Comments on the Aercoustics Phase 1 Report

John Harrison – July 6th, 20010

First of all, the report includes a very good literature survey of the limitations of measuring wind turbine noise and comparing the measured noise with regulated noise limits. Nevertheless, it is clear that there is a way forward.

I accept that the point of the exercise is limited to the question: Given the Ontario noise regulations, how is the Ministry of the Environment to demonstrate compliance or otherwise? Nevertheless, I am of the firm belief that the regulations, as given in the October 2008 document are far too lenient to the wind industry and that the wind industry has been taking full advantage of this leniency. To be more precise:

There is no acceptance that turbine noise is particularly annoying because of its periodic or cyclic character. This amplitude modulation is typically 5 dBA but larger values have been measured. There is no acceptance that the noise specifications of the turbine manufacturer include uncertainty as does the algorithm for determining noise at a receptor. Together these amount to 4 dBA. There is no acceptance that turbulence in the atmosphere increases turbine noise. Ontario is dragging its feet compared to other jurisdictions in maintaining a 40 dBA noise limit compared with 35 dBA in quiet regions in New Zealand, Australia and Germany. It is also becoming clearer that low frequency noise, sometimes below the audible limit, is having an impact on the health of people living close to wind turbines.

The Phase 1 report makes much of the use of L_{90} for sound measurements. However, L_{90} has no place in the measurement of turbine noise. It should be crystal-clear that L_{90} will miss all of the amplitude modulation. L_{eq} by contrast picks up a fraction of the amplitude modulation. The only way that L_{90} should be considered is if it accompanied by a 5 dBA penalty for amplitude modulation. This is the approach of the New Zealand government. There are Ontario noise audit measurements which make it quite clear that $L_{eq} - L_{90}$ can be 5 dBA over periods of time. See the figure below, from an Amaranth Wind Power Development audit.

The Phase 1 Report poses the question: Given a noise audit report, how is compliance determined. There is the suggestion that a typical uncertainty in an acoustic measurement will be ± 1.5 dBA. Therefore such an allowance should be made in determining compliance. However, given that MOE refuses to accept uncertainty in the turbine specifications or in ISO-9613-2, it would be consistent to accept no allowance for uncertainty in the acoustic measurement.

The Phase 1 Report addresses the question of what range of wind speeds are needed to determine compliance. For the October 2008 regulations, the real limit on turbine noise is set by a 10m wind speed of 6 m/s and summer night-time. Wind speed gradient measurements in Ontario are showing an average gradient parameter of about 0.45 for summer night-time. This means that for a fixed-speed turbine and a 10m wind speed of 6 m/s the power and noise are close to maximum. At a 10m wind speed of 6 m/s the noise limit remains at 40 dBA. Above 6

m/s, the noise limit increases with increase in wind speed. Therefore the compliance noise audit can be limited to summer night-time and wind speeds in the range 6 ± 2 m/s.

The problem with this protocol is that wind noise in the microphone limits the ability to measure the background noise. For instance a Larson-Davis 2100K sound meter has microphone noise of over 50 dBA at 6 m/s. A Rion NA-83 sound meter fitted with a WS-13 wind shield has microphone noise of 30, 35 and 40 dBA at wind speeds of 4, 5 and 6 m/s respectively. There are techniques for avoiding wind noise in the microphone using hard boards and oversize wind shields. These are well referenced in the Aercoustics report. Note that the oversize wind shields attenuate all sound and calibration is necessary.

Another question raised concerns rapid measurements of wind speed. Modern Pitot tube, hot wire and ultrasonic anemometers can measure wind speed fluctuations in the kHz range and above. The ultrasonic anemometer is particularly attractive in that it self-corrects for temperature changes. One such instrument is the Gill instruments Windmaster Ultrasonic Anemometer.

The sense of the meeting to discus the draft report was that there are two major and equally important issues: Are the turbines compliant and how is the Ministry of the Environment going to deal with complaints. The second issue is both an instrumentation problem and a management problem. It seems that complainants are getting a run-around from the Ministry of the Environment; officials are not to be seen when the noise is a problem and do show up when there is little wind or during the day when the noise is perhaps masked. Consultants in New Zealand have faced up to this problem by developing a fully automatic noise measuring system (noise level, noise spectrum and noise recording) which communicates with a central computer and which can be started and stopped by the resident. There is associated analysis software. The company has a web-site (www.atkinsonrapley.co.nz) but it is very limited. There are brochures and I will forward copies by mail. The relevant text from the website is as follows:

SAM: the Spectro-Acoustic-Meter.

SAM is the latest technology development from Atkinson & Rapley Consulting Ltd in association with Astute Engineering. It is a pc-based system for measuring and analysing environmental noise.

SAM utilises the latest virtual instrumentation approach to programming, creating a very user-friendly interface built on a modular foundation.

SAM is a PC-based solution to the complex problem of how to measure and analyse environmental noise. Current technological solutions are usually based around dedicated instruments. They have a singular purpose and function. SAM is a computer which has extended functionality specific to the requirements of environmental noise officers.

SAM is unique in that it utilises two input signal sources (microphones) which allow a single instrument to make two sets of measurements simultaneously in real time. This allows for the measurement of sound inside and outside a dwelling, for example, with one instrument.

The audio spectrum SAM uses is 20 HZ to 20 kHz at sound levels nominally in the range of 30 to 120 dB. Sound is sampled from the environment in linear mode; however the results can be displayed in: A-weighted; C-weighed or Linear (Z-weighted). Spectral analysis is available in: 1 octave; 1/3 octave; 1/6 octave; 1/12 octave and 1/24 octave, making it unique among sound analysis systems. In addition, the common acoustic statistics of L_{10}, L_{50}, L_{90}, L_{95}, L_{eq} and Max are always available in a table.

Sound levels can be displayed in real time on interactive graphs. The sound spectra are similarly available. A separate dual-bar graph displays the instantaneous combined sound power for each channel.

Another unique feature of SAM is the ability to record actual sound bites when a pre-set dB threshold is exceeded. In this way, SAM acts like a digital 'tape-recorder' - the recorded sound files can be used as evidence at a later time. After a sound bite has been recorded, the user can set a hold-off period such that even if the sound exceeds the threshold again, no recording will be made until the hold-off period has elapsed. Recorded sound bites are displayed on the dB/time graph as yellow dots that are in fact buttons - clicking on them plays the sound file.

SAM has the added advantage that it can be operated in two distinct modes: real-time or batch mode. In real-time, SAM can be used as a roving sound inspector, determining the origin of a particular sound. Alternatively, SAM can be set up in batch mode where a time and date calendar can be set up in advance, off site. When SAM is placed on site, the batch job(s) can be activated and will automatically start recording data at the appointed date/time. On completion SAM simply goes into sleep mode. Data can be downloaded automatically over the internet to your office if required, at a specific time set by the user. This allows environmental officers to interrogate a SAM field station on an ongoing basis without ever leaving the office.

SAM has been designed with council environmental inspectors in mind. The system can print out a cessation order on the spot with the use of a portable printer. Word templates can be simply filled out with the offender's details and printed on the spot. The system automatically includes graphs of the alleged noise infringement including spectral analysis and acoustic statistics as proof. This really is the equivalent of a 'speeding ticket' for noise infringement.

SAM V.2.0 has a new feature to assist noise abatement officers in the field: the One Touch Button. Turn on the laptop with the interface unit plugged in and simply push the single button to make a 5, 10 or 15 minute spot recording and then print the infringement notice.

Sound Levels Measured at Residence.
Comparison to Wind Speeds and Criteria. Canadian Hydro, Melancthon EcoPower Center.