

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**

# **RAIL DIVISION**



## **REBUILD SPECIFICATIONS FOR LOCOMOTIVE MID-LIFE REBUILD**

**EMD GP40H-2 LOCOMOTIVE 1792**

**Document #**

**0001444**

**Capital Yard Maintenance Facility**

**860 Capital Blvd.**

**Raleigh, NC 27607**

**919-715-5753**



**Document # 0001444**

**Specification for Refurbishment of NCDOT GP40H-2 Locomotive 1792**

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# 1 General Terms & Conditions

## 1.1 Purpose

This specification is issued by the North Carolina Department of Transportation Rail Division, hereafter referred to as NCDOT, to rebuild Tier I Railway Passenger Equipment to the highest level of quality by current industry standards and practice. NCDOT desires to have this work done in a timely manner in order to return the locomotive to revenue service as soon as possible. This locomotive will be used in daily passenger train service to be operated by the National Railroad Passenger Corporation, hereafter referred to as Amtrak, and/or for other special operations by either NCDOT or other carriers.

This document has been authored / adapted from existing specifications for the rebuild of railway locomotives either issued by NCDOT or other agencies. It has been prepared using Microsoft Word XP and/or other software, and includes "hyperlinks" either within this document, or to other documents. All rights thereto are reserved by NCDOT. Proprietary rights associated with the publication of original equipment manufacturers (OEM) documentation remain the property of their respective owner(s). Trade or brand names used within remain the property of their respective owner(s).

NCDOT reserves all right of revision; potential bidders, consultants, vendors, sub-contractors, suppliers, or their agents and assigns are not authorized to revise or change the content of this document, either in fact or intent. NCDOT's right to revision ends on the bid submission deadline, unless changed through a change order after award. Please refer to the associated Request for Proposals (RFP) for additional NCDOT terms, conditions, and/or restrictions.

## 1.2 Project Management / Schedule

Please refer to the associated Project Request for Proposals (RFP) for details as to project management, scheduling, etc.

## 1.3 Order of Precedence; Project Documents

The order of precedence for the project documents shall be:

- 1) The Project Request for Proposals (RFP);
- 2) Addendums to the RFP;
- 3) The Project Specifications (this document);
- 4) Addendums to the Specifications;
- 5) The Project Drawings;
- 6) Other attached documents.

If a conflict is discovered among any of the above requirements, the following order of priority shall govern:

- 1) FRA - USDOT
- 2) AAR
- 3) EPA
- 4) The Contract documents
- 5) NTSB
- 6) APTA

In the event of such conflict, the Contractor shall notify NCDOT promptly for resolution.

## 1.4 Compliance with Standards and Regulations

NCDOT Rail Division has developed a set of standards and practices to be followed for all Contractors performing work on NCDOT owned equipment. Please refer to NCDOT document # 0001413A Standards



& Practices for NCDOT Passenger Cars & Locomotives for further details related to design criteria, paint and exterior finish, testing, and components/parts.

### **1.5 General Terms & Conditions**

#### **1.5.1 Vendor Responsibility**

All of the requirements of schedules, deliveries, inspection, warranties, shall be provided in a separate document with the Request for Quotation and Purchase Orders issued by NCDOT. It is the responsibility of the Contractor to insure that they are in compliance with the latest revision of any or all contract documents.

#### **1.5.2 Locomotive Clearance**

The locomotive clearance envelope shall be in accordance with NCDOT Drawings No. 0000345 and 0000443A-01. All clearance measurements shall be made with the locomotive complete in every respect, without any supplies (all water and/or waste tanks empty), after all leveling and shimming of the trucks, couplers, etc. has been completed. All horizontal clearances shall be measured from the centerline of the locomotive, accounting for the maximum lateral travel in the trucks and suspension. The Contractor shall furnish a complete locomotive clearance diagram to Amtrak and NCDOT showing all measurements taken prior to return shipment.

#### **1.5.3 Locomotive Weight**

The Contractor shall weigh on an approved scale or scales, each end of the locomotive with trucks and the locomotive fully supplied for service, full water tank(s), fuel tank(s), etc., with the locomotive complete in every respect prior return to shipment. The scale weight tickets shall be furnished to NCDOT.

Locomotive weights prior to rebuild (if known) will be furnished upon award of the contract to the successful bidder. The Contractor shall weigh the equipment, and/or calculate the finished weight, to insure that the brake and suspension systems are correctly configured and furnished prior to final acceptance testing, and shall properly document same.

#### **1.5.4 Transport of Equipment**

NCDOT will assume responsibility for preparing locomotive for shipment. Contractor is to assume responsibility and all costs for transportation from NCDOT Capital Yard Facility in Raleigh NC to the locomotive shop and return via freight shipment. NCDOT locomotive shall be in full FRA compliance prior to shipment by the successful bidder.

The locomotive shall have a minimum of 500 gallons of ultra low sulfur diesel fuel remaining in the fuel tank prior to shipment. Contractor is to assume responsibility and all costs for replenishing the locomotive fuel tank with a minimum of 500 gallons of ultra low sulfur diesel fuel prior to return delivery.

#### **1.5.5 Inspections**

The Contractor will request a review of the locomotive by regional FRA and Amtrak inspectors after completion of rebuild and prior to shipment to determine if any issues exist to or with the locomotive. The Contractor shall advise NCDOT of the inspection findings and what action, if any, may be required by the Contractor to address any exceptions taken by FRA or Amtrak inspectors prior to the return of the completed locomotive to NCDOT.



## **1.6 Drawings / Documentation**

### **1.6.1 General**

NCDOT shall require drawings detailing the final as-rebuilt locomotive from the Contractor. These required drawings are listed below. The Contractor shall establish a program to submit finished as-built drawings to NCDOT for approval prior to shipping the locomotive. The drawing approval process shall be conducted incrementally when detail design of an item is essentially complete and its production drawings are ready for release.

It is the intent of NCDOT to take advantage of the appropriate application of computer based solutions to facilitate implementation of this project. Electronic (machine readable) submission of final drawings / documentation is required.

Additionally, NCDOT may from time to time photographically document job progress, either in traditional film based, or newer video or digital imaging technologies, subject to the Contractor's written consent. The Contractor is encouraged to also photographically document progress on the project.

All materials submitted to NCDOT shall include the provision that they may be reproduced (electronically or otherwise) for use by NCDOT (or its mechanical/electrical sub-contractors) for the purpose of maintaining and/or servicing NCDOT owned equipment. Proprietary rights to the data contained within such submitted materials shall remain the property of the respective owner.

### **1.6.2 Contractor Documentation**

The Contractor shall supply final, as-rebuilt drawings for each locomotive and shall include, as a minimum:

- 1) Wiring Schematic
- 2) Wiring Running List

### **1.6.3 Parts Manual**

The Contractor shall furnish an illustrated parts manual for any part which has been modified, upgraded or not replaced in kind. Preferably, these manuals shall be produced in Adobe PDF Format.

## **1.7 Locomotive Description**

Locomotive is a diesel-electric type, with turbocharged prime mover capable of developing 3,000 nominal traction horsepower, including two (2) four-wheel trucks with traction motors on all axles, and control compartment between short and long hoods, complete with all necessary apparatus for multiple unit push-pull passenger operation.

An independent, diesel engine-driven generator provides a continuous 425KW, 480 volt, 60 hertz, 3 phase electrical power for the head end power system.

- 1) Traction power is not used for head end power.
- 2) Head end power is not utilized by the traction power system.
- 3) Head end power is used for layover protection when the locomotive is on wayside power.

### **1.7.1 Major Dimensions**

- 1) Distance, Pulling Face of Coupler to Center Line of Truck: 12ft. – 7in.
- 2) Distance Between Bolster Centers: 34ft.
- 3) Length, Over Pulling Face of Couplers: 59ft – 2in.
- 4) Height 15 ft. - 4 7/16 in. Maximum



- 5) Width 10 ft. Maximum over handrails and vents

### 1.7.2 General Statistics

Power for Traction	–	3,000 HP
Diesel Engine Type	–	EMD 16-645-E3B
Main Generator Model	–	AR10-D14
Companion Alternator	–	D14
Air Compressor Type	–	3 Cylinder, Two Stage
Traction Motors	–	D87B
Gear Ratio	–	57:20
Wheel Diameter	–	40 inches
Wheel Rim	–	2½ inches
Wheel Profile	–	1:40
Brake Rigging	–	Single Shoe
Brake Shoe	–	Composition
Air Brake Equipment	–	26L
Fuel Capacity	–	3000 U.S. Gallons
Maximum Weight (loaded)	–	277,000 lb.
Auxiliary Generator	–	74 VAC
Rating	–	10 KW AC
Cooling Water Capacity	–	295 U.S. Gallons
Lubricating Oil Capacity	–	395 U.S. Gallons
HEP Power	–	425KW
HEP Voltage	–	480/3-phase/60Hz
HEP Type	–	Cummings KTA-19-G2

## 2 Refurbishment Workscope

### 2.1 Scope

This Specification describes the NCDOT diesel electric passenger Locomotive which the Contractor shall overhaul for use in passenger service that is operated in North Carolina. The Locomotive is capable of operating at speeds up to 103 mph on tangent track, equipped for multiple unit (MU) operation.

This Specification defines the conditions and requirements applicable to the overhaul of NCDOT's GP40H-2 locomotive unit, together with its auxiliary equipment and accessories, including the transportation from NCDOT's Capital Yard facility to and from the Contractor's facilities.

There is a total of one (1) GP40H-2 locomotive to be overhauled. The final configuration of the Locomotive after overhaul, pursuant to this Specification, is intended to be identical to the current NCDOT configuration.

Subject to *Section 4: Warranty* of the Refurbishment Specifications, the locomotive after overhaul shall be capable of providing a minimum of ten (10) years of reliable service, averaging 60,000 miles of service each year, without need of major overhaul. The Contractor shall furnish all management, labor, materials, tools, equipment, data, engineering, design, service, and incidentals necessary and deliver the Locomotive in strict conformity with the contract requirements, in a proper, thorough and skillful manner, complete and ready for service. All software/hardware, special tooling/equipment, instruction manuals, drawings, prints and manuals necessary for maintenance and operation shall be supplied as part of this order.



### 2.1.1 System Design Responsibility

The Contractor shall assume complete responsibility for design, implementation of design and satisfactory operation for all systems, sub-systems and the total Locomotive.

### 2.1.2 Definitions

Approval – Review and acceptance, in writing, by NC DOT.

Approved Equal – A proposed substitute to a specification requirement, component and/or supplier/manufacturer which is approved by NC DOT in writing. The substitution request shall be submitted in writing to NC DOT detailing full interchangeability in terms of form, fit, function, quality and properties to the specific requirement and must be proven to the satisfaction of NC DOT.

As Built – The design and materials configured by the OEM (original equipment manufacture) at initial manufacture.

Change Order – A written document issued by NC DOT and accepted in writing signed by the Contractor that alters the scope of work to be performed under the Contract.

Change Request – A written document which thoroughly details rationale for request and ultimate effect to the Contract Specifications and/or terms and conditions, if any, issued to NC DOT by Contractor which may result in a Change Order.

Commissioning – Post Delivery Contractor activities required to begin on-site acceptance testing demonstrating Specification compliance.

Conditional Acceptance – Occurs when locomotive is suitable for service, as determined by NC DOT. Remaining deficiencies, if any, shall be corrected promptly.

Contract – All documents associated with the procurement including the written agreement, Contractor's proposal, the RFP and related documents, and the performance and payment bonds.

Defect – A patent or latent malfunction or failure in manufacture, design or installation of any deliverable, including without limitation any vehicle or any vehicle component, subcomponent, part or material of whatever type, or any failure of any of the foregoing deliverables to conform with the requirements in the Contract.

Delivery – The transfer of the completed vehicle with all in-plant testing completed and results accepted by NC DOT to the NC DOT Capital Yard Facility in Raleigh, NC, ready for commissioning and acceptance testing.

Failure – The inability of a component, system or subsystem to function or perform in accordance with Specifications and requiring a corrective action to restore the specified function or performance.

Final Acceptance – Occurs when Contractor has fulfilled all of its initial obligations under the Contract, as determined by NC DOT, and commences the warranty period. If NCDOT places the locomotive into revenue service prior to issuing Final Acceptance, the locomotive shall be considered to have Final Acceptance issued, notwithstanding any open issues.

Inspect – Visual inspection and measurement to an approved procedure to ascertain suitability for further use in compliance with Specification requirements.

Locomotive History Book – Documentation specific to an individual locomotive containing all records of technical and parts data pertinent to that particular locomotive. Required content and format shall be provided at the pre-proposal meeting.

Maintainability – A measure of a locomotive's capability to be properly maintained based on the ease and frequency of maintenance tasks, applied labor and accessibility of equipment.

Materials – All materials, equipment, systems, components and products incorporated into the Contract required Work.

Modify – To change the design, placement or other aspect(s) of an application to provide an improved functionality as approved by NC DOT.

Notice To Proceed (NTP) – Official NC DOT written notification authorizing the Contractor to proceed with the Contract Work.

Optional Work – Defined tasks in the Contract that shall be considered on a case by case basis for inclusion in the Work.

Overhaul – The complete disassembly, cleaning, inspection, qualification, reconditioning, repair or replacement of parts that are found worn in excess of the OEM serviceable tolerances or specifically



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required by the Specification. Overhaul includes testing the reassembled part or component to assure that it functions to the OEM performance specification for an identical new part.

Proposal – The compliant response to the RFP.

Qualify – The classification, based on evaluation of inspection or test results, of a previously applied part, component or system as fit for re-application and continued service until the next proven service interval for that part, component or system.

Recondition – The restoration of an item to have the performance, service life and appearance of a new item through the replacement of worn parts, adjustments, cleaning, refinishing (i.e. painting, polishing, anodizing, etc.), repair of any damage and any other rehabilitation work required. When an item is beyond reconditioning it shall be renewed. A scope of work procedure, for any item, is required and shall be approved by NC DOT prior to commencement of the work.

Remove/Removal – The elimination of an item from the final locomotive configuration. This removal shall include all other work required to ensure that the final configuration does not reflect any of the original item installation such as wiring, holes, brackets, etc.

Renew/Renewal – The installation of an identical but new item.

Repair – Correction of specific damage approved by NC DOT.

Replace – The installation of a new but different model or design of an item upon removal of the one currently used.

Service Limits – The dimensional tolerance that establishes the wear limit for a component or system to remain in service.

Service Tolerances – The dimensional tolerance that qualifies a component or system for continued service until the next overhaul.

Shipment – The physical departure of the locomotive from the Contractor's facility to NC DOT.

Specifications – That portion of the Contract describing the technical requirements of the procurement which contain written directions and requirements for completing the Work.

Strip – Work necessary prior to the refurbishment of the locomotive. This Work is completed after the pre-work joint inspection.

Test – The means by which a part or system is proven to be functioning to its design parameters.

Unit Exchange (UTEX) – A process where components and sub-assemblies are removed and exchanged with an identical component or sub-assembly that was previously overhauled and is ready for immediate installation.

Upgrade – The replacement of a component, subsystem or system to improve quality, standard and/or performance.

Work – All services and responsibilities to be performed by the Contractor as specified, stated, indicated or implied in the Contract, including furnishing and supervision of all qualified personnel and the supply of all equipment, materials and supplies necessary or required to perform this Contract.

### 2.1.3 General

- A. The Locomotive design shall make every possible provision for safety of employees, for maximum ease and safety of passage through the Locomotive and for ease of cleaning and maintaining.
- B. Maintainability of the Locomotive and associated equipment shall be given prime consideration by the Contractor in the design, overhaul and upgrade of the Locomotive.
- C. No component of the Locomotive shall require scheduled periodic maintenance anymore frequently than once every ninety-two (92) days, normal inspection and servicing excluded.
- D. The Contractor shall ensure that all systems and sub-systems designed into the Locomotive shall incorporate all available features of installed equipment.
- E. Components used in the locomotive shall be operationally compatible and interchangeable with those on the NCDOT's locomotive.
- F. The reconditioning of major components shall be in accordance with the original equipment manufacturer (OEM) or approved reconditioner's latest instructions, subject to NCDOT acceptance. Workscopes for all major component reconditioning shall be provided in the proposal.
- G. Renewal parts for major components, including main engine, rotating electrical, cooling, fuel, lubrication and air systems shall be OEM approved.



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- 1) The NCDOT requires that all parts supplied or reconditioned meet the requirements of the OEM of the Locomotive in terms of durability, tolerances, and fitness of purpose.
  - 2) The NCDOT does not require that parts supplied be purchased from the original manufacturer, as approved by NCDOT, but does require that the parts be of OEM quality.
  - 3) The burden of proof of quality of the parts supplied is the responsibility of the Contractor.
- H. Where components or assemblies are specified to be reconditioned, the Contractor may at its discretion supply new material.
- I. All consumables such as filters, gaskets, seals, brake shoes, diodes, fuses, brushes, lamps, etc., shall be renewed.
- J. All small hardware and fasteners affected by the overhaul process shall be renewed.

### 2.1.4 Basic Requirements

- A. Apparatus requiring frequent inspection or attention shall be readily accessible and replaceable.
- B. Apparatus supports and housing shall be arranged so that apparatus may be mounted interchangeably to the greatest extent possible.
- C. As part of the general requirements for safe construction, the Contractor shall ensure that there shall be no sharp edges or corners any place in the Locomotive where operators or maintenance personnel may come in contact with such edges.

### 2.1.5 Safety Appliances

All steps, grab irons, and other safety appliances must comply with current FRA requirements, APTA standards and shall be of a contrasting color.

### 2.1.6 Regulatory Compliance

The Locomotive shall comply in all respects with the requirements, applicable standards and recommended practices of the Federal Railroad Administration (FRA), the Association of American Railroads (AAR), Environmental Protection Agency (EPA), the National Transportation Safety Board (NTSB), the American Public Transit Association (APTA), and all applicable federal, state and local laws, rules and regulations and recommended industry practices and standards in effect at the time of signing the Contract.

### 2.1.7 General Requirements

- A. This Specification outlines the specific areas of the Locomotive in which work is required for renewal, reconditioning, upgrading and/or qualification of parts or apparatus.
- 1) This specification also describes the degree of overhaul or reconditioning required.
  - 2) After overhaul, the Locomotive will attain 40 CFR Part 1033 Tier 0+ EPA emission requirements and will be certified accordingly through required process. NCDOT with assistance from NC State University has performed extensive emissions tests on all its locomotives. Detailed emissions analysis reports for the locomotive will be made available to Contractor's representatives during the mandatory locomotive inspections at NCDOT's Raleigh, NC maintenance facility.
  - 3) The Contractor shall provide work scopes for all major components required to be reconditioned for NCDOT approval.
- B. Replacement of parts or apparatus.
- 1) The Contractor may, at NCDOT's option, unit exchange (UTEX) parts or apparatus for equivalent parts of the same manufacture and meeting the requirements of this Specification.
  - 2) Components furnished by a manufacturer that are assembled, housed, and wired into package units at the point of manufacture, shall be tested at the point of manufacture and



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a certified test report concerning actual tests made on components being furnished for this Contract shall be mutually agreed upon between the Contractor and NCDOT.

### 2.1.8 Scope of Major Work

- A.** The following preliminary work shall be accomplished prior to the overhaul of the Locomotive:
- 1) Perform a direct current ground insulation megger test and a high potential ground insulation test on all electrical systems/components as appropriate.
  - 2) Perform a load test on the prime mover.
  - 3) Perform a comprehensive inbound inspection on the Locomotive
  - 4) Prepare a Preliminary Work Scope for NCDOT approval.
- B.** Stripping of the locomotive comprises:
- 1) Removal of roof hatches, carbody panels, all major components, assemblies, windows and parts included in the work.
  - 2) Cleaning of the entire remaining frame and cab structure to a paintable surface that shall comply with the painting, lettering and warranty requirements.
- C.** Items to be renewed/replaced shall include, but not limited to the following:
- 1) Shock absorbers, yaw dampers, springs and liners.
  - 2) Pins, bushings and grommets.
  - 3) Coupler carriers.
  - 4) Wear plates.
  - 5) All door hardware, door seals, and weather stripping.
  - 6) Window seals and hardware.
  - 7) HEP trainline cable assemblies.
  - 8) HEP engine and replacement system controls and components as required.
  - 9) Microprocessor control systems including all required ancillary devices and materials.
  - 10) Traction motor blower bellows assemblies.
  - 11) All pressure switches.
  - 12) All hoses.
  - 13) All air, water, lube oil, and fuel filters and strainers.
  - 14) All gaskets, O-rings, and other sealing devices.
  - 15) Emergency fuel cut-off switch assemblies and boots.
  - 16) Power assemblies (EMD).
  - 17) Transfer switch motors (RV, MB).
  - 18) HEP transfer motor.
  - 19) Refrigerator.
  - 20) All electrical cabinet and junction box seals, weather-stripping and insulation.
  - 21) Starter motors
  - 22) Cab flooring, covering and hardware.
  - 23) Nameplates, placards and decals.
  - 24) Toilet system.
  - 25) B-end coupler assembly.
  - 26) B-end draft gear.
  - 27) Contactor tips.
- D.** Major components to be reconditioned shall include, but not be limited to the following:
- 1) Truck assemblies less TM combos
  - 2) Main generator (including renewal of main bearing).
  - 3) Auxiliary generator.
  - 4) Prime mover (including Tier 0+ upgrade).
  - 5) Air compressor.
  - 6) Cooling fans.
  - 7) Inertial blower motors.
  - 8) Cab air conditioning unit.



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- E.** Items to be reconditioned shall include, but not be limited to, the following:
- 1) Pilot plow.
  - 2) A-end coupler assembly.
  - 3) A-end draft gear.
  - 4) Electric sanding system.
  - 5) Hand brake.
  - 6) Traction motor blower assembly.
  - 7) DB fan motor (fan motor and shaft shall be new with qualified blades).
  - 8) Radiators, headers and spacers.
  - 9) Cab and carbody including hatches.
  - 10) DB grids.
  - 11) Contactors.
- F.** Items to be inspected, qualified and repaired/renewed as needed shall include, but not be limited to, the following:
- 1) Draft gear housing.
  - 2) MU, HEP, and communications receptacles and jumper cables.
  - 3) Uncoupling lever assemblies.
  - 4) Safety appliances.
  - 5) All light switches and sockets and low voltage receptacles.
  - 6) Fuel gauges, sight glasses and fills.
  - 7) Battery boxes.
  - 8) Doors.
  - 9) Electrical cabinet structure.
  - 10) Main air reservoirs.
  - 11) Air brake system.
  - 12) Bell.
  - 13) Horn.
  - 14) Frame.
  - 15) Fuel tank/retention tank.
- G.** In addition to the above, the following work must be accomplished on the Locomotive prior to return shipment to NCDOT:
- 1) The Locomotive must be thoroughly cleaned, grit blasted as appropriate, primed, and painted.
  - 2) Load test prime mover and main generator.
  - 3) Load test head end power unit.
  - 4) Prepare Locomotive for shipment.
  - 5) Functional road tests of Locomotive with train consist or equivalent load.

### **2.1.9 Maintenance Instructions**

The latest revision of the following EMD documents and software shall govern the reconditioning of major components, supplemented by the manufacturer's procedures which must be submitted for review and approval by NCDOT:

- A.** Main Engine
1. 16-645-E3B turbocharged engine maintenance manual.
- B.** Main Generator
- C.** Auxiliary Generator
- D.** Air Compressor
- E.** Trucks



## **2.2 Materials and Workmanship**

### **2.2.1 General**

- A.** This section is applicable to all parts of the Locomotive.
- B.** All materials and skillful workmanship shall conform to accepted or better than industry standards.
  - 1) Substitution - Substitution of materials, other than those designated, requires prior review and approval by NCDOT.
  - 2) Joining Surfaces - All joining surfaces shall be clear and free from dirt, grease, scale and other contaminants prior to attachment or joining.
  - 3) Operating Environment - All materials to be used in the overhaul of the Locomotive must be chosen to economically and safely achieve their function for the design life of the Locomotive in the environment outlined.
  - 4) Interior Cleaning - Fabrics and other non-metallic materials used for interior appointments shall not be affected by industrial compounds used for cleaning such materials. When any commonly used cleaner or lubricant will be detrimental to any material, it shall be noted in the service support manuals.
- C.** Cleaning During Locomotive Overhaul
  - 1) During Locomotive overhaul, adequate care shall be taken to prevent drill cuttings or other material from entering in areas of tubing, piping or electrical wiring, or accumulating in areas, which become inaccessible after subsequent assembly.
  - 2) Where drilling or other work has to be performed after installation of air brake equipment, piping or electrical equipment or wiring, adequate precautions shall be taken to prevent metallic or other waste or debris from causing potential future problems.
- D.** Before delivery of the Locomotive, a final clean up shall be made to ensure that all debris is removed. Areas of particular concern, but not limited to these areas are:
  - 1) All electrical junction boxes, lockers, panels, heaters, exposed terminal blocks where retained metallic debris can cause future problems.
  - 2) Oil, water, fuel and air tanks from which debris could be drawn into valves, pumps, or other equipment.

### **2.2.2 Corrosion Between Dissimilar Metals**

Where dissimilar metals are in contact, the Contractor shall apply necessary treatment to prevent electrolytic corrosion.

- A.** Steel
  - 1) Steel Castings - Steel castings shall be sound throughout, in accordance with accepted industry practice. When castings are found to be porous or otherwise unsound, they shall be replaced. Under some circumstances castings may be repaired, but in conformance to prior review and approval of the repair procedures by NCDOT.
  - 2) All steel castings used in the truck structure shall be made of electric furnace or controlled open hearth steel and heat treated.

### **2.2.3 Rubber**

Window and Door Sealing - The compounding of the rubber shall preclude discoloration or staining of neighboring areas, particularly from water drainage.

### **2.2.4 Glass**

The front windshield and rear door window shall conform to FRA 49 CFR part 223, type 1 requirements; side glazing shall conform to FRA 49 CFR part 223, type 2 requirements.



### 2.2.5 Wire and Cable

- A. Conductor Gauge - Wire for control and auxiliary circuits shall not be smaller than No. 16, except that smaller wire where adequate may be permitted for wiring within auxiliary control units and electronic units, as approved by the NC DOT.
- B. All wiring harness will be adequately secured and protected from chafing.
- C. No splices.

### 2.2.6 Wiring

- A. General - Wiring methods shall comply with all applicable FRA, AAR and APTA requirements. Deviations to the requirements may be permitted subject to review and approval of NCDOT, provided the proposed deviation meets the intent of the code.
- B. Grounding - All electrical circuits shall be completely insulated from Locomotive structure.
- C. Terminals - Terminals for wire and cable shall be of the crimp or soldered type. Terminals shall be applied using methods and tools, recommended by the manufacturer.
- D. Service loops in wiring at terminal board connections shall be provided. Conductors shall be protected by suitable means to minimize breakage of the conductor at or near the terminal.
- E. Butt connectors shall not be used. No splices.
- F. Underframe Wiring - All underframe wiring shall be run in conduit. Wire of adequate physical strength may be cleated in place using cleats made of synthetic material, at frequent intervals without conduit or raceways or equipment enclosures. Wiring shall not interfere with access to any underframe equipment.

### 2.2.7 Conduits, Junction Boxes and Fittings

- A. Bend radius of all conduits shall be as large as possible to facilitate wire pull through. Conduit bends shall be by machine, without wrinkles on the inner surface of the bend. Conduit fittings at boxes or bulkheads shall have retained plastic inserts to protect wiring from damage due to abrasion on sharp edges.
- B. Suitable loops shall be provided in the conductors at the equipment compartments to further minimize the possibility of the entry of water. Where such conductors pass through a structural or other member, means shall be used to prevent damage to the conductors due to chafing or other causes.
- C. All covers for underframe fittings pull and junction boxes, etc., shall be new gaskets. Fasteners used to retain covers, shall be stainless steel. Use of tapped holes with threaded fasteners shall be avoided. Anchor nuts or retaining tap plates shall be provided. Interior of boxes shall be suitably protected by paint against condensation and corrosion.
- D. All terminal blocks shall be permanently identified including those on sub-contractor supplied equipment. Identification shall be in accordance with pertinent schematic wiring drawings.
- E. For maintenance purposes, access to junction boxes, panels, and other wiring areas shall be as easy and simple as possible.
- F. All wiring external from equipment lockers shall be enclosed in raceway or in rigid or flexible conduit. (Except at air dryers and magnet valve locations where suitable multi-conductors shall be provided.)

### 2.2.8 Welding

- A. Responsibility – The Contractor shall be responsible for the quality of all welding and brazing including that which is done by sub-contractors.
- B. All welders employed in the making of welds on structures or products built under this specification shall have been tested and certified to AWS standards assuring their ability to operate the welding equipment to be used, in making the types of welds required hereunder and



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to produce satisfactory welds therewith. Standards for workmanship quality control and design for steel welding shall be to the Contractor's Standards.

- C. The Contractor shall provide protection from weld spattering onto areas adjacent to the welds, and particularly onto functional equipment.
- D. Cleaning - Before welding of any sort is started, parts to be joined shall be properly cleaned of coatings and films such as rust, oxide, mill scale, oil, grease, corrosion products and other foreign materials. Any corrosion protection removed for welding shall be replaced after welding is completed.

### 2.2.9 Piping and Tubing

- A. Air Brake Piping Materials - Locomotive body air piping shall conform to the AAR Standards and recommended practices on brakes and brake equipment. Procedures for cleaning air brake piping before welding, after welding, and before valves are installed, shall conform to the current AAR standards.
- B. Joints and Fittings - Fittings of wrought copper or cast brass may be used. Flare fittings shall be used at removable equipment.
- C. Routing and Clamping - All piping shall be installed in a manner allowing for efficient maintenance. It shall be so routed as to preclude or minimize moisture accumulation and to minimize damage from outside sources. Sufficient clamps shall be installed to prevent vibration and rattling.
- D. Water, Fuel and Oil Piping Materials - All piping material shall be in accordance with accepted industry standards.

### 2.2.10 Lubricants

- A. Lubricating Oil and Grease - Only lubricants approved for use by the NC DOT or per the following shall be specified for use on Locomotive equipment.
  - 1) Approved Lubricants:
    - a. Brake Cylinders -- Air brake cylinder grease to AAR Spec. M-914
    - b. Hand brakes -- Locomotive crankcase oil
    - c. Air Compressor Crankcase – Shell Turbo T 32, Part No. 65602
    - d. Battery Terminals - Rustproof "L" Texaco
    - e. Bell Ringer -- Dow Corning type "A" Valve seal
    - f. Center Castings -- Journal Box Oil per AAR Specification M-963
    - g. Engine Crankcase -- Shell Caprinus XT40WT, Part No. 54263
    - h. HEP Engine Crankcase – Shell Rotella T multigrade SAE 15W – 40, Part No. 50012
    - i. Hardware -- Doors & Window - SAE 10W Oil
    - j. Journal Bearings -- To AAR Spec. M-942
    - k. Shutters & Linkage -- MP Lithium Grease NLG1 #2, Imperial Unirex EP-2 or Texaco Marfak MP - 2
    - l. Traction Motor Gear Cases – Mobile SHC 6800 CPI No. 3
  - 2) All electrical rotating equipment, mechanical blowers and fans shall be equipped with sealed grease lubricated bearings where possible.
  - 3) Lubrication - The Contractor shall make certain each moving part and component is adequately lubricated for railway operation using approved lubricants.

## 2.3 Air Brake System and Auxiliaries

### 2.3.1 General

- A. The entire power brake system, including the handbrake, all valves, valve portions, and cocks, including related dirt collectors and filters shall be inspected, overhauled (if required) and tested



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in accordance with the periodic tests required by 49 CFR 229 (The activity scope and vendor to be reviewed and approved by NC DOT).

- 1) All components of a given function shall be identical for the Locomotive.
- 2) All air brake component work shall be done at an AAR approved facility.

### 2.3.2 Performance

The Locomotive shall operate in complete compatibility with the existing NCDOT rail fleet in consists of one (1) to seven (7) passenger cars equipped with 26-C brake equipment.

### 2.3.3 Brake Piping, Lines and Hoses

- A. All steel or iron piping/fittings, copper lines/fittings and hoses/fittings shall be inspected, tested, and repaired or replaced in kind as required.
- 1) Missing clamps shall be replaced.

### 2.3.4 Air Compressor and Air Dryer

- A. The air compressor shall be unit exchanged and tested in accordance with the manufacture's guidelines.
- B. Air compressor drive shaft bushings/grommets shall be new in accordance with the manufacturer's instructions.
- C. The air compressor governor switches shall be renewed and adjusted to maintain reservoir pressure between 130 and 140 psi.
- D. All piping to AC heads, unloaders and intercooler shall be stainless steel braided hose.
- E. The filler plug shall have provision for sealing.
- F. Air compressors shall be equipped with a new crankcase oil level gauge.
- G. The Salem 975-100 twin tower desiccant air dryer shall be inspected tested, and repaired if required.

### 2.3.5 Gauges and Fittings

- A. Cab Gauges shall be inspected and tested. Labeling of the gauge is to be on the console panel and not on the face of the gauge.
- B. Replace existing engine room air compressor gauge in kind and calibrate.

### 2.3.6 Main Reservoir

- A. Main reservoirs shall be hydrostatically tested to 300 psi in accordance with the procedures of 49 CFR 229.31.
- 1) Failed reservoirs shall be replaced with NC DOT accepted replacements.
  - 2) Following successful testing, the reservoirs shall be primed, painted, and stenciled.
- B. Salem 880 – 081 automatic drain valves shall be inspected, tested and repaired if required.
- C. The J-1 Safety valve set at 150 psi (1034 kpa) shall be overhauled in accordance with the manufacturer's instructions and tested to comply with the requirements of 49 CFR 229.49.
- D. Control and equalizing reservoirs shall be inspected and tested in accordance with 49 CFR 229.31.
- 1) Failed reservoirs shall be replaced with NCDOT accepted replacement.

### 2.3.7 Warning Devices

- A. The five (5) chime Nathan horn and 12" inch bell shall be reconditioned in accordance with the manufacturer's instructions.



- B. The horn and bell magnet valve and other related components shall be reconditioned.

### **2.3.8 Brake Cylinders (9 Inch Wabco or Approved Equal)**

- A. Brake system has undergone a complete COT&S on 08/25/08 and no further work is anticipated. Contractor shall perform a brake test to ensure proper operation of brake system.

### **2.3.9 Testing**

The complete air system performance shall be thoroughly tested to the satisfaction of the NC DOT and in compliance with 49 CFR 229. See also Section 2.15.

## **2.4 Sanding Systems**

### **2.4.1 Sand Traps**

- A. Sand traps shall be renewed with new Salem 277-2 sand traps.

### **2.4.2 Sand Boxes**

- A. Sand boxes, access covers and fill lids shall be cleaned, inspected, and repaired as required.
  - 1) Replace cover/lid seals with new.
  - 2) Clean and paint interior of sand boxes.
  - 3) Fills shall be provided with new screens.
- B. Hoses and Nozzles.
  - 1) Inspect and repair mounting brackets and supports and replace if bent or broken.
  - 2) Renew all hoses with heavy duty integrally guarded material.
  - 3) Renew all nozzles with EMD Part No. 8328553 nozzles.

### **2.4.3 Air Systems**

- A. Clean, flush, test, and repair or replace air piping/hose system as required.

### **2.4.4 Electrical Systems**

- A. Clean, inspect, test, and repair or replace electrical system as required.
- B. Control switches and solenoids shall be reconditioned.



## **2.5 Electric and Pneumatic Trainlines**

### **2.5.1 Jumper Cables**

- A. Install new spring loaded cable supports of same type as found on NCDOT locomotives 1755 and 1797.

### **2.5.2 Receptacles**

- A. Existing M.U. receptacle assemblies shall be cleaned, inspected, tested, and repaired or renewed as required.
- B. Existing HEP receptacle assemblies shall be cleaned, inspected, tested, and repaired or renewed as required.
- C. Existing 27 point communications receptacle assemblies shall be cleaned, inspected, tested, and repaired or renewed as required.
- D. Appropriate warning and identification of all receptacles shall be provided on each end of Locomotive.

### **2.5.3 Pneumatic**

- A. All hoses and heads shall be renewed.
- B. Hoses shall be less than one (1) year old from date of manufacture at time of installation.
- C. New dummy hose couplings and chains shall be provided at both ends of the locomotive.

## **2.6 Electrical System**

### **2.6.1 Rotating Electrical**

- A. The Locomotive rotating electrical apparatus identified in Section 2.1.8 shall be reconditioned and/or renewed in accordance with the specifications of the OEM.

### **2.6.2 Electrical, Wiring, Control and Lighting**

- A. **Wiring - General**
  - 1) All new wiring conductors shall be stranded copper conforming to basic standards of APTA, FRA, AAR and U.L.
  - 2) Each wire and cable shall be clearly marked at both ends adjacent to the terminals with designation according to the wiring diagram with a permanently marked sleeve or permanent stamping on the conductor jacket. The location of wire identifications shall allow for the requirement of three renewals of terminals if required.
  - 3) All wiring singly and in bundles or trees, shall be supported to prevent the imposition of undue strain on the terminals. Sufficient extra wire shall be provided at all terminal points to prevent strain and allow three renewals of the terminals if required. The extra wire shall be neatly dressed back into the wiring bundles.
  - 4) Wiring bundles shall be liberally supported and secured with self-locking nylon straps of suitable width to prevent cutting of the wire insulation. Wiring bundles shall be suspended clear of the Locomotive floor and routed away from areas of contamination such as the alternator and engine sumps.
  - 5) All panel board wiring shall be applied in a neat and secure manner.



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- 6) Wires entering or leaving electrical cabinets shall be protected from chafing by a nipple - bushing arrangement.
- 7) All wiring circuits shall be tested to verify continuity, proper polarity and integrity of insulation after assembly and installation of all equipment. The Contractor shall submit to NCDOT a test plan for review and approval. Contractor shall also provide test results to NCDOT.

### **B. Electrical Control Cabinets**

- 1) The electrical control cabinets shall be cleaned, inspected and tested.
- 2) Adjust and recondition lock keepers, or renew as necessary.
- 3) Check timing of all time delay devices.
- 4) Renew device identification name plates/tags as required.
- 5) Power, brake and RV and MB magnetic contactors shall be reconditioned. All contact tips shall be replaced.
- 6) RV and MB transfer motors shall be renewed.
- 7) Cooling fan contactors shall be reconditioned. All contact tips shall be renewed.
- 8) ST and STA contactors shall be reconditioned. All contact tips shall be renewed, including HEP.
- 9) GF, GFA and GFD contactors shall be reconditioned. All contact tips shall be renewed.
- 10) Renew all thermal/acoustical insulation and seal/gasket material.
- 11) All P-contactors shall be reconditioned and tips renewed.

### **2.6.3 Storage Battery**

- A. The batteries shall be renewed (if required) with Exide 500 A.H. or greater capacity with an 8-hour discharge rate.

### **2.6.4 Battery Boxes**

- A. Battery boxes and grates shall be cleaned, inspected and repaired as required.
- B. The interior shall be painted with two coats of a corrosion resistant paint.

### **2.6.5 Dynamic Brake**

- A. Dynamic brake grids shall be reconditioned.
- B. Fan motor and shaft will be new with qualified blades.

### **2.6.6 Endlights**

- A. Headlight assemblies shall be inspected and repaired as required with all seals/gaskets renewed.
- B. Marker light assemblies shall be inspected and repaired as required with all seals/gaskets renewed.
- C. Ditch light assemblies shall be inspected and repaired as required with all seals/gaskets renewed.



## 2.7 Engine System

### 2.7.1 Engine

- A.** The EMD 16-645-E3B engine shall be reconditioned and modified to meet Tier “0+” emissions standards per 40 CFR Part 1033. All system sensors shall be cleaned, qualified or replaced as needed.
- B.** The following components will be renewed:
- 1) Complete power assemblies (Tier 0+).
  - 2) Main bearings.
  - 3) Connecting rod bearings.
  - 4) Existing Tier 0 Injectors to be reused.
  - 5) Valve bridges.
  - 6) Fuel pump.
  - 7) Soak back pump.
  - 8) Lube oil cooler core.
  - 9) Turbo screen.
  - 10) Exhaust silencer.
  - 11) Exhaust expansion joints.
  - 12) Filters.
  - 13) Top deck frame and cover gaskets.
  - 14) Gaskets.
  - 15) Wiring harness to governor.
  - 16) Four pass aftercooler with copper core.
  - 17) Cylinder test valves.
  - 18) Camshaft bearings.
  - 19) Starter motors.
  - 20) Gear damper.
  - 21) Lube oil gauge.
  - 22) Top deck cover hinges.
- C.** The following components may be reconditioned or unit exchanged; including but not limited to:
- 1) Turbocharger - UTEX.
  - 2) Water pumps - perform spring pin modification.
  - 3) Lube oil pumps (scavenging and piston cooling).
  - 4) Turbo soak back pump motor.
  - 5) Strainer housing.
  - 6) Lube oil cooler tank.
  - 7) Hand hold covers.
  - 8) Auxiliary generator drive.
  - 9) Main generator flexible coupling.
  - 10) Flywheel ring gear.
  - 11) Heat shields.
  - 12) Fuel pump motor.
  - 13) Rocker arms.
  - 14) Governor – UTEX to meet Tier 0+ requirements.
- D.** Only new gaskets, O-rings, seals, bushings, grommets, etc., shall be used in the reassembly and installation of equipment.
- E.** Engines shall be cleaned and masked as necessary and given one coat of high temperature primer and two coats of high temperature light gray color DuPont paint, DuPont Tufcote #917 part number 917M24260.
- 1) After installation of engine in Locomotive, touch-up finish coat of paint as necessary.



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- F. A replacement data plate shall be attached to the side of the engine block showing the name of the rebuilder, the date of the remanufacture, the serial number of the engine, and any other pertinent information. A separate Tier “0+” certification plate/decals shall also be applied to the engine block.
- G. Install new oil drain line in prime mover.
- H. Repipe sump lines to holding tank.

### 2.7.2 Engine Cooling

- A. Mechanical bonded radiator cores shall be cleaned, inspected, tested and repaired in accordance with M.I. 549 or the latest revision, or renewed.
  - 1) Headers and spacers are to be qualified for reuse or renewed if found defective.
  - 2) No tubes are to be crimped or plugged.

### 2.7.3 Temperature Control

- A. Temperature control system will be tested and inspected.

### 2.7.4 NDE Testing

- A. Inspect and test all areas of the block and crankcase that typically are subject to failure. Block A frame, head pot seats, etc. are included.

### 2.7.5 Lubrication System

- A. Renew turbocharger filter tube assembly.
- B. Renew soak back filter tube assembly.

### 2.7.6 Head End Power

- A. Inspect existing HEP engine and generator and repair as required. NCDOT does not anticipate any repairs will be required. NCDOT installed a new Cummins engine in 2005 and a new generator in 2007.
- B. Clean, inspect and repair starter motor as required.
- C. Replace all wiring from main HEP cabinet to terminal boards ATB1 and ATB2 located on HEP alternator terminal board.
- D. Replace overhead fan contactors.

## 2.8 Trucks

### 2.8.1 Trucks

- A. Trucks shall be totally rebuilt in accordance with all applicable EMD maintenance instructions.
- B. Trucks shall be disassembled, sandblasted to bare metal, and all parts intended for re-use thoroughly cleaned and visually inspected.
- C. All dimensions shall be restored to OEM standards.
- D. Tram of frames shall be checked in accordance with approved procedure.
- E. Frames, swing hangers, bolsters and spring planks shall be magnefluxed.



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- F. All pins, bushings, wear plates, pedestal liners, snubbers, slack adjusters, nose suspension blocks and elastomeric stops shall be renewed.
- G. Traction motor/wheel/axle/bearing assemblies shall be re-applied. If condemning defects are found, NCDOT shall be notified and the material held for further instructions.
- H. Primary (coil) and secondary (elliptical) springs shall be inspected and tested per OEM specifications. Any non-qualifying springs shall be renewed.
- I. Brake piping shall be cleaned and inspected, renewed if damaged. Gaskets and seals shall be renewed.
- J. Truck center casting liners renewed.
- K. Traction motor gear cases to be upgraded to accept Mobile SCH 6800 CPI No. 3 synthetic lube.

### 2.8.2 Truck Brakes

- A. New composition brake shoes shall be installed.
- B. Pin type slack adjusters shall be cleaned, inspected and repaired or replaced in kind.
- C. All new brake pins and bushings shall be provided which shall be hardened and ground.

## 2.9 *Wheels and Traction Motors*

Current locomotive wheels have a 1:20 taper. NCDOT desires to convert the wheels to a 1:40 taper during this rebuild program.

## 2.10 *Carbody*

### 2.10.1 General

- A. Restoration:
  - 1) Use structural materials for replacement and repairs which are equivalent to those used for the original construction.
  - 2) Repair or replace any structural or supporting member whose cross-sectional area has been reduced by 10% or more.
  - 3) Insulate and weatherproof the finished locomotive to meet all applicable FRA standards.
  - 4) Drain holes, weather stripping, sealants, and other measures shall be used to prevent premature carbody deterioration.
  - 5) The underframe and structural components of the finished locomotive shall be equivalent to new for the collision strength of the overhauled locomotive.

### 2.10.2 Underframe

- A. Underframe shall be thoroughly cleaned and inspected for cracks and alignment, including center of bolsters, and all defects shall be corrected.
- B. Replace all traction motor blower bellows assemblies.
- C. Center plate securement weld shall be sandblasted, including 12" of ballast out from the securement weld, magnefluxed, inspected for cracks and repaired as required.

### 2.10.3 Exterior Locomotive Body

- A. Clean and inspect entire exterior of locomotive for corrosion and damage.



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- B.** Major exterior locomotive components shall be ASTM A36 welded steel construction or other materials, as appropriate, subject to acceptance by NCDOT.
- 1) Small tears, holes and cracks that have penetrated through the car body sides, ends and roof shall be welded closed, the area grit blasted clean, body putty applied and ground smooth, and the area primed in preparation for painting.
  - 2) Minor dents, deep scratches, brush-burns, and corroded areas, that would be noticeable after finish painting shall be grit blasted clean, body putty applied and ground smooth, and the area primed in preparation for painting.
  - 3) Where corrosion has penetrated more than 40% of the base metal, the effected area shall be removed and replaced with new material of equivalent thickness.
  - 4) All welds in car body side sheets shall be ground smooth.
  - 5) Particular attention shall be given to minimize distortion of side plates during welding.
  - 6) Hollow areas, dents and voids shall be properly filled and ground smooth to present an unblemished finish.
  - 7) AEI tags will be removed during cleaning then reinstalled.

### **2.10.4 Long Hood**

- A.** Existing side body engine room man and equipment access doors must be cleaned, inspected, and repaired to correct wear and assure positive latching.
- 1) All damaged areas shall be repaired and primed.
  - 2) All hardware, including latching mechanisms, shall be renewed

### **2.10.5 Interior Carbody**

- A.** The entire interior of the locomotive body shall be thoroughly cleaned of dirt, grease, and oil and then inspected for corrosion and damage.
- B.** Shutter valves, operators, and shutter assemblies shall be cleaned, inspected, tested, and repaired or replaced as required.
- C.** Engine cooling water tank and filler necks shall be cleaned, inspected, leak-tested, and overhauled or replaced in accordance with OEM.
- D.** All cooling fans, including the HEP cooling fan and motor assemblies shall be cleaned, inspected, tested, and overhauled or replaced, and balanced as required in accordance with guidelines recommended by OEM.
- E.** Inertial air discharge motors and fans shall be cleaned, inspected, tested, and overhauled or replaced in accordance with guidelines recommended by OEM.
- 1) Inertial filters shall be removed, cleaned, inspected, and qualified or replaced.

### **2.10.6 End Arrangements**

- A.** Clean and inspect pilot plates and recondition to original construction.
- B.** Clean and inspect buffer plates at rear of locomotive for damage, and repair or replace as required.
- C.** Couplers and Draft Gear.
- 1) Couplers at the B end shall be renewed, and reconditioned at the A end.
  - 2) Draft gear at the B end shall be renewed, and reconditioned at the A end.
  - 3) All cushion elements shall be new.
  - 4) Renew all hardened bushings and pivot pins.
- D.** Clean and inspect plow for damage and recondition as required.



## **2.11 Cab**

### **2.11.1 Interior**

- A. Ceilings and side sheets shall be cleaned, inspected, and repaired or replaced in kind.
- B. Underfloor and short hood compartments shall be thoroughly cleaned and repainted.
- C. Interior of main compartment shall be completely repainted and all letters, placards and decals renewed according to FRA regulations.
- D. Combustible interior materials shall comply with 49 CFR Part 238.103 and the Contractor shall provide the appropriate documentation in report form verifying same.

### **2.11.2 Cab HVAC System**

- A. Replace existing HVAC System. Contractor to provide alternatives for NCDOT consideration.

### **2.11.3 Insulation**

- A. Renew thermal/acoustic type insulation, in accordance with Contractor's specifications for the standard Locomotive model shall meet the acoustic requirements of 82+/-2dB on a time weighted, duty cycle basis.
  - 1) Non-flammable thermal and acoustic insulating material shall be installed in cab.
  - 2) Contractor will use approved FRA and/or APTA approved material.

### **2.11.4 Flooring**

- A. Replace existing cab flooring.
- B. Existing one piece trap door shall be modified to a two piece configuration and all hardware renewed.
- C. Inspect existing subfloor for rust and corrosion and repair as required.
- D. Contractor will provide floor samples of approved FRA and/or APTA materials for NCDOT approval.

### **2.11.5 Glazing, Doors and Windows**

- A. Moveable and fixed windows including sash, track and latches shall be cleaned, inspected, tested and repaired or replaced, as required, and all weather stripping/gasket material renewed. Drainage design shall be reviewed to ensure positive drainage is achieved. Glazing that is broken, cracked, clouded or damaged in any way shall be replaced with the appropriate Tier I or II FRA approved glass.
- B. Cab hood and engine room doors shall be cleaned, inspected and repaired as needed and all hardware renewed.
  - 1) Renew cab door, engine room door and main generator access door seals.
  - 2) All weather stripping/gasket material shall be renewed.
- C. All cabinet doors and other access doors and panels including hardware shall be cleaned, inspected, and repaired or replaced as required.
- D. Replace insulation in module access door. Contractor to recommend FRA and/or APTA approved material for NCDOT approval.

### **2.11.6 Windshield Wipers**

- A. Air operated wipers shall be renewed.



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- 1) All wiper blades shall be renewed.
- 2) All associated piping shall be inspected, and repaired or replaced as necessary.
- 3) All windshield wiper motors shall be renewed.

### **2.11.7 Operator's Controls and Switches**

- A. The operating control panel located at the lower left of the console shall have all switches and indicators renewed.

### **2.11.8 Other Operator's Control**

- A. The engine control (isolation) panel shall be cleaned, inspected, tested, and components repaired or replaced as required.
- B. The HEP Cab Remote Panel shall be cleaned, inspected, tested, and components repaired or replaced as required.

### **2.11.9 Miscellaneous Cab Equipment**

- A. New cardholders for FRA card forms shall be replaced in kind.
- B. The cab refrigerator shall be renewed. Contractor to recommend unit for NCDOT approval.
- C. The Prime wind deflectors/mirrors shall be renewed.
- D. All head bump pads shall be renewed.
- E. All visors shall be inspected and replaced as required.
- F. The toilet assembly shall be inspected, tested and replaced as required

## ***2.12 Fuel System***

### **2.12.1 Fuel Tank**

- A. Clean fuel tank interior thoroughly.
- B. Install fuel tank compartment condensate drain valves and gaskets.
- C. Rock guards shall be installed to protect new condensate drain valves.
- D. Interior inspection covers to be installed on the side of the take to allow visual inspection of each compartment.

### **2.12.2 Gauges**

- A. Sight gauges shall be removed and cleaned.
- B. Fuel gauges on tank shall be renewed

### **2.12.3 Emergency Fuel Cutoff**

- A. EFCO switch assemblies and boots shall be renewed.

## ***2.13 Layover Heating***

- A. Layover heating system shall be inspected, tested and repaired or replaced as required.



## **2.14 Radio and Communications**

- A. Radio (including interface) shall be tested and sent to manufacturer or certified facility for reconditioning if required.
- B. Event recorder, Rail View, Qualcomm and Accel Emergency Call equipment and wiring shall remain intact, and shall be protected from any damage during contractor's refurbishment work.

## **2.15 Styling and Painting**

### **2.15.1 Paint, Painting and Lettering**

- A. Each Locomotive shall be completely painted in accordance with the Locomotive exterior paint scheme including logos and striping. Locomotive number boards and other exterior lettering to comply with NCDOT'S configuration. Refer to NCDOT Document 0001413A and drawing set 0001425A for additional painting details.
- B. The Contractor shall provide the following
  - 1) Materials and General Requirements - Painting materials shall be applied according to the recommendations of paint manufacturer including cleaning and material preparation.
  - 2) All surfaces to be painted will be as free as possible of surface blemishes that may detract from the finished appearance.
  - 3) All exterior painted surfaces shall have a three-coat paint application consisting of one primer coat and two finish coats, including a clear coat. Interior painted surfaces shall have a minimum of two coats.
  - 4) Interior signs and equipment markings shall be rigid labels securely applied, or decals or vinyl lettering.
  - 5) Exterior Painting – The Contractor shall paint the exterior of the carbody using DuPont "IMRON" polyurethane paints or equivalent as approved by NCDOT, of approved colors to the approved NCDOT paint scheme.
  - 6) Equipment, except couplers and draft gear, outside the Locomotive body, including end sills, shall be painted black in accordance with NCDOT Document 0001413A. Underfloor equipment and structure, except control equipment, shall be given at least two coats of rust preventative paint. The underframe structure shall be cleaned of all scale, flux, etc. and Prime painted before application of finish paint.
  - 7) Interior Paint - The interior of the Locomotive shall be painted gray using DuPont Tufcote #917 part number 917M24260.
  - 8) Trucks – The Contractor shall apply one coat of metal primer on all exposed surfaces of trucks, except the wheels, axles, exposed neoprene and brake shoes. Before priming, the Contractor shall remove all accumulated dust, dirt or other foreign matter by means appropriate to the purpose and shall then spray and air dry a final coat of light-bodied approved truck paint, of a type that will not conceal cracks that may develop in service. Wheels, axles, exposed elastomers and brake shoes shall not be painted.
  - 9) Equipment Compartment and Lockers - The inside of all control equipment compartments, electrical lockers and junction boxes shall receive at least two coats of an approved white paint.
  - 10) Battery Enclosure - Metal battery enclosure (s) shall be given two coats of an approved acid resisting paint.
  - 11) Lettering and Numbering - Lettering, numbering and logos shall be applied to the exterior and interior as applicable, subject to review and acceptance by NCDOT. Circuit breakers, switches and gauges shall be properly and clearly identified. All electrical items such as terminal blocks, relays and resistors shall be clearly and permanently identified per applicable Locomotive or subcontractor wiring drawings.



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- 12) Tags and Stenciling - All FRA required stenciling shall be provided, in conformance with FRA requirements. Raised letter identifying tags shall be applied at all external air and electrical receptacles, and hoses.
- 13) The locomotive exterior shall include renewed reflective red tape. See paint scheme for details.

### **2.16 Inspections and Tests**

#### **2.16.1 General**

Prior to final acceptance, tests shall be performed in accordance with previously submitted and approved test procedures. The results of these tests must demonstrate compliance with all FRA test and specification requirements. NCDOT may elect to witness all, or part of the tests. NCDOT will bare all costs associated with having an NCDOT representative in attendance during these tests.

#### **2.16.2 Test Procedures**

Unless otherwise specified, the Contractor's standard test procedures for this submitted model Locomotive shall apply. To expedite Final Acceptance, test procedures to be used shall be reviewed by NCDOT prior to testing. Test results shall be submitted to NCDOT for review and approval. The following tests shall be performed on the Locomotive and its components:

- A.** Functional Test
- B.** Brake Tests
  - 1) Hand Brake Test – the hand brake on each Locomotive shall be tested.
  - 2) Air Brake test – Air brakes shall be tested and adjusted for performance complying with FRA regulations.
  - 3) Road Brake Test – A road brake test shall be performed. The road brake test shall be performed in conjunction with the Locomotive Track Test. A single locomotive shall also be tested to determine stop distance and wheel temperatures up to maximum authorized speed at 10 mph increments.
  - 4) Blended Brake Test – On each Locomotive, the blended air/dynamic brakes shall be functionally tested in accordance with the Contractor's standards to meet the performance requirements.
- C.** Electrical Tests – Contractor to submit standard test procedures for NCDOT approval.
- D.** Locomotive Sequence Test – A complete sequence test shall be made on each Locomotive, including front rear sequence changes, relays and switches, sanding, auxiliary motor starting circuits, wheel slip control, main propulsion and braking, main circuit breaker, calibration of safety relays, meter calibration, excitation, and any other testing required to insure that all circuits are performing properly.
- E.** Carbody Water Tightness Test
  - 1) Each Locomotive shall be tested for water tightness, as described below:
  - 2) After construction is completed all areas of the sides, ends, and roof, including doors and windows, of the Locomotives shall be given a complete test for water tightness. Water shall be sprayed from nozzles which are spaced no more than three feet from and aimed directly at the surface being tested. Not less than 0.625 gallons per minute shall be delivered to each square foot of surface being tested. Velocity of water shall not be less than 150 ft. per second. The Contractor will test completed Locomotive, cab and carbody



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sides for water leaks. Any leaks found will be repaired by the Contractor. Functional openings provided for fans, blowers, etc., as well as ventilation louvers, are excluded.

- F.** Clearance Test and provide a new PC5 form.
- G.** Truck, Couple and Cable Clearance Tests
- H.** Headlights, various - The headlights at each end and the ditch lights on each locomotive shall be aimed and adjusted to meet the required FRA beam characteristics.
- I.** Light Adjustment for headlights.
- J.** Fueling – The locomotive shall be fueled to assure fueling capabilities and proper operations of fuel cut off devices. (See Section 1.5.4)
- K.** Locomotive Track Test
  - 1) The completed Locomotive with a trailing load equivalent to 6 heritage cars shall be track tested. This test shall demonstrate the satisfactory operations of all control systems, auxiliary systems, propulsion systems, braking system alarm circuits, and HEP systems. The test shall demonstrate the performance and ride quality characteristics of the Locomotive. The test shall be coordinated with and witnessed by an NCDOT representative.
  - 2) This test shall be conducted by and at the expense of the Contractor. The test shall demonstrate the operational performance of the Locomotive regarding acceleration, maximum running speed and braking.
  - 3) The data recorded during the tests shall include, but is not limited to, the following:
 

Acceleration	Deceleration
Traction motor current	Traction motor voltage
Brake pipe pressure	Locomotive brake cylinder pressure
Dynamic brake current	Speed
Distance intervals	Time intervals
Ride quality	Wheel slip and slide performance
- L.** Qualification Test
  - 1) The following qualifying tests shall be performed:
 

Sound Levels Test	Clearance Test
Road Brake Test	Blended brake Test
Trainline Test	Trainset Track Test
Performance Test	
  - 2) All charts of data recorded shall be treated for permanence, and shall become the property of NCDOT.
- M.** Wheel Slip/Slide Test
- N.** Sound Test and In Cab Sound Test
  - 1) Sound level measurements shall be performed during the qualification track tests on a Locomotive as well as statically with all auxiliary equipment operating using a standard sound level meter to determine sound levels in the cab and externally. The DB readings in the cab shall not exceed 82 +/- 2DB.
- O.** HEP Test
  - 1) The Head End Power source tests shall include, but not be limited to Voltage, Current, Frequency, and output in KW. The load shall be varied over the full range up to 110% of full load.
- P.** HVAC Test
  - 1) The HVAC system shall be functionally tested. Controls shall be checked and adjusted for temperature distribution and proper volume of air.



### **2.16.3 Written Reports**

Written reports of all tests performed on the Locomotive and its components shall be submitted to NCDOT. Results of tests required by the Specification which are performed on the Locomotive or its components shall be included in the Locomotive History Book.

### **2.16.4 General Test Requirements**

All tests shall be performed at facilities of the Contractor. All tests and test facilities shall be approved by NCDOT.

- A. The Contractor shall identify track of proper length and alignment to permit implementation of the qualification track tests required. These tests shall be conducted by and at the expense of the Contractor.
- B. All working and moving parts, and all operating devices and controls of each Locomotive and its apparatus, shall be tested and put in proper operating condition before Locomotive is accepted. The Contractor shall perform all of the adjustments specified herein.
- C. Should the Locomotive be disassembled in any way for shipment, it shall be given an operational test upon reassembling at the delivery point on the track provided by NCDOT, at the expense of the Contractor.
- D. After receipt of the Locomotive at the Capital Yard Facility in Raleigh, NC and before passing into regular operation; each Locomotive will be carefully inspected by NCDOT and Contractor personnel and any part, device or apparatus requiring adjustment, repair or replacement will be called to the attention of the Contractor, in writing, who shall make adjustment, repair or replacement at the Contractor's own expense.
- E. NCDOT reserves the right to make, at its own expense, additional operating tests of the Locomotive within the parameters set out in this Specification. The Contractor shall assign a competent representative to witness such operating tests. Any defects disclosed before final acceptance by such tests, in apparatus, material or workmanship shall be corrected at the Contractor's expense. All expense and costs incurred in the removal of the Locomotive from the Capital Yard Facility in Raleigh, NC for correction of defects shall be borne by the Contractor.
- F. Official final acceptance of the Locomotive by NCDOT shall be performed at Capital Yard Maintenance Facility, Raleigh NC after all tests are successfully completed in accordance with the requirements stated except as noted, all costs and expenses incurred in performing these tests, including transportation to and from the test tracks, shall be borne solely by the Contractor.

### **2.16.5 Body and Collision Posts Tests**

- A. No body or collision post compression tests shall be required if the following conditions are met:
  - 1) An existing design is used without significant structural change; and
  - 2) The existing design has been embodied in a Locomotive which passed a satisfactory compression test for which adequate records exist and
  - 3) It can be agreed between NCDOT and the Contractor that the total weight of this Locomotive does not exceed that of the tested Locomotive by more than 5%.

### **2.16.6 Horn Test**

- A. Horn must be tested to meet all new FRA requirements.

### **2.16.7 Test Plans and Data**

- A. All test data shall be subject to NCDOT review and approval, and shall become the property of NCDOT upon satisfactory completion of tests. The Contractor is permitted to keep a copy of all test data. If the Locomotive or any related equipment or subsystems fail to satisfy the test



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- requirements, or demonstrate noncompliance with proposal performance, necessary corrective adjustment shall be made, and this Locomotive shall be tested as directed by NCDOT.
- B. The Contractor shall, within 90 calendar days following award of the contract, submit to NCDOT, for review and approval, a detailed test plan for this section.
  - C. The Contractor shall advise NCDOT 15 days in advance of the time and place of all tests.

### 2.16.8 Pre-Delivery Tests

- A. These tests shall verify that all systems are functioning as specified. Individual testing of components or systems may be performed at the Contractor's option during manufacture, at final static test or during track test. In the event of a test failure, the discrepancy shall be repaired and the test repeated.
- B. The following tests shall be performed as a minimum:
  - 1) Preliminary Test - Visual inspection on brake pressure, brake piston travel, fuel, sand, piping, water and oil levels. Inspection of all joints and connections for leaks.
  - 2) Calibrate all air gauges with a deadweight tester.
  - 3) Check all air lines for pressure drops.
  - 4) Continuity checks of all wiring, including engine failure lights and alarms, control console, switches and circuits, ac fan conductors, control sequence check, HEP, Zero Speed, and interlock configuration checks of all conductors and relays in the high voltage cabinet and HEP panels.
- C. Engine Start-Up-Prime Mover:
  - 1) Leak check
  - 2) Oil and coolant levels
  - 3) Generator excitation
  - 4) Operation of independent and emergency brakes
  - 5) Engine(s) shutdown
  - 6) Fan rotation & sequence
  - 7) Battery charging
- D. Head End Power Engine Start-Up:
  - 1) Leak check
  - 2) Oil and Coolant levels
  - 3) Generator output and phasing
  - 4) Engine shutdown
- E. Static Load Test - The Locomotive shall be subjected to a static load test during which all power functions will be qualified and full horsepower demonstrated. The following shall be included on both prime mover and head end power supply engine where applicable:
  - 1) Engine speeds throttle sequencing idle, 1-8
  - 2) Check speed settings in idle through overspeed
  - 3) Check and set temperature control switches and overheating switch
  - 4) Hot engine vibration checks
  - 5) Preliminary air brake checks

### 2.16.9 Track Tests at Plant

- A. Dynamic testing shall be performed on the Contractor's test track to qualify air and dynamic brakes, MU connections and all other features that cannot be checked during the static test.
- B. The dynamic tests will include, as a minimum, Functional brake tests. These tests will be done in accordance with the recommendations of the brake equipment supplier and FRA standards:
  - 1) Air leakage check.
  - 2) Brake cylinder pressure check.



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- 3) Brake release check.
  - 4) Automatic brake functions check.
  - 5) Independent brake check.
  - 6) Recording of pressure and reaction times.
  - 7) Sanders check.
  - 8) Train monitoring system functions check.
  - 9) Power Control Switch check with overspeed and emergency functions.
  - 10) Break-in-features test.
  - 11) Functional check of dynamic brake blending.
- C. Wheelslip - To be checked per the Contractor's procedures and OEM.
- D. Speed/Overspeed - Operational check of speed indicator
- E. Other Tests
- 1) Forward and reverse operation.
  - 2) High voltage cabinet pressure test (in Run 8).
  - 3) Cab noise test, and wayside noise test.
  - 4) Operation check of traction motor cut-out switch.
  - 5) Hot bearing detection system.
  - 6) Air, water and oil leaks.

### **2.17 Quality Assurance**

#### **2.17.1 General**

- A. This specification defines the requirements for an inspection system to be maintained by the Contractor. The Contractor's inspection system shall be capable of providing evidence that supplies and/or services meet the quality requirements of the Contract.
- B. The requirements of the Specification shall apply to the extent necessary to demonstrate conformance with Contract requirements.
- C. The Contractor shall demonstrate a quality control program which provides for inspection, testing, documentation of material dispositions, acceptance/rejection and status identification of materials, components, processes, work in process and finished work to assure conformance with the Contractor's standards and with the requirements of this Specification.

#### **2.17.2 Requirements**

- A. The Contractor shall be responsible for conducting an inspection required to demonstrate full conformance of the work to Contract requirements.
- B. The Contractor shall use its own or any other inspection facility and service. The Contractor shall provide an inspection system capable of producing objective evidence that finished work meets the quality requirements of the Contract.
- C. The system shall be considered acceptable when, as a minimum, it provides for the detection and removal of non-conforming material, either prior to or at the latest stage of fabrication manufacture or other processing where a characteristic can be tested, observed or measured. Inspection necessary to demonstrate conformance to contract requirements, wherever performed, shall hereinafter be referred to as "Final" Inspection.

#### **2.17.3 Quality Assurance Representative's Authority**

- A. The Contractor's designated Quality Assurance Representative shall have authority, on behalf of the Contractor to resolve inspection matters to the satisfaction of the NCDOT.



#### **2.17.4 Quality Control Manual and Inspection Plan**

- A. The approved Contractor's Quality Assurance Manual shall be the controlling document for the refurbished Locomotive. A copy shall be supplied to the NCDOT for review and approval.

#### **2.17.5 Documents for Inspection**

- A. The Contractor shall ensure that the latest approved versions of the applicable drawings, specifications, instructions, and changes are used for inspection purposes.
- B. The documents shall be made available at NCDOT's request for viewing, at the Contractor's location and should also be made available in electronic formats.

#### **2.17.6 Test and Inspection Equipment**

- A. The Contractor shall be responsible for the provision and maintenance of test/inspection equipment suitable to demonstrate conformance of the work to technical requirements. This inspection equipment shall be maintained under a recognized gauge control system. Calibration shall be traceable to applicable standards.

#### **2.17.7 Purchasing**

- A. The Contractor shall be responsible to ensure that all purchased material and services conform to the Contract requirements.
  - 1) Incoming Material Inspection – The Contractor shall provide for inspection, testing and identification of incoming material in accordance with the Contractor's Quality Assurance Manual.
  - 2) Fabrication, Manufacturing and Assembly Inspection – The Contractor shall, as a minimum, perform all required final inspections. The Contractor may institute any additional inspection of material in process considered necessary to determine the quality of work.
  - 3) The Contractor shall ensure that the work has been subjected to all final inspections indicated on the inspection plan and that relevant inspection records are complete. The Contractor shall subject all finished work to final inspection to ensure that Contract requirements are met. Only finished work which fully conforms to requirements shall be submitted for acceptance or be delivered.
  - 4) The Contractor shall keep objective evidence of the inspection and use check-lists to be sure that no major functional characteristic has been overlooked.

#### **2.17.8 Workmanship**

- A. The Contractor shall ensure that skillful workmanship is maintained at a level of quality consistent with the technical and functional requirements of the work. Workmanship shall be defined to the greatest practical extent by written standards or production samples inspected and accepted by the Contractor as examples of satisfactory skillful workmanship.
  - 1) Welding – The Contractor's facilities and welders shall be certified in accordance with AWS and the Contractor's standards and shall be verified as meeting these standards by random inspections of test pieces and of process variables. The Contractor may repair welding anomalies using industry-approved practices. The Contractor shall make Welder Certifications available to the NCDOT, upon request.
  - 2) Test and Inspection Records – The Contractor shall maintain records of all tests and inspections performed to substantiate conformance to Contract requirements.



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- 3) Records shall include positive identification of material, and finished work, the specific inspection performed, and the results obtained. Records shall include disposition of all rejected materials.

### **2.17.9 Material Control**

- A. The Contractor shall maintain a system which precisely indicates the up-to-date inspection status of material and finished work.

### **2.17.10 Accommodation, Facilities and Assistance**

- A. The Contractor shall provide the NC DOT with reasonable access at all times to plants of the Contractor and all sub-contractors to monitor compliance with contractual quality requirements.
- B. The Contractor shall provide adequate office facilities including space, furniture and telephone service for such monitoring during the entire span of time during which work on this contract is performed.

### **2.17.11 Final Inspection**

- A. Pre-Shipment Inspection – The Contractor shall perform a Final Inspection before shipment. The NCDOT may monitor the inspection and require that any part, device or apparatus needing adjustment, repair or replacement be corrected.
- B. Receiving Inspection and Final Acceptance Testing - Upon arrival at the designated point of delivery, the Locomotive shall be jointly inspected by the NCDOT and by the Contractor representative(s) to assure that the Locomotive is in safe and operable condition, to determine any damage incurred in transportation, and to conduct an inventory to assure that no items have been removed. A checklist will be prepared listing all corrective actions that must be performed. The NCDOT may withhold final acceptance until all corrective actions have been performed.
- C. The designated point of delivery is NCDOT's Capital Yard Maintenance Facility in Raleigh, NC.

## ***2.18 Documents and Specifications***

### **2.18.1 Records and Forms**

- A. Prior to, or upon delivery of the unit(s), the Contractor shall supply the following for each unit, contained in loose-leaf bound and/or electronic format "Locomotive History Books":
  - 1) Certificate of vehicle conformance. It shall be the responsibility of the Contractor to obtain all certificates of conformance.
  - 2) Scale tickets showing the weight at each end and the total weight of the Locomotive.
  - 3) Serial number listing of main components. Engine serial number and clearance record to include injector serial numbers. Truck serial number record to include wheels, traction motors, and gear cases.
  - 4) Air brake cleaning and testing records, if required
  - 5) Main reservoir certificate.
  - 6) Copies of all required test reports.
  - 7) Three copies of FRA Form F-6180-49, "Monthly Locomotive Unit Inspection and Repair Report," completely filled out and notarized, for submission to the FRA, for display in the Locomotive and for the files of NCDOT.



### **2.18.2 Technical Assistance**

- A. The Contractor shall provide, at no additional cost, Service Representative(s) at the NCDOT's Capital Yard Maintenance Facility in Raleigh, NC to conduct receiving inspection, final acceptance testing, and one week of locomotive break in observation. The break in observations by Contractor's representative shall be performed during routine daily Piedmont passenger train service between Raleigh and Charlotte, NC, on Trains #73 and #74.

### **2.18.3 Document Submittals**

- A. The Contractor shall submit to the NCDOT for review and approval a listing and submittal schedule of all required documents described in this specification within 60 calendar days after contract award.

## **3 NCDOT Rail Division Standards & Practices**

Refer to NCDOT document # 0001413A Standards & Practices for NCDOT Passenger Cars & Locomotives for further details on:

- Design Criteria
- Reconditioning & Exterior Finish
- Tests & Adjustments
- Components List
- Reference Specifications
- Reference Equipment

## **4 Warranty**

Contractor shall provide a one (1) year warranty of all workmanship, labor and materials provided by the contractor. Warranty shall go into effect upon final acceptance of locomotive to NCDOT Capital Yard Maintenance Facility in Raleigh NC.