Bringing you the **NEXT GENERATION** of transit.

**PLAN. BUILD. MOVE.**

Carrie Schindler, PE  
Director of Transit & Rail
Redlands Passenger Rail Project

Background
Redlands Passenger Rail Project Schedule

**Background**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>ENVIRONMENTAL CLEARANCE</td>
<td>March 2015</td>
</tr>
<tr>
<td></td>
<td>VEHICLE PROCUREMENT</td>
<td>Oct 2016</td>
</tr>
<tr>
<td></td>
<td>START FINAL DESIGN</td>
<td>January 2017</td>
</tr>
<tr>
<td></td>
<td>UTILITY RELOCATION</td>
<td>Early 2018</td>
</tr>
<tr>
<td></td>
<td>MAINLINE CONSTRUCTION</td>
<td>Early 2019</td>
</tr>
<tr>
<td></td>
<td>START OPERATIONS</td>
<td>Mid 2021</td>
</tr>
</tbody>
</table>
SAN BERNARDINO
VALLEY MASS
TRANSIT CONNECTIVITY

Potential Expansion
Diesel Multiple Unit Conversion

Alternative Propulsion Module

Power Pack
Diesel Multiple Unit Conversion

TIRCP Grant Award $30M
- SBCTA received funding from Transit and Intercity Rail Capital Program (TIRCP) to complete research and development on zero or low emissions rail vehicles (ZEMU)

Funding for:
- Research on the conversion of Diesel Multiple Unit to Zero Emission Multiple Unit
- Development of suitable technology and procurement of the zero emission unit and testing on the Arrow corridor

SBCTA ZEMU Program Approach
- Phase 1 – Planning
- Phase 2 – Design & Engineering
- Phase 3 – Project Implementation and Construction
Selection of Preferred Technology

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Capital, Operations &amp; Maintenance</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Right-of-Way, Charging &amp; Fueling, Utilities</td>
</tr>
<tr>
<td>Environmental Considerations</td>
<td>Land use, GHGs, Aesthetics, Noise, Socio-Economic</td>
</tr>
<tr>
<td>Operations</td>
<td>Range, Scalability, Reliability, Operations, Life Span</td>
</tr>
<tr>
<td>Regulatory Compliance</td>
<td>FRA, NFPA, CPUC</td>
</tr>
<tr>
<td>Implementation Schedule</td>
<td>Timeline for Planning, Design, Construction phases</td>
</tr>
<tr>
<td>Risk Analysis</td>
<td>Identify and document risks for further analysis</td>
</tr>
</tbody>
</table>
Key Tasks Underway

• Task 3 - ZEMU Project Definition and Constraints
• Task 4 - Assessment of OESS Rail Vehicle and Charging System Alternatives
• Task 5 - OESS and Charging Systems Feasibility Studies
• Task 6 - Options Evaluation and Report
• Task 7 – Contract Development for Supplier

Key Dates

• April 2018 – Grant Award
• October 2018 - Grant Allocation
• March 2019 – Complete Task 3 & 4
• April/May 2019 – Update to Transit Committee/Board & Complete Task 5
• June/July 2019 – Board direction on technology to carry forward (Task 6)
• July 2019 Vehicle RFP
Attendance at workshops, seminars, facility tours including:

• Lessons learned from Midlands Metro Rail (Birmingham, England)
• SunLine Transit hydrogen facility tour
• Railway Motive Power and Alternative Propulsion Seminar

Supplier engagement

• Interviewed suppliers of battery, hydrogen fuel cell technologies and also rolling stock providers
Midlands Metro Rail Lessons Learned Workshop

Task 3 – Research Technologies
SunLine Transit Hydrogen Facility Tour

Task 3 – Research Technologies
Railway Motive Power and Alternative Propulsion Seminar – Port Tour

Task 3 – Research Technologies
Railway Motive Power and Alternative Propulsion Seminar – Port Tour

Task 3 – Research Technologies
Engagement with Suppliers

Task 3 – Research Technologies
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Technology</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Reliability</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Ease of Maintenance</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Initial Cost</td>
<td>Moderate</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Long-term Costs</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Relative Capital Costs</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Life Cycle Cost</td>
<td>Moderate</td>
<td>Poor</td>
<td>Good Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>GHG Emissions</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Audibility</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Range</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Scalability</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Life Span</td>
<td>Good</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Regulatory Compliance</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Task 3 – Research Technologies**

- **High Level Pre-Screening**
  - **Baseline – Advanced (AW)**
  - **Future Power Supply**
  - **On-Board Energy Storage Systems (OESS)**
  - **Hybrid Systems**
Energy Usage & Modeling Scenarios

Scenario 1  2-Car ZEMU

Scenario 2  4-Car ZEMU

Scenario 3  2-Car ZEMU + 2-Car DMU

Task 4 – Modeling
<table>
<thead>
<tr>
<th>Journey</th>
<th>Section Length (Miles)</th>
<th>Energy Between Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scenario 1 2-Car ZEMU</td>
</tr>
<tr>
<td>RPRP - West End</td>
<td>RPRP – East End</td>
<td>8.89</td>
</tr>
<tr>
<td>RPRP – East End</td>
<td>RPRP – West End</td>
<td>8.89</td>
</tr>
<tr>
<td>LA</td>
<td>RPRP – West End</td>
<td>57.63</td>
</tr>
<tr>
<td>RPRP – West End</td>
<td>LA</td>
<td>57.63</td>
</tr>
</tbody>
</table>
Performance and Energy Usage Modeling

Primary inputs

- Vehicle characteristics (mass, loading condition, tractive & braking curves, rotating inertia, electrical efficiencies and auxiliary loads)
- Track characteristics (distances, grades, curves, speed limits and restrictions)

Applications

- Quantify key requirements – power charge/discharge rates and energy storage capacity
- Support assessment of technology feasibility
Initiate a regular communication plan with FRA

Key FRA elements
- Crashworthiness
- Fire safety
- Inspection
- Vehicle Maintenance
- Record keeping
Complete Feasibility Studies and Evaluation of OESS and Hydrogen Technologies
Engagement with FRA – Develop plan for ongoing engagement
SBCTA evaluation and selection of preferred technology alternative by SBCTA Board
Engineering of ZEMU vehicle
Determination of infrastructure needs and engineering design
Project procurement and implementation
FRA concurrence
Operational testing
Revenue service
Statewide analysis for ZEMU service in California

www.goSBCTA.com
909.884.8276

@goSBCTA