

# *N-ViroMotive*

## *NREC Ultra Low Emitting Locomotives*

### **NREC ULEL GenSet Advantages**

- 1. Proven Product** – Over a six year period of market analysis, engineering design, development and testing, NREC's N-ViroMotive product has garnered critical Class I, Short line, Industrial and Transit acceptance as a high adhesion, low fuel consumption, ultra low emitting locomotive (ULEL). The product services the North American and International four axle and six axle locomotive markets requiring a continuous application duty range of 700 to 2,800 horsepower. The initial prototype unit, UPY 2005, has been operational for more than two years with 210 production units either shipped or now in process for the BNSF Railway, the Canadian Pacific Railroad, the CSX, the Norfolk Southern Corporation, the Union Pacific Railroad, Rail America, Fort Worth & Western, Pacific Harbor Lines, the U.S. Army, Metropolitan Stevedore, MBTA, SEPTA, Bunge North America, Viterra and other shortline railroads and industrial accounts in the United States, Canada, South America and Australia. The product is being considered by several international railroad accounts due to its favorable economic impact on fuel savings and tractive effort capability. Orders have been placed and production is complete for three 2,100 horsepower six axle N-ViroMotive locomotives applied to hump switching yard service and lower speed branch line haul applications. A specialized project in California is presently under consideration for 2,800 horsepower six axle N-ViroMotive locomotives to be utilized for merchandise train movements from the sea ports through mountain passes to strategic main switching yards in south central California.
- 2. Modular Design-** The N-ViroMotive ULEL design facilitates minimal production assembly time and maximum maintenance efficiency. Top deck production assembly ranges from 500-600 hours while skid mounted GenSet removal and reinstallation times are typically less than 6 hours compared to traditional four axle single engine change outs with validation periods of 160-220 hours. The *modular* concept helps to achieve this goal with all 10 top deck modular assemblies, both mechanical and electrical.
- 3. EPA Certified and CARB Recognized-**The N-ViroMotive locomotives are EPA certified to switching and line haul duty cycles at 3.0 gpbhp/hour of NOx. Particulate matter (PM) ratings are at .06 and .05 gpbhp/hour. Diesel particulate filters are now available as an option on each GenSet to further reduce PM emissions to .01 gpbhp/hour which is under the .03 gpbhp/hour

proposed Tier 4 locomotive emission standards for 2015 or later. The units meet and improve upon all current EPA emission standards for locomotives under Tier 2 and the proposed Tier 3 emissions standards to be effected in 2012. In addition, these locomotives are recognized by the Air Resources Board of California (CARB) as Ultra Low Emitting Locomotives (ULEL). Due to the design's inherently low levels of nitrous oxides (NOx) and particulate matter (PM) emissions, the N-ViroMotive is well established within the railway industry as a rugged, reliable and environmentally friendly four axle and six axle locomotive product. It is a high profile and preferred product for local, state and federal grant funding geared to the economics of cost per ton of NOx and PM reduced compared to conventional single engine locomotive products.

- 4. Fuel Reductions and Savings-** End users can expect fuel savings of forty to sixty five percent (dependent on the specific locomotive application duty cycle) and at least an eighty percent reduction in emissions of nitrous oxide compounds and particulate matter. Approximately 50%-65% of the total fuel savings generated are derived from advanced Cummins Engine technology and prime mover design efficiency improvements. Other fuel savings are generated by the electronically activated and controlled N-LIMIT system which monitors engine idling and, after a prespecified period of time, automatically shuts down the GenSet(s) to a sleep mode. In addition, these fuel savings are further enhanced by the power on demand feature of the N-FORCE electronic control system wherein single GenSets are activated individually based upon horsepower demand requirements.
- 5. Tractive Effort Enhancement-** The N-FORCE anti-wheel slip and traction control system has exceeded original engineering projections for adhesion percent capability in actual field tests conducted in Illinois and California. At least three Class I railroads are considering changing their future mix of N-ViroMotive orders from the three engine to the two engine design on the basis of this significant improvement in tractive effort adhesion efficiency. This will result in substantial savings in upfront capital acquisition costs while providing downstream savings in both fuel and maintenance expenses. The adhesion improvement is due in large part to NREC's use of individual traction motor controllers, a conventional electronic control design used by many European passenger locomotive builders. In upgraded switchers, which incorporate traditional anti-wheel slip systems, controllers respond to slippage by reducing power to the entire truck assembly where the wheel is slipping, cutting the unit's power in half. The traction controllers utilized in the N-ViroMotive affect only the motor that is slipping, preserving more of the power and providing 60% or higher increase in tractive effort adhesion efficiency.
- 6. Engine Durability & Horsepower Rating-** The Cummins QSK 19L engine is a heavy duty industrial engine designed for the rigors of off-road mining applications, power generation, railroad and other heavy duty applications. The design inherits the rich experience, technology and success of its

predecessor 16 and 17 liter Cummins QSK truck engine models but it is an *industrial application 19 liter engine*. This engine is rated at 700 continuous horsepower and is presently the only 19 liter industrial grade engine classified as EPA Tier III Off-Road emissions compliant. The Cummins QSK 19 engine has a rebuild life cycle of 30,000 hours versus rebuild life cycles of 10,000-12,000 hours for smaller sized 15-17 liter truck engines rated between 435 to 535 continuous horsepower. QSK 19L engine life is further extended by using an NREC developed engine load sharing system which evens out the wear and tear between each engine. This system tracks the hours that each GenSet has been operating, and assigns workload to the engine with the shortest amount of hours through microprocessor based electronic load sequencing.

- 7. Higher Unit Availability-** Traditional four axle and six axle locomotive power requires clearing out test cocks and adherence to other recommended procedures for restarting a typical four axle switcher or six axle road unit. This can be a 30 to 45 minute process. If the locomotive has been shutdown for 48 hours or more, this time period can expand to approximately 90 minutes with the prelubing of the engine. For this reason, traditional locomotives are usually left at idle for long periods of time to avoid wasting valuable man hours with restarting the engine. In contrast, the N-ViroMotive QSK 19L Cummins engines can be cranked up as quickly as a truck engine. Long idling periods are also avoided by using a bio-degradable glycol coolant in the radiator system that allows the unit to be shut down to temperatures as low as 10 degrees Fahrenheit.
- 8. Advanced Electronic Control Technology-** The N-ViroMotive is purposefully designed with state of the art electrical assemblies and components including the engine control system, the DC chopper control system, individual traction motor controls and engine idle limiting. This virtually eliminates premature product life cycle failures and ensures long term parts replacement availability compared to more traditional market products wherein electrical component obsolescence is becoming increasingly problematic.
- 9. Transferable Technology** - Investment in N-ViroMotive research and development has spawned new aftermarket electronic products designed to improve traditional locomotive economics. The N-LIMIT idle limiting device can reduce switcher locomotive fuel consumption by as much as 25% (dependent on the application duty cycle) while the N-LIGHT LED product increases product life cycles from 6-12 months to 8-10 years, eliminates substantial maintenance labor hours and decreases road unit starting delays. The N-FORCE anti-wheel slip adhesion system provides for wheel adhesion efficiency improvements of up to 60%+ compared to conventional four axle and six axle units, thereby minimizing the requirement for purchasing incremental locomotive power.

- 10. Newly Manufactured Main Frame** – The N-ViroMotive product line incorporates newly built million pound force main frames designed for future regulatory compliance to FRA S-580 specifications to be effected January 1, 2009 for all newly manufactured locomotives.
- 11. New FRA S-5506 Fuel Tank**-This FRA compliant fuel tank is specifically designed and fabricated to eliminate diesel fuel leakage and spillage in the event of a locomotive derailment, wreck damage or rollover. The tank capacity is customized to meet varying locomotive switching and road haul requirements ranging from 400 gallons to 4,000 gallons in four axle and six axle applications.
- 12. Low Decibel Ratings**-The N-ViroMotive products are remarkably quiet compared to traditional locomotives ( 79 dba in the cab under throttle notch 8) and can easily achieve the most stringent regulatory noise level requirements for off-road capital equipment. It has been regularly documented wherein an individual has been in the cab with a single GenSet running and the operator has not been able to recognize that the engine is engaged and operating.
- 13. Battery Monitoring and Automatic Control** – The N-SURE START was designed and developed to eliminate deadened and drained batteries between locomotive shutdowns and start-ups due to improper operational shutdowns. How It Works: If the battery gets too low (below 55 volts which can be adjusted for conventional locomotives) the contactor responds by shutting down battery operations; disconnects all loads from battery (including optional GPS systems). This prevents battery failure/discharge and protects all electronics onboard N-ViroMotive units. To Reset: In the electrical locker there will be a reset push button. This turns the battery system back on (N-ViroMotives can be started with 24 volts) and will allow lights and air conditioning and all other battery system functions to operate properly. Once the reset button is pushed you can start the locomotive. NOTE: If the locomotive is not started within 5 minutes, the unit will go back into Battery Monitoring and Automatic Control mode and stop all battery operated functions to prevent battery failure and discharge.
- 14. Kicking Car Mode Software** – The N-ViroMotive four and six axle product line, from the 1GS-7B 700 horsepower model to the 3GS-28C 2800 horsepower model incorporates the kicking car mode software for quick locomotive response in switching and humping yard services.
- 15. LED Lighting System** – LED lights are standard equipment on the N-ViroMotive to ensure 8-10-12 year product life cycles versus the replacement of incandescent bulbs during a 4-12 month life cycle. This can virtually eliminate the need for train delays caused by premature incandescent bulb failures (FRA defects) and reduce inefficient utilization of labor.

- 16. Centrifuge Oil Separator and Filtration System** – The N-ViroMotive models can be optionally equipped with a centrifuge oil separator and filtration system (one per GenSet) to extend the oil service and maintenance intervals from 750 hours to a minimum of 1000 hours with each QSK19 NREC Gen Set.
- 17. N-Global System** – This is an EMU product option for the N-ViroMotive which has three enabling features: the first incorporates GPS tracking capability to monitor and pinpoint the exact physical location of the locomotive at any given time when activated; the second includes the capability for real time data download from a remote location site; the third incorporates the capability to upload software changes to the unit from a remote location site once the parameters of the locomotive have been secured; i.e., the unit is in a stationary location, in a non-mobile condition and is non-operational other than idle. This enables NREC Engineering and NREC Field Services to monitor the N-ViroMotive mechanical and electrical performance and to perform diagnostic analysis and troubleshooting and downloading data and uploading software for the locomotive in the field from internet sites throughout the world.
- 18. Vertical Integration**-NREC is uniquely positioned as a vertically integrated original equipment locomotive manufacturer. This minimizes the lead times for custom engineering requirements and facilitates quick and decisive turnaround for mechanical and electrical problem solving, including utilization of the internet for diagnostics analysis.
- 19. Company Stability** – Headquartered in Mt. Vernon, Illinois, NREC is a U.S. owned and operated business entity established in 1984. It is a leading locomotive designer, developer and manufacturer of the industry's first Ultra Low Emitting GenSet Locomotives. It has a strong balance sheet with a rich history of reinvestment in research, product development, facilities and equipment inventories for the locomotive markets worldwide. NREC has locomotive, diesel engine, electronic controls and related mechanical and electrical parts manufacturing facilities in fourteen locations throughout the United States and Canada.