and support personnel).

The combined estimated annual operating costs for the recommended Koppers Coke Consolidated Shops, including its Main Repair/Rebuild Shop and its Service and Inspection (S+I) Facility, are as follows:

Manpower (230 @ $17,500)*		$ 4,025,000
Fringe Benefits @ 40% of Manpower		1,610,000
Shop Expense @ 60% of Manpower		2,415,000
Materials Expense (Combined)		2,412,000
Stores Expense @ 10% of Materials		241,200
Sub-Total		$ 10,703,200
15% Contingency		1,605,480
Total		$ 12,308,680
	Say	12,309,000

*230 developed by direct assignment and allocation (see Exhibit VI-13

The estimated annual operating costs for the Hoboken Terminal Yard, involving daily inspection, running repairs, cleaning and refueling, are as follows:

Manpower (123 @ $17,500)*		$ 2,152,500
Fringe Benefits @ 40% of Manpower		861,000
Shop Expense @ 60% of Manpower		1,291,500
Materials Expense @ 50% of Manpower		1,076,250
Stores Expense @ 10% of Materials		107,625
Sub-Total		$ 5,488,875
15% Contingency		823,331
Total		$ 6,312,206
	Say	$ 6,312,000

*123 developed by direct assignment (see Exhibit VI-13)

The estimated annual operating costs for the proposed Sunnyside Yard Service and Inspection (S&I) Facility and Light/Running Repair (L/RR) Shop are as follows:

Manpower (109 @ $17,500)		$ 1,907,500
Fringe Benefits @ 40% of Manpower		763,000
Shop Expense @ 60% of Manpower		1,144,500
Materials Expense (Combined)		953,750
Stores Expense @ 10% of Materials		95,375
Sub-Total		$ 4,864,125
15% Contingency		729,619
Total		$ 5,593,844
	Say	5,594,000

The estimated annual operating costs for the proposed Atlantic City Shop are as follows:

Manpower (12 @ $17,500)		$ 210,000
Fringe Benefits @ 40% of Manpower		84,000
Shop Expense @ 60% of Manpower		126,000
Materials Expense @ 50% of Manpower		136,500
Stores Expense @ 10% of Materials		13,650
Sub-Total		$ 570,150
15% Contingency		85,523
Total		$ 655,673
	Say	$ 656,000

2.2.1 Conclusion

The estimated New Jersey Passenger Rail Services system-wide operating cost for equipment maintenance are compared on a current versus recommended basis in Exhibit VI-16. As may be inferred from the exhibit, we estimate that a potential exists for reduction of approximately nine million dollars in annual operating costs (from an estimated $43,980,000 with current manpower levels and facilities to an estimated $34,948,000 with the recommended manpower levels and facilities) if the concepts developed in this study are implemented. All of the costs and potential savings estimated above are based on October 1979 dollars and, therefore, are subject to escalation for subsequent inflation, as noted at the beginning of this section.

NEW JERSEY PASSENGER RAIL SERVICES
COMPARISON OF ESTIMATED EQUIPMENT MAINTENANCE COSTS
PRESENT VERSUS RECOMMENDED MANPOWER LEVELS AND FACILITIES

Cost Area	Present Manpower* and Facilities	Recommended Manpower** and Facilities
Manpower @ $17,500	$ 14,997,500	$ 11,917,500
Fringe Benefits @ 40% of Manpower	5,999,000	4,767,000
Shop Expense @ 60% of Manpower	8,998,500	7,150,500
Materials Expense @ 50% of Manpower	7,498,750	5,958,750
Stores Expense @ 10% of Materials	749,875	595,875
Sub-Totals	38,243,625	$ 30,389,625
15% Contingency	5,736,544	4,558,444
Totals	$ 43,980,169	$ 34,948,069
Say	$ 43,980,000	$ 34,948,000

*857 personnel assigned
**681 personnel assigned

NOTE: All costs estimated in October 1979 dollars and subject to escalation for subsequent inflation.

EXHIBIT VI-16