Transport Canada's ecoTECHNOLOGY for Vehicles (eTV) Program

Task Force on Vehicle Weights and Dimensions Policy

November 20, 2013

Canada

PURPOSE

The objective of this presentation is to provide the Task Force on Vehicle Weights & Dimensions Policy with:

- an annual update on the eTV program's heavy-duty vehicle (HDV) technical investigations;
- an overview of potential future HDV technical work with weights & dimensions considerations.

Background

At the program's *April 13, 2012* Federal Interdepartmental Steering Committee meeting, members endorsed the program's Multi-Year Testing & Evaluation Work-Plan, which includes testing activities organized into seven high-level technology priorities:

1. **Electric Vehicles (EVs)**, including battery electric and plug-in hybrid vehicles;
2. **Renewable Fuel Technologies**, including biodiesel and various ethanol blends;
3. **Natural Gas Technologies**, including compressed natural gas (CNG) and liquefied natural gas (LNG);
4. **HDV Power-train**, Emissions and Aerodynamic Improvements;
5. **Hydrogen & Fuel Cell Technologies**;
6. **Light-duty Vehicle (LDV) Power-train**, Emissions and Aerodynamic Improvements; and
7. **Connected Vehicle Systems.**




eTV Multi-Year Testing & Evaluation: Projects Completed (2012-13)

In 2012-13, the eTV Program **completed seven (7) testing projects**, and produced/disseminated technical reports to support codes, standards and regulatory development for advanced vehicle technologies: [1]

1. HDV low rolling resistance tire performance in snow packed conditions	• Final report completed and disseminated (i.e. Canadian Rubber Manufacturers, US. Regulators (National Highway Traffic Safety Administration [NHTSA]//Environmental Protection Agency [EPA]), DM Task Force on Vehicle Weights & Dimension). Departmental news release issued in January 2013.
2. HDV single-wide tire performance in snow packed conditions	• Final report completed and disseminated to the eTV HDV technical working group. The report will be disseminated externally to the Canadian Rubber Manufacturers, US. Regulators (NHTSA/EPA) in Fall 2013.
3. Quiet Vehicles – Minimum Noise Phase I: Cars	• Seven (7) vehicles were tested in Fall 2012 and technical results were provided to support TC/NHTSA collaborative efforts under the Canada-U.S. Regulatory Cooperation Council on "*Quiet Vehicles*."
4. Operation of CNG refuse trucks in cold weather climates	• Final report produced, in collaboration with industry (vehicle manufacturers, Canadian Natural Gas Vehicle Alliance, and disseminated to CNG Technical Advisory Committee. Report will be published on gowithnaturalgas.com.
5. CNG vehicle storage in enclosed parking facilities	• Final report produced, and disseminated to technical authorities/regulators.
6. First responder training standards for EVs	• U.S. National Fire Protection Agency (NFPA) training standards reviewed by a working group of Canadian technical experts, police & fire chiefs and adapted to Canada. NFPA/Standards Council of Canada training program will be launched in Fall 2013.
7. Extended cold weather performance testing of EV batteries	• A 30-day "cold snap" vehicle battery test (between -20 °C to -25 °C) completed in Winter 2013. Final report has been distributed to the program's EV committee, and presented at EV2013 to inform vehicle modelling development efforts.

eTV Multi-Year Testing & Evaluation: Active Projects (2013-2014+)

The program currently has **17 testing & evaluation projects underway**, including the following: [2]

Electric Vehicle:

1. EV crashworthiness.
2. Quiet vehicles - minimum noise phase II: motorcycles.
3. Battery pack destruction and abuse testing.

Renewable Fuel:

4. Gasoline direct injection (GDI) engines.
5. Renewable diesel.

Heavy-duty power-train, aero, emissions:

6. HDV drag reduction technology.
7. Boat-tail wake, snow & ice shedding.
8. Camera-based indirect vision systems for HDVs.
9. Use of LiDAR to enhance reliability of HDV aerodynamic drag assessments.

Light-duty power-train, aero, emissions:

10. Light-duty truck mass reduction study.
11. Vehicle data modelling.
12. Low rolling resistance tires.
13. Alternative fuel cross-comparison.
14. Field operational trial of fuel consumption displays.
15. *Light-duty vehicle drag reduction technology. (proposed)*

Connected Vehicles:

16. Cooperative truck platooning systems: Phase I – technology scan.

Hydrogen & Fuel Cell:

17. *Hydrogen material embrittlement (proposed).*

Key HDV technical investigations of interest to the task force ...

[2] Fifteen active and two proposed projects.

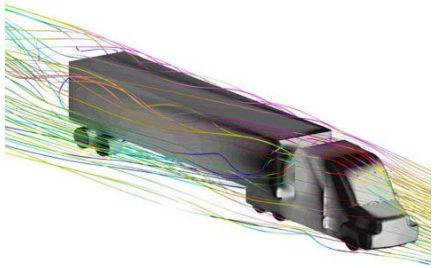
HEAVY-DUTY VEHICLE POWER-TRAIN, EMISSIONS SYSTEMS AND AERODYNAMIC IMPROVEMENTS

Project: **Drag reduction evaluation of HDV aerodynamic technologies**

Status: **Year (2) of (4) in progress**

- Project aims to significantly enhance the fidelity and quality of HDV aerodynamic drag assessments – to reduce key gaps in real world vs. laboratory performance, with a focus on Canadian conditions, vehicle weights & dimensions, etc.
- Year one of the project developed a Flow-Treatment-System to better simulate real-world turbulent wind conditions in a wind tunnel, in addition to a ground treatment system that simulates wheel movement/turbulence.
- In year two of the project, a scale model of a tractor-trailer will be developed in collaboration with a major OEM for various configurations (i.e., short and full-length trailer, day and long-haul tractor) and a list of drag reduction technologies to model/evaluate will be selected/finalized by the project's steering committee.
- Year three of the project will consist of extensive testing of different truck and drag reduction technology combinations. Results will be provided to vehicle regulators to help inform HDV greenhouse gas (GHG)/fuel consumption regulatory approaches.

HDV model equipped with boat-tail in wind-tunnel.



Computational fluid dynamics (CFD) model of HDV aerodynamics (Argonne Labs)

HEAVY-DUTY VEHICLE POWER-TRAIN, EMISSIONS SYSTEMS AND AERODYNAMIC IMPROVEMENTS

Project: **Snow and ice shedding from boat-tails**

Status: **Year (2) of (2) in progress** [4]

- This project is modelling the wake, snow and ice shedding from HDV boat-tails.
- In year one, preliminary CFD was conducted to evaluate dynamic wind loads experienced by a passenger vehicle trailing an HDV equipped with a boat-tail.
- Year two will attempt to assess the importance of this wind load by modelling driver/vehicle interaction, and to assess the materiality of snow/ice accumulation on boat-tails (vs. conventional trailer).

HDV model equipped with boat-tail

Project: **Camera-based indirect vision systems for HDVs**

Status: **Year (2) of (3) in progress**

- In year one, a successful prototype was developed and demonstrated. Estimated savings for system is roughly 1,817 L fuel per year based on reductions in aerodynamic drag (4.1 year payback based on cost estimate).
- In year two, track/driver testing will be conducted to assess system performance in a variety of controlled operating conditions at Transport Canada (TC)'s *Motor Vehicle Test Centre (MVTC)*.
- Track testing is currently underway at the MVTC.

Prototype camera-mirror system equipped on Class VIII Vehicle.

[4] There is an option for year (3) follow-up activities, dependant on year 2 findings.

HEAVY-DUTY VEHICLE POWER-TRAIN, EMISSIONS SYSTEMS AND AERODYNAMIC IMPROVEMENTS (cont.)

Project : **Use of LiDAR to enhance reliability of HDV vehicle aerodynamic drag assessments**

Status: **Year (2) of (4) in progress** [5]

- Project aims to significantly increase the ability to test & measure the drag performance of HDVs on test-tracks using LiDAR.
- Results could help support the development of alternative/new HDV coast-down test procedures for vehicle manufacturers.
- In year two of the project, one LiDAR prototype instrument will be designed and fabricated. Preliminary testing, optimization and validation of the instrument will take place in the wind tunnel.
- Year three will involve full-scale validation track/tunnel testing with a fully instrumented vehicle.

Vehicle equipped with 360 degree LiDAR system

TC Test Vehicle instrumented by National Research Council (NRC) to gather on-road turbulence measurements.

[5] Based on anticipated successful validation of the tool in FY2013-14 (gateway review), subsequent project years (FY 2015-15, 2015-16) will be approved.

CONNECTED VEHICLE TECHNOLOGIES

Project: **Review of HDV Cooperative Truck Platooning Systems (CTPS)**

Status: **Year (1) of (1) in progress**

- To better understand connected vehicle technology (cooperative platooning), including the potential operational and safety considerations, in addition to environmental and efficiency considerations, TC asked NRC to prepare a literature review of available data and existing projects.

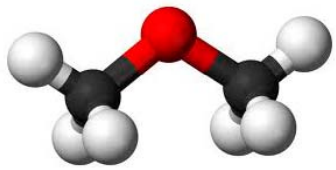
- The final report will be circulated to technical stakeholders in Winter 2014, and will identify potential testing approaches to evaluate the safety, environment, and efficiency performance of CTPS in Canada.

- **Key issues identified** in the report include (e.g.):
  - Unique Canadian weight & dimension restrictions;
  - Knowledge gaps in Canadian winter conditions;
  - Pros/Cons vs. Long Combination Vehicles;
  - Technical considerations, i.e. equipment, frequencies;
  - Interactions with existing traffic;
  - Aerodynamic performance.

European Cooperative HDV Platooning Pilot

POTENTIAL FUTURE HDV TECHNICAL INVESTIGATIONS

- Several emerging areas of technical work are currently under consideration, for example:
  - **Connected Vehicle Systems**, including cooperative truck platooning systems, i.e. CFD modelling, wind tunnel testing and/or track testing;
  - **Alternative Fuels,** including dimethyl ether (DME) Fuels, which are being developed by vehicle OEMs for use in HDV diesel engines.
  - **Advanced Tire Technologies**, i.e. looking at infrastructure impacts of next generation wide based single tires.
  - **Advanced propulsion technologies**, including new power-train/transmission technologies; emissions performance and weights & dimensions considerations for advanced technologies.
  - **Advanced technologies** that manufacturers will introduce to meet increasingly stringent HDV GHG emissions standards.



DME fuel can be made from fossil fuels (natural gas and coal) but also renewable materials, i.e.. Biomass waste.

Significant developments in connected vehicle technologies are anticipated to occur over the next 5-10 years.

CONTACT INFORMATION

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