Lawrence Livermore National Lab, Navistar work to increase semi-truck fuel efficiency

February 16 2010

In a few years, semi-trucks on U.S. highways could save the nation more than $10 billion annually in diesel fuel costs.

In support of the Department of Energy's mission to reduce the United States' dependency on fossil fuels, Lawrence Livermore National Laboratory (LLNL) has teamed with Navistar Inc., NASA's Ames Research Center, the U.S. Air Force and industry to develop and test devices for reducing the aerodynamic drag of semi-trucks. The devices could increase fuel efficiency by as much as 12 percent and could prevent 36 million tons of carbon dioxide from being released into the atmosphere annually, roughly the same amount of CO_2 that is emitted from four 1-gigawatt power plants every year.

"This is a significant step toward reducing the United States' dependency on fossil fuels," LLNL Director George Miller said. "This collaborative effort is a testament to the value of the science and technology developed at the National Nuclear Security Administration's labs for use in industry."

Aerodynamic drag is caused from pressure differences around the vehicle. At highway speeds, a semi-truck uses more than 50 percent of the energy produced by the vehicle engine to overcome aerodynamic drag, while rolling resistance consumes roughly 30 percent of the usable energy.

Along with 30 years of prior semi-truck aerodynamic research and

development conducted worldwide, LLNL computer simulations - using some of the Laboratory's largest computer platforms and most advanced computational fluid dynamics codes - have identified critical drag producing regions around semi-trucks, such as the trailer base, underbody and the gap between the tractor and trailer.

LLNL scientists estimate that with aerodynamic devices placed in these regions, the trucking industry could see as much as a 12 percent increase in the fuel efficiency rate, which annually saves 3.4 billion gallons of diesel fuel, equaling approximately $10.2 billion in diesel fuel savings per year.

"This is a technology that could easily be installed on the tractor trailer trucks that are out on the highway today," said Kambiz Salari, LLNL's lead scientist on the project. "And 12 percent is just the beginning. We expect to increase that savings even more during the current series of wind tunnel tests. It's time to market is incredibly quick. In just three years, we could see these devices on the road and realize the real fuel savings."

LLNL is conducting a full-scale test in the world's largest wind tunnel at the National Full-Scale Aerodynamics Complex (NFAC), which operates under the direction of the Arnold Engineering Development Center, located at Ames. The goal is to identify drag reduction devices, both commercially available and still under development that show the potential for improving fuel efficiency. The wind tunnel's size, 80 feet by 120 feet, makes it ideal for testing a full-scale semi with a 53-foot trailer.

"We are delighted to host this important test that could help our nation save billions of dollars in fuel costs each year," said S. Pete Worden, director of NASA Ames Research Center. "This is an excellent example of what can be accomplished through our collaboration with other

federal laboratories and industry."

The commercially available devices to be tested are manufactured by Aerofficient, Aeroindustries, AT Dynamics, Freightwing, Ladyon and Windyne. Prototype devices currently under development will be provided by LLNL and Navistar, which are collaborating to get proven drag reduction devices on the road. Device performance will be evaluated under different tractor-trailer combinations.

"This testing highlights a special opportunity for an Air Force-run facility to participate in research in areas beyond the Department of Defense and work to improve everyday issues such as fuel economy on national roadways," said Christopher Hartley, test engineer for Jacobs Engineering Group Inc., who is based at NFAC.

Livermore's project is funded by the Department of Energy's Energy Efficiency & Renewable Energy's Program's Freedom CAR (Cooperative Automotive Research) and fuel partnership. This project started in the mid-1990s by the late Sid Diamond of the Department of Energy, who believed that significant fuel savings could be realized through improved semi-truck aerodynamics.

Semi-trucks make up about 12 percent of the United States petroleum consumption (21 million barrels/day). The average fuel mileage of a semi-truck is six miles per gallon. But just a 1 percent increase in fuel economy in tractor-trailers translates into 285 million gallons of diesel fuel saved and $855 million in diesel fuel costs annually. Just those figures alone are impressive to the trucking industry.

The drag reduction devices, which could ultimately increase the fuel efficiency rate to more than 12 percent, are something the trucking industry is excited about. "Making our trucks more fuel efficient means we not only travel further using less fuel, but it means we can get our

goods to the general public in a more timely, and ultimately, less expensive way," said Ron Schoon, chief engineer of aerodynamics at Navistar Inc.

LLNL is collaborating with Navistar to push the state-of-the-art in semi-truck aerodynamics and design the next generation of highly aerodynamic, integrated, energy efficient semi-trucks. Navistar International Corp. (formerly International Harvester Company) produces International® brand commercial trucks, mid-range diesel engines, and other vehicle products.

Provided by Lawrence Livermore National Laboratory