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Report Number 080108-1
Estimated Cooling Tower Sound Emissions
For the
Bell Bend Nuclear Power (BBNPP) Project
August 2008
Revision A, June 2010

Prepared For:

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1.0 Introduction

Hessler Associates has been contracted by AREVA NP, Inc. to develop a noise model for the hyperbolic natural draft cooling towers planned for use at the Bell Bend NPP Expansion project (BBNPP3). The circulating water system cooling tower could be a significant source of environmental noise leaving the site. As a result, the modeled noise emissions from the tower are to be compared to baseline ambient sound level measurement results at discreet points of interest measured in previous leaf-on and off ambient surveys. This comparison permits an estimate of subjective response to cooling tower noise at all potentially sensitive off-site locations.

It is still early in the project and comprehensive noise design data is not available for the bulk of the plant. Sound emissions from existing natural draft cooling towers have been cataloged from in-situ nuclear plant measurements (23 plants) and prediction algorithms have been developed for source sound power levels for the cooling towers.

Since the original issue of this report in 2008, the plant design has evolved such that the cooling towers are located significantly closer to the north boundary of the site. Consequently, Revision A of this report adds additional ambient measurement points to the north for analysis.

2.0 Executive Summary and Conclusions

Cooling tower sound emissions were estimated at one on-site and six off-site community locations surrounding the facility. The large buffer distances between the towers and potentially sensitive receptors are mostly flat farm fields without tree coverage with the distinct exception of a high forested ridge to the north that runs east and west along Beach Grove Road. Revision A of this report adds newly measured (June 2010) ambient sound measurement data for positions to the north of this road.

The estimated sound levels from the cooling towers are tabulated and compared to baseline ambient measurements made during leaf on and off seasons. It is shown that cooling tower emissions from the planned hyperbolic cooling towers, exclusive of the tower recirculation pumps and all other plant sources, will be imperceptible at sensitive locations surrounding the plant, except possibly to the north for very brief periods of time during the late night and early morning hours and only during calm and still wind conditions. Consequently, no adverse community response is predictable from the planned cooling tower sound emissions at any locations around the facility.

3.0 Noise Modeling Methodology

Equal level noise contour plots for the site were calculated using the "CADNA", ver. 4.0135 noise modeling program (Computer Aided Design for Noise Abatement) developed by DataKustik, GmbH (Munich). This software enables the project and its surroundings, including terrain features, to be realistically modeled in three-dimensions. Sound propagation is calculated in the model in strict accordance with ISO 9613 Part 2¹. There is no comparable standard in the U.S. This computer model with standard ISO algorithms essentially predicts long term noise emissions under slight downwind conditions at all locations around the facility.

In general, a three dimensional drawing of the source emitters and the topography of the surrounding area of interest are drawn, and acoustic source strength in sound power level is assigned to each component.

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In this case the sound power model input for the cooling towers was acquired from reference². Noise generated from natural draft cooling towers is the high frequency splash noise of water falling into the basin. This source includes the sound power emitted from the low elevation air inlet faces called ‘rim noise’ and from the high stack top exit termed ‘stack noise’. Data from 23 cooling towers was used to develop these source values for flow rates ranging from 100,000 to 700,000 gallons per minute (720,000 GPM for this project). The source input is considered very good and probably a bit conservative. There was no information provided for the water recirculation pumps and lines so the estimated contours exclude any such sources that are considered relatively minor at this stage.

The surrounding terrain is distinctly different north and south of Beach Grove Road. There is no major dense forest coverage between the planned facilities and the closest residential receptors to the south, and the topography is essentially flat. Conversely, northward, there is a steep incline of heavily forested land to the north of Beach Grove Road. Two ground surface acoustical properties were input in the model to account for these differences. For the flat terrain south, mostly farm fields, an absorption value of $\alpha = 0.5$ was used while $\alpha = 1.0$ was input for the forest floor ground surface.

4.0_ Noise Modeling Results

Figure 4-1 below depicts the estimated total cooling tower sound levels (combined rim and stack noise) for two towers operating at a water flow rate of 720,000 gallons per minute each at every location in the vicinity of the Bell Bend and PPL facilities. The labeled receptors 1 through 7’ correspond to the ambient sound survey locations reported in references^{3 4} and Addendum 2 to these references.

The scattering of the contours to the north are caused by the topography where the ground acts as a sound barrier.

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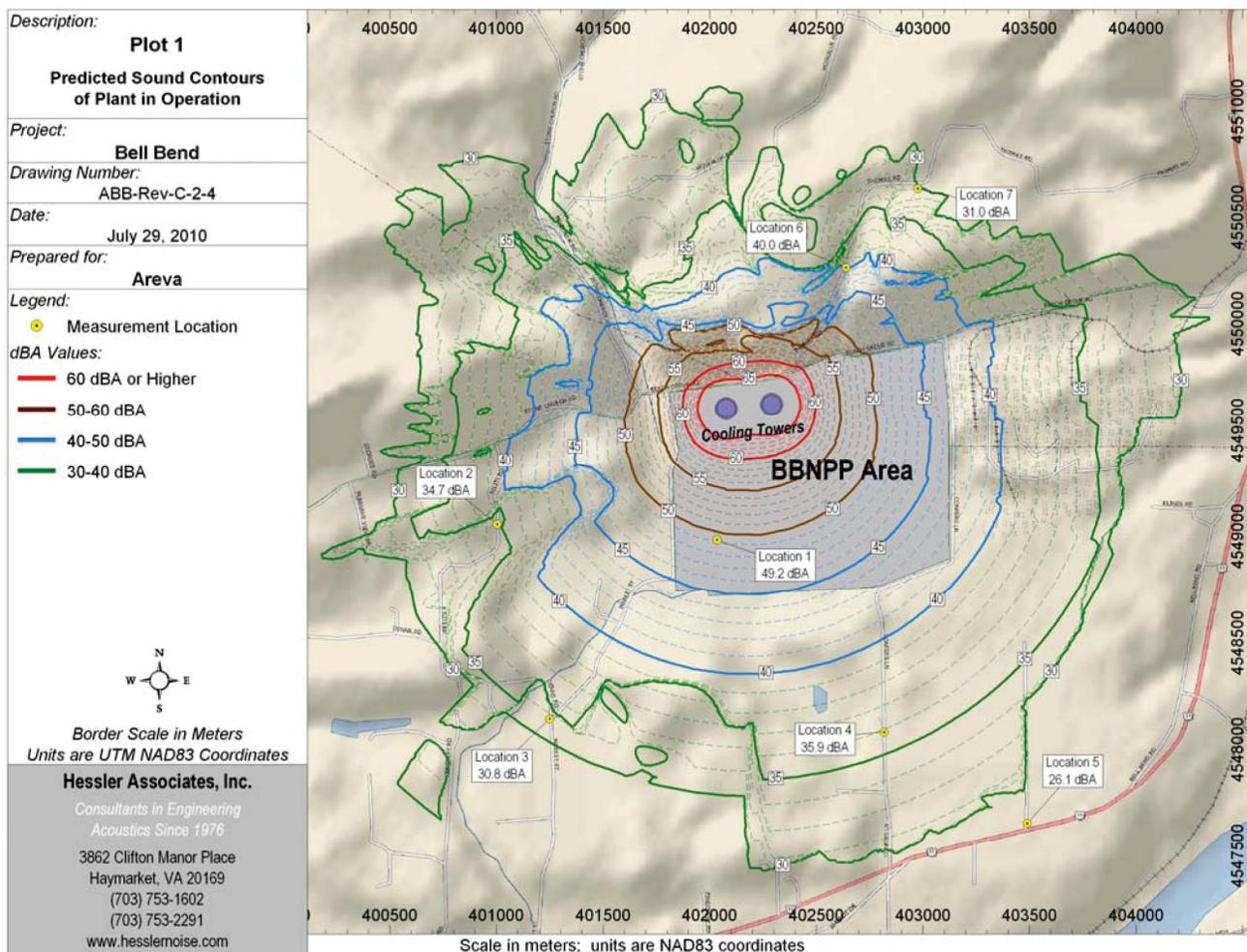


Figure 4.1: Noise contour plots attributable to natural draft cooling towers.

The estimated sound spectra attributable to the cooling towers at the on and off-site locations are plotted below in Figure 4.2. Natural draft cooling towers have little low frequency noise, and the peak frequency is shown to be in the 2000 Hz octave band. The source is created by falling water splashing into the basin. Such high frequency noise decays rapidly with distance from the tower as shown by the octaves above 1000 Hz.

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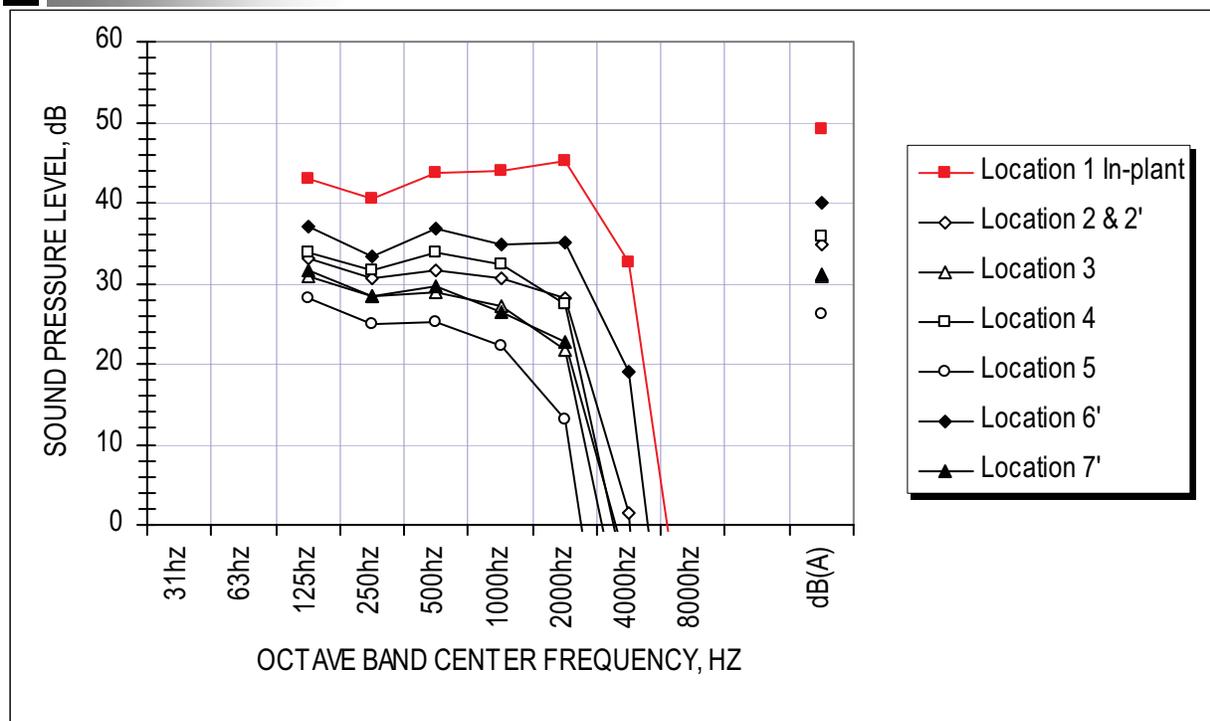


Figure 4.2: Estimated sound spectra at five locations.

5.0 Assessment of Cooling Tower Immissions

A new sound or noise (unwanted sound) arriving at a residential environment (immissions as opposed to source emissions) can be assessed by determining the increase of the new source above the existing ambient. The A-weighted sound levels estimated for the cooling towers at each location are tabulated below on Table 5.1 and compared to the ambient survey results reported in the references. The ambient values shown in the table are the arithmetic average of the LA90 daily-minimum hour measured levels over the three survey periods.

LOCATION	ESTIMATED COOLING TOWER LAeq	LEAF-OFF AMBIENT April 2008 LA90	LEAF-ON AMBIENT June 2008 LA90	LEAF-ON AMBIENT June 2010 LA90	AVERAGE DAILY MINIMUM LA90 ALL DATA LA90	INCREASE ABOVE MINIMUM DAILY LA90 AMBIENT
1 (ON-SITE)	49				N/A	
2 & 2'	35	31	31	26	29	5.4
3	31	32	32		32	0
4	36	31	29		30	5.9
5	26	34	33		34	0
6'	40			24	24	16.0
7'	31			23	23	8.0

Table 5.1: Estimated cooling tower noise in A-weighted levels at six community receptors.

The increases in Table 5.1 range from 0 to 16 dBA at the six locations. It should be noted there are no residences at location 6' and this is the closest off-site location to the cooling towers.

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In general, if the increase is in the range of 0-3 dBA, the new source will be imperceptible unless the source contains some identifiable character such as a tone like a whine, buzz, hiss, rumble, etc. Immissions from a natural draft cooling tower are atonal without doubt and have no identifiable character.

When the increase approaches 5-6 dBA the source may become detectable if atonal and noticeable with identifiable character. When the increase approaches 10 dBA an atonal source like a cooling tower should become detectable and noticeable with careful observation.

An increase of 5 to 10 dBA above the minimum daily LA90 ambient can be considered the threshold for potential adverse response for an atonal new source. When the increase approaches 20 dBA, adverse community response is highly predictable.

Keep in mind that these increases are calculated above the near minimum steady-state LA90 sound level that usually only occurs during the late night early morning hours during calm and still conditions. The increases would be much lower during other times of the day and during less calm wind conditions. A more thorough discussion of the perception of industrial noise is given in reference¹.

Subjectively, cooling tower noise would be essentially imperceptible at the off-site receivers mostly all times of the day and night. This is the observed case for the existing cooling towers. Cooling tower noise would be perceptible only during quiet periods of the night and early morning hours, if at all.

End of Text

References:

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- ¹ ISO 9613, "Acoustics-Attenuation of sound during propagation outdoors-Part 2: General method of calculation (ISO 9613-2:1996), ISO International Organization for Standardization, Switzerland.
 - ² Electric Power Plant Environmental Noise Guide, Edison Electric Institute, 2nd Edition, Section 4.4.2 Natural Draft Cooling Towers, Table 4.17, Rev. 1984.
 - ³ Hessler Associates Report Number 041808-1, "Baseline Environmental Noise Survey- Leaf off Season, Bell Bend Nuclear Power Plant (BBNPP)", April 2008
 - ⁴ Hessler Associates Report Number 062608-1, "Baseline Environmental Noise Survey- Leaf on Season, Bell Bend Nuclear Power Plant (BBNPP)", June 2008

¹ 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*, 56(5), Sept-Oct 2008