Multi-Engine GenSet
Ultra Low Emissions
Road-Switcher Locomotive

National Railway Equipment Co.
New Locomotive Concept

- Uses Multiple Diesel Engine GenSets that are EPA Tier III Off-Road certified.

- The locomotive is EPA Tier II Railway Industry certified and is recognized by the California Air Resources Board (CARB) as an Ultra Low Emissions Locomotive (ULEL).

- Control the horsepower and rpm levels for each engine in order to achieve even better emissions and fuel consumption rates.

- Manage “start/stop” functionality to minimize engine idling.

- Provide all electrical power to a common connection so that power can be managed to individual traction motors for better adhesion to the rail and provide all necessary power for the operator’s cab, air brake system and equipment cooling.

- Arrange all the major components on the locomotive frame to enhance ease of replacement.
### Throttle Schedule

<table>
<thead>
<tr>
<th>Notch Position</th>
<th>engines running</th>
<th>engine rpm</th>
<th>total horsepower</th>
<th>duty cycle</th>
<th>horse power weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle</td>
<td>1</td>
<td>900</td>
<td>25</td>
<td>59.8%</td>
<td>14.95</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1300</td>
<td>125</td>
<td>12.4%</td>
<td>15.50</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1500</td>
<td>225</td>
<td>12.3%</td>
<td>27.68</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1500</td>
<td>425</td>
<td>5.8%</td>
<td>24.65</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1800</td>
<td>650</td>
<td>3.6%</td>
<td>23.40</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1600</td>
<td>850</td>
<td>3.6%</td>
<td>30.60</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1500</td>
<td>1000</td>
<td>1.5%</td>
<td>15.00</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>1500</td>
<td>1250</td>
<td>0.2%</td>
<td>2.50</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>1800</td>
<td>1400</td>
<td>0.8%</td>
<td>11.20</td>
</tr>
</tbody>
</table>

Bar Graphs:

- **Idle - 4**: 94%
- **5 - 8**: 6%
20.7% Fuel Consumption Savings

<table>
<thead>
<tr>
<th>Throttle Notch</th>
<th>12 645E RPM</th>
<th>NREC SW RPM</th>
<th>NREC SW ENGs</th>
<th>12 645E BHP</th>
<th>NREC SW BHP</th>
<th>12 645E Fuel Rate Gal/Hr</th>
<th>NREC SW Fuel Rate Gal/Hr</th>
<th>Duty Cycle %</th>
<th>12 645E Weighted BHP</th>
<th>NREC SW Weighted BHP</th>
<th>12 645E Weighted Gal/Hr</th>
<th>NREC SW Weighted Gal/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>900</td>
<td>1800</td>
<td>2</td>
<td>1517</td>
<td>1377</td>
<td>90.6</td>
<td>68.86</td>
<td>0.8%</td>
<td>12.14</td>
<td>11.02</td>
<td>0.72</td>
<td>0.55</td>
</tr>
<tr>
<td>7</td>
<td>820</td>
<td>1500</td>
<td>2</td>
<td>1334</td>
<td>1210</td>
<td>76.4</td>
<td>65.36</td>
<td>0.2%</td>
<td>2.67</td>
<td>2.42</td>
<td>0.15</td>
<td>0.13</td>
</tr>
<tr>
<td>6</td>
<td>729</td>
<td>1500</td>
<td>2</td>
<td>1016</td>
<td>1051</td>
<td>61.1</td>
<td>56.79</td>
<td>1.5%</td>
<td>15.24</td>
<td>15.76</td>
<td>0.92</td>
<td>0.85</td>
</tr>
<tr>
<td>5</td>
<td>651</td>
<td>1500</td>
<td>2</td>
<td>858</td>
<td>844</td>
<td>48.0</td>
<td>49.29</td>
<td>3.6%</td>
<td>30.89</td>
<td>30.40</td>
<td>1.73</td>
<td>1.77</td>
</tr>
<tr>
<td>4</td>
<td>568</td>
<td>1800</td>
<td>1</td>
<td>641</td>
<td>658</td>
<td>36.0</td>
<td>34.64</td>
<td>3.6%</td>
<td>23.08</td>
<td>23.68</td>
<td>1.30</td>
<td>1.25</td>
</tr>
<tr>
<td>3</td>
<td>490</td>
<td>1500</td>
<td>1</td>
<td>415</td>
<td>430</td>
<td>24.0</td>
<td>23.57</td>
<td>5.8%</td>
<td>24.07</td>
<td>24.93</td>
<td>1.39</td>
<td>1.37</td>
</tr>
<tr>
<td>2</td>
<td>370</td>
<td>1500</td>
<td>1</td>
<td>221</td>
<td>234</td>
<td>13.7</td>
<td>12.50</td>
<td>12.3%</td>
<td>27.18</td>
<td>28.76</td>
<td>1.69</td>
<td>1.54</td>
</tr>
<tr>
<td>1</td>
<td>300</td>
<td>1300</td>
<td>1</td>
<td>62</td>
<td>123</td>
<td>5.6</td>
<td>6.79</td>
<td>12.4%</td>
<td>7.69</td>
<td>15.28</td>
<td>0.70</td>
<td>0.84</td>
</tr>
<tr>
<td>Idle</td>
<td>300</td>
<td>900</td>
<td>1</td>
<td>10</td>
<td>44</td>
<td>3.2</td>
<td>2.86</td>
<td>59.8%</td>
<td>5.98</td>
<td>26.31</td>
<td>1.93</td>
<td>1.71</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>148.93</strong></td>
<td><strong>178.55</strong></td>
<td></td>
<td><strong>10.53</strong></td>
<td><strong>10.01</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Weighted BSFC:**

- 12 645E: 0.0707
- NREC SW: 0.0561
- % Diff: 20.7%
USA EPA EMISSIONS LIMITS FOR LOCOMOTIVES VS. NREC LOW EMISSIONS SWITCHER COMPARISON CHART

<table>
<thead>
<tr>
<th>EMISSIONS (G/BHP-H)</th>
<th>TIER II RAIL SWITCHER</th>
<th>LINE HAUL</th>
<th>NREC SWITCHER SWITCHER</th>
<th>% LOWER</th>
<th>LINE HAUL</th>
<th>% LOWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>8.1</td>
<td>5.5</td>
<td>3.37</td>
<td>58%</td>
<td>2.88</td>
<td>48%</td>
</tr>
<tr>
<td>HC</td>
<td>0.6</td>
<td>0.3</td>
<td>0.04</td>
<td>94%</td>
<td>0.02</td>
<td>93%</td>
</tr>
<tr>
<td>CO</td>
<td>2.4</td>
<td>1.5</td>
<td>1.51</td>
<td>37%</td>
<td>0.93</td>
<td>38%</td>
</tr>
<tr>
<td>PM</td>
<td>0.24</td>
<td>0.2</td>
<td>0.05</td>
<td>80%</td>
<td>0.02</td>
<td>89%</td>
</tr>
</tbody>
</table>

![USA EPA RAIL TIER II SWITCHER](image)
USA EPA RAIL TIER II SWITCHER

![USA EPA RAIL TIER II LINE HAUL](image)
USA EPA RAIL TIER II LINE HAUL

![NREC SWITCHER - SWITCHER](image)
NREC SWITCHER - SWITCHER

![NREC SWITCHER - LINE HAUL](image)
NREC SWITCHER - LINE HAUL
TRACTIVE EFFORT VS SPEED

Dispatch TE 77,400 LBS.
Continuous TE 52,123

62:15 Gear Ratio
40 inch Wheels
1385 BHP - 129 Tons
D77 Traction Motors

Actual THP May Vary
Entire Curve May Not Be Available At All Times Due To Limitations of Wheel/Rail Adhesion

Dispatch TE is based on 30% adhesion
Cummins QSK19 Tier III

Engine Type = In-Line, 4-Cycle, 6-Cyl
Displacement = 1159 cu. In. 19 Liters
Rated Power = 510-700 BHP 379-522 kW
Aspiration = Turbocharged

Air-to-Air Charge Air Cooled

- The Engine is designed and certified as EPA Tier III Off-Road compliant
- Full Authority Electronic Controls
- Cummins Modular Common-Rail Fuel System
- Over 6500 QSK19 Engines in Industrial Applications
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

2006 Model Year Certificate of Conformity

Manufacturer: National Railway Equipment Company
Certificate Number: NRE-LOC-06-01
Effective Date: DEC 16 2005
Date Issued: DEC 16 2005

Merylin Zaw-Mon, Director
Compliance and Innovative Strategies Division
Office of Transportation and Air Quality

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR 92, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engine which has been found to conform to applicable requirements and which represents the following locomotive engines, by engine family, more fully described in the documentation required by 40 CFR 92 and produced in the stated model year.

Locomotive Engine Family (New engine): 6NREGCM19LOC

This certificate of conformity covers only those new locomotive engines which conform in all material respects to the design specifications that applied to those engines described in the Application for Certification required by 40 CFR 92 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR 92.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 92.215(d)(1) and 92.504 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR 92. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void ab initio for other reasons specified in 40 CFR 92.
The GenSet in Process
Work in Process
GENSET INSTALLED
Electronic Propulsion control

- NRE Electronics provides the Electronic Control module called the N-FORCE. This equipment provides all propulsion, accessory equipment, and low voltage control. The N-FORCE is equipped with an Operator Interface Panel (Display) for monitoring of real time events, storing fault and run time data, and performing self tests.

- A high voltage DC Chopper provides propulsion power to each traction motor separately for enhanced adhesion control
Electric Cabinet in Process
Microprocessor

NRE Electronics “N-FORCE”
DC Chopper Compartment

Chopper Cooling Air Exhaust
Cab Console in Process
Cab Console Completed
Accessory Equipment

- Equipped with a variable speed 3 phase 240-480 VAC electric motor driven Atlas-Copco model rotary screw air compressor.

- The Equipment blower provides 15,000 cfm cooling air for the traction motors, DC Choppers, DC Rectifier, Low Voltage Power Supply and Electric Cabinet Pressurization.

- The Low Voltage Power Supply Converts 240-480 VAC to 64-74 VDC for battery charging and low voltage control.

- A DC to AC inverter is provided to convert 64-74 VDC to 115 VAC for RV type heating, ventilation and air conditioning (HVAC) power as well as 24 VDC for Low Voltage GenSet Control.

- Equipped with standard 26L air brake.

- NYAB electronic air brake is optional.
Air Compressor and Equipment Blower
RV Type HVAC
OUT WITH THE OLD AND IN WITH THE NEW