Electric Multiple Units RFI Update

Fiscal and Management Control Board
June 15, 2020
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Agenda

- Request for Information (RFI) Overview
- Summary of Responses
- Alternative Concepts
- Continuing Efforts
Request for Information (RFI) Overview

• RFI Goal: solicit the input and experience of the industry relative to existing Electric Multiple Unit (EMU) designs and their applicability to the MBTA Commuter Rail system of the future
  • Contained 27 questions covering 13 topics
  • Encouraged respondents to submit additional information
• Publicly advertised on the MBTA’s Business Center on January 15, 2020
• Original response date of April 15, 2020 was extended to May 21, 2020
Summary of Responses

• Respondents: Alstom, Bombardier, CRRC, Hitachi Rail, Hyundai Rotem, and Stadler
  • All respondents indicated a willingness to discuss their submittals.

• Responses were also received from equipment suppliers Wabtec and Harting and the advocacy group TransitMatters.

• Respondents answered the questions posed to industry and provided technical information about existing EMU designs.
  • Some respondents provided commentary about the Commuter Rail transformation vision that extended beyond vehicle technology.

• A final report synthesizing all RFI responses and other available information will be completed in summer 2020.

Note: Submittals varied greatly in the level of detail provided.
Alstom

- **Suggested:**
  - 3 or 6 car semi-permanently coupled units
  - A mix of single-level power and multi-level trailer cars
  - One of three cars powered
  - Low-level boarding at select doors

- **Alternatives:**
  - 3 to 10 car semi-permanently coupled units
  - Entirely single-level or multi-level train sets
  - Additional powered cars or trucks
  - Articulated train sets
  - Hydrogen fuel cell powered train sets
  - Hybrid electric + battery train sets
  - Hybrid electric + diesel train sets
Alstom Coradia Concept for MBTA

- Alstom’s suggested concept is a variant of the CFL 2200 provided to the national railroad of Luxembourg
- Fixed train sets with multiples of three cars: 1 power car and 2 trailer cars
- Mix of single-level and multi-level cars

Image source: https://groupe.cfl.lu/en-gb/amenities/detail/automotrice-serie-2200

These images represent two of several possible configurations
Bombardier

- **Suggested:**
  - A comprehensive transition plan featuring:
    - Multilevel EMUs
    - Dual-power electric + diesel locomotives
    - Continued use of the MBTA’s existing coaches

- **Alternatives:**
  - Hybrid electric + battery train sets
Bombardier’s suggested concept EMU is the NJT Multilevel III

EMU trains in multiples of three cars:
  • One of three cars powered
  • The trailer cars could be existing MBTA multi-level coaches
    • Would impose compatibility requirements between new and existing equipment
  • Can be used in a push-pull train

These images represent five of several possible configurations
CRRC

- **Suggested:**
  - 3 or 4 cars semi-permanently coupled
  - The merits of stainless steel and aluminum carbodies
  - The merits of a shaped nose with emergency exit door vs a flat front with end door

- **Alternatives:**
  - Hybrid electric + diesel train sets
  - Hybrid electric + battery train sets
Hitachi Rail

• Suggested:
  • 6 to 9 car semi-permanently coupled units
  • Single-level cars
  • A mix of powered and unpowered cars
  • Shaped nose on cab ends

• Alternatives:
  • Multiple configurations possible once service requirements defined
  • Hybrid electric + diesel train sets
  • Hybrid electric + battery train sets


Hyundai Rotem

- Suggested:
  - 2 cars semi-permanently coupled (married pairs)
  - Single-level vehicles
  - 100% powered trucks
  - Cab end doors

- Alternatives:
  - Hybrid electric + battery train sets

Image source: https://www.hyundai-rotem.co.kr/Eng/Business/Rail/Business_sub.asp?d1=1&d2=1&d3=1
Hyundai Rotem Silverliner-V Concept for MBTA

- Hyundai Rotem’s suggested concept is the Silverliner-V
- Currently used by SEPTA and RTD (Denver)
- Married pairs and single cars
- 100% powered trucks
- Current variants do not have toilets
- Low platform boarding at select doors only

Image source: Famartin / CC BY-SA (https://creativecommons.org/licenses/by-sa/4.0)
Stadler

• Suggested:
  • 2 to 8 car semi-permanently coupled units
  • Multi-level vehicles
  • A mix of powered and unpowered trucks
  • Dedicated doors for high-level and low-level boarding
  • Use of 2 x 2 seating to improve boarding and alighting
  • Shaped nose on cab ends

• Alternatives:
  • Single-level vehicles
  • Articulated train sets
  • Hybrid electric + battery train sets
  • Hybrid electric + diesel train sets
Stadler KISS Concept for MBTA

- Stadler provided a concept drawing of a four-car KISS multilevel EMU
- Stadler indicated that the Caltrain version of their KISS vehicle is not compatible with MBTA’s existing standard high-level platform dimensions
## Industry Consensus and Variations

<table>
<thead>
<tr>
<th>Consensus</th>
<th>Variations</th>
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</thead>
<tbody>
<tr>
<td>OCS: 25 kV, 60 Hz</td>
<td>Single-level or multi-level vehicles</td>
</tr>
<tr>
<td>Onboard energy storage not suggested</td>
<td>Stainless steel or aluminum carbody</td>
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<tr>
<td>A carbon fiber carbody structure is not suggested</td>
<td>Married pairs vs longer semi-permanent units</td>
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<tr>
<td>An exclusively steel carbody is not suggested</td>
<td>Ratio of powered to unpowered cars or trucks</td>
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<tr>
<td>Compatibility with legacy fleets adds cost per vehicle</td>
<td>Shaped nose vs end door on cab end</td>
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<tr>
<td>Low platform boarding at select doors only</td>
<td>Standard or alternative compliance to FRA structural standards</td>
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Carbon Reduction Suggestions

- Driver advisory systems
- Temperature control of traction system cooling
- High-efficiency propulsion system
- Intelligent HVAC recirculating/fresh air control
- Passenger load dependent HVAC control
- HVAC setpoint control for ambient temperature
- Improved thermal insulation
- Passenger requested door operation
- Lightweight vehicle construction
- Aerodynamics
- Regenerative braking
- Prefer electric actuation over pneumatic
- HVAC sizing
Alternative Concepts
Articulated Train Set

Alstom Coradia Continental


Stadler FLIRT
Dual-Power or Electric Locomotives

- Bombardier suggested dual-power ALP-45DP locomotives to:
  - Extend the service life of existing MBTA coaches
  - Allow for electrification over time on a line-by-line basis
  - Replace aging MBTA locomotives

- The same train can operate as an electric train on an electrified inner core and transition to diesel on the less dense outer portion of the line
Electric/Battery Hybrid

- Requires recharging after every use
  - Can charge when operating on OCS or at designated charging stations
  - 30-60 minute recharge time at charging stations
  - Limited operating range
- Batteries have finite life
  - High replacement cost
  - Complex disposal requirements
- The same train can operate as an electric train on an electrified inner core and transition to battery on the less dense outer portion of the line
  - Reduced performance when on battery
  - Trade performance vs. range when on battery

Image source: https://upload.wikimedia.org/wikipedia/commons/6/6b/J33_770_%C3%96BB_%C2%BBCityjet%C2%AB.jpg
Electric/Diesel Hybrid

- Mentioned by 5 of 6 manufacturers
- The same train can operate as an electric train on an electrified inner core and transition to diesel on the less dense outer portion of the line
  - Reduced performance when on diesel
- Additional onboard energy storage required to recover brake energy
- Requires refueling for diesel operation

Image source: https://www.stadlerrail.com/media/pdf/feabmu0916e.pdf
Hydrogen Fuel Cell

- Requires a hydrogen source for refueling
- Additional onboard energy storage required to recover brake energy
- Emerging technology for rail

Continuing Efforts

• There may not be one best solution for the Commuter Rail
  • A single “best compromise” fleet simplifies procurement and maintenance
  • Fleets tailored to the needs of each mission optimize passenger service

• Strategic Mission Decisions to determine how EMUs fit into the Commuter Rail Transformation
  • Schedule types, headways, capacity
  • Timeline for electrification, stations and platforms, maintenance facilities
  • Integrating EMU service into existing and planned Commuter Rail service

• Vehicle Engineering is ready to support the Office of Commuter Rail Transformation
Next Steps

- Technical Specification and Contract Terms for new Bi-Level Coaches (single-level coach replacement) is in Final Development
  - Anticipated Summer 2020
- Strategic decisions need to be made in order to determine long-term fleet makeup
- Additional funding for long-term decisions needs to be identified
  - Current funding is limited to professional services for the bi-level coach procurement

Once our strategic direction is chosen:
- Vehicle manufacturers responded that it will take approximately 36 to 42 months from notice to proceed to deliver the first trainset.
- Assuming an 18-month strategic decision-making process for Commuter Rail Transformation, we anticipate delivery for a new fleet would begin in 2025/2026.
- Additional funding for EMU procurement, wayside, and facility changes needs to be identified.