Lower Fraser Valley Ports Landside Emission Inventory - *Data Management and Emissions Estimation*

EPA Emissions Inventory Conference
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Some Background……

- A Port Landside Emission Inventory: air contaminant emissions for port landside activity - Cargo Handling, Trucking and Rail sources.

- The Landside Inventory project began in January 2007.

- VFPA tenant data collection began in May of 2007
Available Estimation Tools

- US EPA MOBILE 6.2C Vehicle emissions model;
- US EPA NONROAD 2005 offroad/nonroad engine emissions model;
- Locomotive emissions research programs (EPA, SwRI);
- US EPA SPECIATE database for air toxics.
The Challenges......

ISSUES:

• Inventory Boundary?

• 90+ Terminals!

• Efficient Data Collection and Storage

• Emission Calculations (see next slide)

• COMMUNICATION
The Challenges.....Scenario Development

• Emission estimates from 1990 to 2030 in 5 year increments;
• Accounting for the effects of emission reduction initiatives that \textit{have} or \textit{will} happen;
• Accounting for use of alternative fuels and technology changes (e.g., hybrid equipment).
The Solution:
Use an ‘intelligent’ database system
Emission Calculations:
What are the appropriate methodologies?

• A **high degree of consistency** has been applied in terms of general approach for landside EIs in North America
• Estimates are to be ACTIVITY BASED
• Calculations – Use EPA emissions models (Nonroad, Mobile) and Rail emissions data by throttle notch (e.g., SwRI)
• Much ‘activity data’ needed!
  – *Types of equipment with engine size and model year*
  – *Hours of use per year*
  – *Annual fuel consumption*
Innovative Approach 1: Data Collection

- How do we collect activity data from 90+ terminals???
  - *Inventory Questionnaire Form (MS Excel based)*
Inventory Questionnaire (Excel)

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**LFV Ports Landside Activity and Emissions Inventory Questionnaire**

Please use the links below to describe all Cargo Handling, Trucking and Rail activity that occurs on your facility grounds. We have a designated person at SENES who will be happy to assist in answering any and all of your questions related to this questionnaire form:

*Jennifer Rossi: 604 685-1612 (ext. 202), jrossi@senes.ca*

It is expected that each facility will submit their questionnaire response through email. The electronic forms have additional information in comments that are viewed by passing your mouse over a cell, and by drop down lists that allow you to select a response from a list of appropriate responses. A printout of the questionnaire forms will not have these features visible.

*Attached to the email, is an introductory letter prepared by the Port of Vancouver. Please read this first.*

- **Activity by Month for 2005**
  This information will allow us to understand differences in air emissions by month of the year.
- **Cargo Handling - 2005**
  Types and ages of equipment used on facility grounds and hours of use in 2005.
- **Cargo Handling - Past/Future**
  Estimates of past equipment use and projections to future years.
- **Trucking**
  Highway trucking and company owned or leased trucking on facility grounds.
- **Rail**
  Locomotive hours of use on facility grounds.
# Inventory Questionnaire

## 2005 Off-road (cargo or material handling) equipment on facility grounds

Please choose type of equipment (left column) and engine/usage information that corresponds to that equipment. **GREEN** = required.

### Table CHE1: Equipment owned or operated on site including contractor equipment (2005)

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Equipment Model</th>
<th>Engine Model</th>
<th>Engine Model Year</th>
<th>Hours of Use</th>
<th>Typical Fuel Use (gallons per hour)</th>
<th>Fuel Type (on both engines)</th>
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<tbody>
<tr>
<td>Top or Side Pick Chassis or Reach Stackers</td>
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<td>Top or Side Pick Chassis or RTG Other Forklifts</td>
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<td>RTG Cranes</td>
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<td>Cranes (not RTG)</td>
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<td>Reach Stackers</td>
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<td>Rubber Tire Loaders</td>
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Questionnaire – Necessary Fields

- Activities and engine criteria to support use of MOBILE, NONROAD and locomotive (throttle notch) emission factors;
- Throughput, fuel (or other) data to appropriately indicate activity changes by year;
- Indication of fleet/equipment changes of the past and expected in the future.
What was the response from terminal managers??

Unfortunately, they were somewhat overwhelmed......

But site visits and many phone calls helped considerably.
Innovative Approach 2: Emission Estimation

Some Pre-planning:

- The calculations must be *automated* to directly use the activity data collected. This will facilitate terminal updates, quality checks, scenario testing etc.
- Use the power of a database effectively
  - Enforce data integrity and appropriate relationships
  - Improved transparency and repeatability
  - Ensure all summarizing and reporting is updated automatically with ongoing changes to terminal activities
- Perform internal quality checks as data are collected
- Generate informative summary letters for the terminal managers
Requirements for Emission Estimates:

- Trucking: Generate full suite of emission rates from Mobile 6.2C. ✓
- Rail: Generate full suite of emission rates from locomotive testing programs. ✓
- Cargo Handling: Generate full suite of emission rates from Nonroad? ✗
Challenge for Emission Estimates:

**Challenge:**
- Nonroad does not provide un-aggregated emission rates (g/hour) for specific pieces of equipment.

**Solution:**
- Adopt data tables from Nonroad and mimic estimation methodology, including deterioration rates.
- Add alternative fuels and technology groups.
- Add additional air contaminant species.
Linking to NONROAD Data

\[ DF = 1 + \left( A_{\text{coef}} \times \left( \frac{\text{HoursPerYear}_{\text{Loaded}} \times (\text{Age} + 1)}{\text{HoursLife}_{\text{Median}}} \right)^{B_{\text{coef}}} \right) \]

Where:

- \( \text{HoursPerYear}_{\text{Loaded}} = \text{HoursPerYear}_{\text{Activity}} \times \text{EquipmentLoadFactor} \)
- \( \text{Age} = \text{Year}_{\text{inventory}} - \text{Year}_{\text{engine}} \)
- \( A_{\text{coef}}, B_{\text{coef}} \) are from the deterioration lookup tables by pollutant and technology type

\[ EF_{\text{in-use}} = EF_{\text{base}} \times DF \]

Where:

- \( DF \) is Deterioration Factor
- \( EF \) is Emission Factor (g/hp - hr)

Sample Values for PM
- T1  Diesel Technology
  - \( A_{\text{coef}} = 0.473 \)
  - \( B_{\text{coef}} = 1.0 \)
An ‘Emissions Inventory Tool’ was developed for the Lower Fraser Valley terminals.

Enter facility specific information through survey sheets and calculate emissions for the three main landside activities.

Review the results.
Results presented to allow digging deeper into each type of activity with Pivot tables.

Review the results by individual source category or total for all emission groups.
Review Emission Results using a Pivot Table

Filter by year, business type, facility type, activity and fuel type

<table>
<thead>
<tr>
<th>Facility Identifying Codes</th>
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<tbody>
<tr>
<td>Emissions Totals</td>
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Benefits of a Database Tool

• Internal quality checks – model derived fuel consumption versus facility reported consumption;

• Auto reports for facility managers – how does fuel get used (fuel intensity, activity types (idle, work));

• Costs associated with activities: emission costs (tonne NO\textsubscript{x}) and derived $$ costs (fuel).
Some Positive Feedback

- Modelled fuel consumption versus fuel purchases – internal database quality checks
  - Allows us to double check assumed activity rates from terminal managers – quite useful for the managers to consider.
  - Breakdown of fuel use by equipment and mode of activity. (‘Our trucks use that much fuel just idling??’)


Thank-you!

Questions or comments:

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