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Report Number 041808-1
Baseline Environmental Noise Survey
Leaf-off Season

Bell Bend Nuclear Power Plant (BBNPP) Project
April 2008

Prepared For:

AREVA NP Inc.
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1.0_Introduction

Hessler Associates has been retained by AREVA NP, Inc. to conduct a baseline environmental noise level measurement survey in the surrounding environs at the proposed Bell Bend Nuclear Power Plant (BBNPP) project located near the town of Berwick, Pennsylvania. The site contains two existing PPL nuclear power units, rated at nominal capacities of 1105 and 1111 Mw, located just to the east of the planned Bell Bend project. An aerial map with topography shading is given on **Figure 1.0.1** that shows the planed Bell Bend expansion area and the selected community noise survey locations 1 through 5.

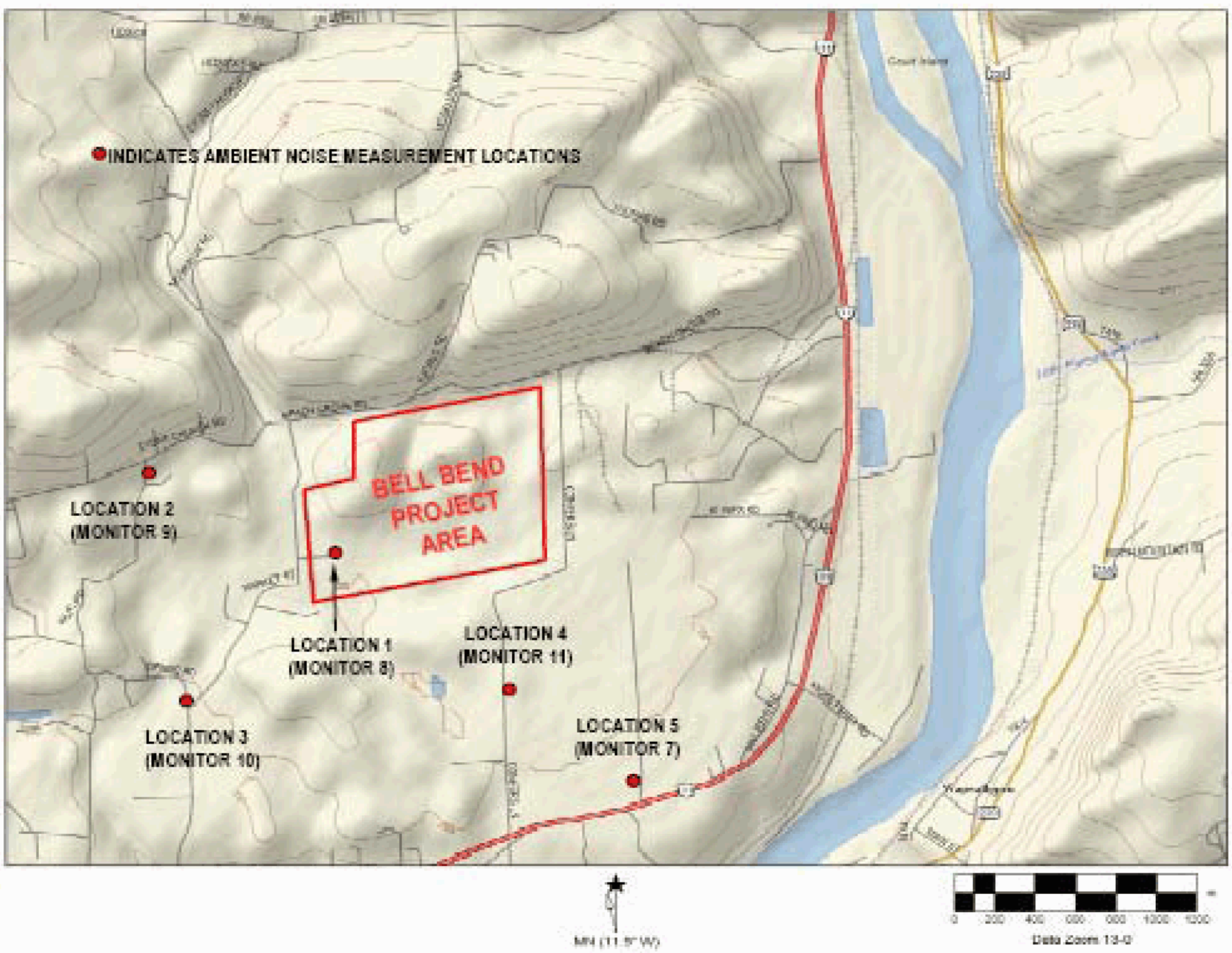


Figure 1.0.1: *Site Map of Bell Bend Project Showing Sound Measurement Locations.*

Noise level survey results are required environmental information to define existing noise conditions. Measured levels at the closest potentially sensitive receptors are used to assess any potential noise impact from the planned project. Typical receptors of concern are residential units, hospitals, parks and houses of worship. In this case, all potentially sensitive locations were the closest residential land uses.

Ambient or existing environmental community noise levels during leaf-off conditions were measured continuously over a 13 day period and are reported as complete days from midnight March 1st through March 13th, 2008. Monitors were installed on February 29th and removed on March 14th. Measurements are made during leaf-off conditions to detect any contribution from the existing generating facilities, since the excess attenuation from dense trees between the plant and community would be minimal. Measurements are repeated during leaf-on warmer weather conditions when use of the outdoor environment for enjoyment by the community is normal. Potential adverse impact is more likely during warmer leaf-on conditions.

Ideally, environmental levels should be measured during quiescent or calm and still weather conditions when minimum levels occur to provide the most conservative baseline[1]. Surveying over a 13-day period provides the ambient under many weather and time conditions. Baseline levels measured under these conditions provide always-present masking noise levels for evaluation of any new predicted emissions.

2.0_ Executive Summary and Results

Subjectively, existing facility noise emissions were not detectable at any location during normal operation of both PPL units on February 29th while installing the noise monitors and conducting manual measurements. Unit 1 was shut down March 3rd for a planned outage. Construction or maintenance noise was detectable on March 14th during manual measurements while removing the continuous monitors.

There are no identified state or local noise ordinances for the project. Compliance with applicable noise regulations is usually deemed an adequate assessment. When there is no ordinance, noise assessment is typically done by comparing the noise emissions from the planned facilities to measured baseline ambient sound levels and is called an ambient-based assessment. Impact, or lack of, is quantified by the incremental change or increase to the measured ambient sound level. If the increase to the residual ambient level is small, i.e. 0 to 3 dBA, little noise impact is expected. The threshold for potential impact from noise is typically a 5 dBA increase above existing conditions. Adverse impact would be predictable with large increases in level caused by the new source.

This study documents measured ambient levels in the surrounding environs of the planned Bell Bend project for assessing noise impact. The final baseline ambient level cannot be established until completion of the leaf-on warmer-weather survey. The data presented below are the minimum measured hourly levels in three metrics for each of the thirteen complete measurement days. It is customary in three states (NY, MA and CA) with codified ambient-based procedures to use the minimum ambient level present during facility operational hours. For the proposed project with planned 24/7 operation at this rural environment, the minimum value may occur in any hour of the 24-hour day.

Table 2.0.1 below forms the key finding for this leaf-off study with the minimum daily levels measured by the three most common metrics. The average daily weather conditions for each day is plotted for reference, and conditions were not extreme (such as thunder, etc.) to exclude data for any of the measurement time. Note that minimum ambient levels generally occur on calm and still days. Both units 1 and 2 were fully operational at the start of monitoring but unit 1 was shut down for a planned outage on the night of March 3rd.

LOCATION	3/1 SAT	3/2 SUN	3/3 MON	3/4 TUE	3/5 WED	3/6 THU	3/7 FRI	3/8 SAT	3/9 SUN	3/10 MON	3/11 TUE	3/12 WED	3/13 THU	AVERAGE DAILY MINIMUM HOURLY LEVEL
	LA50 METRIC MINIMUM HOUR MEASUREMENT													
1	28	27	34	32	33	32	36	36	28	28	32	28	31	**31**
2*	30	27	35	34	37	34	36	35	29	29	34	30	32	**33**
3	32	28	34	36	38	37	34	32	32	32	34	30	31	**33**
4	31	27	37	34	39	33	38	37	27	26	36	33	35	**33**
5	39	34	36	52	43	36	48	46	32	28	40	39	34	**39**
	LA90 METRIC MINIMUM HOUR MEASUREMENT													
1	27	25	32	31	32	30	34	33	27	27	29	26	28	**29**
2*	29	26	33	33	35	32	34	32	27	28	31	28	30	**31**
3	30	27	33	36	38	34	33	31	30	31	32	29	30	**32**
4	29	26	33	32	36	31	36	33	25	25	33	30	32	**31**
5	33	31	34	39	35	33	39	42	27	26	36	33	29	**34**
	LAeq METRIC MINIMUM HOUR MEASUREMENT													
1	31	28	35	32	34	33	38	37	28	28	34	30	32	**32**
2*	35	28	37	35	40	38	38	36	32	29	36	35	34	**35**
3	40	29	37	37	40	37	37	33	38	32	35	38	32	**36**
4	33	28	39	36	46	44	38	38	30	28	38	37	37	**36**
5	51	47	51	55	56	55	54	53	53	51	53	53	52	**53**

AVERAGE WIND SPEED, MPH	8	6	5	7	8	3	6	8	10	5	3	8	5
AVERAGE WIND DIRECTION	NW	NNW	S	ESE	WNW	WNW	SE	WSW	NW	NW	NNW	NW	SSE
PRECIPITATION, INCHES	0	0	0	1.2	0.9	0	0.6	0.4	0	0	0	0	0

* EST FROM MACRO DATA RESULTS AT LOCATIONS 1, 3 & 4

WEATHER DATA FROM TOP OF SHICKSHINNY MOUNTAIN, APPROX. 7 MILES NORTH OF SITE

Table 2.0.1: *Tabulation of daily minimum A-weighted sound levels measured over a 13-day sampling period under leaf-off cold weather conditions.*

3.0_Conclusions

Ambient noise in a residential community varies greatly with time of day and day to day. The levels measured in this survey are representative for daily minimum levels during leaf-off conditions over an extended time period. Any industrial or power plant noise or far-off road system noise would be at maximum levels under leaf off conditions since there is no foliage attenuation in the path between the plant and receptors. A leaf-on survey is planned for two reasons; ambient levels could be lower due to the excess sound attenuation provided by dense tree cover and soft ground, and potentially sensitivity would be higher when receptors are outdoors enjoying the milder environment.

4.0_ Definitions and Background Information

Units and Discussion of Sound Levels

The universal measure of sound in decibels used throughout the world is the A-weighted sound level, abbreviated dB(A) or dBA. The overall sound level is defined as the summed level in decibels over the entire *audible* frequency range (for young adults) of approximately 20 to 20,000 cycles/second (Hertz). The A-weighted sound level is a convenient single number to quantify the entire spectrum of a sound. A-weighting is an electronic filter applied to the spectrum that reshapes the spectrum to simulate human hearing response to frequency content. Lower frequency sound is subtracted by the A-weighting filter since humans perceive higher frequencies easier than lower notes. The reshaped or weighted new spectrum is summed over the same audible frequency span and is called the overall A-weighted level. Thus, the A-weighted sound level becomes an excellent single number descriptor for audible sounds.

Reference [2] is an informative and a more detailed reference source for definitions and units used in this report.

Table 4.0.1 below is a scale of common sound levels that have similar character to the sounds created by a well designed power plant and many industrial facilities. These data come from the author's files over many years. All of the sounds are broadband, meaning the spectrum is smooth without sharp peaks or tonal noise. Examples of broadband noise are slow speed airflow from HVAC ducting, rushing water, tree leaf rustling and traffic noise without truck diesel tones. More irritating non-broadband tonal noise examples are an alarm clock, siren, diesel engine or construction equipment back-up bells or buzzers.

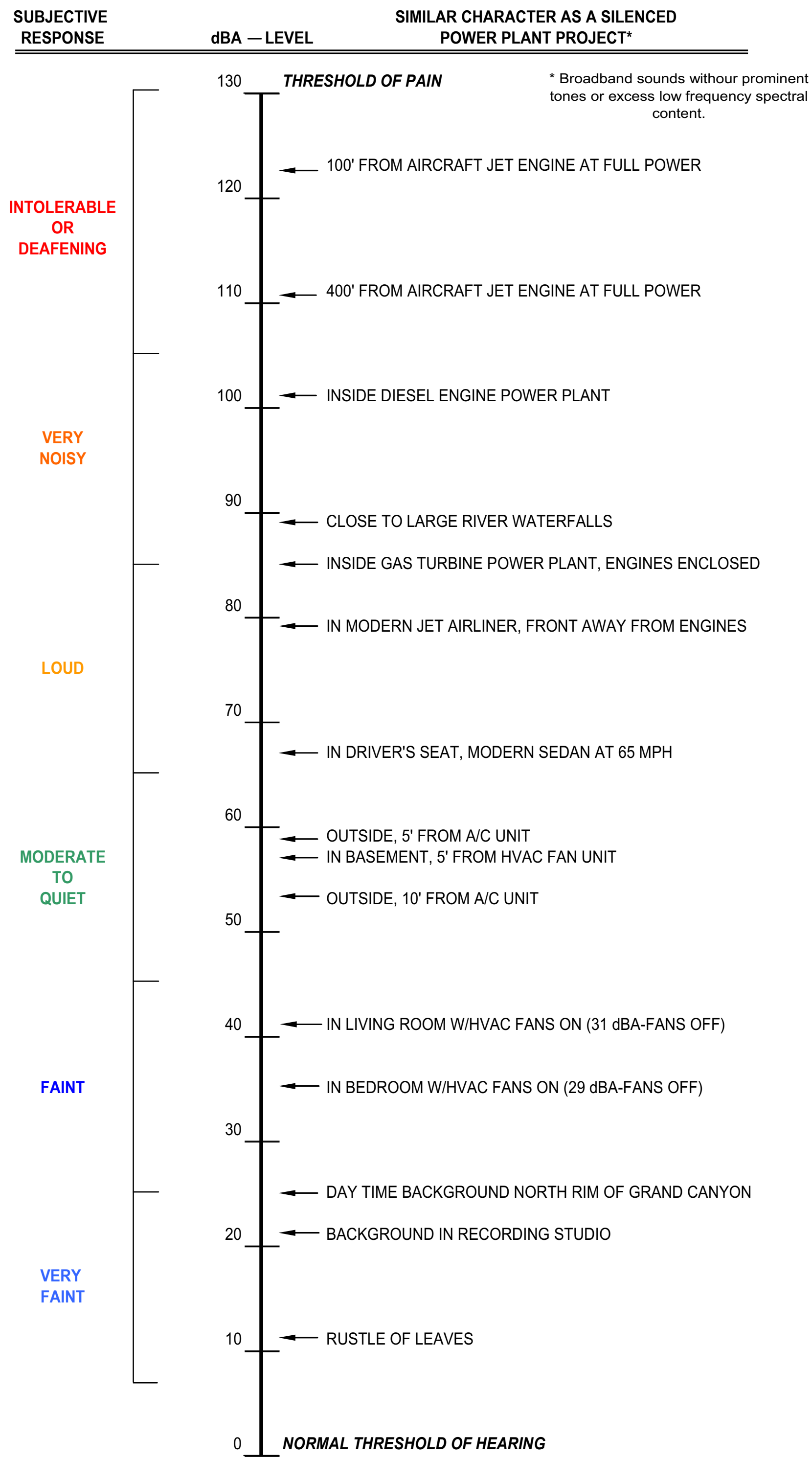


Table 4.0.1: *Table of Common Sounds in A-weighted dBA Units*

The *instantaneous* A-weighted sound level in any residential community varies over any sampling period as sporadic noise events occur. Such events may be passing vehicles, aircraft or rail events, dog barking, tree leaf rustle, song birds, etc. **Figure 4.0.1** below shows the instantaneous level for a 10-minute daytime sample in a quiet rural environment.

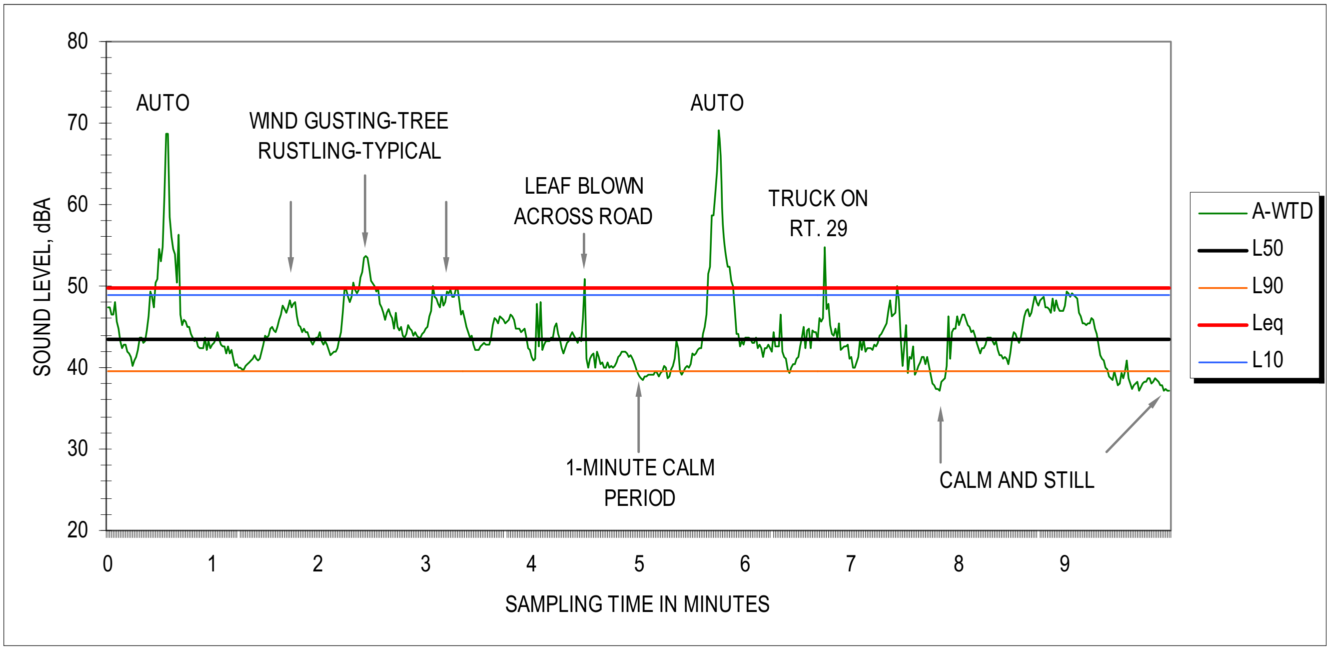


Figure 4.0.1: *Instantaneous sound level plot for a quiet residential environment remote from highways and airports.*

To condense this widely varying data to a more usable form, standard measurement metrics are defined in reference 2. The obvious ones are the minimum, maximum and average levels that occur over the interval. The max and min are the highest and lowest measured instantaneous level during the sampling period. The average, designated Leq is the *equivalent* steady sound level that has the same or equivalent acoustic energy as the actual time varying signal. It can be thought of as the true energy or true pressure average, and is not simply the arithmetic average over the period.

Percentile levels or exceedence levels, designated L_1, L_{10}, L_{50} and L_{90} are statistically derived units over the sampling period. They are the levels exceeded for 1, 10, 50 and 90% of the sampling time. L50 is the mean level where half the time the sound level is higher or lower. Of course, all of these units would be identical if the sound were perfectly steady without any variance with time, i.e., L_{min} would equal L_{max} would equal L_{eq}. etc.

The L_{90} percentile level is often used for evaluating community noise in residential environments. L_{90} is defined in reference 3, pages 5-6 as the "residual" sound level, which is the quasi-steady level that occurs in the absence of all identifiable sporadic sound levels occurring over the interval. The vast majority of all residual sound levels found in communities come from far-away unidentifiable steady levels from traffic and/or industrial sources.

Typical residual daytime levels[3] found throughout the U.S. under calm and still wind conditions are shown in **Table 4.0.2** below:

Typical Residential Area Sound Levels
Daytime Residual Level, dBA, Level Exceeded 90% of the Time, L90

Description	Typical Range	Average
Very Quiet Rural or Remote Area	26 to 30 inclusive	28
Very Quiet Suburban or Rural Area	31 to 35 inclusive	33
Quiet Suburban Residential	36 to 40 inclusive	38
Normal Suburban Residential	41 to 45 inclusive	43
Urban Residential	46 to 50 inclusive	48
Noisy Urban Residential	51 to 55 inclusive	53
Very Noisy Urban Residential	56 to 60 Inclusive	58

Table 4.0.2: *Typical Residual Sound levels in Residential Communities.*

5.0_ Methodology

5.1_Instrumentation for Continuous and Manual Measurements

The instantaneous sound level was measured on a continuous and simultaneous basis over the 13-day period using type 2 precision data loggers programmed to record the metrics discussed in Section 4 above. The meters report the data in hourly intervals. A typical continuous data logger is shown in **Figure 5.0.1** below:

Figure 5.1.1: *Data logger shown in weatherproof case with power supply and remote microphone.*

The loggers were checked for calibration by inserting two independent type 1 precision portable calibrators onto the microphone when each meter was setup and taken down. This calibrates the entire system of microphone, preamplifier and sound level meter (SLM) electronics. The reason for using separate calibrators, each with a different sensitivity (94 and 114 dB at 1000 Hz), is to ensure accuracy even though each calibrator is checked for accuracy yearly at a NIST certified laboratory. The chance of one being out of calibration is low, but would show up immediately if the proper sensitivity of each did not agree. The start and finish calibrations for this survey are tabulated below:

	START		FINISH	
LOCATION	B&K 4230	NOR 1251	B&K 4230	NOR 1251
1	94.0	114.0	93.7	114.2
2	↓	114.0	93.9	113.9
3	↓	113.9	93.9	113.8
4	↓	114.0	94.3	114.3
5	↓	114.0	94.2	114.1

Table 5.1.1: *Calibration at start and finish of monitoring period.*

The calibration change was insignificant (<0.5 dBA) at all locations 1 through 5.

In addition to the continuous data loggers, manual measurements were carried out at each location during day time periods with a Rion model NA27 type 1 precision sound level meter (SLM) and 1/3 octave band frequency analyzer. The meters were programmed to run for ten-minute intervals to calculate the average and other statistical metrics described in Section 4 above. Attended measurements allow observations of weather effects and identification of environmental noise sources.

5.2_Noise Monitor Locations

Five monitor locations were chosen after review of the site to locate potentially sensitive receptors in all directions around the site as shown on **Figure 1.0.1**. The monitors were mounted to trees or utility poles at a height of approximately 6 feet above grade.

Monitor location 1 was placed in the planned Bell Bend plant area and reasonably close to the existing PPL plant. Locations 2 through 4 are near residences that are closest to the new plant. Monitor location 5 is on the power line right-of-way approximately 200 feet from busy route 11.

The GPS coordinates for each location are given below:

LOCATION	DEGREES	MINUTES	DEGREES	MINUTES
1	N38	58.956	W81	55.717
2	N38	59.372	W81	56.878
3	N38	59.270	W81	56.884
4	N38	59.447	W81	56.055
5	N38	58.828	W81	56.678

6.0_Discussion of Results

6.1_Monitor Measurement Results

Appendix A contains graphic plots of the measured hourly data at four locations for the entire sampling program. All metrics are plotted for each hour including the minimum and maximum levels, Leq and the statistical metrics of L10, L50 and L90. The maximum levels in each hour represent passing traffic. Note maximum levels at location 5 are nearly constant over the 13 day period averaging about 75 dBA, while at all other locations, the traffic subsides at night and the early morning hours. Note also that the hourly temporal trend is the same at all locations but differs substantially at location 5.

Monitor 9 at location 2 ran for the entire period but did not download or write the data to the compact flash card within the meter. It is the first instance and inexplicable at present why the measurement parameters were written to the card but the data file was empty? Fortunately, the environment at all of the sampled residences is a "macro" area ambient and the levels at location 2 can be easily estimated from the remaining data. The residual ambient in a macro area is essentially constant for all practical purposes at any of the three locations 1, 3 and 4. This occurs in areas where the environmental sound sources are far off in distance relative to the distance between monitoring points, and natural sources are similar at all locations. The major source of environmental noise in the project area is from far-off unidentifiable traffic.

To illustrate, **Figure 6.1.1** below is a plot showing the residual hourly LA90 sound level at the five locations. The trends are consistent in the five community locations except at location 5 (dotted line) that contains nearly constant noise from the route 11 only 200 feet away. The levels for location 2 are calculated from the average of results at locations 1, 3 and 4.

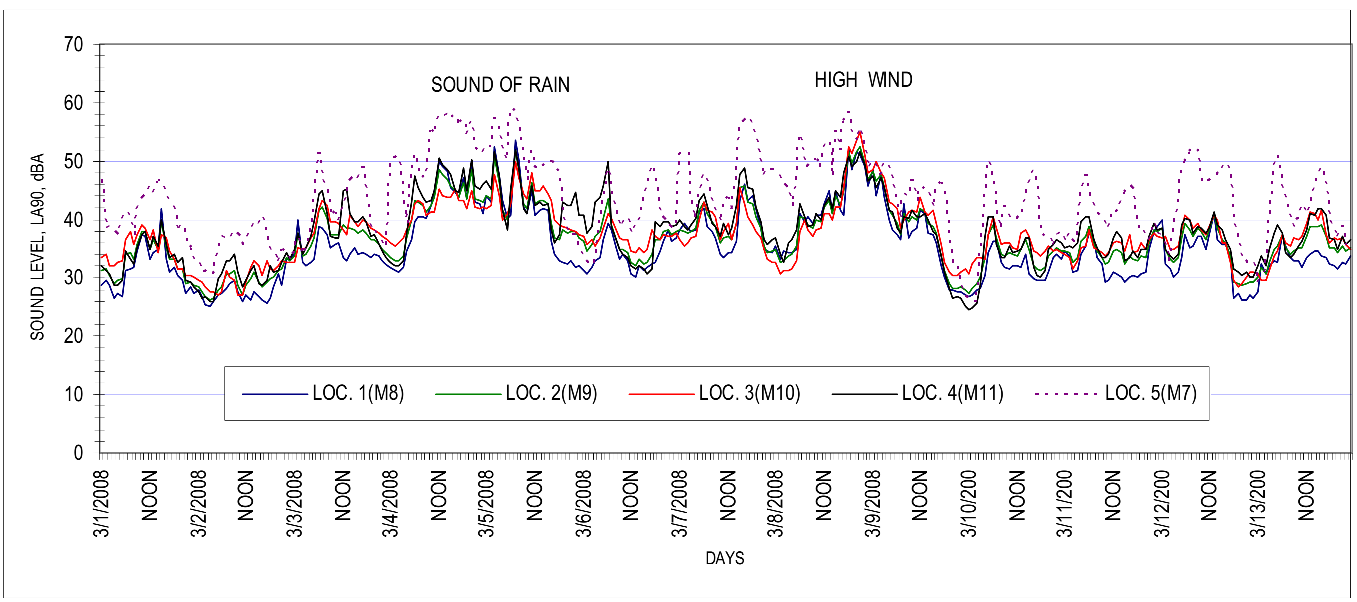
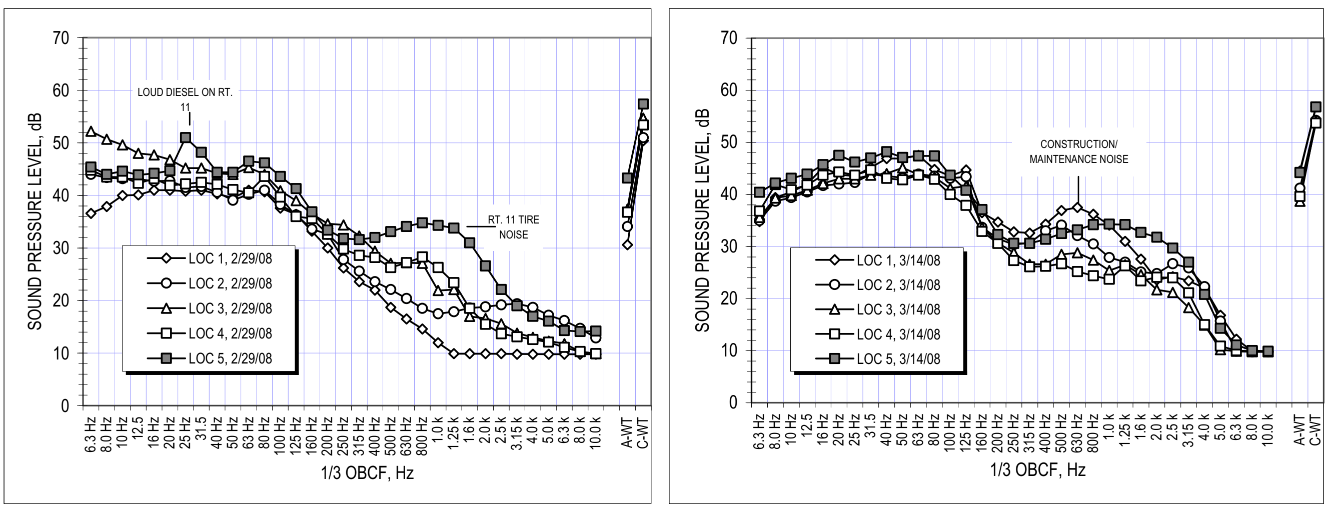


Figure 6.1.1: *Plot of residual LA90 sound level at locations 1, 2, 3, 4 and 5 over the entire sampling period.*

6.2_Attended Measurement Results

Attended 10-minute sampling measurements were carried out to observe sources of environmental sounds and to record the frequency spectrum of the level. **Figure 6.2.1** below shows the measured spectra at all five locations at the start and finish of the monitoring period. It was a little breezy on 2/29 and the very low frequency data below 20 Hz shows wind induced microphone noise even with protective wind screens. This effect has no impact on the A-weighted sound level results due the electronic weighting at these low frequencies. Measurement conditions were absolutely perfect on 3/14 with quiescent calm and still wind.

As noted above, unit 1 was shut down on March 3rd. Absolutely no sounds from the plant were detectable for normal full operation on 2/29. Noise from the plant presumed to be construction or maintenance sources was readily audible during the 3/14 survey.



a) NO NOISE DETECTABLE FROM PPL PLANT AT ANY LOCATION

b) CONSTRUCTION/MAINTENANCE NOISE CLEARLY OBSERVABLE FROM PPL PLANT

***Figure 6.2.1:** One third octave band spectra at five sampling locations on two days at the start and finish of the survey.*

7.0_ Noise Assessment Guidelines

A web search did not turn up any local or county noise ordinances for this site area. An ambient-based noise assessment methodology[4] is proposed for use that is based on years of successful application in three states, NY, MA and CA.

End of Text

8.0_References

[1] Hessler, G. F., “Controlling Noise Impact in the Community from Power Plant Operations – Recommendations for Ambient Noise Measurements”, *Noise Control Engineering Journal*, Volume 48, Number 5, 2000 Sept-Oct

[2] “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety”, US EPA Report PB-239 429, March 1974

[3] “Community Noise”, US EPA Report NTID300.3, Dec. 1971.

[4] Hessler, G. F., “The Noise Perception Index (NPI) for Assessing Noise Impact from Major Industrial Facilities and Power Plants in the U.S.”, *Noise Control Engineering Journal,* Draft Publication dated 4/17/08 currently undergoing peer review process for publication.

TECHNICAL MEMO

Title: **ADDENDUM 1 TO HAI REPORT 041808-1:**
Baseline Environmental Noise Survey, Leaf-off Season

Project: **BELL BEND NUCLEAR POWER PLANT**

Location: Berwick, PA

Prepared For: **AREVA NP, Inc.**

Prepared By: **George F. Hessler, P.E.**

Revision: **0**

Issue Date: **August 14, 2008**

Reference No: **TM-081408-1**

Attachments: None

Attn. Mr. J. Snooks

Introduction

This addendum adds additional requested measured data to the subject report and forms an integral part of the report. The measured daily 24-hour day/night sound level metric, abbreviated both as DNL and Ldn, was computed from the measured Leq hourly data given in the primary report. DNL must be calculated from 24 hours of measured hourly Leq data because a weighting or penalty factor of 10 dBA must be added for the hours from 10 p.m. to 7 a.m. This accounts for the greater sensitivity to nighttime noise experienced at potentially sensitive receptors.

Results

The following Table summarizes the developed DNL results. The arithmetic average and standard deviation are given for the sampling period at each sampling location. The "log average" is the true pressure average and is calculated by averaging the anti-log of each measured decibel value and converting back into decibels as opposed to directly averaging the decibel quantities. Summations or averaging of Leq based data is usually log averaged. For example, the FAA uses the yearly average DNL to assess aircraft noise in communities.

BBNPP LEAF OFF	24-HOUR DAILY DAY/NIGHT SOUND LEVEL (DNL OR Ldn), dBA				
	LOCATION				
DATE	1 (ON-SITE)	2	3	4	5
3/1/2008	66	55	60	57	62
3/2/2008	42	46	52	49	60
3/3/2008	48	52	58	61	64
3/4/2008	53	55	57	62	66
3/5/2008	61	60	60	63	68
3/6/2008	50	53	57	61	67
3/7/2008	54	55	58	59	66
3/8/2008	61	61	62	59	66
3/9/2008	61	62	63	58	65
3/10/2008	45	51	59	57	66
3/11/2008	55	55	58	58	65
3/12/2008	52	53	56	58	65
3/13/2008	52	55	60	58	66
ARITH. AVERAGE	N/A	55	58	58	65
LOG AVERAGE	N/A	57	59	59	65
STD DEV	N/A	4.3	2.8	3.4	2.1

Table 1: *24-hour Day/Night Sound Levels for a 13 Day Sampling Period during Leaf-off Seasonal Conditions at the Proposed Bell Bend Project*

Let me know if I can assist in any other way or answer any questions.

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