

Newfoundland
and Labrador
Refinery
Corporation



SNC • LAVALIN



*Air Quality Impact
Assessment*

May 2007



PRESENTATION OVERVIEW

1. Emission Inventories
2. Sources Characterization
3. Dispersion Modelling
4. Air Quality Monitoring
5. Compliance Assessment
6. Emission Reduction Alternatives
7. Reporting



EMISSION DATA COLLECTION

Data collection tasks include:

- ◆ **Plant Data Review**

- **Capacity**

- 300,000 bbl/day

- **Main products**

- Gasoline

- Kerosene

- RBOB

- Diesel

- Sulphur

- Coke

- ◆ **Process Review and Sources characterisation**

- ◆ **Process Operational Data**

- ◆ **In situ measurements (e.g. equipment leaks, stack sampling, ambient air)**

- ◆ **Reasonable assumptions for data gaps**



EMISSION INVENTORIES (1)

- ◆ Estimation methods for all sources and pollutants emissions:
 - CPPI “Code of Practice for Developing a Refinery Emission Inventory”
 - Emission factors for AP- 42 and other sources
 - Tanks 4
 - Water 9
 - Other U.S. EPA models and correlations
 - Comparison with other Petroleum Refineries
 - Etc.



POLLUTANTS ASSESSED

- ◆ **Criteria Pollutants (i.e. NO_x, SO_x, CO, PM_{2.5} & PM₁₀)**
- ◆ **Toxic Substances (e.g. benzene)**
- ◆ **Volatile Organic Compounds (VOC)**
- ◆ **Odorous Compounds**
- ◆ **Greenhouse Gases (CO₂, CH₄, N₂O)**



SOURCES CHARACTERIZATION

- ◆ **Stacks & Vents (Point Sources)**
- ◆ **Equipment Leaks (Process Fugitive Emissions)**
- ◆ **Storage Tanks (Fixed or Floating Roofs)**
- ◆ **Loading Unloading Operations (Vessels)**
- ◆ **Wastewater Collection and Treatment**
- ◆ **Upsets and Accidental Releases**
- ◆ **Others (cooling towers, etc.)**



EQUIPMENT LEAKS ASSUMPTIONS

- ◆ **Pumps Count:**
- ◆ **Compressors Count:**
- ◆ **Emissions equations for volatile organic compounds conform of 90-6 Law (MUC), Appendix F:**
 - Valves: $E = 2.29 * 10^{-6} * C^{0.746}$
 - Flange: $E = 4.61 * 10^{-6} * C^{0.703}$
 - Mixer, pump and compressor: $E = 5.03 * 10^{-5} * C^{0.610}$
- ◆ **Where: 98% for C = 1,000 ppm, 1% for C = 10,000 ppm and 1% for C = 15,000 ppm**



VESSEL OPERATIONS ASSUMPTIONS

- ◆ **Vessels cruise from Placentia Bay inlet to the site**
- ◆ **Berthing maneuvers**
- ◆ **Loading and unloading operations**
- ◆ **Reberthing maneuvers**
- ◆ **Vessel cruise to quit Placentia Bay**



DISPERSION MODELLING

◆ Maps: Land use and Topography

- Natural Resources Canada topographical maps
 - Water
 - Wooded areas
 - Barren-scrub lands
 - wetlands

◆ Normal operations

- CALPUFF

◆ Accidental releases

- PHAST
- CALPUFF

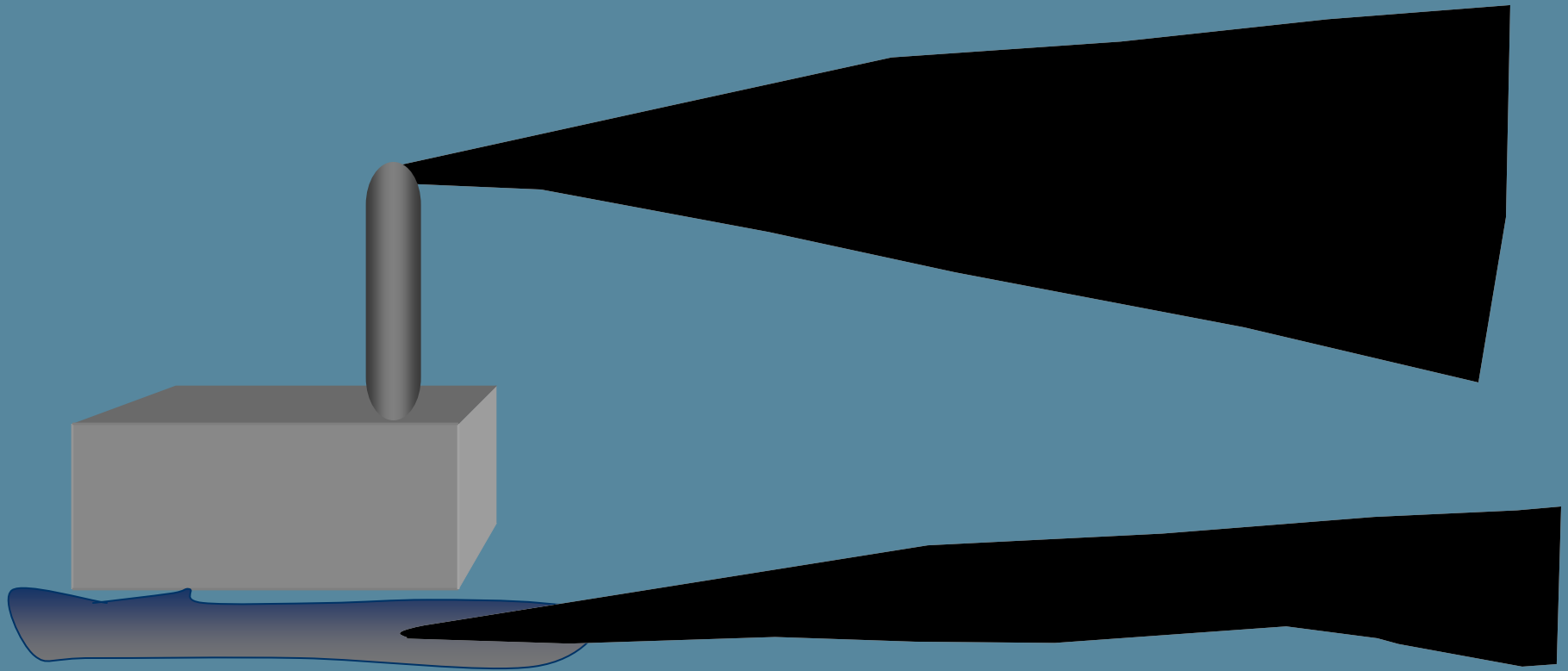


AIR DISPERSION MODEL - CALPUFF

- ◆ The NL Department of Environment & Conservation has designated the CALPUFF air dispersion model suitable for all regulatory applications. *(Guide for Plume dispersion Modelling, Nov. 2006)*
- ◆ CALPUFF is the most advanced of regulatory air dispersion model and uses 3D meteorological fields.
- ◆ CALPUFF is the preferred model of Regulating Agencies for complex terrain and coastal environments.



POINT SOURCE VS FUGITIVE EMISSIONS ATMOSPHERIC DISPERSION



AIR DISPERSION MODELLING

◆ Inputs

- Emissions: stack location, height, temperature, flow, contaminant emission rates
- Local hourly meteorology: winds, temperature, mixing heights, stability
- Local topography and land use (water, forest, barren land, urban areas, etc.)
- Modelling domain (area covered by the model): 25 x 25 km domain, 500 m resolution grid of receptors (Cartesian, Polar grid + sensitive receivers)

◆ Results

- Concentration of contaminants in ambient air over the whole modelling domain (hourly and daily maximums, long term averages)
- Sources ranking and mitigation measures evaluation



DISPERSION MODELLING

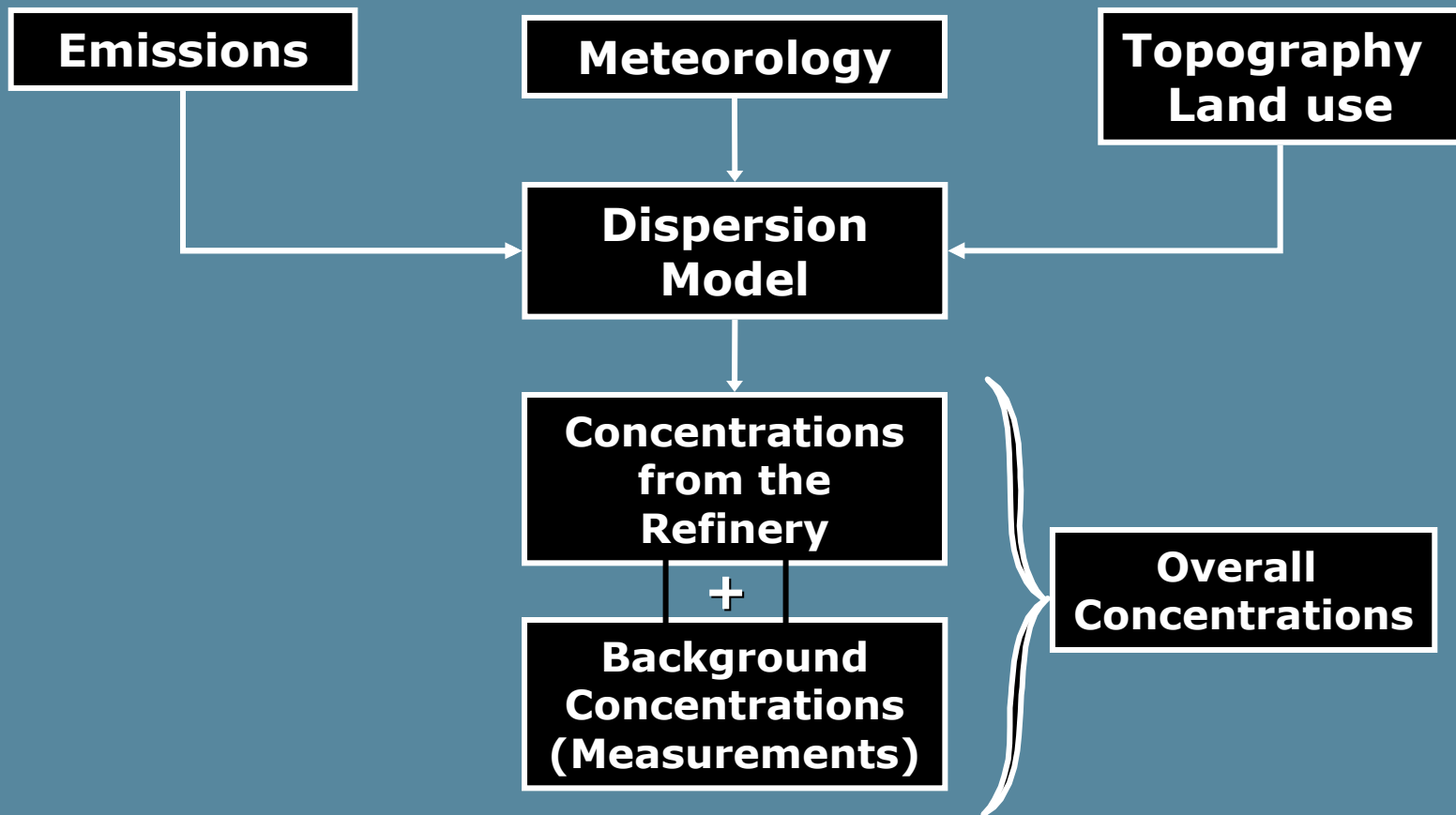
◆ Dispersion

- **Meteorological Data: Based on available data at NARL Refinery, year 2002**

Type of station	Station name	Station localisation	Parameters	Frequency
Surface	NARL Refinery	Near site	Wind, air temperature, pressure	Hourly
Surface	St-John's (Env.Canada)	Off site	Wind, air temperature, pressure, cloud cover, humidity ceiling	Hourly
Over Water	Nickerson Bank Buoy (Env.Canada)	Off site	Wind, air and water temperature	Hourly
Upper air	St-John's (Env.Canada)	Off site	Wind, air temperature, humidity, pressure, height	Twice daily



AIR DISPERSION MODELLING



Results are compared with air quality criteria and standards



AMBIENT BACKGROUND CONCENTRATIONS

1/19/07

ug/m3

Pollutants	Time Frame	Ambient Standard	Arnold's Cove	Come by Chance	North Harbour	Southern Harbour	Sunnyside
SO ₂	1-hour	900	348	279	200	175	235
	3-hours	600	220	169	125	125	149
	24-hours	300	79	74	20	30	70
	Annual	60	2	5	1	1	6
NO _x	1-hour	400	100	75	60	30	45
	24-hours	200	12	10	6	5	10
	Annual	100	1	1	1	1	1
PM _{2.5}	24-hours	25	10	10	9	8	11

Provided by the Department of Environment & Conservation, St. John's, NL



AIR QUALITY IMPACT ASSESSMENT

Newfoundland and Labrador Draft Guidelines for Environmental Impact Statement:

- ◆ Emissions inventory of all Significant sources
- ◆ Ambient air quality baseline
- ◆ Methodology (study area, inputs, outputs)
- ◆ Atmospheric Dispersion Study for Construction and Operation
- ◆ Evaluation of Potential effects on land, sea products harvested, picked, hunted or otherwise collected for human consumption
- ◆ Cumulative Environmental Effects: Other projects or activities to be considered:
 - North Atlantic Refining
 - NTL Transshipment Facility
 - Proposed Future Developments
- ◆ Mitigation Measures: BATEA and BMP's
- ◆ Environmental Monitoring and Follow-up Programs

AIR QUALITY IMPACT ASSESSMENT

Results from Air Dispersion Modeling are compared to air quality criteria:

- ◆ Newfoundland and Labrador Air Quality Standards
- ◆ Canada-wide Air Quality Standards
- ◆ Other agencies (Ex.: World Health Organisation)
- ◆ Federal Regulatory Framework (May 2006) for GHG and Criteria Air Pollutants



NEWFOUNDLAND AND LABRADOR REGULATION

Ambient Air Quality Standards at Reference Conditions

No	Name of contaminant	Unit of concentration	Concentration	Period of time
1	CO	mg/m ³	35 000	1 hour
			15 000	8 hours
2	NO ₂	mg/m ³	400	1 hour
			200	24 hours
			100	1 year
3	PM _{2,5}	mg/m ³	25	24 hours
4	PM ₁₀	mg/m ³	50	24 hours
5	SO ₂	mg/m ³	900	1 hour
			600	3 hours
			300	24 hours
			60	1 year
6	Dioxins and furans	pg/m ³	5	24 hours
7	Benzene	mg/m ³	10 ¹⁾	1 year / 24 hours
8	1,3-Butadiene	mg/m ³	1,9 ²⁾	24 hours
			2,4 ³⁾	1 year

1) Ministry of the Environment of Quebec Guideline

2) Arizona Department of Environmental Quality Guideline

3) New Zealand Guideline



AIR QUALITY MONITORING

◆ Monitoring Network

- Existing
- New stations
- Results available through internet

◆ Proximity to Sensitive Receivers to establish baseline values

◆ Air dispersion modeling results validation

◆ Validation of Anticipated Impacts

◆ Environmental follow up



AIR QUALITY MONITORING

◆ EXISTING REFINERY

- **NARL monitoring network**
 - Sunnyside
 - Come by Chance
 - Etc.

◆ NEW REFINERY

- **Property limits**
- **Surrounding populated areas without monitoring stations**
 - Goobies
 - North Harbour



COMPLIANCE ASSESSMENT

- ◆ **Standards and Regulations Review for Compliance**
- ◆ **Cumulative Effect of Projects in the Pipeline**
- ◆ **Construction vs. Operational Phase of the Project**
- ◆ **Recommendations on Mitigation Measures**



EMISSIONS REDUCTION (1)

Pollution prevention

Vents:

- ◆ Catalytic and thermal oxidizers
- ◆ Gas treatment and recovery processes (absorption, fractionation, etc.)

Equipment leaks:

- ◆ Specify low- emissions equipment
- ◆ LDAR program



EMISSIONS REDUCTION

Storage tanks:

- ◆ Pressure-vacuum vent
- ◆ Vapour balancing system
- ◆ Floating roof (internal and external)
- ◆ Vapour control system (recovery or destruction)

Wastewater sources:

- ◆ Conservation vent on sewer system
- ◆ Sealed covers on sewer drains and hubs
- ◆ Floating roof on API separators
- ◆ Closed vent system on fixed-roof units



EMISSION REDUCTION (3)

Loading operations:

- ◆ Vapour balancing system
- ◆ Vapour destruction units
- ◆ Vapour recovery unit (e.g. carbon filters)



REPORTING

- ◆ **Adapted to local guidelines and regulations**
- ◆ **Uncertainty evaluation**
- ◆ **Quality assurance and quality control**
- ◆ **Documentation & references**



