CoolCab Truck Testing
Project Update

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CoolCab Project

• The Problem
  – Trucks consume 2.5 million barrels of oil per day
  – Idling consumes 838 million gallons of fuel per year
  – Future emissions requirements
    • lower fuel economy
    • increase underhood temps.

Redesigning the Heavy Truck is an opportunity to reduce oil importation
CoolCab Project

• The Challenge
  – Cab climate control requires idling to provide comfort
  – Varying thermal conditions inhibit use of idle reduction technologies
CoolCab Project

The Solution
- Design efficient thermal management systems
  - Keep the cab comfortable
  - Eliminate excessive idling
CoolCab – Advanced Technologies

- Exhaust Heat Recovery
- Insulation
- IR Reflective Materials
- Advanced Seating – Low Mass
- Advanced Glazings or Shades
- Efficient HVAC Equipment
- Comfort Based Air Distribution

NREL National Renewable Energy Laboratory
Infrared Image Test – Schneider National

- Investigate potential for improving cab efficiency
- Qualitative comparison
  - Identify high heat loss areas
  - Note areas with greatest potential for improvement
CoolCab Testing with Volvo

- Volvo Truck at NREL for testing
  - 77” sleeper cab
  - On-board idle reduction technologies
    - Bergstrom battery electric AC
    - Airtronic diesel-fired heater

- Objectives
  - Quantify truck cabin heat transfer
  - Identify potential areas for improvement
Testing Approach

- Co-heat tests to determine UA
  - Measure effect of sleeper curtain and window shades
  - Insulate windows to quantify loss
- Measure air exchange rate
- Solar soak tests to determine solar effects
  - Soak with windows insulated
- Infrared imaging to examine high heat loss areas
  - Hot spots
Volvo Test Results

• Heat transfer
  – UA = overall heat transfer coefficient = 65 W/K
  – 15% reduction (improvement) with sleeper curtain closed
  – 20% reduction with windows covered

• Solar heat soak
  – $\Delta T = $ temperature rise above ambient = 15°C
  – $\Delta T = $ 5°C with windows covered

• Air leakage rate
  – ~1 air change per hour
CoolCab Testing with International

- **International Truck at NREL**
  - ProStar sleeper cab tractor
  - Electric HVAC system with battery APU
- **Objectives**
  - Quantify truck cabin heat transfer
  - Predict HVAC system load requirements
- **Began spring 2007**
International Test Results

• Heat transfer
  – UA = overall heat transfer coefficient = 50 W/K
  – 20% reduction (improvement) with sleeper curtain closed
  – 25% reduction with arctic curtain
  – 13% reduction with windows covered

• Solar heat soak
  – $\Delta T = \text{temperature rise above ambient} = 11^\circ\text{C}$
  – $\Delta T = 7^\circ\text{C}$ with windows covered

• Air leakage rate
  – $\sim0.5 \text{ air change per hour}$
Thermal Modeling

- Previously developed model for International
  - Fluent CFD
  - Radtherm
- Validate with test data
  - Solar soak air temperatures predicted within 3°C
  - Apply multiple configurations
- Simulation runs
  - Baseline A/C case
  - Increased cab insulation
  - Solar reflective glass
Next Steps – FY08

• Begin development of HVAC load calculation tool
• Generic truck cab geometry
• Input key parameters
  – Climatic conditions
  – Vehicle geometry
  – Material properties
• Estimate potential load reduction
• Work with industry to define requirements
  – Truck OEMs
  – Idle reduction technology manufacturers
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