APPENDIX K

TECHNICAL REPORT ON

NOISE IMPACT ANALYSIS

BP CHERRY POINT COGENERATION PROJECT

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EXECUTIVE SUMMARY

The proposed BP Cherry Point Refinery Cogeneration Project (Cogeneration Project) is located in Whatcom County near Blaine, Washington. Noise levels are regulated by the State of Washington under the Washington Administrative Code (WAC) 173-60.

A noise-propagation computer model was used to estimate noise levels that would be generated by the Cogeneration Project, based on information provided by equipment suppliers to BP. Both standard A-weighted sound levels and low-frequency octave-band sound levels were predicted.

Baseline noise level monitoring was conducted at 15 locations in the vicinity of the Cogeneration Project site. The baseline monitoring collected existing ambient noise data from both steady-state and transient sources. Steady-state sound is essentially constant in the environment. Examples of steady-state noise in the vicinity of the project include steady wind, creeks, the wave action of the sea, and the Chemco plant and BP Cherry Point Refinery, which both operate around the clock. Examples of transient noise sources are vehicular traffic, wind gusts, airplanes, animals, trains, and other human-caused disturbances. The noise receptors for this monitoring included residential properties, Birch Bay State Park, and other key locations. The results of this baseline noise level monitoring indicate that the background steady-state sound levels are very low, and transient noise sources, especially vehicular traffic, was significant at the monitored locations.

A computer-generated model was used to predict the noise levels that would be generated by the future Cogeneration Project. Information about the sound characteristics of the equipment planned for the Cogeneration Project was put into the model. The resulting modeled values indicated that the Cogeneration Project will comply with state and local noise regulations at each of the 15 monitoring locations.

Furthermore, the Cogeneration Project would result in only very slight increases in noise levels at some receptor locations. Only one off-site receptor is expected to experience an increase above background that will be barely perceptible to the human ear. The Cogeneration Project is not expected to generate significant low frequency noise.

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LIST OF ACRONYMS

ANSI	American National Standards Institute
dB	Decibel
dBA	A-weighted decibel
Ecology	Washington Department of Ecology
EDNA	Environmental designation for noise abatement
EPA	Environmental Protection Agency
GTG	Gas turbine generator
HRSG	Heat-recovery steam generator
Hz	Hertz
MW	Megawatt
Pa	Pascal
SCR	Selective catalytic reduction
SPL	Sound pressure level
STG	Steam turbine generator
WAC	Washington Administrative Code

1. INTRODUCTION

BP proposes to construct a combined-cycle, gas turbine-powered cogeneration facility on land zoned "Heavy Impact Industrial" in Whatcom County, Washington. This project is named the BP Cherry Point Cogeneration Project (Cogeneration Project). Figure 1 shows the location of the proposed facility.

The proposed project site is located on BP property, on the east side of the existing Refinery , 337 feet from Grandview Road. The proposed project site, the noise monitoring stations, and the noise receptor locations (numbers 1 through 15) used for the noise estimates are shown in Figure 2. The closest residential area is approximately one mile to the east-southeast, at sampling location 14.

Golder performed background noise monitoring study to assess the existing noise levels in the project area prior to the construction and operation of the Cogeneration Project. The field effort to collect the background noise level data took place on May 31 and June 7, 2001. The study consisted of measuring the steady state and transient background noise levels and octave bands at 15 monitoring locations at BP property boundaries and at the nearby residential communities to the north, east, and west. In order to avoid property access issues, the monitoring was conducted on public property, usually along public thoroughfares. As a result, measured noise levels were strongly influenced by transient noise from motor vehicles passing the monitoring location. The effect of the vehicular traffic was an overall increase in the average noise level at the monitoring locations. If the sampling had been performed away from the streets, the influence of the transient vehicular traffic would have been lessened, reducing the overall measured noise levels.

Because the operation of the Cogeneration Project will result in sound emissions, Golder Associates, Inc. (Golder) also performed predictive modeling using the Noisecalc noise-propagation computer-modeling program. Both standard A-weighted noise levels and noise levels at low-frequency octave bands were predicted for 15 receptor locations near the proposed Cogeneration Project site, corresponding to the 15 locations used for background monitoring.

The background noise data, along with the estimates of noise emitted by the Cogeneration Project's equipment during operation, were used to assess the cumulative effect of project noise and existing noise sources. The results of the modeling indicate that the contribution of the predicted noise levels to the existing background levels at the selected receptor locations will not create a perceptible difference in noise levels.

2. NOISE MEASUREMENT AND REGULATION

Noise levels or loudness, which is referred to as sound pressure level (SPL), is measured in decibels (dB). Decibels are calculated as a logarithmic function of SPL in air to a reference effective pressure, which is considered the hearing threshold, or:

$$SPL = 20 \log 10 (P_e / P_o)$$

where:

P_e = measured effective pressure of sound wave in micropascals (μPa)
P_o = reference effective pressure of 20 Pa

The decibel is a unitless measure. Based on the logarithmic scale, a doubling of sound pressure will result in a measured increase of 6 decibels. To the human ear, however, an increase of 10 decibels is perceived as a 100 percent increase (or doubling) in sound level.

Sound power levels indicate the total sound energy generated by the noise source per unit time. The unit of measure for sound power is typically watts.

To account for the effect of how the human ear perceives sound pressure, at moderate to low levels, sound pressure levels are adjusted for frequency (or pitch). The most commonly used frequency filters is the A-weighting (measured in A-weighted decibels or dBA), which adjusts measurements for the approximated response of the human ear to low-frequency SPLs (i.e., below 1,000 hertz [Hz]) and high-frequency SPLs (i.e., above 1,000 Hz). In contrast, C-weighting (dBC) adjusts measurements to correspond to the human ear's response to sound levels above 85 dB. C-weighting is sometimes used for evaluating energy at the low end of the frequency spectrum. However, all Washington noise regulations utilize the A-weighted decibel scale.

Sound-related terms used in this appendix are defined in Table 1.

Typically, environmental baseline (background) sound levels vary over short periods of time (minutes to hours). The measured noise levels are generally given in terms of the equivalent sound level (L_{eq}), which is the equivalent constant SPL that would be equal in sound energy to the varying SPL over the same time period. Its equation is:

$$Leq = 10 \text{ Log } \frac{\sum_{i-1}^{N} 10^{(SPL1/10)}}{N}$$

where:

N = number of observations
SPL_i = individual sound pressure level in data set

TABLE 1

Definitions of Sound-Related Terms

A-Weighted Sound Level	The human ear does not respond equally to all sounds in a medium. The A-weighted decibel scale assigns weights to different frequencies based on how they are perceived by the human ear. The A-weighted sound level is also called the noise level. Sound level meters have an A-weighting network for measuring A-weighted sound level.
C-Weighted Sound Level	The C-weighted scale is only slightly weighted at the low and high frequencies, and for many measurements is used interchangeably with the linear or un-weighted sound levels. SPL meters with a C-weighting filter are intended for measuring fairly loud sound pressures, such as 85 dB SPL or greater. These filters were originally used relative to occupational hazards and industrial noise exposure.
Decibel	The decibel (dB) is a measure, on the logarithmic scale, of the magnitude of a particular quantity (such as sound pressure, sound power, or intensity) of sound with respect to a standard reference value (0.0002 microbar for sound pressure and 10^{-12} watt for sound power). Decibels can only be added logarithmically.
Frequency	Frequency is the number of times per second that the sine wave of sound repeats itself, or that the sine wave of a vibrating object repeats itself. This term is now expressed in Hertz (Hz).
Hertz	Unit measurement of frequency, numerically equal to cycles per second.
L_{min}	L_{min} is the minimum value of sound pressure level occurring during the measurement period.
L_{max}	L_{max} is the maximum value of sound pressure level occurring during the measurement period.
L_n	L_n is the sound pressure level that is exceeded n% of the time of the overall measurement.
Sound Level (Noise Level)	The weighted sound pressure level obtained by use of a sound level meter having a standard frequency-filter for attenuating part of the sound spectrum.

More detailed sound level data may also indicate maximum sound levels the L_{max} and minimum sound levels L_{min}. The sound level that is exceeded 99 percent of the time can be expressed as L_{99}; the sound level exceeded 95 percent of the time can be expressed as L_{95}, etc.

Attenuation of noise can occur through distance, physical barriers, absorption, or meteorological effects. As sound travels over distance, the energy waves can be affected by these factors, resulting in a reduction of noise. A rule of thumb for noise travel over distance is that when the distance between two points is doubled, the reduction in noise level decreases by approximately 6 dBA. Physical barriers such as walls or shielding equipment can be very effective noise reducers. The closer the barrier is to the noise source, the more effective it is at reducing noise at a distance. Noise can also be reduced through vegetation, as the energy waves are absorbed along the path of travel. For example, noise waves traveling across a grassy surface will be reduced significantly more than noise waves traveling across a concrete or asphalt surface. Sound propagation can be affected by wind and will result in higher sound measurements in the downwind direction, and where the increased velocity of the wind crosses the microphone. Atmospheric absorption from humidity or pressure is limited, and not considered a significant factor.

2.1 Federal Noise Regulations

Other than Occupational Safety and Health Administration (OSHA) regulations governing sound exposure by workers at the Cogeneration Project, there are no federal noise regulations applicable to the Project.

2.2 Department of Ecology Noise Limits

Chapter 173-60 of the Washington Administrative Code (WAC) specifies maximum environmental noise levels. These limits apply in all areas of the State of Washington. The applicable limits depend upon the environmental designation for noise abatement (EDNA) of both the noise source and the receiving property. In general, the EDNA designations conform to zoning ordinances as follows:

- Residential Zones – Class A EDNA
- Commercial Zones – Class B EDNA
- Industrial Zones – Class C EDNA

The regulatory noise limits are summarized in Table 2.

TABLE 2
State of Washington Maximum Permissible Environmental
Noise Levels (dBA)

EDNA of Receiving Property			
EDNA of Noise Source	**Class A**	**Class B**	**Class C**
Class A	55 (45 nighttime)	57	60
Class B	57 (47 nighttime)	60	65
Class C	60 (50 nighttime)	65	70

The regulation (WAC 173-60-040) includes two adjustments to the limits in Table 2. The limits are reduced by 10 dBA at night (10 p.m. to 7 a.m.) for Class A EDNA (residential) receiving properties. The limits are also increased by 5 dBA for 15 minutes in one hour, or by 10 dBA for 5 minutes in one hour, or by 15 dBA for 1.5 minutes in one hour. These are equivalent to the L_{25}, $L_{8.3}$, and $L_{2.5}$ statistical noise descriptors, respectively. Noise from temporary construction activities is exempt from all limits, except for those that apply to noise received in Class A (residential) EDNAs at night (10 p.m. to 7 a.m.).

2.3 Whatcom County Noise Ordinance

The Whatcom County Code (Title 20 Zoning) includes general provisions regarding noise. Chapter 20.68.705 Noise applies to Heavy Impact Industrial (HII) Districts and states, “Noise in this district shall not exceed the maximum environmental noise level established by Chapter 173-60 WAC" (Ord. 91-075, 1991). There are no numerical limits in the Whatcom County Code, and all references are to the State code. Therefore, the limits in WAC 173-60 were used to evaluate the estimated noise effects in the area from the operation of the proposed facility.

2.4 Low-Frequency Noise

As explained in the preceding sections, in Washington noise is regulated based on the A-weighted decibel scale. There are no regulations employing the C-weighted decibel scale, or establishing limits on decibel levels in particular octave bands. There are no regulations directed specifically at low-frequency noise or tones. However, the A-weighted decibel scale does take into account both low-frequency noise and tones, and assigns those noise levels a weighted value based upon how those noises are perceived by the human ear. Although the Washington Department of Ecology has decided to regulate noise using the A-weighted decibel scale, Section 7 below addresses the extent to which low-frequency noises are expected from the Cogeneration Project.

3. MODELING PREDICTED NOISE LEVELS

3.1 Noise Output Modeling

The impact evaluation of the Cogeneration Project was performed using Noisecalc, a noise-propagation computer model developed by the New York State Department of Public Service for predicting noise levels from power plants. Noisecalc is a hemispherical free field (HFF) noise prediction model.

Standard conditions of 59° F and 70 percent relative humidity were assumed. No reductions were made for ground absorption or other attenuation factors. The model accounted for the noise emissions from each source in each octave band that propagates to each point on a specified receptor grid, identifying the source and value of all data inputs used.

In the model, noise sources are entered as octave-band SPLs. The user can specify coordinates, either rectangular or polar. All noise sources are assumed to be point sources; line sources can be simulated by several point sources. Sound propagation is calculated by accounting for hemispherical spreading and three other user-identified attenuation options:

- atmospheric attenuation,
- path-specific attenuation, and
- barrier attenuation

Atmospheric attenuation is calculated using the data specified by the Calculation of the Absorption of Sound by the Atmosphere (ANSI, 1999). Path-specific attenuation can be specified to account for the effects of vegetation, foliage, and wind shadow. Directional source characteristics and reflection can be simulated using path-specific attenuation. Attenuation due to barriers can be specified by giving the coordinates of the barrier. Barrier attenuation is calculated by assuming an infinitely long barrier perpendicular to the source-receptor path.

Using the model, noise levels were predicted at 15 different receptors corresponding to the 15 locations where background monitoring was performed. Table 3 describes the receptor locations. The receptor locations are also shown on Figure 2.

TABLE 3

Noise Modeling Receptors and Monitoring Locations

Location Number	Description
1	On Grandview Road, in front of the Chemco Plant, 0.69 miles northeast of the Cogeneration Project
2	Northwest corner of the 4-way stop at Aldergrove Road and Kickerville Road intersection, 1.26 miles southeast of the Cogeneration Project.
3	Aldergrove Road at entrance to PraxAir facility, 0.82 miles south of the Cogeneration Project.
4	Southeast corner of 2-way stop at Aldergrove Road and Jackson Road intersection, 1.37 miles southwest of Cogeneration Project.
5	At Cascade Natural Gas regulator station on west side of Jackson Road, 1.11 miles southwest of Cogeneration Project. (The regulator was not operating.)
6	Southeast corner of 4-way stop at Grandview Road and Jackson Road intersection, 1.10 miles west of Cogeneration Project.
7	West side of Jackson Road at Birch Bay Community Church, 1.22 miles northwest of the Cogeneration Project.
8	Southwest corner of 3-way stop at Grandview Road at Pt. Whitehorn, 2.08 miles west of the Cogeneration Project.
9	Northwest corner of Jackson Road and Helweg, 1.44 miles northwest of Cogeneration Project.
10	In front of residence at 4570 Bay Road, 1.20 miles north of Cogeneration Project.
11	Northwest corner of 4-way stop at Kickerville Road and Bay Road, 1.48 miles northeast of Cogeneration Project.
12	Intersection of Grandview Road and Blaine Road, on south side of street, 0.16 iles north of Cogeneration Project.
13	West side of Blaine Road, north of Grandview Road, at turnout 0.51 miles north of the Cogeneration Project.
14	Northwest corner of Kickerville Road and Brown Road, 1 mile east – southeast of the Cogeneration Project, near the residences closest to the Project site.
15	Birch Bay State Park, near park entrance, 1.92 miles northwest of Cogeneration Project.
Project Site	Open field on BP property, south of Grandview, and west of the Refinery.

3.2 Modeling Results

The noise impact modeling was performed to predict the maximum noise levels produced by the proposed Cogeneration Project as well as the cumulative effect of the Cogeneration Project and existing noise sources.

The modeling was performed for the plant configuration currently under consideration. The primary noise generating equipment will consist of three gas turbine generators (GTGs), one steam turbine generator (STG), three-heat-recovery steam generators (HRSGs), and an air-cooled condenser containing 45 fans. Modeling assumed that the gas turbines will be housed within a casing, but not within a building. Modeling also assumed that the steam turbine will be enclosed in a building, with sufficient sound attenuation characteristics such that sound produced from this turbine is completely attenuated at the property boundary on Grandview Road.

BP and Duke Fluor Daniel (2001) provided the primary information that was used to quantify noise levels from the HRSGs and the air-cooled condenser. Frequency spectra for the STG and GTG were obtained from other noise modeling studies and sampling performed by Golder for projects of similar size. The frequency spectra for the plant equipment and the noise data used for the estimates are summarized in Table 4.

TABLE 4

Noise Source Data

Major Equipment Items Typical Overall A-weighted Sound Pressure Levels (SPL) @ 400 ft (dB)									
	Octave Band Center (Hz)								
Source	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
HRSG inlet duct, (3 each)	52	60	60	54	46	42	35	13	-16
HRSG casing, (3 each)	52	60	60	54	46	42	35	13	-16
HRSG stack wall, (3 each)	48	53	51	43	32	24	3	-22	-51
Air-cooled condenser (9 sources with 5 fans each)	68	69	66.5	60.6	56.9	52.6	44.4	38.6	29.7

Major Equipment Items Typical Sound Power Levels									
	Octave Band Center (Hz)								
Source	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Combustion turbine generator (3 each)	123.0	125	120	116	112	115	109	105	102
Steam turbine generator (1 each)	97.4	99.5	92.5	88.2	87.5	86.4	81.6	77.3	72.5

Source: Duke Fluor Daniel 2001

Based on the modeling output, the estimated noise levels in Table 5 were generated for each numbered receptor location (Figure 2). The modeled results indicate that the sound levels produced by the proposed Cogeneration Project are all well below established regulatory limits.

TABLE 5

Estimated Noise Levels
Produced by the Proposed Cogeneration Facility

Receptor Location I=industrial, R=residential	**Predicted Noise Level (dBA)** L_{eq}	**Regulatory Limit Day/Night (dBA)** L_{eq}
1 (I)	51.7	70
2 (R)	44.5	60 / 50
3 (I)	49.8	70
4 (I)	43.2	70
5 (I)	45.7	70
6 (I)	45.7	70
7 (R)	44.4	60 / 50
8 (R)	37.8	60 / 50
9 (R)	42.3	60 / 50
10 (R)	44.6	60 / 50
11 (R)	42.2	60 / 50
12 (I)	65.1	70
13 (I)	54.4	70
14 (R)	47.5	60 / 50
15 (R)	38.8	60 / 50

4. BACKGROUND NOISE MONITORING

A background noise-monitoring program was performed at the Cogeneration Project site, at the BP property boundaries, and at the nearby locations. The purpose of this monitoring was to evaluate the existing levels of steady state and transient noise present in the vicinity of the Project site. Steady state noise sources in the vicinity of the project include the steady wind, creeks, the wave action of the sea, and industrial facilities such as the Chemco plant, the Praxair facility and the Refinery. Transient noise sources include vehicular traffic, wind gusts, airplanes, animals, trains, and other human-caused disturbances. Monitoring was conducted at the 15 locations described in Table 3 above. In order to avoid private property access issues, noise monitoring was performed on public property and primarily along public roads, in close proximity to the transient noise generated by vehicular traffic.

4.1 Sampling Equipment

The noise monitoring was performed using a Larson-Davis Model 824 continuous-integrating sound level meter during all monitoring. The sound level meter complied with the American National Standards Institute (ANSI) S1.4, 1983 specification for Type I (Precision) sound level meters. The sound level meter was calibrated and calibration was verified before and after the noise monitoring periods. The instrumentation is described in Table 5. The Larson Davis sound level meter complies with Type I Precision requirements set forth for sound level meters and for one-third octave filters. The specifications and calibration certificates for the noise measurement equipment are provided in Attachment A.

The sound level meter was set to the slow response mode to obtain consistent, integrated, A-weighted sound pressure levels. Concurrent one-third octave band frequencies were also measured and stored at all sites during each monitoring period. The SPL data were analyzed and reported in both decibels (dB) and A-weighted decibels (dBA).

A windscreen was used on the equipment because all measurements were taken outdoors. The microphone was positioned so that a random incidence response was achieved. The sound level meter and octave bank analyzer were calibrated immediately prior to and just after the sampling period to provide a quality control check of the sound level meter’s operation during monitoring.

Monitoring was conducted using the sound level meter mounted on a tripod at a height of 4 to 5 feet above grade.

TABLE 6

Noise Instrumentation

Device	Model	Comments
Sound level meter	Larson Davis Model 824	Precision integrating sound level meter with real-time frequency analyzer
Acoustical calibrator	Larson Davis Model CAL200 Sound Level Calibrator	94/114 dB at 1,000 Hz
Microphone Preamplifier	Larson Davis Model PRM902	Microphone preamplifier
Microphone	Larson Davis Model 2560	Prepolarized ½" condenser microphone

4.2 Study Design

4.2.1 Weather Conditions

Local meteorological conditions (wind speed, wind direction, and temperature) were measured during the monitoring periods. The temperature ranged between 51.2 F and 69.5 F. The wind speed ranged between 0 and 3.2 mph. The wind direction varied depending on location. Relative humidity ranged between 35 and 79 percent. No sound recordings of actual sounds were made during the monitoring, but detailed field notes were recorded by the operator during monitoring, including the passage of vehicles during each sampling event.

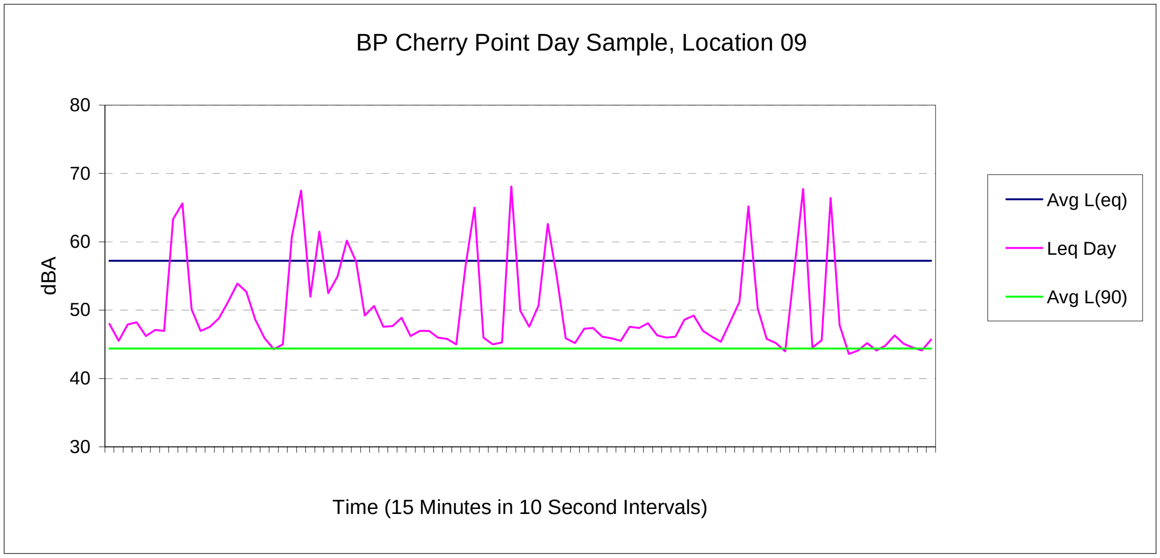
4.2.2 Study Locations

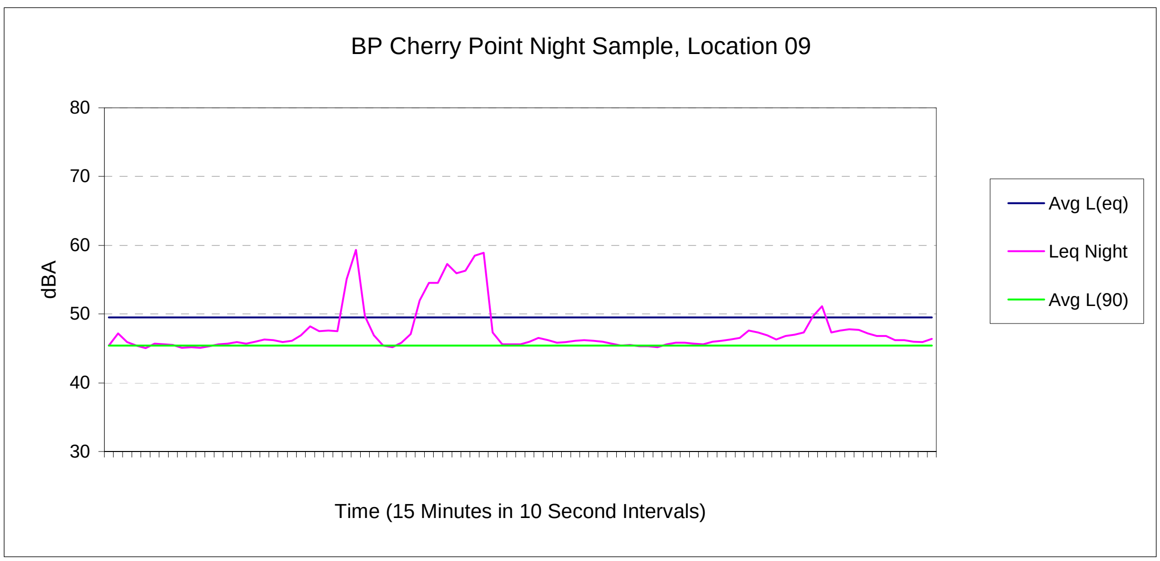
The SPLs and octave band data were collected at 15 different locations, which are shown on Figure 2 and described in Table 3.

Data was collected for a minimum of 15 continuous minutes, using measurement techniques set forth by ANSI S12.9-1993/Part 3 (ANSI, 1993) and the Washington Administrative Code (WAC) Chapter 173-58 – Sound Level Measurement Procedures. One additional 24-hour sample was collected at the proposed project site.

Locations No. 1 through No. 15 were monitored for two 15-minute periods, once during the hours defined as "day" (7 a.m. through 10 p.m.), and once during the hours defined as "night" (10 p.m. through 7 a.m.). The project site was monitored for a period of 24 hours. There were no unusual natural environmental circumstances such as wind or rain that would have influenced the measurements.

Two types of ambient noise were monitored during the data collection. The first type of noise is steady state noise, which is essentially constant in the background of the environment. Background noise in the vicinity of the project includes the steady wind, creeks, the wave action of the sea, and nearby industrial facilities. The difference between the steady state and transient components of ambient background noise is illustrated in the following graphs, which are two of the complete set of graphs provided in Attachment C. The steady state noise is the relatively constant baseline, which is approximately the L_{90} noise level (90% of the noise is above the L_{90}). This average L_{90} sound level is shown by the green line in the chart below.





The background sources of noise at and around the sampling locations are fairly consistent in any 24-hour period. Two of the industrial sources of noise, Chemco and the Refinery, operate 24 hours a day. Other industrial sources include a PSE peaking station that operates at times when additional power is required, and the Prax Air plant. The PSE station was not in operation at the time of Golder's noise monitoring. Based on this steady environment of sound, it was determined that two 15-minute background samples would be representative for the purposes of this study.

The second type of noise monitored during the data collection was transient noise, with sources that include vehicular traffic, wind gusts, airplanes, animals, trains, and other human-caused disturbances. The significant influence of this transient noise can be seen in the graphical representation of the data.

The magenta line in the graphs presented above shows L_{eq} measurements taken over a 15 minute interval during the day at noise monitoring location 9 for day and night time, respectively. As shown on the day time graph, the average of these measurements (average L_{eq}) is shown by the blue line at approximately 57 dBA. The green line shows the average L_{90} for this interval of about 45 dBA, which approximates background sound level in the absence of transient noise sources such as traffic, animals, or human-caused disturbances. The average contribution of transient noise is the difference between the average L_{90} and average L_{eq}, or 12 dBA.

In order to avoid private property access issues, noise monitoring was performed along public roads, in close proximity to the transient noise generated by vehicular traffic. The effect of collecting noise data in such close proximity to the source of the transient noise is an increase in the amplitude of the spikes, which develop when loud noise sources pass the microphone location. The influence of these transient noise sources results in an increase in the overall L_{eq} at the sampling location. If sampling were performed further from the roadways, the effects of the transient noise would diminish, and the overall L_{eq} would be lower.

4.3 Monitoring Results

The results of the background noise monitoring are presented in Table 7. The column headings are defined below. Graphs of the day and night samples for each of the 15 receptor locations are included in Attachment C.

A graph representing 24-hour continuous sound levels monitored at the location, titled Proposed Project Site, with A-weighting applied, is provided in Attachment B.

TABLE 7

Noise Measurement Results (dBA)

Location	Date	Start Time	L_{min}	L_{99}	L_{95}	L_{90}	L_{50}	L_5	L_1	L_{max}	L_{eq}
1	6/4/01	12:41:35	45.9	46.6	47.9	48.6	55.0	74.3	79.7	85.8	67.5
1	5/31/01	04:30:59	45.0	45.6	46.2	46.7	49.5	65.8	78.1	89.7	65.3
2	6/4/01	08:08:49	37.4	37.8	38.5	39.0	43.6	60.7	71.0	80.2	58.4
2	5/31/01	06:49:35	38.2	38.6	39.7	40.2	46.1	67.7	77.1	84.1	63.2
3	6/4/01	08:28:25	49.8	50.3	51.1	51.8	55.2	61.2	74.1	82.4	61.2
3	5/31/01	06:31:50	51.4	52.0	53.0	53.5	56.4	65.1	72.8	76.2	60.4
4	6/4/01	08:50:05	37.6	38.1	39.0	39.6	46.0	56.1	59.5	66.0	50.3
4	5/31/01	06:13:26	49.2	49.4	49.7	50.0	51.1	54.5	60.4	67.4	52.4
5	6/4/01	09:08:41	47.0	47.4	47.8	48.1	49.7	68.6	77.2	82.2	63.0
5	5/31/01	05:55:14	48.3	48.6	49.0	49.3	50.9	57.8	72.2	78.6	58.1
6	6/4/01	09:26:46	48.6	49.0	50.0	50.6	53.1	66.4	72.3	78.2	60.7
6	5/31/01	05:37:04	48.5	48.9	49.4	49.6	51.1	62.9	73.6	76.7	59.2
7	6/4/01	09:44:58	47.2	47.9	48.6	48.9	51.1	68.7	75.5	82.8	62.6
7	6/6/01	23:20:29	49.4	49.6	49.9	50.2	51.5	55.0	66.7	76.5	55.7
8	6/4/01	13:01:40	38.1	38.7	39.7	40.5	44.4	60.6	68.5	71.2	54.7
8	6/4/01	06:47:19	38.9	39.3	39.9	40.4	44.8	58.6	64.3	68.5	52.0
9	6/4/01	12:20:30	43.0	43.3	43.9	44.4	47.1	62.8	71.1	74.6	57.2
9	6/6/01	23:59:00	44.8	44.9	45.2	45.4	46.1	55.2	59.7	64.3	49.5
10	6/4/01	12:00:56	39.2	39.9	40.8	41.1	43.3	63.6	76.8	83.9	62.3
10	6/7/01	00:47:28	34.0	34.1	34.2	34.4	35.9	48.9	59.7	81.2	53.9
11	6/4/01	13:28:30	40.2	43.1	45.1	46.2	52.4	67.4	73.8	78.8	60.7
11	6/7/01	01:21:30	34.0	34.1	34.3	34.5	35.4	48.8	67.8	75.0	52.7
12	6/6/01	21:12:39	52.2	52.7	53.1	53.3	55.2	63.1	72.1	83.2	60.9
12	5/31/01	04:50:41	40.3	40.8	41.5	43.1	50.3	70.1	77.3	81.5	63.7
13	6/4/01	11:42:04	44.8	45.3	46.0	46.4	48.8	68.3	75.0	80.5	61.7
13	5/31/01	05:08:35	36.6	37.5	38.4	39.0	42.0	61.0	71.5	75.8	56.8
14	6/4/01	14:05:42	38.2	38.6	39.9	41.6	47.5	66.0	74.0	78.9	60.0
14	6/7/01	01:55:41	34.0	34.1	34.3	34.5	36.7	48.9	63.5	74.4	51.3
15	6/7/01	08:17:56	36.1	36.9	37.6	38.2	42.8	53.1	57.2	62.4	47.2
15	6/6/01	22:30:36	34.2	34.3	34.6	34.8	36.7	43.4	45.9	51.1	38.6
Project Site	6/7/01	10:13:29	52.0	54.1	54.8	55.2	56.8	57.9	59.1	88.4	57.0

Noise generated by vehicles at many of the sampling areas was very noticeable during the monitoring and had a significant influence on the values measured. As explained above, the L_{90} data presented in Table 7 above provides a likely estimate of the current steady-state background noise levels in the vicinity of the Project site.

The L_{90} data are a good representation of the background noise without vehicles or other sporadic sounds, based on the field observations during sampling. Field notes indicated that, other than the sound from passing vehicles and wildlife in the early morning hours, the background sound was steady and fairly quiet.

The results of this baseline noise level monitoring indicate that the background levels are low, and are significantly influenced by transient sources, especially vehicular traffic. Had monitoring been conducted further away from the public roads, the baseline noise levels would have been lower.

4.4 Cumulative Effect of Cogeneration Facility and Existing Noise Sources

The modeling also produced data that represents the predicted noise levels that would result from the Cogeneration Project when added to the existing background levels, including transient noise events (vehicular traffic, human and animal-generated sounds, airplanes, etc.). Table 8 presents the average (L_{eq}) background levels measured in the field, the predicted levels at each of the 15 receptors (when added to the background levels), and the magnitude of the increase at each location.

TABLE 8

Estimated Noise Levels Combining Modeled and Background Sources

Receptor Location	Day Noise Level (dBA)				Night Noise Level (dBA)			
	Back-ground	Project Only (Modeled)	Back-ground plus Modeled Level	Difference	Back-ground	Project Only (Modeled)	Back-ground plus Modeled Level	Difference
1 (I)	67.5	51.7	67.6	0.1	65.3	51.7	65.5	0.2
2 (R)	58.4	44.5	58.6	0.2	63.2	44.5	63.3	0.1
3 (I)	61.2	49.8	61.5	0.3	60.4	49.8	60.8	0.4
4 (I)	50.3	43.2	51.1	0.8	52.4	43.2	52.9	0.5
5 (I)	63.0	45.7	63.1	0.1	58.1	45.7	58.3	0.2
6 (I)	60.7	45.7	60.8	0.1	59.2	45.7	59.4	0.2
7 (R)	62.6	44.4	62.7	0.1	55.7	44.4	56.0	0.3
8 (R)	54.7	37.8	54.8	0.1	52.0	37.8	52.2	0.2
9 (R)	57.2	42.3	57.3	0.1	49.5	42.3	50.3	0.8
10 (R)	62.3	44.6	62.4	0.1	53.9	44.6	54.4	0.5
11 (R)	60.7	42.2	60.8	0.1	52.7	42.2	53.1	0.4
12 (I)	63.7	65.1	66.5	2.8	60.9	65.1	67.5	6.6
13 (I)	61.7	54.4	62.4	0.7	56.8	54.4	58.8	2.0
14 (R)	60.0	47.5	60.2	0.2	51.3	47.5	52.8	1.5
15 (R)	47.2	38.8	47.8	0.6	38.6	38.8	41.7	3.1

Golder calculated the difference between the background (present-day) noise levels and the modeled future levels that are predicted to result from operation of the cogeneration facility. The difference indicated that a very small increase in noise level is predicted to result from the new facility.

The human ability to hear or notice changes in noise levels has been a source of scientific study. Small changes in noise levels (less than 3 decibels) are difficult for humans to perceive or detect. According to Kryter (1970), the human ear cannot generally perceive a change of 1-decibel (dB). Outside the laboratory, a 3-dB change is considered a just-perceptible difference, and a change of at least 5-dB is usually required before any noticeable change in community response can be expected.

The modeling indicates that a perceptible increase in noise would only occur at receptor locations 12 and 15. Receptor 12 is the closest receptor to the Project Site and is located only about 300 feet away at the intersection of Grandview and Blaine Roads. There is a stop sign at this intersection, and vehicle traffic is moderate. BP-owned lands surround this monitoring location for at least 0.5 miles. No residential development is present or will be present in the vicinity of this location; therefore the change in noise levels is not expected to be noticed. Receptor 15 is located inside the entrance of the Birch Bay State Park. The predicted 3.1 dBA increase in nighttime sound levels is likely to be imperceptible. Background noise levels in this location were very low, with contributions from birds, humans and infrequent vehicles, and will remain very low despite this increase. Moreover, Project-related sound is expected to be even lower at campsites within the Park because they are located further from the Project site.

5. LOW-FREQUENCY NOISE

Localized disturbance from low-frequency noise have sometimes been associated with simple-cycle combustion turbine installations. Combustion turbines are capable of producing high levels of low-frequency (40 Hz or less) noise when the exhaust gas exits from the equipment. In simple-cycle configurations, the exhaust gas passes through an exhaust silencer that is effective at reducing mid- and high-frequency noise but are less effective at reducing low-frequency noise emissions.

However, low-frequency noise has not typically been a reported concern when combustion turbines are placed in combined-cycle configurations. In combined-cycle configurations (as proposed for the Cogeneration Project design) the exhaust gas passes through the HRSG equipment, which is quite effective at reducing the low-frequency combustion noise associated with turbine operation. The cooling of the exhaust gases in combined-cycle facilities also reduces the low frequency noise emissions.

Although Washington regulates low frequency noise through noise regulations utilizing the A-weighted decibel scale, Table 9 summarizes the modeled low-frequency sound pressure levels at the measured receptors.

TABLE 9

Low Frequency Sound Levels at Receptors
(dB)

Location	Octave Band Center (Hz)				Total
	31.5 Hz	63 Hz	125 Hz	250 Hz	dBC
Receptor 1 (I)	61.8	63.4	59.4	53.7	65.8
Receptor 2 (R)	56.7	58.1	54.1	47.7	60.4
Receptor 3 (I)	60.5	62.0	58.3	52.3	64.4
Receptor 4 (I)	55.8	57.2	53.3	46.6	59.5
Receptor 5 (I)	57.5	59.0	55.1	48.8	61.3
Receptor 6 (I)	57.5	59.0	55.1	48.8	61.3
Receptor 7 (R)	56.6	58.0	54.1	47.6	60.3
Receptor 8 (R)	52.0	53.4	49.1	41.7	55.5
Receptor 9 (R)	55.1	56.6	52.5	45.8	58.8
Receptor 10 (R)	56.6	58.2	54.1	47.7	60.4
Receptor 11 (R)	55.0	56.4	52.3	45.6	58.6
Receptor 12 (I)	72.7	74.4	70.8	65.6	77.0
Receptor 13 (I)	63.8	65.5	61.6	56.0	67.9
Receptor 14 (R)	58.7	60.3	56.3	50.2	62.6
Receptor 15 (R)	52.7	54.0	49.8	42.6	56.2

To provide protection from low-frequency noise disturbance, the American National Standards Institute (ANSI) has presented recommendations in the document titled, “Gas

Turbine Installation Sound Emissions," 1989. ANSI recommends limiting noise levels at residences near new gas turbine facilities to 75 to 80 dBC.

The modeling indicates that low frequency noise from the Cogeneration Project will be below the recommended ANSI levels, except at location 12, which is across Grandview Road from the Project site and on BP industrial owned land

6. POTENTIAL TRAFFIC NOISE IMPACTS

During construction of the Cogeneration Project, traffic volumes will increase as a result of construction contractor employees commuting to and from work at the site, as well as owner, supplier, delivery, and service vehicles (including trucks of various sizes) doing business at the site. The average workforce at the project during construction is expected to range from less than 300 workers to approximately 400 workers for a three-month period. Most of the construction traffic would be due to the arrival and departure of the workforce, primarily between the hours of 7:00 a.m. and 6:00 p.m. In addition, the construction traffic will be temporary and the peak volumes of traffic will occur for less than 90 days. Transient noises such as construction traffic are exempt from the State regulations.

During operation of the Cogeneration Project there will only be minor increases in vehicular traffic to and from the site. Operation of the facility will result in approximately 30 additional vehicles (60 vehicle trips) during a week, corresponding to the number of employees that will work at the facility and the limited number of delivery, supply or maintenance vehicles anticipated to support the Cogeneration operations. This volume represents less than a 10 percent increase in traffic volume over that currently generated by the Refinery. Because of the relatively insignificant increase in traffic associated with Cogeneration Project operations, a more detailed analysis of the noise associated with the slight traffic increase was not performed.

7. MITIGATION

The proposed Project will be located adjacent to the Refinery, which has been operating at Cherry Point since the early 1970's. The proposed facility is in an area zoned Heavy Impact Industrial and is relatively remote from residentially zoned areas.

When considering the location and orientation of the proposed Cogeneration Project, many factors, including noise, were evaluated. Siting the Project 337 feet from the nearest public road (Grandview Road) will result in a reduction of noise levels at the road and beyond. The configuration of the plant equipment, which includes the three combustion turbine generators in parallel to the south leading away from Grandview Road, is an orientation that will allow for optimal sound reduction through physical barriers. The equipment noise from the two most southerly generators will be blocked by the presence of the generator closest to Grandview Road.

The steam turbine generator will be positioned south of the three combustion turbine generators, with its noise contribution substantially reduced by the physical presence of the combustion turbine generators and the housing enclosure that will be constructed around the steam turbine generator. Based on distance and housing, it is anticipated that there will be no noise contribution from the steam turbine generator at Grandview Road, located approximately 900 feet to the north.

The modeling results provided above indicate that the Cogeneration Project will not result in any significant adverse noise impacts because noise increases will be largely imperceptible. Accordingly, no additional noise mitigation is proposed at this time.

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