



Summary of comments on Aurora Application

March 9th, 2017 Luanne Roth

There can be no meaningful public input into an Environmental Assessment without full and frank disclosure of all material facts and assumptions. In this specific case, it is central to doing an analysis of the environmental risk posed by this proposed (Aurora) project to know what was assumed in the Aurora Application (regarding Aurora MEIT version used and assumptions) in order to review and comment on emission and concentration estimates. In this case, there has not been sufficient disclosure to allow a valid public input process.

See attached -Angela McCue

There are numerous concerns with the Aurora Application. Given the time constraints, we, T. Buck Suzuki Environmental Foundation (TBSEF), Prince Rupert Environmental Society (PRES) and United Fishermen and Allied Workers Union- UNIFOR (UFAWU) are focusing on the calculation of the CEA case concentrations of Criteria Air Contaminants (CACs).

Our three issues are:

1. Use of 10% (vs 30%) in-stack NO₂/NOx ratio underestimating NO₂ (CAC)
2. MEIT assumptions- do they correctly predict CACs from existing marine sources
3. Miscellaneous factors which underestimate CAC concentrations- including: flares, O₃, geographic divisions, etc.

All these issues are important for human health;

If addressed these issues could significantly increase the forecast concentrations of CACs in residential areas. A priority concern relates to human health impacts from these dangerous air contaminants.

1) 10% In-stack ratio used in Aurora Application should be corrected to 30% --For those living near the proposed LNG plant this would increase their calculated NO₂ exposure **significantly.**

We have found a serious error in the calculation of NO₂ (CAC) concentrations from three of the proposed LNG projects' main turbines; the NOx emissions from these, contribute half the NOx in the CEA case. This means cumulative effects have been seriously underestimated in the Application. The

portion of this NOx which converts to NO2 is crucial because NO2 is a health concern. The Aurora Application should have used an in-stack conversion ratio of 30% NO2/NOx whereas they only used 10% for these turbines.

NO2 concentration forecasts are calculated from NOx using an in-stack ratio as part of the calculation. The amount of NO2 coming out of the stacks is especially important for nearby residents like Dodge Cove and possibly west Prince Rupert because a portion of stack *emissions* will become concentrations over these nearby residential areas.. The EPA recommends a default in-stack ratio of 50%, unless there is evidence to support a lower ratio. See Attached L Roth "Aurora underestimated NO2 concentrations"

The Aurora Application materially underestimated NO2 concentrations as a result of incorrectly using 10%. The Prince Rupert Airshed Study, for these same projects, used 30% for conversion calculations from NOx. We are not aware of any authority to suggest that any lower value could be justifiable in the relevant area and the Proponent has not in its Application, provided justification. Aurora's use of this unsubstantiated 10% conversion calculation seriously underestimates CAC concentrations.

"I have briefly reviewed the NOx modeling carried out by Stantec on behalf of the Aurora LNG applicant. Stantec used the Ozone Limiting Method (OLM), as published, to estimate the concentration of ambient NO2 from modeled NOx concentrations. It is recommended that they adjust the OLM parameters to correspond to the higher ratio of NO2:NOx that actually occurs in modern low-NOX emission gas turbines. For those living near the proposed LNG plant this would increase their calculated NO2 exposure significantly."

The default OLM uses an in-stack ration (ISR) for NO2:NOx of 10%, which it assumes is reasonable for most sources. However, it is now known that modern stationary gas-turbines experience an ISR of approximately 30%, and not the 10% value assumed in the published OLM. If it is possible to modify the OLM used in the CALPUFF model, then the change to 30% for the ISR would significantly improve the accuracy of the modeled ambient NO2 concentrations. The increase in calculated NO2 concentrations, for those living near to the LNG plant, would be in the order of 20%." - see attached Gordon Esplin, M.Sc., P.Eng. Genesis Engineering Inc. "Aurora LNG NOx Modeling"

It is essential that the calculation of concentrations of CACs over residential and other areas be redone and submitted to the public for review so that Human Health risk can be assessed based on accurate and justifiable concentration forecasts.

-see attached Gordon Esplin, M.Sc., P.Eng. Genesis Engineering Inc. "Aurora LNG NOx Modeling"
-see attached L Roth "Aurora underestimated NO2 concentrations"

2) Aurora MEIT Assumptions

Do they correctly predict CACs from existing marine sources?

We know that changes in PRAS MEIT Assumptions had a dramatic effect on forecast concentrations over residential areas. The accuracy of the Aurora forecast can therefore not be assessed by the public without transparency and full disclosure of the Aurora MEIT assumptions

There are at least five different names used to refer to sources for estimating marine emissions in the Aurora Application: MEIT Lavalin 2012b MEIT 4.1, Draft PRPA Lavalin 2012a MEIT, EC Lavalin 2012b MEIT, PRPA Lavalin Draft PRPA 2012b MEIT, SNC Lavalin. 2012b. It is impossible to tell what version of MEIT was used and what assumptions were contained in it.

An example which demonstrates how important MEIT assumptions can be, is found in the Prince Rupert Airshed Study (PRAS). Decisions and assumptions associated with PRAS MEIT, which were used to update the PRAS original calculation of marine emissions from existing sources, were associated with a dramatic 400% reduction in forecast NOx and a reduction of other CACs.

Because there is correlation between emissions and concentrations in residential areas, any errors in the Aurora MEIT assumptions will be expected to have an impact on our understanding of the risk to human health. An example can again be found in the PRAS situation where the introduction of new MEIT assumptions resulted in a change in forecast concentrations of CACs and demonstrated that MEIT assumptions can significantly affect forecast and whether Canadian Guidelines for air quality (CCME) in residential areas, will be met.

Aurora MEIT assumptions are significant and material and should be open to public scrutiny especially in light of the potentially significant underestimation of anticipated human health impacts from this project. – **See attached** Luanne Roth “Impact of MEIT Assumptions”

- Two of the major Aurora MEIT assumptions relate to anticipated reductions in marine NOx emission rates and new standards for Sulphur in fuel. An analysis of those assumptions can be used to demonstrate how the many untested assumptions could affect conclusions.

See attached Luanne Roth “Non-compliance with vessel air emission standards”

If we are given access to the MEIT assumptions, some possible errors the public can look for are:

Was 100% compliance with new 0.1% Sulphur in fuel standard assumed, whereas 100% compliance is not expected in Canada?

“If indeed, 100% compliance with International emission standards has been assumed in the forecast emission and concentrations in the Aurora Application; then the Proponent would be making assumptions that even the IMO, the Canadian government (including Transport Canada) and the Regulations themselves seem to acknowledge to be currently impossible.”

–**See attached** Angela McCue Letter

Some examples of other Aurora MEIT assumptions that could have similar significant impact on the forecast of emissions and CAC concentration in residential areas and that therefore must be disclosed to allow public scrutiny include:

- Was 100% compliance with the IMO Tiered NOx emission standards for ECA's assumed and is that demonstrated to be realistic?

- What age distribution of vessels was assumed, e.g. the bulk carrier fleet? What vessel life was assumed (25 years, 40 years)? We understand that older higher polluting engines will gradually be retired out of the fleet. It is necessary to know at what rate these older vessels are assumed to be retiring and compare that to the rate at which they actually are.
- Was the forecast number of vessels of each class, reasonable, in light of local knowledge?
- In order to meet NOx standards many vessels are slow steaming (going slower to a more fuel efficient speed) which results in an average reduction of NOx. However that average reduction cannot be applied to NOx emissions in harbour where speed restrictions were already included in the forecast emissions. Aurora must provide sufficiently transparent information to allow important matters like this to be assessed. Was a cross the board reduction to NOx emissions assumed in the Aurora MEIT? We simply cannot tell from the available information.
- Was 50% shore power for all large vessels applied despite the continuing technical adaption issues which have been severely limiting shore power use? We understand records should be available from the port to show the percentage of shore power that is currently used and so determine what is reasonable possible.
- Was the existing number of container ships estimated from the Aurora MEIT but not checked with the Fairview Phase II container expansion estimate in the Application to make sure the total forecast of the number of container ships after Phase II, matches planned capacity.

- Aurora MEIT specifications and assumptions are not described with sufficient specificity in the Application to allow the assumptions to be tested or verified. Efforts have been made to obtain access to the Aurora Assumptions but the requested information has not been provided or made available to the public

The Aurora Application is not transparent on how they calculated marine vessel emissions

- **See attached** Klym Bolechowsky, P.Eng. "Aurora LNG Digby Island Project Comment" and "Summary Points Aurora LNG Digby Island Project"

The Application Air Quality Appendix gives several different descriptions of the sources they used to calculate existing marine emissions:

- MEIT version 4.1 (SNC Lavalin 2012b). on page 169/383 [Lavalin 2012b MEIT 4.1]
- SNC Lavalin. 2012a. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email. on page 222/383 [Draft PRPA Lavalin 2012a MEIT]
- SNC Lavaline, 2012b. Canadian 2010 Marine Emissions Inventory. Provided by Environment Canada September 2014. on page 222/383 [EC Lavalin 2012b MEIT]
- Prince Rupert Port Authority (PRPA) SNC Lavalin 2012b on page 20/283[PRPA Lavalin 2012b MEIT]
- 6.2 Personal Communications
- 6.2 Personal Communications
Bellavance, P. March 4, 2015. Email RE: MEIT – Line table and shapefiles – FTP Ready.
McEwen, B. 2015. March 12, 2015. Email RE: Follow up on MEIT questions on page 223/383 [Is

this a change, alteration or clarification to the 2012a MEIT referred to on page 223/383? If so, what is the change, alteration or clarification and what is the basis for it?]

- Note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.

As far as we have been able to determine these references in the Aurora Application are not identical. We also cannot tell if one or all have been relied upon or if there has been “cherry picking” of assumptions from various sources or drafts and whether such “cherry picking” can be justified.

Attached L Roth “Summary of Aurora Description of MEIT”

Efforts to obtain disclosure to allow assessment of Auroras MEIT assumptions

Based on our understanding of the importance of testing the assumptions used, we (TBSEF, PRES and UFAWU-INIFOR) have been making requests for disclosure of the information and access to the Marine Emissions Inventory Tool (MEIT) to help analyze those assumptions since early in the public comment period but as of March 9, 2017, the final deadline for public comments we still have not received responses which would allow us or our experts to properly assess the Application.

In order to review and comment on the assumptions we have been seeking the clarification needed to verify what assumptions were used and we have been given further conflicting descriptions, for example:

- February 15, 2017 email from EAO: “”From the proponent:
The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A.””
- March 3, 2017 email from EAO :“The reports versions are as follows:
-The user guide which is titled: National Marine Emissions Inventory Tool (MEIT) V 4.1.0
-The final emission inventory report which is titled: 2010 National Marine Emissions Inventory for Canada; Final Report ”
- March 7, 2017 email from EAO: “Attached is ECCC’s MEIT information that you requested. EAO will post this to our website for broader reference.” Attached were: Updated Tables MEIT 4.3.1.pdf, EC National Marine Inventory Final_Nov20_2012fs.pdf, and MEIT User Guide March 20,2015.pdf [there is no mention of MEIT 4.3.1 in the Application]
Note these attachments were also published on the EAO Aurora website on March 7, 2017 under: Application and Supporting Studies
- Our expert requested further information in a public comment on March 8th but no reply has been received as of March 9, 2017: “A document posted on the EAO web site on March 7, 2017, ‘MEIT User Guide V4.3 March 20, 2015.pdf’ includes a model history section (Table 1-1, page 3) that lists version 4.3, March 2015 as the most recent version of the MEIT. However, another file posted on the EAO web site, ‘Updated Tables_MEIT 4.3.1’ includes tables of west coast marine emission estimates sourced from “Excerpt from MEIT Update 4.3.1 (by ECCC)”. For transparency, please clarify which version of the MEIT was used as the source for the emission levels presented in the application” - **See attached** Klym Bolechowsky, P.Eng. “Aurora LNG Digby Island Project Comment”

The necessary information was therefore not available to us, our experts, or to the public for review. Considering these conflicting descriptions, it is important that someone with personal knowledge of exactly which assumptions were used, describe clearly and fully what was used in the Aurora Application to determine existing marine emissions and it is essential that Aurora make this information available to the public, with time to review and make public comment.

See attached Copy of correspondence asking for MEIT clarification

F) There are other issues

- Flares included in peak concentration forecasts or not- they should be
- O3 not based on hourly PRAS used 60ppb Aurora only 50 ppb (80 ppb is the default)
- Secondary O3 not considered and two new LNG projects and greatly increased container facility could result in large O3 levels
- O3 as a health concern in itself
- Geographic – areas chosen in way which dilutes
Water areas not included when they are highest concentration between Rupert and Dodge Cove

How all these issues affect Human Health Risk

CACs in residential areas are a priority concern because looking at concentrations where humans live is directly relevant to the magnitude of the human health risk posed by the Aurora Project. Human health will be at risk if the concentration of Criteria Air Contaminants (CACs) in residential areas, are high and more certainly at risk if CAC levels exceed CCME objectives. Aurora acknowledges that the proposed Project will increase levels of CACs. In order to properly assess the extent to which that acknowledged increase in CACs will increase the risk to human health it is necessary to have an accurate forecast of CAC concentrations to compare to CCME and other air quality objectives.

An error/underestimation of forecast CAC concentrations in the Aurora Application would have serious human health implications and should be corrected prior to assessing human health risk-- **See Attached Dr. David Bowering, retired Chief Medical Health Officer, Northern Health in his attached comment suggests;**

"The health risks are both short and long term: Asthma and respiratory irritation in the short term; cardiovascular disease including heart attacks, and chronic respiratory disease including Chronic Obstructive Pulmonary Disease in the long term." – see Attached Dr. Bowering

The CAC levels in the Aurora Application are concerning at the forecast presented and any significant correction upwards would push them into an area of greater risk to human health. The Prince Rupert Airshed Study F_R (PRAS F_R) [using different assumptions to calculate concentrations for a similar situation as the Aurora CEA case] forecast extreme exceedance of CCME objectives and an update of that forecast still showed concerning levels (PRAS F_R_U) The residential areas of Prince Rupert, Dodge Cove, Port Edward, Crippen Cove and Metlakatla are at risk; a population of about 13,000. A reasonably accurate forecast of CAC concentrations must be done and presented to the public before human health risk is compared to guidelines and assessed; significant errors in projected concentrations of CACs in

residential areas should be corrected and resubmitted to the public for review. – see Bowering
Comment Attached

Luanne Roth <

Aurora LNG NOx Modeling

1 message

Thu, Mar 9, 2017 at 11:00 AM

To: Luanne Roth <

Hi Luanne

I have briefly reviewed the NOx modeling carried out by Stantec on behalf of the Aurora LNG applicant. Stantec used the Ozone Limiting Method (OLM), as published, to estimate the concentration of ambient NO₂ from modeled NOx concentrations. It is recommended that they adjust the OLM parameters to correspond to the higher ratio of NO₂:NOx that actually occurs in modern low-NOX emission gas turbines. For those living near the proposed LNG plant this would increase their calculated NO₂ exposure significantly .

The default OLM uses an in-stack ration (ISR) for NO₂:NOx of 10%, which it assumes is reasonable for most sources. However, it is now known that modern stationary gas-turbines experience an ISR of approximately 30%, and not the 10% value assumed in the published OLM. If it is possible to modify the OLM used in the CALPUFF model, then the change to 30% for the ISR would significantly improve the accuracy of the modeled ambient NO₂ concentrations. The increase in calculated NO₂ concentrations, for those living near to the LNG plant, would be in the order of 20%.

Regards, Gordon

Gordon Esplin, M.Sc., P.Eng.
Genesis Engineering Inc.



**GORDON J. ESPLIN, M.Sc., P.Eng.
AIR POLLUTION ENGINEER**

Mr. Esplin has over 30 years of experience in air pollution consulting for industry and government, as well as conducting leading-edge research into new methods for monitoring, modeling and reducing air pollution.

Skills

- Computer modeling of complex systems; atmospheric dispersion modeling.
- Bulk terminal (coal, potash, sulphur, grain, etc.) dust monitoring and abatement.
- Aerosol physics – applications to aerospace and to dust mitigation
- UV reactor modeling and design of UV disinfection systems
- Air pollution monitoring with a strong emphasis on sampling and sample analysis. Development of new sampling methodologies. Air pollution forensic analysis.
- Assessment of the air pollution impacts of new developments.
- Air pollution meteorology – measurement and logging of meteorology.
- Atmospheric chemistry.
- Energy studies and life-cycle cost analysis
- Team leadership and project management.
- Research and new product development.
- Intellectual property protection

Education

B.Sc. (Chemical Engineering), University of Alberta, Edmonton, 1965.

M.A.Sc. (Chemical Engineering), University of British Columbia, Vancouver, 1988.

Experience

1995 – Present

Genesis Engineering specializes in air pollution consulting and new product development. Recent projects that Mr. Esplin has worked on include:

- Forensic analysis of atmospheric dust particles to determine their origin, using SEM, LA-ICP/MS and other advanced techniques.
- Recommending cost-effective technologies for reducing exhaust contaminants from heavy-duty diesel engines such as trucks, locomotives, construction equipment, ferries, workboats and cruise-ships.
- Design and modeling of UV water disinfection systems.
- Design and modeling of ozone-disinfection systems for cruise-ships, hotels and health-care facilities.
- Using computer modeling to assess environmental impacts of atmospheric emissions from a variety of sources, such as fugitive dust from a ready-mix concrete plant in Vancouver, paint overspray from shipyards, odours from sewage sludge and wastewater treatment facilities, odours from a waste food recycling facility and wood-pellet plant particulate emissions.
- Measurement of exhaust emissions from ocean-going ships. Evaluation (cost/benefit) of technology and economic and regulatory instruments for reducing emissions from ocean-going ships.
- Evaluating (thermodynamic & cost) different hydrogen manufacturing processes and identifying the “bridges” that need to be built to get to the hydrogen future.
- Developing new methods to measure fugitive dust emissions from cargo ships during loading operations.
- Analysis (measurements and computer thermodynamic and kinetic modeling) of the explosion hazard associated with the unloading of sulphur trains.
- Experimentation and computer modeling of the aerosol physics associated with thermal fog generators. Development of new applications for these machines in the aerospace industry and the military.

- Evaluation of technology for reducing leachate emissions from wood residue storage facilities.
- Development and testing of a novel silencer for ship-yard sandblasting.
- Design of an advanced scrubber for reducing power boiler emissions.
- Training Chinese scientists and engineers in air pollution monitoring system design, installation and operation, and in computer modeling for chemical spill simulations and for air pollution dispersion modeling.

In addition to these consulting projects Genesis Engineering is actively involved in new product design. Products include a dust-free ship-loader, ergonomic seating, waste heat recovery system, air pollution software, forest silviculture systems, advanced slurry pump and an automatic water shutoff valve.

1980 – 1995

Group Leader, British Columbia Research Inc

Mr. Esplin led a group of scientists and technologists in applied research and consulting activities. He was responsible for promoting and successfully completing related contract work, developing and promoting novel air pollution measurement and control technologies, as well as the evaluation of biomass gasification and of hazardous waste destruction systems. Example projects for which Mr. Esplin was personally responsible for include:

- Development of advanced air pollution control systems for removing fine particles and toxic gases.
- Development and use of a new sampling technology (Boundary Layer Emission Monitoring) for measuring odour and hazardous chemical emissions from very large area sources such as hazardous-waste disposal sites, effluent treatment lagoons, municipal landfills, Superfund sites, etc.
- Determine and document the effects of kraft pulp mill emissions (particulate, sulfur gases, chlorine gases, etc.) on the environment.
- Assess the environmental impacts of the proposed Hat Creek Coal Liquefaction Plant and associated coal fueled Power Plant.
- Develop the use of sulfur hexafluoride gas as a surrogate hazardous compound in waste incineration studies and as a tracer in industrial ventilation studies.
- Develop the use of rare-earth elements as tracers in industrial paint overspray studies.

- Develop an analytical method for determining the concentration of coal in dustfall samples (Pyrolysis-GC).
- Measurement and reduction of fugitive dust emissions from bulk handling facilities – coal, sulfur, wood-chip, and grain terminals. Computer modeling of dust transport mechanisms. Development of a zero-emission ship-loading system.
- Development of a novel photochemical reactor for removing VOC and odours from gas streams (patents applied for).
- Claus Sulfur Plant efficiency studies and measurements.
- Research relating acid rain deposition to environmental damage.
- Research into the heterogeneous chemistry of acid rain precursors and atmospheric particulate. (This research led to world patents on a novel method for acid rain control – *Limestone-Enhanced Acid Rain Neutralization*).
- Computer modeling of gas-appliance "back-drafting".
- Evaluation of continuous PM₁₀ monitors. Design and construction of ambient PAH samplers.
- Measurement and computer dispersion modeling of chlorine and chlorine dioxide emissions from bleach plants and chemical plants.
- Development of standard protocols for the sampling and evaluation of biomass gasification systems. Testing of different gasifiers using these protocols.
- Development of a coastal log storage system (patent received).
- Process engineering design of a system for electrochemically producing THAQ, an additive for increasing the yield of pulp from wood chips.
- Design and testing of a modular mussel farming system (patent applied for).
- Development and testing of a novel hydrometallurgical process for recovering titanium, as synthetic rutile, from waste paint sludge (patent applied for).
- Research into enhanced liquid fuel combustion based upon the Rayleigh instability principle.

1978 – 1980

Senior Air Pollution Engineer, Environment Canada

Mr. Esplin acted as a consultant on policies and guidelines relating to the control of air pollution in B.C. and the Yukon. His activities included:

- Development of Emission Guidelines and computer modeling of the environmental impacts from coal-fired power plants and other proposed facilities.
- Technical review of all environmental impact statements and pollution permit applications within the British Columbia and Yukon region.

1969 – 1975

Research Engineer, British Columbia Research

Mr. Esplin was responsible for air pollution research, stack and ambient air sampling, and air pollution control technology (mainly for the pulp mill industry). Example projects included:

- Design of new stack-sampling instruments (insitu cascade impactor, high volume particulate sampler, continuous H₂S monitor). Design and deployment of a novel ambient particulate flux monitor.
- Sulfur-gas odour emission inventories at all major pulp mills in B.C.
- Development of computer models to predict the environmental impact of an expanded Vancouver International Airport.
- Environmental impact assessment of coal mines and of a copper smelter.
- Design of odour control technology at a fish packing plant.

1967 – 1969

Process Engineer, Celanese, Edmonton, Alberta

While with Celanese Mr. Esplin worked on chemical plant improvements, new process designs, and on solving air and water pollution problems. Typical projects were:

- Design and installation of a plant odour control system.
- Design of process for recovering valuable fatty acids from a waste chemical stream.
- Distillation tower and heat exchanger designing.
- Improving the steam efficiency of the Power Plant.

1965 – 1967

Design Engineer, Atomic Power Dept., CGE, Peterborough, Ontario

While with CGE Mr. Esplin was involved in the design of nuclear power plant subsystems. Typical activities included:

- Design of the moderator cooling and ion-exchange systems, design of the gas recombination process for the helium cover-gas system, and design of the boron-doping system for the Karachi, Pakistan nuclear power plant. Selection and specifications of all plant testing and analytical instrumentation.
- Computer simulations of loss-of-coolant accidents. Two-phase flow analysis.
- Chief commissioning engineer for the heavy water facility at the Ontario Hydro nuclear power plant, Douglas Point, Ontario.

Associations

- Association of Professional Engineers and Geoscientists of B.C.
- Executive of the Air and Waste Management Association, BC & Yukon Branch

Publications

(Not included are approximately five hundred confidential client reports.)

Esplin, G.J: "Boundary layer emission monitoring." *Air Pollution Control Association Journal*. 38(9): 1158-1161, (Sept. 1988). (Also presented at the AIChE Spring Meeting and Petrochemical Expo '89, Houston, TX, [Apr. 2-6, 1989]).

Esplin, G.J. D.P.C. Fung and C.C. Hsu: "Comparison of the energy and product distribution from biomass gasifiers." *Canadian Journal of Chemical Engineering*. 64:651-662. (August, 1986).

Esplin, G.J. and E. McDonald: *Development of analytical methodology for biomass gasification products*. Presented at Fourth Bioenergy R & D Seminar, Winnipeg, Manitoba. (March 29-31, 1982).

Esplin, G.J., D.P.C. Fung and C.C. Hsu: "Development of sampling and analytical procedures for biomass gasifiers." *Canadian Journal of Chemical Engineering*, 63(6):946-953. (1985).

Esplin, G.J., R.S. Serenius and A.D. McIntyre: "Measurement and characterization of recovery furnace particulate. A status report." *Pulp and Paper Magazine of Canada*, 74(10):T404. (October, 1973).

Tomlins, G.F., M.J. Manore and G.J. Esplin: *The potential of remote sensing for monitoring pulp mill effluents.* Presented at Seminar on Pulp Mill Effluents, Environmental Protection Service, Vancouver, B.C. (March 17-18, 1983).

Esplin, G.J., and M.W. Aiken: "A study of laboratory fume hood performance." *American Industrial Hygiene Association Journal*, 48(6):A389-A391. (June, 1987).

Esplin, G.J: *TRS emissions from effluent lagoons.* Presented at 1988 Environment Conference, Canadian Pulp and Paper Association, Technical Section, Vancouver, B.C. (October 25-27, 1988).

Esplin, G.J: "Total reduced sulphur (TRS) emissions from effluent lagoons." *Pulp and Paper Canada*, 90(10):T398-T400. (1989).

Esplin, G.J.: "An approximate solution to the general line source problem." *Atmospheric Environment*, (In print, 1995)

Patents

Esplin, G.J: Balloon Forest Fertilization, USA Patent 5322219 (June 21, 1994).

Esplin, G.J: Acid Rain Neutralization. European Patent 207,616 B1. (Aug. 8, 1990).

Esplin, G.J: Method of storing logs. U.S. Patent Application 675,353 (Dec. 1985).

Esplin, G.J: Method of storing logs. Canadian Patent 1,239,837. (Aug. 02 1988).

Contact

GENESIS ENGINEERING Inc



Aurora underestimated NO₂ concentrations in their Application by using 10% for in-stack NO₂/NOx conversion ratios for turbines where it would have been more appropriate to use 30% or more

-Luanne Roth

This error has resulted in the NO₂ concentrations over residential areas being significantly underestimated in documents provided to the public during the comment period

We have found a serious error in the calculation of NO₂ (CAC) concentrations from three of the proposed LNG projects' main turbines; the NOx emissions from these, contribute half the NOx in the CEA case. This means cumulative effects have been seriously underestimated in the Application. The portion of this NOx which converts to NO₂ is crucial because NO₂ is a health concern. The Aurora Application should have used an in-stack conversion ratio of 30% NO₂/NOx whereas they only used 10% for these turbines.

"3.7 NO_x to NO₂ Conversion

The oxidation of NO to NO₂ by ozone was predicted by use of the Ozone Limiting Method (OLM). The OLM assumes that the conversion of NO to NO₂ in the atmosphere is limited by the ambient ozone concentrations in the atmosphere. The approach assumes that 10% (on a volume basis) of the NOx is converted to NO₂ prior to discharge into the atmosphere. For the remaining NO, the following is adopted:

--If 0.9 (NOx) is greater than the ambient O₃ concentration then NO₂ = 0.1 (NOx) + 0.9 (O₃). For this case, the conversion is not complete.

-- If 0.9 (NOx) is less than the ambient O₃ concentration then NO₂ = 0.1 (NOx) + 0.9 (NOx) = NOx. This is equivalent to the total conversion approach, since there is sufficient ozone to effect the complete conversion.

The Detailed Model Plan (Appendix 1 of the Air Quality TDR) proposing the above method was approved by BC MOE (Stantec 2015). For this assessment, the maximum hourly O₃ value of 50 ppb measured at Prince Rupert airshed for 2011-2013 was used (W. McCormick (BC MOE) pers.comm. January 7, 2016)." –Page 296 Aurora Application Appendix A Air Quality

NO₂ concentration forecasts are calculated from NOx using an in-stack ratio as part of the calculation. The amount of NO₂ coming out of the stacks is especially important for nearby residents like Dodge Cove and possibly west Prince Rupert because a portion of stack *emissions* will become concentrations over these nearby residential areas.. The EPA recommends a default in-stack ratio of 50%, unless there is evidence to support a lower ratio:

"The national default for ARM2 includes a minimum ambient NO₂/ NOX ratio of 0.5 and a maximum ambient ratio of 0.9. The reviewing agency may establish alternative minimum ambient NO₂/ NOX values based on the source's in-stack emissions ratios, with alternative minimum ambient ratios reflecting the source's in-stack NO₂/NOX ratios. Preferably, alternative minimum ambient NO₂/NOX ratios should be based on source-specific data which satisfies all quality assurance procedures that ensure data accuracy for both NO₂ and NOX within the typical range of measured values. However, alternate information may be used to justify a source's anticipated NO₂/NOX in-stack ratios, such as manufacturer test data, state or local agency guidance, peer-reviewed literature, and/or the EPA's NO₂/NOX ratio database.-- 1Federal Register / Vol. 82, No. 10 / Tuesday, January 17, 2017 / Rules and Regulations 5211."

https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf

The Aurora Application materially underestimated NO₂ concentrations as a result of incorrectly using 10%. The Prince Rupert Airshed Study, for these same projects, used 30% for conversion calculations from NOx. We are not aware of any authority to suggest that any lower value could be justifiable in the relevant area and the Proponent has not in its Application, provided justification. Aurora's use of this unsubstantiated 10% conversion calculation seriously underestimates CAC concentrations.

Table 16 from page 34 Appendix A. Air Quality in the Aurora Application shows the three LNG plants Aurora, PNW and PR emit about 10000 t/y NOx, about half the total NOx emissions in the area. These three plants NOx emissions are all projected to be produced by turbines with NOx reducing equipment.

The use of NOx reduction equipment was premised in Aurora's calculation of NOx emissions from Turbines and other sources and so they should redo and amend the Application calculations using at least 30% rather than only 10% for these sources because NOx reduction equipment increases in-stack ratios.

"NOx reduction is important in lowering the levels of NOx being released into the atmosphere during combustion. When a form of NOx reduction is used, it is important to have accurate measurements of not only NO but also NO₂ because the ratio of NO to NO₂ is changed. The traditional NO₂ amounts as a percent of total NOX (10% or 1.1 factor) cannot be used when NOx reducing methods are used since it will lead to very significant errors in the calculations. When NOx reduction methods are used, the values for NO₂ can be greater than 50% of the total NOx."

- <http://www.e-inst.com/combustion/nox-reduction>

Another study, Prince Rupert Airshed study (PRAS), which calculated NO₂ from Aurora, PNW and PR LNG just as Aurora is doing in their application, used 30% :

*"NO₂/NOx Ratios for RIVAD
NOx emissions will be speciated into NO and NO₂ emissions based on in-stack ratio data.*

*All sources **except turbines** will assume 10% NO₂ and 90% NO (i.e. 0.1 in-stack NO₂/NO_x ratio).*

*Turbines with DLE (or SoLoNox) will use data from Solar indicated **at 30% NO₂** (or a 0.3 in stack NO₂/NO_x ratio) [DLE is dry low emissions]*

Data for in-stack ratios for turbines with SCR also uses the 0.3 in stack NO₂/NO_x ratio”- PRAS page 425) <http://www.bcairquality.ca/airsheds/docs/PR-Airshed-Study-Report-Summ.pdf>

As we noted above, the reason for using 30% or higher in-stack ratios is that NO_x emission reduction equipment increases NO₂ in stack conversion. Dry low emission is one of these NO_x reduction technologies. The Aurora will use DLE in its turbine (and so it should use 30%):

“4.1 Compressor Gas Turbine Drivers

At full buildout, 16 Siemens Trent 60 gas turbines equipped with dry low NOX emission (DLE) combustors will be used as refrigerant compressor drivers.” –pg. 191 Aurora Application Appendix A Air Quality

The correction to 30%, or more if appropriate, should also be applied to all in-stack sources including marine, which are using NO_x reduction equipment. A large proportion if not all the marine emissions were premised on emission reduction efforts which would increase in-stack conversion ratios, most likely to 30% or more.

Impact of MEIT Assumptions -Luanne Roth

Assumed "Decreases in Marine Emission Rates" associated with elimination of Forecast Residential Exceedance of CCME Objectives

The Aurora LNG CEA case¹ and the Prince Rupert Airshed Study (PRAS) ² are based on nearly the same set of projects (proposed and existing).

The PRAS (F_R) original emission forecast for these projects predicted very large exceedances (in red) of CCME objectives in residential areas for peak NO2 as well as concerning levels of SO2 and PM2.5.

PRAS (F_R_U) then updated the forecast with assumed decreases in marine emission rates and predicted CCME objectives would generally be met. You can see the marked difference between PRAS (F_R) and PRAS (F_R_U) -Tables 3-7 and 3-5.³

Table 3-7: The maximum of the 98th percentile of the 1-hour average daily peak concentrations of NO₂ among the grid points assigned to each location for Future Case F_R_U.

Concentrations in $\mu\text{g}/\text{m}^3$ Background = 24.44 $\mu\text{g}/\text{m}^3$	Scenario	
	F_R	F_R_U
Residential		
Dodge Cove	620.4	133.5
Future Residential Expansion	151.3	144
Kitkatla	38	35.7
Lax Kw'alaams	133.8	140.2
Metlakatla	109.7	82.4
Port Edward Proposed Hotel	88.5	84.7
Port Edward Residential	123.7	107.2
Prince Rupert Residential	485.5	116.9
Rainbow Lake	50	47.7
Prudhomme Lake	61.5	60.4
Kloiya Bay	75.5	67.8
North Pacific Cannery	90.5	87.7
Cassiar Cannery	74.3	68.4
Osland	67.5	62.3
Hunts Inlet	56.3	52.4
Oona River	50.6	47.3
Crippen Cove	374.6	92.7

¹ Aurora Application (including Appendix A. Air Quality Final) can be found at "Under Review" in the bottom right hand corner at the link: http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_home_416.html

² PRAS link <http://www.bcairquality.ca/airsheds/docs/PR-Airshed-Study-Report-Summ.pdf>

³ Tables 3-5 and 3-7 are from PRAS pgs. 83-89

Table 3-5: The maximum of the 99th percentile of the 1-hour average daily peak concentrations of SO₂ among the grid points assigned to each location for Scenarios F_R and F_R_U.

Concentrations in µg/m ³ Background = 10.67 µg/m ³	Scenario	
	F_R	F_R_U
Human Health Receptor Location		
Dodge Cove	103.6	34.9
Future Residential Expansion	112.7	111.6
Kitkatla	12.3	12.2
Lax Kw'alaams	20.9	40.8
Metlakatla	44.3	27.9
Port Edward Proposed Hotel	39.5	28.6
Port Edward Residential	80	68.8
Prince Rupert Residential	92.8	57.1

PRAS pointed to **marine emission factor assumptions** when accounting for the most pronounced decreases in NO₂ and SO₂ concentrations [from Scenario F_R to Scenario F_R_U]:

- Decreases in marine NOx emission rates⁴
- More accurate characterization of existing port sources⁵
- Decreases in marine NOX emission rates by using more representative engine load and emission factor data⁶
- Decreases in marine SO₂ emission rates accounting for the new marine fuel standard.⁷
- Decreases in marine SO₂ emission rates accounting for the new marine fuel standard (0.1% sulphur limit for North American ECA)⁸
- Consideration of emission limits or fuel standards that became effective after the submittal of publicly available project descriptions or applications⁹

The PRAS reduction of forecast NOx was roughly 4 to 1 for LNG marine sources¹⁰ (SO₂ also went down).

⁴ "The most pronounced decreases [from Scenario F_R to Scenario F_R_U] in 1-hour NO₂ concentrations are accounted for by more accurate characterization of existing port sources and decreases in marine NOx emissions rates" - PRAS pg. 88

⁵ ditto

⁶ "Additionally, decreases in marine NOX emission rates by using more representative engine load and emission factor data also likely result in decreased concentrations [from Scenario F_R to Scenario F_R_U] in the higher concentration areas." – PRAS pg. 86

⁷ "input changes noted for the decrease in annual SO₂ concentrations [from Scenario F_R to Scenario F_R_U] at the areas of highest concentration also account for the most pronounced decreases in 1-hour average daily peak SO₂ concentrations: the more accurate characterization of existing port sources and decreases in marine SO₂ emission rates accounting for the new marine fuel standard." – PRAS pg. 85

⁸ "Additionally, decreases in marine SO₂ emission rates accounting for the new marine fuel standard (0.1% sulphur limit for North American ECA) likely further decreased concentrations [from Scenario F_R to Scenario F_R_U] in these areas." – PRAS pg. 83

⁹ PRAS pg. 45

¹⁰ PRAS F_R LNG marine sources ~8760 t/y NOx (~24 t/d figure 2-3 page 44 PRAS)

PRAS F_R_U LNG marine sources ~2190 t/y NOx (~6 t/d figure 2-3 page 44 PRAS)

The PRAS points to the Prince Rupert Port Authority (PRPA) to defend the large reduction in forecast emissions.¹¹ The Aurora Application also uses the PRPA¹², who provided them the Marine Emission Inventory Tool (MEIT), to defend the marine-based sources and emission rates used in the Aurora Application forecast. The Aurora Application specifically refers to MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) and note that “SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.”

The MEIT 4.1 was used by Aurora in their Application to “define existing marine-based air emissions”.¹³ “Marine based emissions were assumed to reflect existing marine-based projects” and they reference a further assumption in MEIT 4.1: “the implementation of the international regulations specific to Sulphur content in marine fuel (MARPOL 2008) including the 2010 amendments which designate Canadian waters as an Emission Control Area”¹⁴ and 2015 sulphur regulations

¹¹ “All types of marine-emission sources were modelled as stationary point sources, with emission rates for both the Base Scenario and Scenario F_R_U provided by the PRPA. All types of marine-emission sources were modelled ...with emission rates for ...Scenario F_R_U provided by the PRPA [except ferries]. - PRAS pg. 36

¹² pg. 222 Aurora Appendix A

¹³ 2.2 Marine-based Emission Sources

Regional marine sources were extracted from the Environment Canada (EC) National Marine Emission Inventory Tool (MEIT)... The most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b). The MEIT contains sulphur oxides (SOx), NOX, CO, PM10, PM2.5 and VOCs emission rates. The database also includes total PM (and associated elemental, organic and sulphate fractions), ammonia (NH3) and greenhouse gases (GHGs in the form of carbon dioxide, methane, nitrous oxide and equivalents). For the purposes of this study, air emissions forecasted for 2015 were extracted from the database and define existing marine-based air emissions within the regional assessment area (RAA). The 2015 dataset was chosen as representative of existing marine based sources as it includes the implementation of the international regulations specific to Sulphur content in marine fuel (MARPOL 2008) including the 2010 amendments which designate Canadian waters as an Emission Control Area. These marine-based emissions are assumed to reflect existing marine-based projects (i.e., Fairview Terminal, PRG Terminal, ferries, cruise ships, Ridley Terminals) identified in the Aurora LNG Application for an Environmental Assessment Certificate (the Application).-pg. 169 Aurora

Appendix A

¹⁴ ditto

Canadian Regulations for Vessel Air Emissions (SO₂ and NO_x) and Non-Compliance Issues relevant to the Aurora Application use of MEIT

-Luanne Roth

Are pronounced decreases in NO_x and SO₂ marine emission rates used in the Prince Rupert Airshed Study and Aurora LNG Application, hypothetical or real?

There are references in the Prince Rupert Airshed Study- September 2015 (PRAS) to decreases in marine NO_x emission rates¹ and decreases in marine SO₂ emission rates.² The use of these “lower emission rates” by PRAS, in their updated forecast, played a large part in creating an almost fourfold reduction in NO_x marine emissions (and a large decrease in forecast SO₂ emissions) and the Aurora Application has forecast similar reduced NO_x and SO₂ emissions based on use of Marine Emission Inventory Tool (MEIT).

We need clarification both on what level of NO_x standards PRAS used originally but it seems reasonable to assume the large decreases in NO_x emission rates are premised on assumed compliance with regulations which previously allowed ships greater NO_x emissions. Although each Tier in NO_x, dates when they apply and dates ships were built may all tend to suggest a gradual NO_x reduction, if there has been limited compliance and suddenly NO_x emission forecasts have been changed **from** estimates based on actual ships and the age of their engines and their actual compliance **to** NO_x emissions forecasts based on 100% or lesser but still unrealized compliance, the NO_x reduction could be imagined to be significantly larger than it really is.

Timed provisions for Tier I-III came into effect when we became subject to a proposal to be a party to Annex VI-- North American ECA, including most of US and Canadian coast (NO_x & SO_x: 2010/2012 with 0.1% sulphur standards coming into effect 2015).

We need clarification on the level of compliance assumed in the Aurora Application MEIT assumptions, because of the following reasons to suspect compliance is far from 100%.

1. Transport Canada allows for non-compliance with the 0.1 % Sulphur Regulation

Regulations for Vessel Air Emissions: 2015 Sulphur Emissions Standards - SSB No.: 08/2014

<http://www.tc.gc.ca/eng/marinesafety/bulletins-2014-08-eng.htm>

Enforcement of the Regulations

¹ “The most pronounced decreases [from Scenario F_R to Scenario F_R_U] in 1-hour NO₂ concentrations are accounted for by more accurate characterization of existing port sources and decreases in marine NO_x emissions rates”- PRAS pg. 88

² “input changes noted for the decrease in annual SO₂ concentrations [from Scenario F_R to Scenario F_R_U] at the areas of highest concentration also account for the most pronounced decreases in 1-hour average daily peak SO₂ concentrations: the more accurate characterization of existing port sources and decreases in marine SO₂ emission rates accounting for the new marine fuel standard.” – PRAS pg. 85

"With the reduction in sulphur in compliant marine fuel decreased by 90% from 1% sulphur content to 0.1% sulphur on January 1, 2015, enforcement of these regulations will be increased. Vessels with non-compliant fuel are still required to report. Please see Ship Safety Bulletin 04/2013 for further guidance on reporting non-compliant fuel":

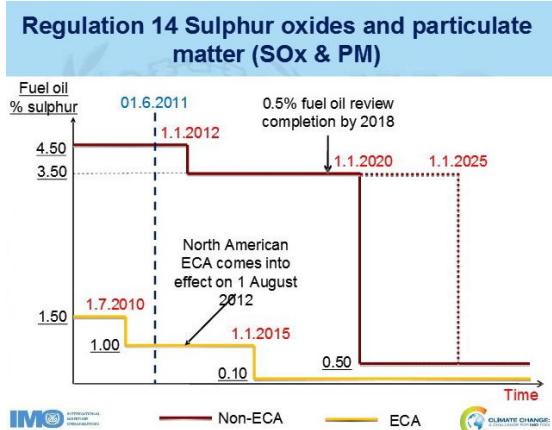
New Regulations for Vessel Air Emissions: REPORTING WHEN COMPLIANT FUEL IS UNAVAILABLE - SSB No.: 04/2013 <http://www.tc.gc.ca/eng/marinesafety/bulletins-2013-04-eng.htm>

Guidance

"In the event a vessel destined to a Canadian port has not been able to obtain compliant fuel, the Amendments require that vessel to report its situation to Transport Canada. A vessel is not required to deviate from its planned route. However, the authorized representative is expected to have considered the availability of compliant fuel oil when planning the voyage. If it is not available where planned, the vessel should attempt to locate alternative sources. Having to change berth or anchor within a port in order to obtain compliant fuel oil is not considered a deviation from a planned route."

"The Amendments do not require a vessel to purchase distillate fuel to meet the 1.00% sulphur content standard. The vessel may purchase fuel with a sulphur content that is as close to the standard as possible. As well, a vessel is not expected to purchase fuel that would not comply with quality specifications set by the vessel's engine manufacturer."

2. Non-ECA countries allow 3.5 % Sulphur until 2020, 2025 or later per 2011 document. Note that if a vessels originates from somewhere where 0.1% fuel is unavailable they are not required to deviate from their route (see 1 above) http://ec.europa.eu/transport/sites/transport/files/modes/maritime/events/doc/2011_06_01_stakeholder-event/item2.pdf



3. Good news is that China, where many of our ships originate, requires 0.5% Sulphur fuel while operating in key ports by 2019. However this is not 0.1%. If

a vessel originates in China where no 0.1% fuel is available it is not required to deviate from its route (see 1 above).



Requirements applicable within China's new domestic emission control areas (ECAs):	
From 1 April 2016,	ships berthing at key ports in the Yangtze River Delta ECA must use fuel with a sulphur content not exceeding 0.50%
From 1 January 2017,	ships berthing at key ports in ECAs must use fuel with a sulphur content not exceeding 0.50%
From 1 January 2018,	ships berthing at all ports in ECAs must use fuel with a sulphur content not exceeding 0.50%
From 1 January 2019,	ships operating anywhere in ECAs must use fuel with a sulphur content not exceeding 0.50%

4. Transport Canada Publication (on their website) acknowledges: “Canada’s marine industry faces challenges to comply with the ECA emissions limits”

-Future Marine Fuel Study, March 2012 (accessed on March 5, 2017)
<http://www.tc.gc.ca/eng/innovation/tdc-projects-marine-1579.html>

*“The report determines that ECA compliance is achievable using available emission control technology. However, the high cost of alternative and conventional distillate fuels will require fuel switching, speed reduction, or expensive exhaust emission after treatment for vessel operators to remain competitive and in compliance. The high cost differential between residual fuels, distillates, and alternative liquid and gaseous fuels will be the primary reason that a **widespread changeover to marine distillates and alternative fuels will not be realized**. A secondary factor inhibiting the changeover is the lack of infrastructure and operational issues related to alternative fuels. In essence, the domestic marine infrastructure cannot provide an adequate supply of alternative fuels.”*

“Fuel switching from HFO to medium diesel oil (MDO) in ECAs is feasible but operationally difficult. Installing exhaust after treatment devices such as SCR or SOx scrubbers requires substantial investment capital that may require the government to provide financial assistance in the form of rebates or tax write-offs. Reducing vessel speed in order to lower emissions will increasingly become a less viable option, because emission limit areas are set to expand considerably. The longer transit times at reduced speed will impact schedule and cost.”

5. Exemptions from sulphur in diesel restrictions are so common in the US that the EPA has an online system for applying for them.

Have similar exemptions in Canada been factored in to MEIT?
“owners and operators of vessels can electronically submit a disclosure of fuel oil non-availability using a Fuel Oil Non-availability Disclosure (FOND) form” -
<https://www.epa.gov/enforcement/marpol-annex-vi>

6. EU also allows exemptions to low Sulphur regulations

- *The documentation of switchover should clearly state: Interdiction of the use of LSF in a vessel without approved modifications [does this constitute a record that they attempted to achieve compliance?]*
- *The international MARPOL Regulations is transferred to European law by Directive 2012/33/EU regarding sulphur content of marine fuels. It regulates inter alia the sulphur content of fuels used by maritime transport in the Baltic Sea, North Sea and English Channel. It states in the relevant regulations: Member States shall take all necessary measures to ensure that marine fuels are not used [...] within SOx Emission Control Areas if the sulphur content of those fuels by mass exceeds [...] 0,10 % as from 1 January 2015. If a ship is found by a Member State not to be in compliance [...] with this Directive, the competent authority of the Member State is entitled to require the ship to:*
 - *present a record of the actions taken to attempt to achieve compliance; and*
 - *provide evidence that it attempted to purchase marine fuel which complies with this Directive in accordance with its voyage plan [...] and [...] no such marine fuel was made available for purchase.*
 - *The ship shall not be required to deviate from its intended voyage or to delay unduly the voyage in order to achieve compliance.*

<http://www.ics-shipping.org/docs/default-source/Other-documents/industry-guidance-on-compliance-with-the-sulphur-eca-requirements.pdf?sfvrsn=2>

7. Does Transport Canada Allow Further Exemptions from Sulphur Regulations, see (1) above: “a vessel is not expected to purchase fuel that would not comply with quality specifications set by the vessel’s engine manufacturer”

Transport Canada records should be reviewed and referred to in the Aurora Application to ensure that the actual record of levels of compliance supports the Assumptions which they make. The wording given by TC above coupled with the statement by one of the major marine engines about low Sulphur fuel’s quality limitation for their engines suggests compliance might be a significant issue:

The European Community Shipowners’ Associations, Industry Guidance on Compliance with the SulphurECA Requirements -October 2014 suggests that low Sulphur fuel does not meet quality specifications set by the vessel’s engine manufacturer:

- *“The change-over procedure from HFO to MGO usually takes a longer period of time, during which there will be a mix of the two very different fuels. As a result of this mixing, the asphaltenes of the heavy fuel are likely to precipitate as heavy sludge, with filter clogging as a possible result (MAN, Primeserve, 2010).”*
- *“Therefore time should be allowed to maintain the temperature gradient recommended by the engine manufacturer, e.g. 2°C/minute, in a controlled*

manner while switching fuel. This will in many cases be necessary in order to avoid a thermal shock to the system, e.g. seizure of fuel injection pumps, and/or other operational problems that may occur due to low viscosity and/or rapid temperature changes. Injection pumps are designed with quite small tolerances and benefit from sulphur content in fuel to ensure lubrication. By running on MGO, these elements may seize due to lack of lubrication, with the result of potential loss of power. Worn injection pumps may have increased leakages leading to alarms and disturbances in operation. Consequently reduced maintenance intervals may be necessary. MAN for example acknowledges these risks and underlines that low viscosity of the marine fuel used may cause seizures, starting difficulties and problems operating at low load. Statistical data shows that the majority of the supplied fuels have viscosities in the range of 2.5 – 4 cSt (at 40 degC). As parameters requiring increased focus operating on distillate fuels, MAN describes:

- Viscosity (> 2 cSt, preferably >3 cSt);
- Change-over between HFO and MDO / MGO;
- (Compatibility, thermal shocks, gassing of hot gas oil);
- And vice-versa (MDO/MGO to HFO);
- Lubricity (max. 460 mm according to ISO12156 (HFRR test));
- Correlation between low sulphur and cylinder oil BN.

MAN recommends to test the engines low viscosity limit, to install "tools" in the fuel system where possible (cool-ing/change over) and to focus on cylinder condition (lub oil consumption/BN)."

8. There is evidence that, when MEIT is used, the forecast emission concentrations are underestimated.

When PRAS compared forecast concentrations using MEIT for Total Base Case Emissions with actual monitoring data there was a roughly tenfold under estimation. Part of that underestimation may have been due to MEIT using overly optimistic assumptions about compliance. F_R PRAS modelled concentrations using 1100 t/y NOx and was nearly a magnitude low compared to the actual concentrations measured at the monitoring station.

This could be because some MEIT assumptions can make it into an idealized emission calculator which does not take into account: fighting high tides in Rupert Harbour, poorly tuned engines, snorting when maneuvering, failure to use correct fuel, failure to meet NOx reduction due to equipment limitations with or without government approval, etc.

9. Does the MEIT or related assumptions used in the Aurora Application consider use of shore power at 50% for all vessels? If so is this realistic considering technical difficulties with incompatible frequency and voltage are expensive to overcome? Port records should be reviewed and existing use of shore power with moderate improvement should be used to realistically estimate the future.

10. Assumed compliance with the Tier 3 emission standards may be too onerous and not followed to a significant extent:

"It was announced for January 1st, 2016 the time of tier 3 requirement of being in force. It is seemed to be impossible the fulfilling of that standard on marine liquid fuels (HFO and MDO)." -Journal of KONES Powertrain and Transport, Vol. 18, No. 2 2011 This is an opinion on meeting European standards.

11) Steamships built on or before 2011 are exempt from Sulphur limit as of 2017

*"Regulation 14.4.4 of Annex VI contains a provision that postpones the application of the ECA fuel sulfur limits with respect to certain steamships that operate in the North American and Caribbean Sea ECA. This flexibility is available to steamships, regardless of flag, "built on or before 1 August 2011 that are powered by propulsion boilers that were not originally designed for continued operation on marine distillate fuel or natural gas." As explained in our paper to IMO requesting this amendment to Annex VI (MEPC 61/7/6), this provision was adopted to provide relief for older steamships that were designed for dedicated operation with heavy fuel oil." -2017
<http://www.hellenicshippingnews.com/north-american-and-u-s-caribbean-sea-eca-understanding-compliance-issues/>*

12) Base Case background concentrations forecast using MEIT assumptions (with similar emission forecasts as those in the Aurora Application) proved to be far too low compared to actual monitoring data

This is mostly important because it suggests there maybe something wrong with MEIT assumptions. The Prince Rupert Airshed Study (PRAS) analysis can be used to understand the similar Aurora Application issues.

Table 2-3: Comparison of Base Scenario Results to Monitored Data for SO₂ and NO₂.

Criteria	SO ₂ Concentrations, ($\mu\text{g}/\text{m}^3$)		Criteria	NO ₂ Concentrations, ($\mu\text{g}/\text{m}^3$)	
	Modelled ^a	Monitored ^a		Modelled ^a	Monitored ^a
1-hr Maximum	6.52	16.46	1-hr Maximum	20.53	50.38
1-hr 98th%	3.26	4.70	1-hr 98th%	8.29	30.68
24-hr Maximum	1.62	2.28	24-hr Maximum	4.38	18.27
Period Average ^b	0.36	0.77	Period Average	1.18	10.25

- a. The modelled and monitored concentrations shown in this table are for the period starting April 14, 2013, 11AM and ending August 16, 2013, 4PM, for which the MAML was in place on Water Street, Prince Rupert (latitude 54.305962N, longitude 130.342344W). The modelled concentrations do not include any background concentrations.
- b. The period averages for the modelled and monitored concentrations are for the limited period with a total of 2,981 hours, and are not directly comparable to the annual average background concentrations used in PRAS.

Table 2-3 (PRAS pg. 76) shows the PRAS Base Case estimate was extremely under-conservative when compared to actual monitoring data. NO₂ concentrations for the period average may not be directly

comparable however they do indicate a magnitude of difference if the monitored period is similar to the year average (1.18 modelled compared to 10.25 measured). NO₂ 1-hr 98th percentile, a parameter of special concern for human health, was almost four times higher when actually measured than the PRAS model forecast (8.29 modelled compared to 30.68 measured).

The Aurora Application Base Case estimate:

“Total Base Case Emissions (t/y): SO₂-45.3, NO_X-1188, CO-262, PM10-198, PM2.5-115, VOC-66.3” –Aurora Application

closely resembles the PRAS Base Case estimate which was found to be extremely under-conservative when compared to actual monitoring data –see Table 2-3 above.

- F_R PRAS modelled concentrations using 1100 t/y NOx was nearly a magnitude low compared to the actual concentrations measured at the monitoring station. The Aurora Base Case estimate for NOx was 1188 t/y nearly the same as PRAS, so it is likely Aurora is low compared to monitored as well.
- The Base Cases can be compared but Aurora but they are not identical for instance because Aurora used MEIT database 2015 and PRAS used MEIT 2013 (“The Base Scenario used emission rates based on actual 2013 activities.” -PRAS pg. 32). This discussion of Base case vs measured is to show that the adjustments used in MEIT which reduced the forecast emissions could be corrected down by a factor of roughly four to one and match the monitored data better than they do now. This is not to say there is such a large error, only that it is important for the public to have access to the Aurora Application MEIT assumptions in order to review them.
- F_R PRAS pg. 4 Port Facilities terminals shipping and anchorages totals ~3 t/d NOx which is ~1100 t/y NOx. This F_R PRAS estimate of 1100 t/y NOx is close to the Aurora Applications estimate of 1188 t/y NOx
- F_R base case modelled concentrations revealed that they would be much higher over Dodge Cove area than over the Water Street monitor area – pg. 48 PRAS. This indicates that a simple addition to background would not correct for the large discrepancy between estimated background and actual if the discrepancy is due to MEIT unrealistic assumptions about compliance to emission regulations.
- The Aurora application and the PRAS both acknowledged the discrepancy to monitored data but their solution, an adjustment upwards of baseline concentrations to match monitored data, would not correct for any systemic MEIT underestimation of emission rates nor would it correct for the use of in stack conversion ratios which were far too low for marine emissions.
- The PRAS used 30% for on land Turbine stacks but both Aurora and PRAS used only 10% for marine stacks even though NOx reduction equipment was likely assumed in MEIT. So, as well as the MEIT issue for total marine NOx, in the case of NO₂, the discrepancy may be exacerbated by errors in the calculation of NO₂/NOx from known sources. PRAS used 10% for its stack NO₂/NOx ratio for marine sources and this may be too low if NOx reduction equipment is in place (for compliance with regulations considered in MEIT). NOTE that Aurora also used 10% (See attached discussion re NO₂/NOx ratios)
- The argument given by PRAS and Aurora, that the discrepancy is the result of “sources not included”, is undermined by the fact that modelled SO₂ was far less than actual monitored data

and it is unlikely SO₂ sources were missed. It needs to be considered that assumptions about sulphur in fuel compliance are too optimistic.

- The SO₂ 1 hour max was 16.46 according to monitoring data but PRAS had only calculated/modelled it to be 6.52. This suggests there is a problem with the marine emissions from PRPA MEIT; they made assumptions which underestimated the true SO₂ by half. This is unlikely to be missed sources because SO₂ doesn't come from domestic sources.
- It is also unlikely that the NO₂ is from missed or domestic sources. In a larger city where domestic traffic is a larger consideration this may have been valid but generally Prince Rupert has very little traffic for its population and this is especially true of domestic traffic in the area where the monitor was on Water Street
- In the PRAS (pg. 75) there is discussion that monitored levels greatly exceeded modelled levels so PRAS added "background" to the PRPA base emissions to adjust, they say this was needed because cars and other non-industrial sources weren't included but we do not agree that this accounts for the whole discrepancy. It could also be that their emission factors were/are too low; MEIT current regulations were not being met and new ones will not be met either.
- In both the MEIT error and NO₂/NO_x calculation error scenario, simply adding a proportion to background as PRAS and Aurora did, will not correct the repetition of those errors when adding Fairview 2 or calculating all other marine emissions.
- Simply adding a proportion will also fail to place the highest concentration of the extra NO₂ (SO₂, etc.) in the correct place: namely over Dodge Cove and Westview Rupert and Metlakatla, because if the discrepancy is from under estimation by the MEIT of known source ships it will be concentrated over those residential areas and would have been much less at the monitoring site.
- The modelled concentrations of max of 98th percentile 1 hr. ave. daily peak NO₂ were well into the red CCME for Dodge and Crippen Cove and western portions of Prince Rupert residential in the F_R pg. 89 (the forecast which did not include reductions related to possibly improper use of MEIT). This is important because it shows that the baseline concentrations are much higher in these areas than at the monitoring site and so rather than underreporting them as Aurora has done by simply adding a proportion, they should be conservative.
- We disagree with a simple addition to background to adjust for the monitored data discrepancy but we would still like clarification on what adjustment was made, if any.

Although the Application does not make it clear whether or not any adjustments were made to account for discrepancies with monitored data, Aurora stated in their *4.3 Baseline Air Quality*: "*24-hour baseline NO₂ and SO₂ values were calculated based on available monitoring data. The NO₂ baseline is based on the 98th percentile of the monitoring data...Kitimat ...Baseline Annual NO₂ ($\mu\text{g}/\text{m}^3$) 5.64*". We understand that the data from the monitoring station did not include a whole year but it would still be the conservative average to use. We do not know if a full year would have given a higher or lower value. "*Annual NO₂ from Rupert monitoring was 10.3 $\mu\text{g}/\text{m}^3$ at Water St.*" - pg. 75 PRAS, so why was 5.64 used by Aurora?

PRAS used an adjustment to get it up to 6.8 but acknowledged that this was still less than monitored: *"For annual NO₂, Base Scenario modelled concentrations plus background concentration is equal to 6.8 µg/m³ compared to the monitored period average of 10.3 µg/m³. While the average Base Scenario + background NO₂ is less than that measured by the MAML, it should be noted that the MAML monitoring took place for approximately 4 months and is not representative of annual average concentrations. Adjusting the annual average background upward by 3.5 µg/m³ would not result in a change in risk category at an location in the health section".-pg 75 PRAS*

An adjustment upward in the Aurora Application from 5.64 to 10.3 might very well result in a change in risk category at a location in the health section.

- As mentioned we would like clarification that 5.64 adjustment was actually used in Aurora because another excerpt from the Aurora Application leaves it in doubt:

3.3 BACKGROUND AIR QUALITY

3.3.1 Continuous Monitors

"To be consistent with the Guidelines (BC MOE 2008), background concentrations for the substances of interest are established based on the MAML and Prince Rupert Seal Cove data (see Table 2). Section 10.1 of the Guidelines (2008) allows the background value for the hour averaging period to be established from the 98th percentile within the dataset. Other averaging periods should use the measured maximum for that averaging period. On Table 2, these background values are compared to background values used in the draft Prince Rupert Airshed Study (PRAS 2015). [PRAS being referenced in Aurora Application]

If required by MOE, a proportion of these background levels will be added to the predicted concentrations from the dispersion modelling of the emissions from the existing sources (described above). This is done to account for the effects of sources not included in the dispersion modelling- Aurora Application Appendix A pg. 93

Klym Bolechowsky, P.Eng.
on behalf of the T. Buck Suzuki Environmental Foundation, Prince Rupert Environmental Society, and United Fishermen and Allied Workers Union – UNIFOR

following

March 9, 2017

Dear Luanne,

As requested, here is a brief summary of the main points in my comment submitted yesterday (March 8, 2017) to the BC EAO on the proposed Aurora LNG Digby Island project. The version of the Marine Emission Inventory Tool (MEIT), model inputs, and assumptions are not described in the Application in sufficient detail to allow the assumptions and predicted emission levels to be tested or verified. Differences in the METI version, inputs, and assumptions can result in significantly different predicted levels of Criteria Air Contaminant (CAC) emissions. The Application and supporting documents are not clear on these points so this information should be provided to the public for transparency.

Regards,

Klym Bolechowsky, P.Eng.

Please provide clarification on how existing marine-based air emission rates were established within the regional assessment area (RAA). The Environmental Assessment Certificate Application, Appendix A - 'Air Quality Technical Data Report', references version 4.1 of the Marine Emission Inventory Tool (MEIT) as the source of marine vessel emission rates. It states that marine-based air emission levels from 2010 were forecasted to 2015 in the MEIT for the 2010 National Marine Emissions Inventory for Canada (SNC Lavalin, 2012b). The 2010 emission inventory report acknowledges uncertainty in the west coast emission estimates on page ES-4:

"The Canadian Coast Guard VTOSS data was found to be inferior to INNAV for purposes of marine inventory development. For this reason, the emission estimates for the west coast are considered to have higher uncertainty than estimates for the east coast. The INNAV system is now being used by the Coast Guard on the west coast (as of 2011) and will be available for future marine emission studies."

The conclusion section of the same report includes suggested actions for future improvements to the MEIT and Canada's national marine emission inventory including:

"Evaluation of the west coast inventory by acquiring and using 2011 INNAV data in MEIT V4.0."

Was the higher quality INNAV activity data added to the MEIT for the purposes of this Environmental Assessment?

A document posted on the EAO web site on March 7, 2017, 'MEIT User Guide V4.3 March 20, 2015.pdf' includes a model history section (Table 1-1, page 3) that lists version 4.3, March 2015 as the most recent version of the MEIT. However, another file posted on the EAO web site, 'Updated Tables_MEIT 4.3.1' includes tables of west coast marine emission estimates sourced from "Excerpt from MEIT Update 4.3.1 (by ECCC)". For transparency, please clarify which version of the MEIT was used as the source for the emission levels presented in the application and the source of the MEIT marine vessel activity data for the west coast (VTOSS, INNAV, others...). From this version of the MEIT, please provide reports in Excel spreadsheet format (and/or Excel pivot table format as mentioned in the User Guide) that show the emission levels used in the Environmental Assessment Application. Please also include a list of assumptions including if 100% compliance or partial compliance was assumed with the Emission Control Area (ECA) sulphur fuel standard and the IMO Tiered NO_x emission standards for marine vessels operating within the ECA.

Thank-you,

Klym Bolechowsky, P.Eng.
on behalf of the T. Buck Suzuki Environmental Foundation, Prince Rupert Environmental Society, and United Fishermen and Allied Workers Union - UNIFOR

Klym Bolechowsky, P.Eng., is a Principal at ClearSky Engineering Inc. located near Calgary, Alberta. Mr. Bolechowsky manages air quality and energy related projects including air emission inventories and control studies, marine vessel emission analyses, greenhouse gas verification, and environmental database and software development. Klym has twenty years of experience working both in consulting and industry providing project management and air quality related services. He is an excellent communicator with well developed presentation and multi-sector/stakeholder project management skills. He is a registered Professional Engineer in the province of Alberta and was registered in British Columbia and Ontario previously.

Educational and Experience Summary

Mr. Bolechowsky attended the University of Toronto where he received his Bachelor of Applied Science (B.A.Sc.) in Mechanical Engineering in 1993.

From 1994 to 2000, he worked at General Motors and then at Chrysler as a facility environmental engineer. During this time he was responsible for developing air emission inventories for the painting operations and the entire automotive manufacturing process. He managed environmental projects related to air quality including air permitting, dispersion modelling, and NPRI reporting. In his role as plant energy coordinator, he implemented energy savings projects participating in Canada's Voluntary Challenge and Registry (VCR) and Industrial Energy Innovators Program. His mechanical/facilities engineering work included plant manufacturing support and the installation of water treatment systems.

Klym joined Levelton in 2004, specializing in air emission analysis and emission inventory development in the industrial and transportation sectors. He progressed to the position of Manager of the Environmental Studies Group in Levelton's Environment & Energy Division. He has completed air quality projects for government and industry including oil refining, chemical manufacturing and forest products. He completed a study for the Canadian Petroleum Products Institute (CPPI) analyzing the GHG impacts at Canadian refineries from desulphurization processes to meet ultra low sulphur diesel requirements. In the area of environmental data management, he developed a database application to track air toxic emissions and an emission database for the chemical industry. He designed a diesel fleet emission calculator and a marine emission database application that is the first of its kind in North America.

Klym relocated to Alberta in 2007 and founded ClearSky Engineering (www.ClearSkyEng.com), a business focused on providing world class air quality and energy consulting services. ClearSky's office is located in North America's first solar heated community in Drake Landing, Okotoks, AB. The district solar heating system includes an array of solar panels generating thermal power for space heating and hot water, and geothermal energy storage system (www.dlsc.ca).

Klym is committed to utilizing his technical expertise and project management skills to support air quality improvements and the development of sustainable, renewable energy systems and infrastructure.

- University of Toronto - 1993
 - B.A.Sc. Mechanical Engineering
- Environmental Engineer – 1994-1998
 - General Motors of Canada Ltd., Oshawa, ON
- Environmental & Facilities Engineer – 1998-2000
 - Chrysler Canada Inc., Bramalea, ON
- Sheridan College – 2001
 - Post Graduate Program
- Systems Analyst – 2002-2003
 - ACE INA, Toronto, ON
- Environmental Studies Group Manager – 2004-2007
 - Levelton Consultants Ltd., Vancouver, BC
- Senior Project Manager - 2007 to present
 - ClearSky Engineering, Okotoks, AB

Professional Experience

Senior Project Manager, May 2007 – Present

ClearSky Engineering www.ClearSkyEng.com

- Air quality and energy related consulting services including emission inventory development, renewable fuel and energy technology analysis, emission control options
- Marine emission analysis, ocean-going vessels
- Third-Party GHG Emission & Offset Project Verifier
- Environmental software packages and database development including emission calculators, inventory applications, and environmental databases
- National Pollutant Release Inventory (NPRI) and GHG reporting
- Vehicle & engine emission studies utilizing MOBILE6.2C & NONROAD models
- Air quality support for ERCB Oil & Gas Development Licence applications

Environmental Studies Group Manager, Jan. 2004 – May 2007

Levelton Consultants Ltd. www.levelton.com

- Engineering Manager of Environmental Studies Group within Environment & Energy Division
- Preparation of proposals and detailed workplans, managing project budgets and schedules, providing direction and guidance to multi-disciplinary project teams, allocation of resources
- Detailed project accounting and financial management for short and long-term projects
- Senior engineering consulting services including the development of emission inventories, air quality studies, motor vehicle emission control analysis, renewable fuel & energy technology
- GHG Emission Impacts & Forecasts, Canadian Oil Refineries, multi-stakeholder project for Environment Canada, NRCan, Industry Canada, Canadian Petroleum Products Institute
- Air Toxics Emission Study prepared for Greater Vancouver Regional District (GVRD)

Systems Analyst, 2002 – Dec. 2003

ACE INA Canada www.ace-ina-canada.com

- Systems analysis and business requirements scoping
- Database development & administration: SQL Server, MS Access, Sybase, DB2
- Development and support of web based applications

Environmental & Facilities Engineer, 1998 – 2000

Chrysler Canada Inc., Bramalea, Ontario www.chryslercanada.ca

- Managed environmental projects for air quality, waste water treatment, waste management
- Team Leader for ISO9000 & 14000 cross functional teams
- Environmental auditing and reporting/presenting to management
- Managed paint shop restoration project, coordinating contractor and CAW skilled trades activities and scheduling
- Managed project to install reverse osmosis water treatment system

Environmental Engineer, 1994 – 1998

General Motors of Canada Ltd., Oshawa, Ontario www.gmcanada.com

- Team Leader for Car Plant Annual National Pollution Release Inventory (NPRI) reporting
- Developed and maintained an air emission database
- Plant Energy Coordinator – identification and implementation of energy saving projects
- Managed project to install demineralized water treatment system and distribution piping

Education

- Bachelor of Applied Science (B.A.Sc.), Mechanical Engineering 1993 University of Toronto

Received Dr. Arthur Hermann Memorial Award for thesis project and course work at the University of Toronto reflecting concern for the protection of the environment

- Information Technologies Professional Internship Post Graduate Program 2001 Sheridan College

Received Award for Academic Excellence for the highest cumulative grade point average

Continuing Education

- 2013, Green Marine Annual Conference, Vancouver, BC
- 2009, U.S. EPA Emission Inventory Conference, Baltimore, MD
- 2006, Introduction to ArcGIS, ESRI Canada, Vancouver, BC
- 2005, Project Management Bootcamp, PSMJ, Richmond, BC
- 2005, Ultra Low Sulphur Diesel Conference, A&WMA, Seattle, WA
- 1994, Air Pollution Control, M. Eng Program, University of Western Ontario, London, ON

Affiliations

- Association of Professional Engineers and Geophysicists of Alberta (APEGA)
- Air and Waste Management Association (A&WMA)

Other Technical Activities

- 2010, Chair of Tours & Transportation Committee for the Calgary June 2010 Air & Waste Mgmt. Association Annual Conference and Exhibition event
- 2010, Presented paper and poster at A&WAM Conference in Calgary:: *GHG Emission Verification, Marine Emission Inventory Tool*
- 2009, Presented paper at EPA Emission Inventory Conference, Baltimore, MD: *GHG Emission Verification*
- 2009, Presenter at Sustainable Shipping West Coast Collaborative Meeting, San Francisco, CA: *Marine Emission Inventory Tool*
- 2005, K. Bolechowsky, A. Schutte, Air Quality Workshop, Canadian Petroleum Products Institute
- 2000, guest speaker and member of Brampton Environmental Community Advisory Panel

References

- Available upon request

Marine Related Project Experience

2010 Canadian National Marine Emission Inventory, Environment Canada, March 2012

Klym collaborated with SNC-Lavalin on the development of a 2010 Canadian national marine emission inventory. The inventory includes all commercial marine vessel classes tracked by the Canadian Coast Guard within Canada's territorial waters including container ships, bulk carriers, lakers, cruise ships, etc. The activity data used in the inventory included data logged in the INNAV system for eastern Canada, the Great Lakes, and the Arctic. VTOSS data was utilized for the west coast. Klym's role on the project team was to support use of and updates to the Marine Emission Inventory Tool (MEIT), develop methods for unique vessel classes, review emission factors, and perform QA/QC reviews.

Energy Efficiency Design Index (EEDI) Study, Environment Canada, March 2012

Klym researched energy efficient technologies that could be adopted by Canadian vessels to comply with the terms of the EEDI. The work involved consultation with the shipping industry, engine manufacturers, and ship builders to determine potential energy savings & GHG emission reductions, costs, installation requirements, and case studies.

Canadian Adaptation of the MOVES Model (Motor Vehicle Emission Simulator), Environment Canada, April 2012

In an effort to harmonize vehicle emission regulations and to make meaningful comparisons between Canada and the US, Klym worked on a scoping study describing the work required to develop a Canadian version of the EPA's MOVES model. MOBILE6.2C is the current Canadian-specific emission model that addresses differences in the on-road Canadian fleet in the development of mobile source emission estimates for Environment Canada's Air Pollutant Emissions Inventory, trends and forecasts. The MOBILE model has been replaced by MOVES as the EPA's officially supported model for estimating emissions from cars, trucks and motorcycles. The project deliverables included a report describing the logic and methods required to revise the MOVES underlying database.

Marine Emission Inventory Tool, Environment Canada & Transport Canada, March 2006

The Marine Emission Inventory Tool is a database application developed to estimate emissions from ocean-going vessels travelling in Canadian waters. The marine tool was utilized to prepare a detailed marine emission inventory required as part of a joint application submitted by Canada and the United States to the International Maritime Organization (IMO) to designate North America as an Emission Control Area (ECA). The MEIT was developed due to the increased focus on marine vessel emissions in Canadian ports. It was originally developed in 2005 for Environment Canada and has had a number of enhancements added by various firms. In February, 2009, Klym completed a major upgrade to the Marine Tool for Environment Canada to migrate the database from MS Access to SQL Server. This enhancement provided networking capabilities for multiple users, enhanced security, and a scheduled back-up system. In March, 2010, he completed further updates

including forecasting of NO_x emissions based on fleet turnover, addition of ammonia emissions, detailed vessel statistics, fuel-based emission calculations, and addition of an 'at anchor' mode.

Updates to the Marine Emission Inventory Tool, Environment Canada & Transport Canada, 2007 - 2010

Klym completed a series of enhancements to the Marine Tool in March 2008 to estimate GHG emissions including CO_{2e} and improve the database. In February, 2009, Klym completed a major upgrade to the Marine Tool for Environment Canada to migrate the database from MS Access to SQL Server. This enhancement provided networking capabilities for multiple users, enhanced security, and a scheduled back-up system. In March, 2010, he completed further updates including forecasting of NO_x emissions based on fleet turnover, addition of ammonia emissions, detailed vessel statistics, fuel-based emission calculations, and addition of an 'at anchor' mode.

Sulphur Emission Control Area (SECA) Analysis, Engine Control Technologies and Emission Standards, Transport Canada, April 2008

To assist Transport Canada in their evaluation of the feasibility of a Sulphur Emission Control Area (SECA) designation for Canada, an analysis of control technologies available to the marine sector was conducted. The primary objective of the assessment was to assemble information and data to facilitate the understanding of existing and emerging emission control technologies which would present cost-effective options to the marine sector in complying with a SECA implementation plan, caps on sulphur content in fuel and/or emission standards. As part of the examination of a SECA defined region in Canada, varying SECA scenarios were analysed to determine the impact on oxides of sulphur (SO_x) and particulate matter (PM) emissions from the fleet of Canadian-flagged and foreign-flagged vessels travelling to the east coast of Canada and on the Great Lakes. Klym worked as a sub-contractor to Levelton on this project.

Marine Emission Inventory Study for Eastern Canada and the Great Lakes, Transport Canada, March 2006

The marine vessel emission tool was applied to prepare a regional emission inventory for commercial marine vessels operating on the Great Lakes, the St. Lawrence Seaway, and the East Coast of Canada. The emissions were spatially allocated using a GIS system. Work included development of a spatially resolved air emission inventory using activity-based information recorded in the Canadian Coast Guard INNAV database, preparation of emission forecasts for 2010 and 2020 including emission reductions that could occur for SO_x and PM by implementation of a Sulphur Emission Control Area (SECA), and preparation of an emission inventory spatially resolved to regional polygons and 4 km by 4 km grid cells. Klym was responsible for the methods and inventory development while at Levelton.

Revisions to MOBILE & NONROAD Models, Environment Canada, May 2009

ClearSky Engineering was retained by Environment Canada to revise and enhance the MOBILE and NONROAD models in order to more accurately reflect Canadian-specific conditions. MOBILE6.2C is an on-road emission factor estimation model originally developed by the US EPA, then modified by

Environment Canada to incorporate Canadian fleet testing data. NONROAD2005 is the counter-part model for off-road vehicles, engines and equipment. To support the compilation and reporting of the National Criteria Air Contaminant Inventory, Environment Canada's Pollution Data Division (PDD) required enhancements to the models to more accurately reflect Canadian conditions. The work included enhancements to better approximate the use of renewable fuels in accordance with the US EPA's Renewable Fuel Standard (RFS) program. Recent data on cold-temperature engine emissions were reviewed in detail to develop cold temperature adjustments to the emission factors in order to more closely approximate Canadian conditions.

Nonroad Engine Emission Inventory, Metro Vancouver, November, 2007

Mr. Bolechowsky worked with RWDI Air and Genesis Engineering to develop an inventory of nonroad equipment and associated emissions in the Greater Vancouver and Fraser Valley Regional Districts. The EPA NONROAD2005 model was utilized to estimate emissions from various categories of off-road equipment operating within the study area. Klym was responsible for developing engine population estimates by equipment category, preparing detailed input files, and running the NONROAD model to generate the emission inventory.

Economic and Environmental Impacts of Removing Sulphur from Canadian Gasoline and Distillate Production, Canadian Petroleum Products Institute (CPPI), Natural Resources Canada, Environment Canada, and Industry Canada, August 2004

The study "Economic and Environmental Impacts of Removing Sulphur from Canadian Gasoline and Distillate Production" was a multi-stakeholder study for Canadian Petroleum Products Institute (CPPI), Natural Resources Canada, Environment Canada, and Industry Canada. This study involved a review and assessment of how changes to the Canadian refining industry to meet regulated low sulphur fuels requirements (for gasoline and on-road and off-road grades of distillate), would be undertaken, the potential economic impact on the industry and the resulting incremental GHG emissions and forecasts. Mr. Bolechowsky, working at Levelton at the time and in association with Purvin & Gertz, was responsible for reviewing emission data and working with the refinery contacts and asphalt plants to QA/QC their reported GHG emissions and calculation methodologies. Klym worked closely with John Nyboer of the Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) as well as the industry and government representatives.

Presentations

Marine Emission Inventory Tool and Emission Control Area (ECA) Analysis poster presentation - A&WMA's 103rd Annual Conference & Exhibition, Calgary, June 24, 2010

Marine Emission Inventory Tool Demo - West Coast Collaborative Ports/Marine Sector Meeting, San Francisco, September 29

Marine Emission Inventory Tool Demo - EPA 18th International Emission Inventory Conference, Baltimore, April 14, 2009

Marine Emission Inventory Tool – Tutorial Workshop, presented to Transport Canada, Ottawa, March 27, 2009

Summary of Aurora Application description of Marine Emission Sources- MEIT and assumptions
-L Roth

Air Quality and potential exceedances of CCME objectives in residential areas are of prime concern in reviewing the Aurora Application. Assumptions regarding existing marine based emission sources are a significant factor in determination of forecast air quality. In order to review their validity we would like to find out what the key assumptions are. For instance:

- How many container ships were estimated to be contributing to existing emissions? (This can be compared to the projections for Fairview Phase II to insure the total is accurate)
- What emission rates for SO₂ and NO_x were used for container ships and dry bulk carriers? (this can be checked by experts)
- How many vessels are estimated: grain, log, pellet, container, coal, ferries, cruise and tugs?

We would like to know the exact source of the data and have access to it to check it, however we cannot tell from the Application exactly what was used and who supplied it.

The Application Air Quality Appendix gives several different descriptions of the sources they used to calculate existing marine emissions:

- MEIT version 4.1 (SNC Lavalin 2012b). on page 169/383 [Lavalin 2012b MEIT 4.1]
- SNC Lavalin. 2012a. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email. on page 222/383 [Draft PRPA Lavalin 2012a MEIT]
- SNC Lavaline, 2012b. Canadian 2010 Marine Emissions Inventory. Provided by Environment Canada September 2014. on page 222/383 [EC Lavalin 2012b MEIT]
- Prince Rupert Port Authority (PRPA) SNC Lavalin 2012b on page 20/283[PRPA Lavalin 2012b MEIT]
- 6.2 Personal Communications
- 6.2 Personal Communications
Bellavance, P. March 4, 2015. Email RE: MEIT – Line table and shapefiles – FTP Ready.
McEwen, B. 2015. March 12, 2015. Email RE: Follow up on MEIT questions on page 223/383 [Is this a change, alteration or clarification to the 2012a MEIT referred to on page 223/383? If so, what is the change, alteration or clarification and what is the basis for it?]
- Note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.

More detailed references are noted below. For instance it clearly says in Section 5.1 of the Aurora Application Appendix A Air Quality (AA AA) on page 24 that all marine-based air emissions are extracted from MEIT developed by Environment Canada (SNC Lavalin 2012a):

All marine-based air emissions are extracted from the MEIT developed by Environment Canada (SNC Lavalin 2012a). The locations of existing marine-based activities are shown in Figure 4 and Figure 5, as both point source and line source locations, respectively. Assumptions used to determine marine-based air emissions are summarized in Section 5.1.2.

Aurora told us through Sean Moore of EAO on Feb 15th 2017 that:

"The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A."

Page 3 authorship is given (also see note re pg. 60 where Stantec describes their level of responsibility):

AUTHORSHIP

Magda Kingsley, B.Sc., M.Sc.....	Lead Author
Michelle Bentzen, B.Sc., M.E.Des.	Author
Michelle Xue, Ph.D., P.Eng.....	Emission Inventory
Lily Lu, B.Sc.	Post Processing and Analysis
Baoning Zhang, Ph.D., P.Eng.....	CALPUFF Modelling
Yan Shen, M.Sc.	Meteorological Modelling
Reid Person, M.Eng., B.A.Sc., P.Eng.	Quality Reviewer
Peter Reid, BES, M.A.....	Independent Reviewer

In Aurora Appendix A (AAAA) On page 20/383 just prior to section 5.1.2, sources are given in Table 5:

Table 5 Sources for Publicly-Available Existing and Future Regional Emissions Data

Regional emission inventory	Canadian 2010 Marine Emissions Inventory (SNC Lavalin 2012a)	Information contained in the database for the Marine Emissions Inventory Tool (MEIT)
	BC Environment Assessment Office (2015) website	Existing regional emission inventories used to support the Fairview Container Terminal Phase 2 (Stantec 2009), Canpotex Terminal (Stantec 2011) and the Pacific NorthWest LNG Project (Pacific NorthWest LNG 2014) EAC applications
	EC National Pollutant Release Inventory (NPRI 2014)	2014 NPRI database
	Prince Rupert Port Authority (PRPA) study (SNC Lavalin 2012b)	Port of Prince Rupert air model and emission study
	Transport Canada study (SNC Lavalin 2014)	West coast ports 2010 emissions inventory study

Section 5.1.2 starts on page 26/383 AAAA

On page 26/383 it mentions (SNC Lavalin 2012a) and says regional marine-based air emission estimates for the RAA were extracted from the MEIT database.

5.1.2 Marine-based Activities

Environment Canada has developed the National Marine Emission Inventory Tool (MEIT) v4.1.0 database of marine emissions for Canada. The database contains emission estimates of SO₂, NO_x, CO, hydrocarbons, and particulate matter (total PM, PM10, PM2.5) as well as other CACs, greenhouse gases, and air toxins. The database contains emission inventories for years 1980, 1985, 1987, 1990, 1995, 2000, 2005, 2010, 2015, 2030, and 2050 (SNC Lavalin 2012a). Regional marine-based air emission estimates for the RAA were extracted from the MEIT database. The inventory includes all commercial marine vessel classes and smaller commercial craft (i.e., ferries and tugs) tracked within Canada's territorial waters. MEIT accounts for the latest regulatory restrictions on air emissions from marine-based activities including the International Maritime Organization global initiatives such as the Sulphur Emission Control Area, Engine Control Technologies and Emission Standards (MARPOL 2008).

It is assumed that the MEIT database for 2015 captures the air emissions of all regional marine-based activities. Year 2015 was used since the 2015 inventory includes the relevant regulatory restrictions for sulphur in diesel. The MEIT marine-based activities include Fairview Terminal (Phase 1), Prince Rupert Ferry Terminal, Prince Rupert Grain Terminal, Ridley Terminals, Atlin Terminal, Northland Cruise Terminal, cruise shipping and fishing and aquaculture activities. For 2015, most vessels are classified as merchant bulk (60%) and merchant container (25%), with smaller contributions from tugs, cruise ship and regional passenger ferries. The MEIT

database has both point sources and line sources. The point sources are emissions from anchorages, berthing, and piloting.

The line sources are transient emissions from marine vessels on route between anchorage points.

The locations of the anchorages, berthing, piloting, as well as the vessel routes are shown in Figure 4 and Figure 5. Additional MEIT database details are provided in Appendix 2.

The average marine-based air emissions extracted from the MEIT database are summarized in Table 8 in comparison to the existing land-based regional emissions. This comparison clearly shows that marine-based emissions are substantial contributors to the overall SO₂ and NOX existing regional emissions, and less so in terms of PM₁₀ and PM_{2.5}. As such the spatial distribution of MEIT line and point sources is expected to have a noticeable effect on existing regional concentrations in the RAA, and particularly in the Prince Rupert Harbour area.

On page 27 it again mentions the MEIT and summarizes the marine sources as point and line (see Table 8 from page 27/383) with no detail but refers us to: "Additional MEIT database details are provided in Appendix 2."

Table 8 Base Case Emissions (t/y)

Source Type	Annual Emission Rate (t/y)					
	SO ₂	NO _x	CO	PM ₁₀	PM _{2.5}	VOC
Fairview Terminal (Phase 1)	14.7	145	145	8.34	8.34	22.2
Prince Rupert Grain Terminal	0	0	0	166	84.8	0
PRPA Rail Utility	0.20	62.6	9.20	1.60	1.60	3.40
Total Base Case Land-based	14.9	207	154	175	94.7	25.6
Point (anchorages, berthing, piloting)	20.0	379	50.0	10.4	9.60	13.6
Line (on route)	10.5	602	58.6	11.9	11.0	27.1
Total Base Case Marine-based	30.4	981	109	22.3	20.5	40.7
Total Base Case Emissions	45.3	1,188	262	198	115	66.3

Page60

Says Stantec prepared it and describes Stantec's level of responsibility:

10 CLOSURE

This report has been prepared for the sole benefit of Aurora LNG and their representatives. The report may not be relied upon by any other person or entity without the express written consent of Stantec and Aurora LNG.

Any use of this report by a third party, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report was prepared by a number of Stantec staff, identified in the Authorship section preceding the Executive Summary. We trust that the above information meets with your present requirements.

Respectfully submitted,

STANTEC CONSULTING LTD.

Magda Kingsley, B.Sc., M.Sc. Reid Person, M.Eng., B.A.Sc., P.Eng.

Lead Author, Atmospheric Scientist

Page 68 and 69 Maps show point source and linear source for existing marine emissions from the MEIT but it does not specify which version and says there may be errors. Also it does not specify how many ships at each location and not sure if ferries are included.

MEIT is also mentioned on page 89/383. Here Aurora describes its plan and does not make it clear what emission rates will be used and what level of compliance with Sulphur in fuel regulations will be assumed and what emission rate for ships will be assumed for NOx :

Presently, marine vessels must be compliant with the International Marine Organization (IMO) North American Emission Control Area (ECA) that was adopted under Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL). Because of the new MARPOL regulations for marine fuel sulphur content, SO₂ emissions from the baseline sources will decrease from previous estimates. ... NOX emissions will decrease gradually as the older ships are decommissioned and Tier III compliant vessels become prevalent among the fleet. Current marine emissions will be estimated using the Environment Canada Marine Emissions Inventory Tool (MEIT).

Appendix 2 (referred to in section 5.1.2) starts on page 151/383

(page 169/383) Section 2.2 Marine-based Emission Sources starts on page 169/383 and it suggests that MEIT SNC Lavalin 2012b is an Environment Canada version and its 2015 dataset was used by Aurora:

Regional marine sources were extracted from the Environment Canada (EC) National Marine Emission Inventory Tool (MEIT). The air emission database contains all commercial class marine vessels and smaller commercial crafts (e.g., ferries, tugboats, tour-boats) for major ports-of-call in Canada, including the Port of Prince Rupert. The most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b). The MEIT contains sulphur oxides (SO_x), NO_x, CO, PM10, PM2.5 and VOCs emission rates. The database also includes total PM (and associated elemental, organic and sulphate fractions), ammonia (NH₃) and greenhouse gases (GHGs in the form of carbon dioxide, methane, nitrous oxide and equivalents). For the purposes of this study, air emissions forecasted for 2015 were extracted from the database and define existing marine-based air emissions within the regional assessment area (RAA). The 2015 dataset was chosen as representative of existing marine based sources as it includes the implementation of the international regulations specific to Sulphur content in marine fuel (MARPOL 2008) including the 2010 amendments which designate Canadian waters as an Emission Control Area. These marine-based emissions are assumed to reflect existing marine-based projects (i.e., Fairview Terminal, PRG Terminal, ferries, cruise ships, Ridley Terminals) identified in the Aurora LNG Application for an Environmental Assessment Certificate (the Application).

This description mentions new regulations are in effect but does not make it clear if 100% compliance or some other reasonable level was assumed.

The references for Appendix 2 are given on pages 222 and 223 and they contradict the above description (from page 169) which suggests that MEIT SNC Lavalin 2012b is an Environment Canada version:

- SNC Lavalin. 2012a. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.
- SNC Lavaline, 2012b. Canadian 2010 Marine Emissions Inventory. Provided by Environment Canada September 2014.

Further mention of MEIT in reference on page 223 244

6.2 Personal Communications

Bellavance, P. March 4, 2015. Email RE: MEIT – Line table and shapefiles – FTP Ready.

McEwen, B. 2015. March 12, 2015. Email RE: Follow up on MEIT questions

Note: Somewhere else in the Application is the reference [*note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.*]

Feb 15 email to Sean

Re: Aurora Application Working Group questions comments for Dodge Cove



Luanne Roth > Feb 15 (13 days ago) to Sean, des, Laurie

Hello Sean,

I really appreciated participating in the meeting you organized in Rupert, thanks!

Is there anyway the Improvement District of Dodge Cove can get details on the settings used by Aurora for the Marine Emissions Inventory Tool for experts to review for this public comment period ending March 9th?

Would you be able to forward this request to Aurora for me? Or should I go direct to someone there?

Also Is it possible for me to participate in the working group meetings you said you were going to arrange to discuss the air quality issues further?

Cheers,

Luanne

Luanne Roth

North Coast Energy Campaigner,

T. Buck Suzuki Environmental Foundation

On Tue, Feb 14, 2017 at 3:36 PM, Moore, Sean EAO:EX <> wrote:

Hi Luanne,

Sent to TC and EC

Transportation Development Centre
Transport Canada central research and development branch
<https://www.tc.gc.ca/eng/innovation-contactus.htm>

and also to

EC Environment and Climate Change Canada - Pollutant Inventories and Reporting Division
ges-ghg@ec.gc.ca

February 17th 2017 with return email luanneroth2@gmail.com

Subject MEIT v4.1.0

Hello,

We are reviewing a marine emission forecast which was made using MEIT. As you can see from the description, copied below, the assumptions made in its use account for the "latest regulatory restrictions on air emissions" and the year 2015 was used.

Would you please clarify for us if emissions forecast using MEIT in this way are based on an assumption of 100% compliance with "the latest regulatory restrictions" or a hypothetical assumption of some other level of compliance which we can find documented somewhere?

I understand Transport Canada Innovation is responsible for MEIT and are the experts in this matter and will know what level of compliance is being assumed in the MEIT v4.1.0 use described below. Your help would be most appreciated.

sincerely,

Luanne Roth

Prince Rupert

Working Group Air Quality issues for

Improvement District of Dodge Cove

“All marine-based air emissions are extracted from the MEIT developed by Environment Canada (SNC Lavalin 2012a)”

*“Assumptions used to determine marine-based air emissions...” *

“Environment Canada has developed the National Marine Emission Inventory Tool (MEIT) v4.1.0 database of marine emissions for Canada. The database contains emission estimates of SO₂, NO_x, CO, hydrocarbons, and particulate matter (total PM, PM10, PM2.5) as well as other CACs, greenhouse gases, and air toxins. The database contains emission inventories for years 1980, 1985, 1987, 1990, 1995, 2000, 2005, 2010, 2015, 2030, and 2050 (SNC Lavalin 2012a). Regional marine-based air emission estimates for the RAA were extracted from the MEIT database.”

“MEIT accounts for the latest regulatory restrictions on air emissions from marine-based activities including the International Maritime Organization global initiatives such as the Sulphur Emission Control Area, Engine Control Technologies and Emission Standards (MARPOL 2008).”

*“It is assumed that the MEIT database for 2015

Feb 15 reply from Sean EAO quoting Aurora

RE: Aurora Application Working Group questions comments for Dodge Cove

Inbox x



Moore, Sean EAO:EX Feb 15 (13 days ago)

to me, des, Laurie, Alli

Hi Luanne,

From the proponent:

The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A.

Regarding participation of the Working Group in future meetings, I have not yet determined how we will set up the topic-specific sessions. I will connect with the Working Group once we have a better grasp of how to tackle the key issues in front of us.

Cheers,

Sean

From: Luanne Roth

Sent: February 15, 2017 9:58 AM

To: Moore, Sean EAO:EX

Cc: des Nobels; Laurie Moore

Subject: Re: Aurora Application Working Group questions comments for Dodge Cove

Hello Sean,

I really appreciated participating in the meeting you organized in Rupert, thanks!....

Feb 17th confirmation from TC that they received my contact.

I had contacted them to find out about MEIT on their online contact section (this is additional to the email sent to Ernst Radlof

Confirmation of feedback / Confirmation de rétroaction

Inbox x



Luanne Roth > Feb 17 (11 days ago) to me

This message may not have been sent by: [Learn more](#) Report phishing Transport Canada has received your e-mail. We will reply in a timely manner to English and French inquiries only.

Thank you for contacting us.

General Inquiries

Tel: [613-990-2309](tel:613-990-2309) TTY: [1-888-675-6863](tel:1-888-675-6863)

facsimile: [613-954-4731](tel:613-954-4731)

Mailing Address:

Transport Canada 330 Sparks Street Ottawa, ON K1A 0N5
Government of Canada

Feb 17th email to EC pollutant inventory div asking about assumptions used in MEIT 2012a

MEIT v4.1.0



Luanne Roth > Feb 17 (11 days ago) to ges-ghg, bcc: Luanne

Environment and Climate Change Canada - Pollutant Inventories and Reporting Division
ges-ghg@ec.gc.ca

Hello,

We are reviewing a marine emission forecast which was made using MEIT. As you can see from the description, copied below, the assumptions made in its use account for the "latest regulatory restrictions on air emissions" and the year 2015 was used.

Would you please clarify for us if emissions forecast using MEIT in this way are based on an assumption of 100% compliance with "the latest regulatory restrictions" or a hypothetical assumption of some other level of compliance which we can find documented somewhere?

I understand Environment Canada is responsible for MEIT and are the experts in this matter and will know what level of compliance is being assumed in the MEIT v4.1.0 use described below. Your help would be most appreciated.

sincerely,

Luanne Roth email

Prince Rupert

Working Group Air Quality issues for

Improvement District of Dodge Cove

"All marine-based air emissions are extracted from the MEIT developed by Environment Canada (SNC Lavalin 2012a)"

"Assumptions used to determine marine-based air emissions..."

**"Environment Canada has developed the National Marine Emission Inventory Tool (MEIT) v4.1.0 database of marine emissions for Canada. The database contains emission estimates of SO₂, NO_x, CO, hydrocarbons, and particulate matter (total PM, PM10, PM2.5) as well as other CACs, greenhouse gases, and air toxins. The database contains emission inventories for years 1980, 1985, 1987, 1990, 1995, 2000, 2005, 2010, 2015, 2030, and 2050 (SNC Lavalin 2012a)."

Regional marine-based air emission estimates for the RAA were extracted from the MEIT database.”*

“MEIT accounts for the latest regulatory restrictions on air emissions from marine-based activities including the International Maritime Organization global initiatives such as the Sulphur Emission Control Area, Engine Control Technologies and Emission Standards (MARPOL 2008).”

*“It is assumed that the MEIT database for 2015

Feb 20 EC pollution inven reply cannot find MEIt and my reply found Monica

Re: FW: MEIT (Marine Emission Inventory Tool) v4.1.0 GHG In-box



Luanne Roth > Feb 20 (8 days ago) to GES

Hello Angie,
Thanks for your efforts. I am now in contact with
Monica Hilborn

Senior Program Engineer | Ingénieur Principal de Programme

Integrated Transportation Policy / Cross Sectoral Energy Division

Politique intégrée des transports / Division intersectorielle de l'énergie

and I think she will be able to answer my question.

Thanks again

Luanne

On Mon, Feb 20, 2017 at 4:38 AM, GES / GHG (EC) <ec.ges-ghg.ec@canada.ca> wrote:

Hello Ms. Roth,

Canada's National Inventory Report (NIR) is available on-line
at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php.

I searched last year's NIR for words such as "Marine Emission Inventory Tool", "MEIT" and "SNC Lavalin 2012a". I was unable to find this material in the latest NIR.

In your email, you included the above-noted text from a report. Kindly share the title of this report and I

will then be able to better address your questions.

Thank you,

Angie

Angie Giammario, P.Eng.

Environment and Climate Change Canada

16th Floor, Queen Square

45 Alderney Drive

Dartmouth (Nova Scotia) B2Y 2N6

Government of Canada

Website www.ec.gc.ca

Angie Giammario, P.Eng.

Environnement et Changement climatique Canada

16ième étage, Queen Square

45 promenade Alderney

Dartmouth (Nouvelle-Écosse) B2Y 2N6

Gouvernement du Canada

Site Web www.ec.gc.ca

From: Luanne Roth
Sent: Friday, February 17, 2017 2:51 PM
To: GES / GHG (EC)
Subject: MEIT v4.1.0

Environment and Climate Change Canada - Pollutant Inventories and Reporting Division
ges-ghg@ec.gc.ca

Hello,

We are reviewing a marine emission forecast which was made using MEIT. As you can see from the description, copied below, the assumptions made in its use accoun

Feb 20th Email to Monica Hilborn EC what level of compliance was in MEIT in Aurora

Query re MEIT



Luanne Roth > Feb 20 (8 days ago) to monica.hilborn, Laurie, bcc:

Luanne

Monica Hilborn

Senior Program Engineer | Ingénieur Principal de Programme

Integrated Transportation Policy / Cross Sectoral Energy Division

Politique intégrée des transports / Division intersectorielle de l'énergie

Hello Monica,

We are reviewing the Aurora LNG Application and are unable to discover the degree of compliance with marine emission regulations which has been assumed with the use of MEIT 4.1.

Attached please find Impact of Assumptions.... pdf. which gives details of the specifics of the version of MEIT used in the application and discusses the impact the assumptions about decreases in marine emission rates (associated with MEIT) have made towards eliminating previously forecast residential area exceedance of CCME objectives.

Also attached is a pdf about non-compliance issues related to MEIT assumptions.

We would appreciate your help determining what level of compliance was assumed in the Aurora Application use of MEIT and whether that level of compliance is realistic or hypothetical.

Luanne Roth

assisting Improvement District of Dodge Cove in Working Group,

T. Buck Suzuki Environmental Foundation

Prince Rupert

Email to Monica ref her call and confusion 2012b

Re: Query re MEIT



Luanne Roth > Feb 21 (7 days ago) to monica.hilborn, bcc: Luanne

Hello Monica,

Thanks for getting back to me, I got your phone query about references to MEIT in PRAS late in the day, is a better number for me.

MEIT is only mentioned once in PRAS, specifically regarding stack parameters, on page 38. However, the Prince Rupert Port Authority (PRPA) is mentioned numerous times as the source for the PRAS emission rates in their updated version. PRPA is also the source for the Aurora Application marine emission information at roughly the same time and PRPA gave Aurora that information in the form of MEIT 4.1 SNC Lavalin 2012b.

We know the MEIT 4.1 SNC Lavalin 2012b used by Aurora resulted in roughly the same low marine emission forecasts as the updated PRAS.

The Environmental Assessment process allows for public review of the Aurora Application and we want to review, with the help of experts, the accuracy of the forecast marine emissions but we cannot determine what the assumptions are, in the MEIT the Aurora Application specifically refer to as MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) and note that “SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.”

Please call again if I can provide you with any information or clarification or vice versa.

Cheers,

Luanne

Luanne Roth

assisting Improvement District of Dodge Cove in Working Group,

T. Buck Suzuki Environmental Foundation

Prince Rupert

Left blank

Feb 22 to Sean asking for extension experts need time no specific ref to MEIT

Need extension for TBSEF, UFAWU and PRES public comments



Luanne Roth Feb 22 (6 days ago) to Sean, des, Laurie, bcc: Luanne

Hello Sean,

As you may know CEAA granted T. Buck Suzuki Environmental Foundation, United Fishermen and Allied Workers Union- UNIFOR and Prince Rupert Environmental Society funding to hire experts to comment on the Aurora Application. This funding decision was only made February 17th, about halfway through the public comment period and we are struggling to get experts organized for commenting. We have some excellent resources but they are finding the deadline very difficult.

Would you please grant us an extension so we can submit our comments by Sunday March 19th midnight instead of March 9th. That at least gives us one month from the time we were given funding. I think the comments will be more valuable to the EAO assessment process if we can have that extra bit of time.

Thank-you for your consideration,

sincerely

Luanne

Feb 23 call Alli EAO Notes made feb 28 by Luanne

Monica Hilborn EC had talked to me on the phone and said she had not got back to me because she had checked with others and as it was concerning an EA she was seeing if it was better if they helped me instead. I asked her to at least tell me something about the MEIT but she did not want to and said she would follow-up to ask someone else to respond. This was after a couple of calls with her and me spending a lot of time sending her two backgrounders specifically made for her and giving her excerpts from the application to track down the MEIT, etc.

After this Alli called and said she had been approached because I had been enquiring with EC and she would help.

I said I had been in touch with EC and they had said they would be passing it onto someone else in EC and I guessed this is where she had heard I was needing help.

I told her I still could not find out what assumptions Aurora had used....

She asked me to put it in an email enquiry to her and I sent her the email copied in this file

Alli Morrison EAO February 23, 2017 2:47 PM

Feb 23 email to Alli EAO after her call saying she would help instead of the EC person I had contacted

what marine emission factors were used by Aurora



Luanne Roth Feb 23 (5 days ago) to alli.morrison, bcc: Angela,
bcc: Luanne

Alli Morrison EAO

February 23, 2017

Hello Alli,

Thank-you for your offer to help us find information about the marine emission factors used in the Aurora Application. I understand you were contacted by EC after I went to them for help understanding how to discover that information from the description of MEIT given in the Aurora Application.

When I wrote to EAO (Sean Moore) on February 15th:

Is there anyway the Improvement District of Dodge Cove can get details on the settings used by Aurora for the Marine Emissions Inventory Tool for experts to review for this public comment period ending March 9th?-Luanne

He replied on February 15th:

“From the proponent:

The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A.”

When we reviewed the description in Appendix A and consulted with experts it was not clear to us or them what settings were used.

- We are not clear that MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) or (SNC Lavalin 2012a) were used. See contradictory quotes from Application below.
- If 2012b (or a) was used, where are the settings publicly available? We have not been able to locate them.
- Was 100% compliance with new Sulphur regulations assumed despite evidence that exemptions are allowed?

- What NOx emission rate for LNG carriers was assumed and what is the justification (did it include tugs)
- What NOx emission rate for bulk carriers was assumed? Is it different than the one normally used.
- How many ships per year were forecast for base case for Fairview, coal terminal, grain terminal etc?
- Was 50% shore power assumed for all vessels
- What stack parameters were used are they different than normal forecasts.
- Etc.

The Aurora Application specifically refers to MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) and note that “SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.” Was this draft used? Is it available? Does it require licensing? Can we see the assumptions and settings it used?

We would appreciate it if you are able to provide us with the information we need to review the marine emissions forecast in the Aurora Application. Note some excerpts follow showing some of the references to MEIT and emission rates in the Aurora Application.

Thanks for your help in this matter,

Sincerely,

Luanne Roth

T. Buck Suzuki Environmental Foundation

On page 157 Aurora Application Appendix A it says it used “the most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b)” but on page 24 it says it uses (SNC Lavalin 2012a). I have been checking with experts to see if the Aurora Application description is adequate to know what emission rates and other important factors were used but no one has been able to help ascertain them yet, from their description.

The Aurora description does not make it clear what emission rates were used and what level of compliance with Sulphur in fuel regulations was assumed and what emission rate for ships was assumed for NOx :

Presently, marine vessels must be compliant with the International Marine Organization (IMO) North American Emission Control Area (ECA) that was adopted under Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL). Because of the new MARPOL regulations for marine fuel sulphur content, SO₂ emissions from the baseline sources will decrease from previous estimates. -pg. 85 AA

Aurora description of MEIT 4.1 pg. 157 Appendix A

2.2 Marine-based Emission Sources

Regional marine sources were extracted from the Environment Canada (EC) National Marine Emission Inventory Tool (MEIT)... The most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b). The MEIT contains sulphur oxides (SO_x), NO_x, CO, PM10, PM2.5 and VOCs emission rates. The database also includes total PM (and associated elemental, organic and sulphate fractions), ammonia (NH₃) and greenhouse gases (GHGs in the form of carbon dioxide, methane, nitrous oxide and equivalents). For the purposes of this study, air emissions forecasted for 2015 were extracted from the database and define existing marine-based air emissions within the regional assessment area (RAA). The 2015 dataset was chosen as representative of existing marine based sources as it includes the implementation of the international regulations specific to Sulphur content in marine fuel (MARPOL 2008) including the 2010 amendments which designate Canadian waters as an Emission Control Area. These marine-based emissions are assumed to reflect existing marine-based projects (i.e., Fairview Terminal, PRG Terminal, ferries, cruise ships, Ridley Terminals) identified in the Aurora LNG Application for an Environmental Assessment Certificate (the Application).-pg 157 Appendix A

[note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.]

on Page 18 Aurora application AA:

On pg 24:

5.1.2 Marine-based Activities

Environment Canada has developed the National Marine Emission Inventory Tool (MEIT) v4.1.0

database of marine emissions for Canada. The database contains emission estimates of SO₂, NO_x, CO,

hydrocarbons, and particulate matter (total PM, PM10, PM2.5) as well as other CACs, greenhouse gases,

and air toxins. The database contains emission inventories for years 1980, 1985, 1987, 1990, 1995,

2000, 2005, 2010, 2015, 2030, and 2050 (SNC Lavalin 2012a). Regional marine-based air emission

estimates for the RAA were extracted from the MEIT database.

The inventory includes all commercial marine vessel classes and smaller commercial craft (i.e., ferries

and tugs) tracked within Canada's territorial waters. MEIT accounts for the latest regulatory restrictions on

air emissions from marine-based activities including the International Maritime Organization global initiatives such as the Sulphur Emission Control Area, Engine Control Technologies and Emission Standards (MARPOL 2008).

It is assumed that the MEIT database for 2015 captures the air emissions of all regional marine-based

activities. Year 2015 was used since the 2015 inventory includes the relevant regulatory restrictions for

sulphur in diesel. The MEIT marine-based activities include Fairview Terminal (Phase 1), Prince Rupert

Ferry Terminal, Prince Rupert Grain Terminal, Ridley Terminals, Atlin Terminal, Northland Cruise Terminal, cruise shipping and fishing and aquaculture activities.

For 2015, most vessels are classified as merchant bulk (60%) and merchant container (25%), with

smaller contributions from tugs, cruise ship and regional passenger ferries. The MEIT database has both

point sources and line sources. The point sources are emissions from anchorages, berthing, and piloting.

The line sources are transient emissions from marine vessels on route between anchorage points.

The locations of the anchorages, berthing, piloting, as well as the vessel routes are shown in Figure 4 and

Figure 5. Additional MEIT database details are provided in Appendix 2.

The average marine-based air emissions extracted from the MEIT database are summarized in Table 8 in

comparison to the existing land-based regional emissions. This comparison clearly shows that marinebased

emissions are substantial contributors to the overall SO₂ and NO_X existing regional emissions, and

less so in terms of PM₁₀ and PM_{2.5}. As such the spatial distribution of MEIT line and point sources is

expected to have a noticeable effect on existing regional concentrations in the RAA, and particularly in

the Prince Rupert Harbour area.

Feb 28 call from Alli EAO notes

Alli says NEXEN Aurora is being cooperative and will get back to her with information about the MEIT on about Thursday. She is also waiting to hear back from Nic Russo EC about whether we can have access to the (a?) MEIT

Feb 28 Email to Sean EAO bcc angela

still need emission source info and time to review



Luanne Roth > 11:31 AM (1 hour ago) to Sean, bcc: Angela

Hello Sean,

We have been trying to find out what assumptions were used in the Aurora Application for existing marine based emission sources since February 14th and still do not have them.

We need this information and we need an extension to the March 9th comment period so the experts we have standing by can review it and comment on it.

Our main concern is air emissions and we have reason to believe the assumptions made in the forecast of existing marine based emissions are very important in determining the level of exceedances of CCME objectives for human health. We want to check them but now it is February 28, only nine days before the comments are due, and we have not been given anything but an ambiguous contradictory and improperly referenced description of what sources and emission factors were used.

You emailed me and said on Feb 15th and quoted Aurora:

"The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A."

The Aurora Application, Appendix A Air Quality page 157, says they extracted from the 2015 database [2012b] to define the existing marine emissions, but the whole section is ambiguous. They could have extracted the sources from MEIT 2012a and the rates from 2012b or vice versa. An additional problem is the references on page 210 mixes up the MEITs from EC and PRPA. They say the 2012b came from EC and the 2012a is a draft from PRPA, but elsewhere they say the 2012b is from PRPA. Our understanding is the 2012a is from EC and we are not sure what the 2012b is all about and cannot get a clear answer from EC or anyone. The mix up on page 210 regarding source references makes it difficult to see any clear line of responsibility. There are other examples of seeming contradictions in the Application regarding MEIT use.

If we do get written confirmation about what Aurora used in the Application then we want access to it so our experts can review it. If it is a draft update to MEIT SNC Lavalin 2012a which is called "MEIT SNC Lavalin 2012b – draft from PRPA" then we want a copy of it and/or details about it.

We are concerned that the forecast marine emissions from existing sources in the Aurora Application are reasonable. We want to know what they are with enough detail to be able to have them checked by experts for our comments (from TBSEF, PRES UFAWU and Dodge Cove) but here it is one week to the deadline for comments and we still haven't even found out what Aurora used as their source and we certainly haven't been able to access it. We haven't been able to find out what emission rates were used for dry bulk carriers or container ships, how many ships were estimated, etc.

We still don't have answers to basic questions like:

- What emission rate for NOx was used for dry bulk carriers in the existing marine emissions?
- How many container ships were estimated per year for the existing marine emissions?
- What emission rate for SOx was used for the dry bulk carriers?
- What stack height was assumed?
- Etc.

On Feb 23rd we were starting to get some help from EC Monica Hilborn but then EAO took over from them and Alli phoned and said she would help instead. We emailed her with some of the contradictory references to MEIT 2012a and b in the Application and asked for clarification about the issues described above and still have not received a reply.

Sincerely,

Luanne Roth

North Coast Energy Campaigner

T. Buck Suzuki Environmental Foundation

Coordinating comments on Aurora Application for

UFAWU, TBSEF and PRES as well as helping IDDC

Re: what marine emission factors were used by Aurora

1 message

Luanne Roth <>

Mon, Mar 6, 2017 at 8:56 AM

To: "Morrison, Alli EAO:EX" <>, "Moore, Sean EAO:EX"

Hello Sean and Alli,

Sean I have included you in this email because it is of extreme importance for the public and for our team of experts to have access to the assumptions about existing emission sources which were used to forecast CAC concentrations over residential areas.

It is also important that there is a clear signed declaration by Aurora consultants that those were the assumptions used in the concentration forecast.

This reply from Alli is inadequate:

The reports versions are as follows:

- The user guide which is titled: National Marine Emissions Inventory Tool (MEIT) V 4.1.0
- The final emission inventory report which is titled: 2010 National Marine Emissions Inventory for Canada; Final Report

The Application Air Quality Appendix is unclear; it refers to using the following sources:

- MEIT version 4.1 (SNC Lavalin 2012b). on page 169/383
- SNC Lavalin. 2012a. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email. on page 222/383
- SNC Lavaline, 2012b. Canadian 2010 Marine Emissions Inventory. Provided by Environment Canada September 2014. on page 222/383
- Prince Rupert Port Authority (PRPA) SNC Lavalin 2012b on page 20/283
- 6.2 Personal Communications
Bellavance, P. March 4, 2015. Email RE: MEIT – Line table and shapefiles – FTP Ready.
- McEwen, B. 2015. March 12, 2015. Email RE: Follow up on MEIT questions on page 223/383
- [and possibly] note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email. but I can't locate the page

reference just now.

As far as I know these are not identical. Before we can review and comment on the assumptions we need to know what assumptions were used.

We do need access to the version of the MEIT which was used and we need assurance that we have the correct version to review with clear statements by the person responsible defining the assumptions used in it.

Cheers,

Luanne

Luanne Roth

North Coast Energy Campaigner

T. Buck Suzuki Environmental Foundation

coordinating Aurora Application comments for

TBSEF,PRES and UFAWU as well as working with Dodge Cove

On Fri, Mar 3, 2017 at 9:53 AM, Morrison, Alli EAO:EX <> wrote:

Hi Luanne,

The reports versions are as follows:

- The user guide which is titled: National Marine Emissions Inventory Tool (MEIT) V 4.1.0
- The final emission inventory report which is titled: 2010 National Marine Emissions Inventory for Canada; Final Report

Cheers,

Alli

From: Luanne Roth [mailto:]
Sent: Friday, March 3, 2017 9:39 AM
To: Morrison, Alli EAO:EX
Subject: Re: what marine emission factors were used by Aurora

Hello Alli,

Thanks for the update. Did you get written confirmation from NEXEN about which version of MEIT they used to model the concentrations, so when we get approval from ECCC we will know we have the correct version to review?

Cheers,

Luanne

On Fri, Mar 3, 2017 at 8:25 AM, Morrison, Alli EAO:EX <> wrote:

Hi Luanne,

We're still waiting on ECCC's indication that the reports can be forwarded along. I'll let you know when I learn more.

Cheers,

Alli

From: Luanne Roth [mailto:]
Sent: Thursday, February 23, 2017 2:47 PM
To: Morrison, Alli EAO:EX

Subject: what marine emission factors were used by Aurora

Alli Morrison EAO

February 23, 2017

Hello Alli,

Thank-you for your offer to help us find information about the marine emission factors used in the Aurora Application. I understand you were contacted by EC after I went to them for help understanding how to discover that information from the description of MEIT given in the Aurora Application.

When I wrote to EAO (Sean Moore) on February 15th:

Is there anyway the Improvement District of Dodge Cove can get details on the settings used by Aurora for the Marine Emissions Inventory Tool for experts to review for this public comment period ending March 9th?-Luanne

He replied on February 15th:

"From the proponent:

The settings used for the Marine Emissions Inventory Tool are laid out in section 5.1.2 of the Air Quality TDR in EA Appendix A."

When we reviewed the description in Appendix A and consulted with experts it was not clear to us or them what settings were used.

- We are not clear that MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) or (SNC Lavalin 2012a) were used. See contradictory quotes from Application below.
- If 2012b (or a) was used, where are the settings publicly available? We have not been able to locate them.
- Was 100% compliance with new Sulphur regulations assumed despite evidence that exemptions are allowed?
- What NOx emission rate for LNG carriers was assumed and what is the justification (did it include tugs)
- What NOx emission rate for bulk carriers was assumed? Is it different than the one normally used.
- How many ships per year were forecast for base case for Fairview, coal terminal, grain terminal etc?

- Was 50% shore power assumed for all vessels
- What stack parameters were used are they different than normal forecasts.
- Etc.

The Aurora Application specifically refers to MEIT 4.1 for 2010 and 2015 (forecast) (SNC Lavalin 2012b) and note that “SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.” Was this draft used? Is it available? Does it require licensing? Can we see the assumptions and settings it used?

We would appreciate it if you are able to provide us with the information we need to review the marine emissions forecast in the Aurora Application. Note some excerpts follow showing some of the references to MEIT and emission rates in the Aurora Application.

Thanks for your help in this matter,

Sincerely,

Luanne Roth

T. Buck Suzuki Environmental Foundation

On page 157 Aurora Application Appendix A it says it used “the most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b)” but on page 24 it says it uses (SNC Lavalin 2012a). I have been checking with experts to see if the Aurora Application description is adequate to know what emission rates and other important factors were used but no one has been able to help ascertain them yet, from their description.

The Aurora description does not make it clear what emission rates were used and what level of compliance with Sulphur in fuel regulations was assumed and what emission rate for ships was assumed for NOx :

Presently, marine vessels must be compliant with the International Marine Organization (IMO) North American Emission Control Area (ECA) that was adopted under Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL). Because of the new MARPOL regulations for marine fuel sulphur content, SO₂ emissions from the baseline sources will decrease from previous estimates. –pg. 85 AA

Aurora description of MEIT 4.1 pg. 157 Appendix A

2.2 Marine-based Emission Sources

Regional marine sources were extracted from the Environment Canada (EC) National Marine Emission Inventory Tool (MEIT)... The most recent MEIT version 4.1 includes individual air emission information for 2010 and 2015 (forecast) (SNC Lavalin 2012b). The MEIT contains sulphur oxides (SO_x), NO_x, CO, PM10, PM2.5 and VOCs emission rates. The database also includes total PM (and associated elemental, organic and sulphate fractions), ammonia (NH₃) and greenhouse gases (GHGs in the form of carbon dioxide, methane, nitrous oxide and equivalents). For the purposes of this study, air emissions forecasted for 2015 were extracted from the database and define existing marine-based

air emissions within the regional assessment area (RAA). The 2015 dataset was chosen as representative of existing marine based sources as it includes the implementation of the international regulations specific to Sulphur content in marine fuel (MARPOL 2008) including the 2010 amendments which designate Canadian waters as an Emission Control Area. These marine-based emissions are assumed to reflect existing marine-based projects (i.e., Fairview Terminal, PRG Terminal, ferries, cruise ships, Ridley Terminals) identified in the Aurora LNG Application for an Environmental Assessment Certificate (the Application).-pg 157 Appendix A

[note SNC Lavalin. 2012b. Draft – PRPA Air Model Description and Results. Provided by PRPA. Jason Scherr by email.]

on Page 18 Aurora application AA:

On pg 24:

5.1.2 Marine-based Activities

*Environment Canada has developed the National Marine Emission Inventory Tool (MEIT) v4.1.0 database of marine emissions for Canada. The database contains emission estimates of SO₂, NO_x, CO,
hydrocarbons, and particulate matter (total PM, PM10, PM2.5) as well as other CACs, greenhouse gases,
and air toxins. The database contains emission inventories for years 1980, 1985, 1987, 1990, 1995,
2000, 2005, 2010, 2015, 2030, and 2050 (SNC Lavalin 2012a). Regional marine-based air emission
estimates for the RAA were extracted from the MEIT database.*

*The inventory includes all commercial marine vessel classes and smaller commercial craft (i.e., ferries
and tugs) tracked within Canada's territorial waters. MEIT accounts for the latest regulatory
restrictions on
air emissions from marine-based activities including the International Maritime Organization global
initiatives such as the Sulphur Emission Control Area, Engine Control Technologies and Emission
Standards (MARPOL 2008).*

It is assumed that the MEIT database for 2015 captures the air emissions of all regional marine-

based

activities. Year 2015 was used since the 2015 inventory includes the relevant regulatory restrictions for

sulphur in diesel. The MEIT marine-based activities include Fairview Terminal (Phase 1), Prince Rupert

Ferry Terminal, Prince Rupert Grain Terminal, Ridley Terminals, Atlin Terminal, Northland Cruise Terminal, cruise shipping and fishing and aquaculture activities.

For 2015, most vessels are classified as merchant bulk (60%) and merchant container (25%), with

smaller contributions from tugs, cruise ship and regional passenger ferries. The MEIT database has both

point sources and line sources. The point sources are emissions from anchorages, berthing, and piloting.

The line sources are transient emissions from marine vessels on route between anchorage points.

The locations of the anchorages, berthing, piloting, as well as the vessel routes are shown in Figure 4 and

Figure 5. Additional MEIT database details are provided in Appendix 2.

The average marine-based air emissions extracted from the MEIT database are summarized in Table 8 in

comparison to the existing land-based regional emissions. This comparison clearly shows that marine-based

emissions are substantial contributors to the overall SO₂ and NO_X existing regional emissions, and

less so in terms of PM10 and PM2.5. As such the spatial distribution of MEIT line and point sources is

expected to have a noticeable effect on existing regional concentrations in the RAA, and particularly in

the Prince Rupert Harbour area.

RE: FW: Aurora LNG and MEIT data

1 message

Morrison, Alli EAO:EX

Tue, Mar 7, 2017 at 11:39 AM

To: Luanne Roth <>

Cc: "Moore, Sean EAO:EX" "Mayall, Jane EAO:EX" <>

Hi Luanne,

Could you please submit any further inquiries regarding the MEIT via the online public comment form? The proponent will respond to any requests in a public comment tracking table, which will be posted to EAO's website.

Thanks,

Alli

From: Luanne Roth []

Sent: March 7, 2017 10:44 AM

To: Moore, Sean EAO:EX

Subject: Re: FW: Aurora LNG and MEIT data

Hi Sean,

I am not sure if this is what I requested. How does this relate to the Application? There is no mention of 4.3.1 in the application.

Cheers,

Luanne

On Tue, Mar 7, 2017 at 9:43 AM, Moore, Sean EAO:EX <> wrote:

Hi Luanne,

Attached is ECCC's MEIT information that you requested. EAO will post this to our website

for broader reference.

Regards

Sean

Sean Moore, MRM | Project Assessment Manager
Environmental Assessment Office
836 Yates Street, Victoria, BC, V8W 1L8

Dr. David Bowering, retired Chief Medical Health Officer, Northern Health

Additional comment March 7th 2017 regarding Aurora Application

- The forecast CAC concentration levels showed extreme exceedance of CCME objectives in one forecast (the PRAS F_R) and still show concerning levels in the updated forecast (PRAS F_R_U)
- The CAC levels in the Aurora Application are concerning at the forecast presented and any significant correction upwards would push them into an area of greater risk to human health.
- The air dispersion model used to estimate CAC concentrations did not include a range of predictions based on the likelihood of climate change over the life of the project. Worst case scenarios could be considerably worse than predicted depending on the effects of climate change on weather and wind patterns.
- The health risks are both short and long term. Asthma and respiratory irritation in the short term; cardiovascular disease including heart attacks, and chronic respiratory disease including Chronic Obstructive Pulmonary Disease in the long term.
- The residential areas of Prince Rupert, Dodge Cove, Port Edward, Crippen Cove and Metlakatla are at risk. It is my understanding that those areas have a population of about 13,000.
- A reasonably accurate forecast of CAC concentrations needs to be done and presented to the public before human health risk is compared to guidelines and assessed; significant errors should be corrected and resubmitted to the public for review.

ANGELA McCUE
Barrister and Solicitor

#1001 – 1111 Beach Avenue, Vancouver BC V6E 1T9
Telephone (604) 790-0945; e-mail amccue@telus.net

March 9, 2017

Submitted online (<http://www.eao.gov.bc>)

Project Assessment Manager
BC Environmental Assessment Office
PO Box 9426 Stn Prov Govt
Victoria, British Columbia
V8W 9V1

Attention: Sean Moore

Dear Sirs/Mesdames:

Re: Environmental Assessment of the Proposed Aurora LNG Project (proposing to construct and operate a liquefied natural gas (LNG) facility and marine terminal near Prince Rupert B.C. for the export of LNG). Addendum to Comment on behalf of T. Buck Suzuki Environmental Foundation, Prince Rupert Environmental Society and United Fishermen and Allied Workers Union – UNIFOR,

This letter is attached to and forms part of the Comment on behalf of T. Buck Suzuki Environmental Foundation (“TBSEF”), Prince Rupert Environmental Society (“PRES”) and United Fishermen and Allied Workers Union – UNIFOR (“UFAWU”) in response to the proposed Aurora LNG Project to construct and operate and LNG facility and marine terminal near Prince Rupert, BC (“the Aurora Project”).

I have been asked to comment in relation to two matters. These are:

- 1) Legal (including International, Statutory and Regulatory) Requirements Related to Marine Emissions; and
- 2) Public Participation and Information Disclosure Requirements in Environmental Assessments.

For the purpose of my submission, I have reviewed the Comment being submitted on behalf of TBSEF, PRES and UFAWU and attached expert opinions.

1) Legal (including Statutory and Regulatory) Requirements Relating to Marine Emissions (including sulphur oxides).

The Comment being submitted by my clients focuses on the Air Quality aspects of the Aurora Application. There are various issues raised, one of which relates to sulphur in marine fuel and one of which relates to NO² and NOx. Any assumptions being made in the Aurora Application regarding the sulphur content of marine fuel would, of course, be relevant to determining the accuracy of projected emissions and concentrations of sulphur oxides. Assumptions regarding compliance with emission standards for nitrogen oxide would also be relevant.

i) Canada Shipping Act

Marine emissions, including those relating to sulphur oxides as well as nitrogen oxides are governed by Federal legislation and Regulations. In this instance, the relevant legislation is the Canada Shipping Act, 2001, SC 2001, c26, as amended [<http://canlii.ca/t/52lnb>] (the “Act”).

International Conventions, Protocols and Resolutions are also relevant to interpretation and application of the Act. For example, section 29 of the Act states:

INTERNATIONAL CONVENTIONS, PROTOCOLS AND RESOLUTIONS

Schedule 1

29. (1) Schedule 1 lists the international conventions, protocols and resolutions that Canada has signed that relate to matters that are within the scope of this Act and that the Minister of Transport has determined should be brought into force, in whole or in part, in Canada by regulation.

Schedule 2

(2) Schedule 2 lists the international conventions, protocols and resolutions that Canada has signed that relate to matters that are within the scope of this Act and that the Minister of Fisheries and Oceans has determined should be brought into force, in whole or in part, in Canada by regulation.

Codes and guidelines

(3) A convention or protocol includes any code or guideline that is attached to it.

Schedule 1 to the Act lists a number of Conventions and Protocols relevant to ship emissions including:

... 18. International Convention for the Prevention of Pollution from Ships, 1973

... 23. Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships

... 30. Protocol of 1997 relating to the International Convention for the Prevention of Pollution from Ships

ii) The Convention for the Prevention of Pollution from Ships (MARPOL)

The Convention for the Prevention of Pollution from Ships (“the Convention”) is also known as MARPOL and it is administered by the International Maritime Organization (the “IMO”), which describes itself as “the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships”.¹

There are currently six annexes to the Convention including Annex VI, which is described on the IMO/MARPOL Convention website² as follows:

Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005)

Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SO_x, NO_x and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships. [Emphasis Added]

In summary, through the Canada Shipping Act, Canada legislates and regulates air pollution from ships (including emissions of SO_x and NO_x) with a view to meeting Canada’s international obligations. A consideration of the SO_x and NO_x emissions in the Aurora Environmental Assessment process must therefore be considered in that context. Canada has obligations under the Convention with respect to the gathering and reporting of data. Regulations under the Act include requirements for authorized representatives of individual vessels to collect and report information that allows Canada to monitor individual vessel performance and then report to the IMO on Canada’s progress under the Convention.

iii) The Vessel Pollution and Dangerous Chemicals Regulations

The relevant regulations under the Canada Shipping Act include the *Vessel Pollution and Dangerous Chemicals Regulations SOR-2012-69, as amended³*(the “Regulations”). Air Quality and Emission controls for vessel are addressed at Division 6 (Air) including sections 108 – 116 of the Regulations.

¹ <http://www.imo.org/en/About/Pages/Default.aspx>

² [http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx)

³ <http://laws-lois.justice.gc.ca/eng/regulations/SOR-2012-69/index.html>

Sections 110–111 of the Regulations address NOx and SOx in considerable detail with reference to the Convention and set out a range of dates by which various targets must be met. The targets to be achieved are also defined with reference to the age of the vessel. I point this out to emphasize the relevance of various types of information and assumptions mentioned in my clients' Comments including remarks relating to the potential importance of age of vessel and compliance rates as well as other assumptions. The full text of sections 110-111 containing those detailed requirements is appended to this letter for ease of reference.

An additional point to note is that extensive records are required to be kept and submitted. This includes records from individual vessels as well as records kept by Canada and submitted to document its progress under the Convention. In summary, records that are of relevance to assessing important assumptions utilized (but not specified) in the Aurora Application do exist and production of those records would allow comparison of assumptions to actual conditions and compliance. I understand (as noted in my clients' Comments) that assumptions have not been clearly stated in the Aurora Application and that records relating to significant assumptions have not been provided or referred to.

iv) Transport Canada Bulletin Relating to Compliance with Regulations and Reporting of Non-Compliance

One known compliance issue that arises from a review of existing Regulations can be utilized to demonstrate how important it is in this case to know what assumptions have been used. There is a known issue with respect to obtaining marine fuel that is compliant with international (sulphur) standards as adopted by the Regulations. Simply put, compliant fuel is frequently unavailable. Ongoing lack of available compliant fuel is relevant to forecasting emissions. Otherwise stated, if there is no available low sulphur fuel then there will be higher than expected sulphur emissions and concentrations which will impact forecasts regarding human health risk impacts. It does not appear to be possible to determine if or how this non-compliance issue has been accounted for in the Aurora model because assumptions have not been clearly disclosed.

The issue regarding expected non-compliance relating to sulphur emissions is acknowledged and addressed in a Bulletin issued by Transport Canada in 2013⁴ (the Marine Fuel Bulletin) which discusses the Regulations regarding sulphur content of marine fuel (including MARPOL requirements) and reminds “stakeholders” of the requirement to report when non-compliant fuel is not available.

The Regulations, specifically anticipate this issue and include a special section, section 116.1, which states:

⁴ <http://www.tc.gc.ca/eng/marinesafety/bulletins-2013-04-eng.htm>

Unavailability of Compliant Fuel Oil

Canadian vessels and Canadian pleasure craft

116.1 (1) If a Canadian vessel or a Canadian pleasure craft cannot, while voyaging in accordance with its voyage plan, obtain fuel oil that meets the requirements of this Division, its master must notify the Minister and, if its port of destination is not in Canada, the competent authority of that port.

Foreign vessels and foreign pleasure craft

(2) If a foreign vessel or a foreign pleasure craft whose port of destination is in Canada cannot, while voyaging in accordance with its voyage plan, obtain fuel oil that meets the requirements of this Division, its master must notify the Minister.

Contents of notification

(3) The notification must include

- (a)** the vessel's name and, if applicable, the vessel's IMO ship identification number;
- (b)** the vessel's port of origin and port of destination;
- (c)** details of the attempts that were made to obtain fuel oil that meets the requirements of this Division, including the names and addresses of the fuel oil suppliers contacted, and the dates on which contact was made;
- (d)** the sulphur content of the fuel oil that was obtained; and
- (e)** the measures that will be taken to obtain, as soon as feasible, fuel oil that meets the requirements of this Division.

SOR/2013-68, s. 19.

In summary, the Regulations and Bulletins issued by Transport Canada specifically anticipate that there will be some degree of non-compliance and require reporting. This indicates that records are available in some situations to show the extent of reported non-compliance so that it can be properly accounted for.

v) Assumption of 100% Compliance?

I understand from my clients that one of the concerns with the Aurora Application is that there may be an assumption of 100% compliance (or other compliance levels that cannot be substantiated or justified) with the International standards (for sulphur and sulphur oxides)

described in the Convention even though it is known by the IMO, Transport Canada and others that there will necessarily be levels of non-compliance due to lack of availability of compliant fuel and other factors and even though levels of non-compliance are required by the Convention as well as the Regulations to be documented and reported.

If indeed 100% compliance with International emission standards has been assumed in the forecast emission and concentrations in the Aurora Application; then the Proponent would be making assumptions that even the IMO, the Canadian government (including Transport Canada) and the Regulations themselves seem to acknowledge to be currently *impossible*. Not only do the Regulations contemplate that there will be non-compliance for reasons such as lack of availability of compliant fuel; there are also extensive acknowledgements in the Regulations that certain ages of vessel will necessarily be non-compliant and that there will be other necessary and anticipated reasons for non-compliance. If such impossible assumptions have been made then they must be stated so that they can be identified and must be rejected as patently unreasonable. The concern is that unreasonable assumptions made for the purposes of the Aurora Application may be “hidden” by the failure or refusal of the Proponent to state its assumptions in the Application or “hidden” by the failure to clearly respond to subsequent requests (detailed in my clients’ Comment) from my client and experts to clearly and unambiguously set out the assumptions utilized in the Proponent’s Application.

The foregoing discussion highlights the importance of proper disclosure (discussed in more detail in my client’s Comment and discussed further below). The lack of proper disclosure renders it impossible to determine if significantly inappropriate or impossible assumptions have been made.

In summary, international law, statute and regulations govern marine emissions including those involving sulphur and nitrogen oxides. There are compliance records that should be available to shed light on key assumptions made by Aurora and permit verification of assumptions that may significantly affect forecast of human health risk. Assumptions need to be explicit so that they may be tested to demonstrate to the affected members of the public that human health risk arising from this project is at an acceptable level. None of this appears to have been done in this case.

2) Public Participation and Information Disclosure

Both the federal and provincial environmental legislation anticipate meaningful public participation. There can be no meaningful public input into an Environmental Assessment without full and frank disclosure of all material facts and assumptions. The public’s right to participate is undermined when there is not sufficient disclosure to allow for properly informed input. In this specific case, knowing what was assumed in the Aurora Application (including MEIT version used and assumptions input into the MEIT) is absolutely essential in order to be

able to review, analyse and comment on emission estimates as well as the environmental and human health risk posed by this proposed Aurora project.

As noted in my clients' Comment, the Aurora application does not clearly identify which version(s) of MEIT was (were) used. Indeed multiple references to different versions of MEIT including references to drafts imply that there may have been cherry picking from multiple versions of MEIT. There is no apparent way to be able to identify the versions or portions of versions of MEIT being used so as to be able to assess or critique what was used and to assess the reliability of the forecasts. There were no apparent statements of assumptions used to run whatever model was run from the assumptions and no statements as to the sensitivity of the model to the various assumptions. There was therefore insufficient information to even be able to tell which assumptions may be most important to a proper forecast and risk assessment so that the underlying rationale relating to those most important assumptions could be tested.

The public right to participate has been eviscerated by the lack of transparency. Members of the public and experts whom they have retained to provide input, assistance and opinions have been hindered by the lack of transparency. In this case, there is direct evidence from my clients' experts to substantiate the manner in which the lack of transparency has hindered the ability of the experts to provide useful input and analysis.

Meaningful public participation is considered so essential in the environmental context that public funding is made available to facilitate that participation and input. The funding includes funding for experts. The lack of transparency in the Aurora Application has effectively undermined the goal of public participation by ensuring that funding for experts at this stage will not be capable of being utilized to obtain the necessary and anticipated review and scrutiny. This is an error so significant that it cannot be "fixed" simply by having the Proponent later disclose the information. The funds for the experts have already been utilized to carry out preliminary reviews of the Aurora Application and to attempt to identify missing information and to pursue production of it (apparently to no avail in this instance). It is now not possible to have key assumptions properly scrutinized by experts (as intended by the statutory schemes and funding mechanisms). Proper and meaningful public participation is now not possible without full and frank disclosure of material information (including specifying assumptions used and version(s) of MEIT used) followed by a new and properly funded public review period to allow the public and expert review contemplated by the statutory schemes.

It is worth noting that one of the few instances in the Aurora Application in which the basis for calculations was stated was the in stack NOx calculations (30% vs 10% issue described in my clients' Comment and discussed by experts). The lack of validity of that approach was able to be properly reviewed and challenged.

Summary of Legal Position

The Aurora Application must be considered in the context of the legal (including statutory and regulatory) requirements relating to marine emissions (including sulphur and nitrogen oxides). As a result of that structure, records would be available to assist in confirming assumptions relating to matters such as sulphur and nitrogen oxide emissions. Issues have already been identified as part of the existing legal framework to assist in identifying areas of anticipated non-compliance so that reasonably accurate forecasts can be generated. It appears that this information has not been utilized or accounted for or that it has not been utilized in a manner that is discernable to the public.

It is our position that the Aurora Application is legally defective in numerous respects. In this case, there simply has not been sufficient disclosure to allow a valid public input process in the manner contemplated by the federal and provincial environmental assessment legislation.

In our submission, the lack of transparency in this case is sufficiently serious to require that the Application be rejected with a requirement of a full new (and properly funded) public input process upon resubmission.

ALL OF WHICH IS RESPECTFULLY SUBMITTED

Sincerely,

Angela McCue
Barrister and Solicitor

APPENDIX – Text of sections 110 and 111 of the *Vessel Pollution and Dangerous Chemicals Regulations SOR-2012-69*, as amended⁵.

Nitrogen Oxides (NO_x) — Marine Diesel Engines

Application

110 Sections 110.1 to 110.3 do not apply in respect of a marine diesel engine that is

- (a) intended to be used solely for emergencies;
 - (b) intended to be used solely to power any device or equipment that is intended to be used solely for emergencies on the vessel on which the device or equipment is installed; or
 - (c) installed in a lifeboat that is intended to be used solely for emergencies.
- SOR/2013-68, s. 15.

[Previous Version](#)

Tier I — power output of more than 130 kW

110.1 (1) This section applies in respect of a marine diesel engine that has a power output of more than 130 kW and that is installed on

- (a) a Canadian vessel or a Canadian pleasure craft that was constructed after December 31, 1999 but before January 1, 2011 and that does not engage only on voyages in waters under Canadian jurisdiction;
- (b) a foreign vessel or a foreign pleasure craft that was constructed after December 31, 1999 but before January 1, 2011;
- (c) a Canadian vessel or a Canadian pleasure craft that was constructed after May 2, 2007 but before the day on which this section comes into force and that engages only on voyages in waters under Canadian jurisdiction;
- (d) a Canadian vessel or a Canadian pleasure craft that was constructed before January 1, 2000 and that does not engage only on voyages in waters under Canadian jurisdiction, or a foreign vessel or a foreign pleasure craft that was constructed before January 1, 2000, if
 - (i) after December 31, 1999 but before January 1, 2011,

⁵ <http://laws-lois.justice.gc.ca/eng/regulations/SOR-2012-69/index.html>

- (A) the engine replaced a marine diesel engine that is not identical to the engine, or
 - (B) the engine was installed as an additional engine,
 - (ii) after December 31, 1999, a substantial modification, as defined in section 1.3.2 of the NO_x Technical Code, is made to the engine, or
 - (iii) after December 31, 1999, the maximum continuous rating of the engine is increased by more than 10%; or
- (e) a Canadian vessel or a Canadian pleasure craft that was constructed before May 3, 2007 and that engages only on voyages in waters under Canadian jurisdiction, if
- (i) after May 2, 2007 but before the day on which this section comes into force,
 - (A) the engine replaced a marine diesel engine that is not identical to the engine and that was installed on the vessel before May 3, 2007, or
 - (B) the engine was installed as an additional engine, or
 - (ii) after May 2, 2007,
 - (A) a substantial modification, as defined in section 1.3.2 of the NO_x Technical Code, is made to the engine, or
 - (B) the maximum continuous rating of the engine is increased by more than 10%.

Tier I — power output of more than 5 000 kW

(2) This section applies in respect of a marine diesel engine that has a power output of more than 5 000 kW and a displacement of 90 L or more per cylinder, and that is installed on

- (a) a Canadian vessel or a Canadian pleasure craft that was constructed after December 31, 1989 but before May 3, 2007 and that engages only on voyages in waters under Canadian jurisdiction;
- (b) a Canadian vessel or a Canadian pleasure craft that was constructed after December 31, 1989 but before January 1, 2000 and that does not engage only on voyages in waters under Canadian jurisdiction; or
- (c) a foreign vessel or a foreign pleasure craft that was constructed after December 31, 1989 but before January 1, 2000.

Emission limits

(3) Subject to sections 110.5 and 110.6 and, in the case of a marine diesel engine to which subsection (2) applies, regulations 13.7.1 to 13.7.3 of Annex VI to MARPOL, the authorized representative of a vessel must ensure that a marine diesel engine is not operated on the vessel if the quantity of nitrogen oxides emitted from the engine, calculated as the total weighted emission of NO₂, exceeds the following limits, where n represents the rated engine speed (crankshaft revolutions per minute) of the engine:

- (a) 17.0 g/kWh, where n is less than 130 revolutions per minute;
- (b) $45.0 \times n^{-0.2}$ g/kWh, where n is 130 revolutions per minute or more but less than 2,000 revolutions per minute; and
- (c) 9.8 g/kWh, where n is 2,000 revolutions per minute or more.

Certificates

(4) In the case of a Canadian vessel that engages only on voyages in waters under Canadian jurisdiction, a reference in regulation 13.7.1 of Annex VI to MARPOL to the vessel's International Air Pollution Prevention Certificate is to be read as a reference to the vessel's Canadian Air Pollution Prevention Certificate.

- SOR/2013-68, s. 15.

Tier II

110.2 (1) This section applies in respect of a marine diesel engine that has a power output of more than 130 kW and that is installed on

- (a) a vessel that is constructed after December 31, 2010, other than a Canadian vessel or a Canadian pleasure craft that was constructed before the day on which this section comes into force and that engages only on voyages in waters under Canadian jurisdiction;
- (b) a vessel, other than a Canadian vessel or a Canadian pleasure craft that was constructed before the day on which this section comes into force and that engages only on voyages in waters under Canadian jurisdiction, if
 - (i) the vessel was constructed before January 1, 2011, and
 - (ii) after December 31, 2010,
 - (A) the engine replaces a marine diesel engine that is not identical to the engine and that was installed on the vessel before January 1, 2011, or
 - (B) the engine is installed as an additional engine; or
- (c) a Canadian vessel or a Canadian pleasure craft that engages only on voyages in waters under Canadian jurisdiction, if

- (i) the vessel was constructed before the day on which this section comes into force, and
- (ii) on or after the day on which this section comes into force,
 - (A) the engine replaces a marine diesel engine that is not identical to the engine and that was installed on the vessel before the day on which this section comes into force, or
 - (B) the engine is installed as an additional engine.

Non-application

(2) This section does not apply in respect of a marine diesel engine to which section 110.3 applies.

Emission limits

(3) Subject to sections 110.5 and 110.6, the authorized representative of a vessel must ensure that a marine diesel engine is not operated on the vessel if the quantity of nitrogen oxides emitted from the engine, calculated as the total weighted emission of NO₂, exceeds the following limits, where n represents the rated engine speed (crankshaft revolutions per minute) of the engine:

- (a) 14.4 g/kWh, where n is less than 130 revolutions per minute;
- (b) $44.0 \times n^{-0.23}$ g/kWh, where n is 130 revolutions per minute or more but less than 2,000 revolutions per minute; and
- (c) 7.7 g/kWh, where n is 2,000 revolutions per minute or more.

- SOR/2013-68, s. 15.

Tier III

110.3 (1) This section applies in respect of a marine diesel engine that has a power output of more than 130 kW and that is installed on

- (a) a vessel that is constructed on or after January 1, 2016; or
- (b) a vessel that is constructed before January 1, 2016 if, on or after January 1, 2016,
 - (i) the engine replaces a marine diesel engine that is not identical to the engine and that was installed on the vessel before January 1, 2016, or
 - (ii) the engine is installed as an additional engine.

Exception — marine diesel engines installed on certain vessels

(2) This section does not apply in respect of a marine diesel engine that is

- (a) installed on a vessel with a length less than 24 m that has been specifically designed for, and is used solely for, recreational purposes;
- (b) installed on a vessel with a combined nameplate diesel engine propulsion power of less than 750 kW, if it is not possible for the engine to meet the requirements of subsection (4) because of design or construction limitations of the vessel;
- (c) installed on a vessel after December 31, 2015 as a replacement for a marine diesel engine that is not identical to the engine, if it is not possible for the engine to meet the requirements of subsection (4); or
- (d) installed on a vessel that is entitled to fly the flag of the United States.

Exception — vessels operating in certain waters

(3) This section does not apply in respect of

- (a) a Canadian vessel or a Canadian pleasure craft that is operating
 - (i) in arctic waters, or
 - (ii) in waters that are not waters under Canadian jurisdiction and are not within an emission control area; or
- (b) a foreign vessel or a foreign pleasure craft that is operating in arctic waters or in Hudson Bay, James Bay or Ungava Bay.

Emission limits

(4) Subject to sections 110.5 and 110.6, the authorized representative of a vessel must ensure that a marine diesel engine is not operated on the vessel if the quantity of nitrogen oxides emitted from the engine, calculated as the total weighted emission of NO₂, exceeds the following limits, where n represents the rated engine speed (crankshaft revolutions per minute) of the engine:

- (a) 3.4 g/kWh, where n is less than 130 revolutions per minute;
- (b) $9.0 \times n^{-0.2}$ g/kWh, where n is 130 revolutions per minute or more but less than 2,000 revolutions per minute; and
- (c) 2.0 g/kWh, where n is 2,000 revolutions per minute or more.

Change of date

(5) If the IMO, in accordance with regulation 13.10 of Annex VI to MARPOL, sets a later date for the purposes of regulation 5.1.1 of that Annex, the references in subsection (1) to January 1, 2016 are to be read as references to that later date.

- SOR/2013-68, s. 15.

Determining quantity of nitrogen oxides

110.4 For the purposes of subsections 110.1(3), 110.2(3) and 110.3(4), the quantity of nitrogen oxides emitted must be determined in accordance with the NO_x Technical Code.

- SOR/2013-68, s. 15.

Exhaust gas cleaning systems

110.5 A marine diesel engine may be operated if an exhaust gas cleaning system or any other equivalent method is used to reduce the quantity of nitrogen oxides emissions to no more than the limits specified in subsection 110.1(3), 110.2(3) or 110.3(4), as the case may be.

- SOR/2013-68, s. 15.

Exceptions to prohibited emissions

110.6 Nitrogen oxides may be emitted in the circumstances set out in section 5 that apply in respect of the emission.

- SOR/2013-68, s. 15.

Sulphur Oxides (SO_x)

Maximum sulphur content of fuel oil

111 (1) Subject to subsections (2) to (5) and section 111.1, the authorized representative of a vessel must ensure that the sulphur content of the fuel oil used on board the vessel does not exceed

- (a) 3.50% by mass before January 1, 2020, in the case of a foreign vessel or a foreign pleasure craft that is operating in arctic waters or in Hudson Bay, James Bay or Ungava Bay;
- (b) 3.50% by mass before January 1, 2020, in the case of a Canadian vessel or a Canadian pleasure craft that is operating in arctic waters or in Hudson Bay, James Bay or Ungava Bay;
- (c) 3.50% by mass before January 1, 2020, in the case of a Canadian vessel that is operating in waters that are not waters under Canadian jurisdiction and that are not in an emission control area;
- (d) 0.50% by mass after December 31, 2019, in the case of a foreign vessel or a foreign pleasure craft that is operating in arctic waters or in Hudson Bay, James Bay or Ungava Bay;
- (e) 0.50% by mass after December 31, 2019, in the case of a Canadian vessel or a Canadian pleasure craft that is operating in arctic waters or in Hudson Bay, James Bay or Ungava Bay;
- (f) 0.50% by mass after December 31, 2019, in the case of a Canadian vessel that is operating in waters that are not waters under Canadian jurisdiction and that are not in an emission control area;
- (g) 1.00% by mass before January 1, 2015, in the case of a Canadian vessel or a Canadian pleasure craft that is operating in waters under Canadian jurisdiction other than arctic waters;
- (h) 1.00% by mass before January 1, 2015, in the case of a Canadian vessel that is operating in waters that are not waters under Canadian jurisdiction and that are in an emission control area;
- (i) 1.00% by mass before January 1, 2015, in the case of a foreign vessel or a foreign pleasure craft that is operating in waters under Canadian jurisdiction other than arctic waters or in Hudson Bay, James Bay or Ungava Bay;

- (j) 0.10% by mass after December 31, 2014, in the case of a Canadian vessel or a Canadian pleasure craft that is operating in waters under Canadian jurisdiction other than arctic waters;
- (k) 0.10% by mass after December 31, 2014, in the case of a Canadian vessel that is operating in waters that are not waters under Canadian jurisdiction and that are in an emission control area; and
- (l) 0.10% by mass after December 31, 2014, in the case of a foreign vessel or a foreign pleasure craft that is operating in waters under Canadian jurisdiction other than arctic waters or in Hudson Bay, James Bay or Ungava Bay.

Steam-powered foreign vessels and foreign pleasure craft

(2) Subject to subsections (3) and (4), in the case of a foreign vessel or a foreign pleasure craft that is powered by a propulsion boiler that was not originally designed for continued operation on marine distillate fuel or natural gas, the vessel's authorized representative must ensure that, when the vessel is operating in the North American Emission Control Area or in the Great Lakes and St. Lawrence waters, the sulphur content of the fuel oil used on board the vessel does not exceed

- (a) 3.50% by mass before January 1, 2020; and
- (b) 0.50% by mass after December 31, 2019.

Non-application

(3) Subsections (1) and (2) do not apply in respect of a foreign vessel or a foreign pleasure craft that

- (a) is powered by a propulsion boiler that was not originally designed for continued operation on marine distillate fuel or natural gas; and
- (b) operates solely on the Great Lakes and their connecting waters.

Alternative measure

(4) Instead of meeting the requirements of subsection (1) or (2), the authorized representative of a vessel may ensure that

- (a) the vessel operates an exhaust gas cleaning system that meets the requirements of Resolution MEPC.184(59); and

(b) the emissions of sulphur oxides produced by the operation of the system do not exceed the emissions that would be produced were fuel oil with the sulphur content by mass required by that subsection used on board the vessel.

When different fuel is ussed

(5) The master of a vessel referred to in subparagraph 122(1)(a)(ii) or (iii) must ensure that the requirements of regulation 14.6 of Annex VI to MARPOL are met if the vessel is entering or leaving an emission control area and the fuel oil used on board within the area is different from the fuel oil used on board outside the area.

Residues from exhaust gas cleaning systems

(6) If a vessel operates an exhaust gas cleaning system that has been certified in accordance with Resolution MEPC.184(59), the vessel's authorized representative must ensure that

- (a)** any exhaust gas cleaning system residues are delivered to an onshore reception facility; and
- (b)** the washwater from the operation of the system, as well as the monitoring and recording of the washwater, meets the requirements of section 10 of the Resolution.

- SOR/2013-68, s. 15;
- SOR/2013-235, s. 37(F).

[Previous Version](#)

Application

111.1 (1) This section, instead of section 111, applies in respect of an authorized representative's Canadian vessels when they are operating in the Great Lakes and St. Lawrence waters during the period referred to in paragraph (4)(a) or during a year referred to in subsection (4) if, before the period or year begins, the authorized representative

- (a)** notifies the Minister that the authorized representative elects to have this section apply in respect of that period or year; and
- (b)** provides the Minister with a report that specifies the manner in which each of the vessels will be managed for the purposes of meeting the requirements of subsection (4) or (6) for that period or year.

Application — alternative

(2) This section, instead of section 111, applies in respect of an authorized representative's Canadian vessels when they are operating in the Great Lakes and St. Lawrence waters during the period beginning on the day on which this section comes into force and ending on December 31, 2020 if the authorized representative

- (a) before the period begins, notifies the Minister that the authorized representative elects to have this section apply in respect of that period; and
- (b) before the period referred to in paragraph (5)(a) and before each year referred to in column 3 of the table to subsection (5), provides the Minister with a report that specifies the manner in which each of the vessels will be managed for the purposes of meeting the requirements of subsection (5) or (6) for that period or year.

Fuel oil used in other waters under Canadian jurisdiction

(3) In the notification, the vessels' authorized representative may

- (a) for the purposes of calculating the total amount of fuel oil used on board the vessels, elect to include the fuel oil used on board any of the vessels when they are operating in waters under Canadian jurisdiction that are not within the Great Lakes and St. Lawrence waters; and
- (b) for the purposes of calculating the average sulphur content by mass of the total amount of fuel oil used on board the vessels, elect not to include
 - (i) 10% of the sulphur content by mass of the fuel oil used on board any of the vessels that were first delivered after December 31, 2008 but before August 1, 2012, and
 - (ii) 20% of the sulphur content by mass of the fuel oil used on board any of the vessels that were first delivered after July 31, 2012 or on which a marine diesel engine that has a power output of more than 5 000 kW was installed after July 31, 2012.

Average sulphur content

(4) If an election is made under subsection (1), the vessels' authorized representative must ensure that the average sulphur content by mass of the total amount of fuel oil used on board the vessels does not exceed

- (a) 1.30% in the period beginning on the day on which this section comes into force and ending on December 31, 2013;
- (b) 1.20% in 2014;
- (c) 1.10% in 2015;
- (d) 1.00% in 2016;
- (e) 0.80% in 2017;
- (f) 0.60% in 2018;
- (g) 0.40% in 2019; and
- (h) 0.10% in 2020.

Average sulphur content and cumulative average sulphur content

(5) If an election is made under subsection (2), the vessels' authorized representative must ensure that the average sulphur content by mass of the total amount of fuel oil used on board the vessels does not exceed

- (a) 1.70% during the period that begins on the day on which this section comes into force and ends on December 31, 2013;
- (b) the amount set out in column 1 of the table to this subsection during the year set out in column 3; or
- (c) the amount set out in column 2 of the table to this subsection during the period that begins on the day on which this section comes into force and ends on December 31 of the year set out in column 3.

table

	Column 1	Column 2	Column 3
Item	Average sulphur content by mass	Cumulative average sulphur content by mass	Year

	Column 1	Column 2	Column 3
Item	Average sulphur content by mass	Cumulative average sulphur content by mass	Year
1	1.60%	4.40%	2014
2	1.50%	5.50%	2015
3	1.40%	6.50%	2016
4	1.20%	7.20%	2017
5	1.00%	7.70%	2018
6	0.80%	8.00%	2019
7	0.10%	8.00%	2020

Alternative measures

(6) Instead of meeting the requirements of subsection (4) or (5), the vessels' authorized representative may ensure that any combination of the following on one or more of the vessels results in total emissions of sulphur oxides that do not exceed the total emissions of sulphur oxides that would be produced were fuel oil with the sulphur content by mass required by that subsection used on board the vessels:

(a) the operation of an exhaust gas cleaning system that meets the requirements of Resolution MEPC.184(59);

(b) the use of equipment or materials or the carrying out of procedures; and

(c) the use of fuel oil with a reduced sulphur content.

Washwater from exhaust gas cleaning systems

(7) The vessels' authorized representative must ensure that

(a) any exhaust gas cleaning system residues are delivered to an onshore reception facility that is licensed by the jurisdiction where the facility is located; and

(b) if one or more of the vessels operate an exhaust gas cleaning system that has been certified in accordance with Resolution MEPC.184(59), the washwater from the operation of the system, as well as the monitoring and recording of the washwater, meets the requirement of section 10 of the Resolution.

Report — the manner in which vessels will be managed

(8) The vessels' authorized representative must provide the Minister with a revised report as soon as feasible if

(a) after a report is provided under paragraph (1)(b), the manner in which any of the vessels are managed in order to meet the requirements of subsection (4) or (6) changes; or

(b) after a report is provided under paragraph (2)(b), the manner in which any of the vessels are managed in order to meet the requirements of subsection (5) or (6) changes.

Interim report — the manner in which vessels are being managed

(9) The vessels' authorized representative must, during the period beginning on June 1 and ending on September 30 of any year in respect of which an election is made under subsection (1) or (2), provide the Minister with an interim report that describes how each of the vessels is being managed in order to meet the requirements of subsection (4), (5) or (6) for that year.

Report — how vessels were managed

(10) The vessels' authorized representative must

(a) if an election is made under subsection (1) in respect of a period or year, provide the Minister, on or before March 1 of the year following the period or year, with a report that describes the manner in which each of the vessels was managed in order to meet the requirements of subsection (4) or (6) for that period or year; or

(b) if an election is made under subsection (2), provide the Minister, on or before March 1 of each year starting in 2014 and ending in 2021, with a report that describes the manner in which each of the vessels was managed in order to meet the requirements of subsection (5) or (6) for

- (i) the period that begins on the day on which this section comes into force and ends on December 31, 2013, in the case of a report made in 2014, or
- (ii) the year before the report is made, in any other case.

Auditing

(11) The reports referred to in subsection (10) must be audited for accuracy by a person who has knowledge of the methods of conducting audits and is independent of the authorized representative.

Canadian Air Pollution Prevention Certificates

(12) Despite paragraph 122(1)(a), if an election is made under paragraph (1)(a) or (2)(a) in respect of a vessel, the vessel

(a) must hold and keep on board a Canadian Air Pollution Prevention Certificate; and

(b) is not required to hold and keep on board an International Air Pollution Prevention Certificate, unless the vessel operates in waters that are not waters under Canadian jurisdiction and are not within the Great Lakes and St. Lawrence waters.

- SOR/2013-68, s. 15.

Documentation if exhaust gas cleaning system is operated

111.2 If a vessel operates an exhaust gas cleaning system referred to in paragraph 111(4)(a) or 111.1(6)(a) or (c),

(a) the vessel must hold and keep on board a certificate of type approval certifying that the system meets the applicable requirements referred to in Resolution MEPC.184(59);

- (b) the vessel must keep on board an EGC System Technical Manual “Scheme A” that meets the requirements of section 4.2.2 of Resolution MEPC.184(59) or an EGC System Technical Manual “Scheme B” that meets the requirements of section 5.6 of Resolution MEPC.184(59);
 - (c) the vessel must keep on board a SO_x Emissions Compliance Plan that meets the requirements of section 9.1.1 of Resolution MEPC.184(59);
 - (d) the authorized representative must ensure that the information required by Resolution MEPC.184(59) respecting the operation, maintenance, servicing, adjustments and monitoring of the system is recorded as required by the Resolution; and
 - (e) the vessel must keep on board the information referred to in paragraph (d) in the form and manner required by Resolution MEPC.184(59).
- SOR/2013-68, s. 15.

Diesel Engines with a Displacement of Less than 30 L Per Cylinder

New diesel engines

111.3 (1) The authorized representative of a Canadian vessel or a Canadian pleasure craft must ensure that any new diesel engine that has a displacement of 7 L or more per cylinder but less than 30 L per cylinder, and that is installed on the vessel for its propulsion, has been certified

- (a) by the United States Environmental Protection Agency as meeting the requirements of Title 40, section 1042.101, of the *Code of Federal Regulations* of the United States for Category 2 engines; or
- (b) by the government of another state as meeting requirements for emissions of particulate matter, nitrogen oxides and hydrocarbons that are equivalent to the requirements referred to in paragraph (a).

Deferred application

(2) Subsection (1) does not apply before January 1, 2016.

- SOR/2013-68, s. 15.