ITEM OPPORTUNITY SYNOPSIS: Amtrak – 2015 - 7

TECHNICAL INFORMATION

Description of Item(s) Sought:
Integrated Cab/Crash Energy Management (CEM) Structure:
The cab carbody shell structure is a fabricated monocoque construction made up of custom framing members that are welded together to form a skeleton style structure and then completely enclosed by the carbody steel skin. Each of the framing members are a fabrication of rolled and formed shapes, using high-strength low-alloy steel. Once assembled the carbody structure will have the approximate overall dimensions of 10 feet x 13 feet and up to 78 feet in length.

On the leading end of the cab car structure is the integrated CEM system. The CEM components must collapse in a controlled manner when overloaded in order to absorb the collision energy and protect the train operator.

End Product/System Application:
High speed passenger trainsets.

Product Class and Size:
Between eight (8) to twenty-eight (28) trainsets. Each Trainset will typically have a cab control car (either powered or unpowered) at each end of the Trainset.

Item Materials and Likely Manufacturing Processes:
The carbody shells being proposed for the passenger vehicles of the high-speed trainsets are a precision welding of custom framing members (some of which span the entire length of each car (up to 78 feet)) that are enclosed by the carbody steel skin. The carbody shell is built from six subassemblies (roof, underframe, two (2) side frames, and two (2) end frames) that are in-turn spliced together into the complete monocoque structure. All of the steel framing members are custom designed in order to optimize their strength while minimizing weight. The steps involved in fabricating
the subassemblies include, forming, machining, jiggling, and welding using specialized tooling. The subassemblies are then spliced together to form the fully fabricated car body shell.

The CEM components of the leading end of the cab car structure are specifically designed to collapse in a precisely controlled manner when they are overloaded during a vehicle collision. These components have evolved through an extensive R&D program to ensure they function appropriately during a vehicle accident and absorb much of the collision energy. The manufacturing of these components is done following strict requirements to ensure proper operation when engaged. The photos below are an example of CEM components that have been designed, manufactured and tested by the FRA as part of their North American crash energy management R&D.

Summary of Technical Specifications and Performance Requirements:
The specification requirements of the Northeast Corridor Next Generation High-Speed Trainsets (Reference Appendix 1) include several challenging constraints including 17 metric tons per axle. In addition, specific carbody structural loading requirements are mandated to provide a survivable structure for the engineers/driver in the event of an extreme accident. These structural requirements (especially the accident loading requirements), together with the weight requirements, necessitate fabrication from light-weight, high-strength steel profiles.

The solicitation specifically requires a proven design be offered and requires the first car body shell be delivered 17 months after Notice to Proceed.

BUSINESS INFORMATION

Estimate of Potential Business Volume (# Units per Year):
Between eight (8) to twenty-eight (28) trainsets comprising of two (2) end control cab vehicles (one at each end of the trainsets) produced over 24 months.

Target Price / Cost Information:
The recurring cost of a carbody shell is estimated to be $190k to $250k per shell, with many undefined variables.
There will also be non-recurring cost for the capital equipment and technology transfer which is anticipated to be a significant amount per trainset.

**Delivery Requirements:**
Delivery of the end control cab vehicles structures with their integrated CEM system components will be done in just under 24 months. (Expected to be 2017 – 2018)

**Certification Requirements:**
The carbody shell must meet Federal regulations and pass a test regime as defined in the Technical Specification.

**OTHER NOTES**

**Other Information about supply that is noteworthy:**
At this time, none of the proposers have facilities in the United States that can produce these specialized cab car vehicle structures, especially at the production rates demanded by the Amtrak High-Speed Trainset project schedule. Any US supplier who desired to enter this market would be subject to developing a facility that would meet the quality requirements of the design, including the procurement and installation of precision tooling and fixtures and the manufacturing learning curves.

Because these Amtrak structures are very similar to the structures already being manufactured in the proposers’ overseas facilities for other regional markets, all of the production jigs, fixtures, production equipment, etc. would have to be duplicated for use solely in a US facility and at a substantial cost. Facility and process development constitute a major challenge and a project risk to Amtrak’s business case with respect to the cost of the Trainsets and the 17-month delivery requirement.

Since the specific Amtrak High-Speed Trainset requirement will not sustain a long-term capacity for this new facility, the Amtrak Trainset contract will likely have to fully absorb a one-time capital and start-up cost, with an uncertain future for further orders.
APPENDIX 1: EXTRACT OF CAR SHELL SPEC

8 VEHICLE AND SUBSYSTEM PERFORMANCE REQUIREMENTS

8.2 STRUCTURE AND CRASHWORTHINESS

8.2.1 General Description
The Contractor shall comply with the technical criteria and procedures produced by the FRA RSAC Engineering Task Force (ETF) for Tier III service (reference ETF_001-03 – Proposed Ruletext for NPRM). The Contractor shall also adhere to the requirements of EN 12663 and EN 15227, or comparable Relevant Standards, unless otherwise noted in this Specification.

8.2.2 Vehicle Masses
The maximum payload depends on the number of seats for passengers and on the number of passengers in the standing areas. These values take into account any statutory regulations and give the mass for the payload and the number of passengers that are allowed to be transported in these Trainsets.

Per EN 15663, the typical weight of a passenger, with luggage is identified as 80 kg (176 lbs.). The typical weight of a crew member, with luggage and Equipment, is identified as 80 kg (176 lbs.). A review of U.S. Center for Disease Control weight statistics for adult males and females has been conducted. Based on these statistics, by 2043, the average weight for a U.S. male is predicted to be 97.5 kg (215 lbs.), and the average weight for a female is predicted to be 84.2 kg (186 lbs.). To calculate payload, the Contractor shall utilize the projected U.S. adult average weights identified above with a 50/50 gender distribution, and shall include a 15 kg (33 lbs) weight for luggage per person.

The weight, with luggage, of seated passengers (seating density Specified in Section 8.4.6), 6 crew members shall be the absolute minimum payload weight used for Trainset design. One crew member will be assumed to be within the Cab, one crew member in the Café Vehicle, one crew member in the First Class and the remaining three crew members will be distributed throughout the Trainset.

The Contractor shall confirm that the structural design of the proposed service proven Trainset can accommodate this payload, developed in accordance with EN 15663, utilizing the projected U.S. adult average weights identified above. This information shall be submitted to the Owner for review and approval.

Full load conditions, as identified in this Specification, shall be inclusive of the maximum payload, 6 crew members, all materials needed for operation (e.g., lubricants, coolants, catering Equipment, toilet flushing medium, onboard fire suppression System medium, etc.), and two-thirds of consumables (e.g., sand, water, food, etc.).

8.2.3 Carbody Strength
The Contractor shall demonstrate, by means of appropriate calculations and tests, that the carbody strength and fatigue performance of the carbody and Bogies are suitable for the service life of the Trainset within the expected loading conditions, mass distributions, and design configuration for the Owner’s Operations. The Contractor shall demonstrate compliance with the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.703.
8.2.4 Crash Energy Management
Each Trainset shall be provided with a crash energy management (CEM) System to dissipate kinetic energy during a collision. The System shall provide for controlled deformation and Collapse of designated sections within the unoccupied volumes to absorb collision energy and to reduce the decelerations on passengers and crewmembers resulting from dynamic forces transmitted to the Occupied Volumes.

The design of the CEM System and the end structure of the Trainset shall satisfy the requirements identified in Sections 8.2.5 and 8.2.6.

8.2.5 Occupant Volume Strength – Dynamic Collision Scenario
The Trainset shall be designed to withstand the dynamic impact conditions defined within the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.705.

8.2.6 End Structure Integrity of Cab End and Fluid Entry Inhibition
The forward ends of Cab Vehicles shall be capable of absorbing energy in a simulated collision with a rigid object per the requirements in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.711.

The skin covering the forward-facing end of the Trainset shall comply with the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.709.

8.2.7 End Structure Integrity of Non-Cab End
Non-Cab ends of Vehicles shall follow the requirements detailed in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.713.

8.2.8 Overriding
Anti-climbing resistance shall be demonstrated at both the impacted Interface and at the coupled Interfaces in accordance with the criteria set out in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.707.

8.2.9 Roof and Side Structure Integrity
The roof and side integrity strength for all Vehicles shall conform to the requirements as described in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.715.

8.2.10 Obstacle Deflector
Vehicles with a driving Cab shall be fitted with an obstacle deflector at the Cab end to reduce the risk of derailment resulting from impacts with objects or animals lying at, or near, rail level. The Contractor shall demonstrate that the deflector is comparable with that defined in EN15227.

8.2.11 Load Cases for Bogie-to-Carbody Attachments
The Bogie-to-carbody attachment shall conform to the requirements detailed in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.717.

8.2.12 Load Cases for Equipment Attachments
Safety brackets, hangers, and other similar Devices shall be designed to carry the Equipment within the clearance envelope under Normal operating load conditions in case of failure of the primary attachment System. With the failure of any one of the attachments, the Equipment shall remain within the clearance.
envelope of the Vehicle. Further, Equipment attachment strength shall be demonstrated to the same levels as specified for interior fitting attachments in the proposed regulatory text for Tier III Equipment defined in 49CFR Parts 238.733, 238.735, 238.737, and 238.743.

8.2.13 Modes of Vibration
The natural modes of vibration of the carbody, when fully equipped, shall be separated sufficiently, or otherwise decoupled, from the suspension frequencies to achieve acceptable ride quality per Section 8.19.10. The fundamental modes of vibration of items of Equipment, on their mountings and in all operating conditions, shall be separated sufficiently, or otherwise decoupled, from the modes of vibration of the carbody structure and suspension, to avoid undesirable responses.

The Contractor shall create FEA models of each System attached to the carbody and its respective mounting Equipment. Shock and vibration requirements for Trainset Equipment shall be in accordance with CENELEC EN 61373 – Railway Applications – Rolling Stock Equipment – Shock and Vibration Tests.

8.2.14 Safety Appliance Mechanical Strength and Fasteners
Drawings of all safety appliances to be installed on the Trainsets shall be submitted to the Owner for review and approval. Contractor preference for welding over mechanical fastening shall be justified to the Owner for evaluation with FRA. Safety appliances shall be affixed as required to the carbody with sufficient strength to ensure proper function as required in existing 49CFR requirements. The size, location, and function for each safety appliance shall be clearly described for presentation. Design and mounting of safety appliances shall account for aerodynamic effects on and acoustic emissions from the Vehicle.

The Contractor shall ensure that all safety appliances and fasteners comply with FRA regulations. The Contractor shall be responsible for generating information needed to support any public hearing required for non-compliance of safety appliance statutes. The Contractor shall develop safety appliance drawings for the Trainset for submission to the FRA and participate in a safety appliance sample Trainset inspection by the FRA.

8.2.15 Emergency Signage and Markings
Emergency exits shall be clearly identified to passengers and emergency responders by means of suitable signs. Emergency signage shall be implemented as described within APTA PR-PS-S-002-98.

Emergency exits shall be clearly identified to passengers by means of low-location exit path markings as described within APTA PR-PS-S-004-99.

The Contractor shall develop emergency signage drawings for submission to the FRA and participate in a sample Vehicle inspection by the FRA for determination of compliance.

8.2.16 Evacuation via the Doors
Trains shall be equipped with emergency Devices allowing the evacuation of passengers via access doors, when not present at a platform, to a variety of surfaces and heights (e.g., ballast shoulder, raised walkway, TOR road crossing, tunnels and trenches where space may be limited, etc.). The emergency evacuation Device shall be provided with a means to mechanically fasten to the Vehicle, adjacent to the door threshold. Evacuation from the Equipment, with the associated times detailed in Section 8.13.1, shall be described in an emergency egress
plan to be submitted for review and approval by the Owner.

8.2.17 Emergency Window Egress and Rescue Access
Each passenger Vehicle shall comply with the emergency window egress and rescue access requirements in the proposed regulatory text for Tier III Equipment defined in 49CFR 238.741.

8.2.18 Emergency Roof Access
Each passenger Vehicle shall have a minimum of two emergency roof access locations. Emergency roof access shall be provided by means of a conspicuously marked structural weak point in the roof for access by properly equipped emergency response personnel. Specific requirements for size and placement of emergency roof access points are described within 49CFR 238.123.

8.2.19 End-Facing, Side-Facing and Interior Glazing
The Trainsets shall be equipped with certified end-facing and side-facing glazing compliant with the requirements set forth in the Technical Criteria and Procedures produced by the ETF for Tier III service (reference and draft NPRM language for non-Cab glazing (ETF_001-03 – Proposed Ruletext for NPRM)). Further all glazing, inclusive of Trainset interior glazing, shall conform to EN 15152 and Relevant Standards.

Each exterior window shall remain in place when subjected to air pressure differences caused by two passing high speed trains travelling at maximum velocity in opposite directions, at the minimum separation for two adjacent tracks, and by a Trainset entering a tunnel.

Side-facing glazing shall also meet the passenger and crew containment requirements of GM/RT 2100, Issue 4, December 2010 Appendix C, or equivalent.

8.2.20 Carbody Aerodynamic Provisions
The Contractor shall demonstrate that the body profile, nose shape, and structural response of the Trainsets have been designed to accommodate the requirements of 2008 HS RST TSI Sections 4.2.6.2, 4.2.6.3, and 4.2.6.4.

8.2.21 Corrosion Protection
Materials shall be compatible with the System’s ambient conditions and environments Specified in the Infrastructure Interface Specification (Appendix B).

Anti-corrosion measures, including the prevention of water build-up, shall be incorporated. The Contractor shall provide the following information:

a) The type and location of anti-corrosion measures and design features.
b) Protective measures employed where dissimilar metals are in contact.
c) Suggested Maintenance requirements, if special attention is required.
d) Protective measures to be taken during shipping and prior to the commencement of trial operation.

8.3 Exterior Requirements

8.3.1 Exterior Equipment
Underfloor Equipment shall be protected from water splash, Vehicle water drains, airborne debris, ice, or other
objects.

Equipment installations shall allow for the maximum ventilation of parts and minimum restriction to cooling air.

Equipment cover latches shall not violate the Trainset dynamic clearance outline when not engaged, and shall hold the cover firmly to the box without rattling in the engaged condition. Safety catches shall be provided for each Equipment box cover. The catches shall be designed to retain the cover within the Trainset dynamic clearance envelope at all Operating Speeds without the cover latches engaged.

8.3.2 Exterior Finishing
The Trainset exterior, including Front End and skirting, shall be painted in accordance with the color schemes to be proposed by the Contractor and agreed upon with the Owner.

Exterior Vehicle finishes shall be compatible with the Owner’s livery schemes. Finishes shall also be compatible with the Owner’s cleaning methods, trainwash Equipment, and associated cleaning chemicals (refer to the Infrastructure Interface Specification (Appendix B). the Contractor shall suggest a cleaning solution within the constraints of Amtrak Trainwash Facilities, see Section 13.1-i of Schedule 1 Part A.

8.3.3 Exterior Graphics
Suitable graphics shall be provided throughout the Trainset to provide passengers with information. The graphics shall not cover retro-reflective material for the purposes of emergency instructions and access identifications. Final configuration shall be established during design review and approved by the Owner.

8.3.4 Side Skirts
Hinged side skirts shall be provided outboard of the Bogies and elsewhere as required to complement the overall aerodynamic and aesthetic design. Bogie skirts shall be designed so as to provide minimum aerodynamic drag, and maximum wheel/Bogie noise abatement capabilities, while ensuring adequate cooling air for all Bogie mounted Equipment.