SUPPLEMENTAL SECTION B-7

NOISE REPORT

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SUPPLEMENTAL SECTION B-7
NOISE REPORT

B-7.1 EXISTING CONDITIONS

B-7.1.1 Characteristics of Noise Propagation and Attenuation

Ambient sound levels can be generated by a number of noise sources, including mobile sources, such as automobiles, trucks, trains, and airplanes, and stationary sources, such as construction sites, machinery, or industrial operations. Often "background" sound sources can contribute substantially to ambient sound levels; background sources can include birds chirping, an occasional vehicle passing by, a television or radio, or leaves rustling in the wind. These background sources can determine the ambient sound levels in areas not dominated by a single major noise source.

Noise is any sound that is undesirable because it interferes with speech and hearing, or is otherwise annoying (unwanted sound). If present in high intensities, loud sounds have the potential to cause hearing damage. Sound is measured in decibels (dB), a logarithmic ratio between pressures caused by a given sound source and a reference sound pressure. The human ear is not equally sensitive to all frequencies in the sound spectrum. Thus, it is standard to represent sound levels using a scale corresponding to the range and characteristics most consistent with the way human ears perceive sounds: the A-weighted scale, dB(A). Because this scale is logarithmic and associated with the typical sensitivity response of the human ear, a dB(A) increase does not always result in a direct increase in perceived loudness. In fact, small fluctuations in A-weighted sound level (less than 3 dB) are not typically audible.

Using the A-weighted scale, sound levels at an average residence typically range from 45 dB(A) to 55 dB(A). Sounds associated with nearby freeway and highway traffic are generally louder, ranging from 65 dB(A) to 80 dB(A), depending on the type, number, and speeds of vehicles on the roadway, distance from noise-sensitive receptors to the noise source (traffic), and topographic conditions (attenuation effects). Because sounds do vary (depending, for example, on equipment type and duration of use), the equivalent average sound level (denoted as L_{eq}), is used to represent the acoustical energy equivalent, over a specified period of time, to the actual fluctuating sound over that same time span.

B-7.1.2 Regulatory Controls

Regulations applicable to the proposed Phase II expansion are codified in Washington Administrative Code (WAC) Chapter 173-60, Maximum Environmental Noise Levels. There are no community noise regulations in effect for Grays Harbor County.

The State of Washington has established noise regulations based on land use compatibility as shown in Table B-7-1. Compliance with these regulatory limits is judged separately for each source. In other words, the regulations prohibit a source from generating more than the specified amount of sound at the receiving location. They do not require the cumulative sound generated by all sources to remain below the specified levels. For the purpose of this analysis, we have analyzed the impacts of Phase II, and then the cumulative impacts of Phases I and II as a single source.

Table B-7-1
Maximum Permissible Environmental Sound Levels

EDNA of Noise Source	Maximum Permitted Sound Level by EDNA of Receiving Source		
	Class A[a]	Class B[a]	Class C[a]
Class A	55	57	60
Class B	57	60	65
Class C	60	65	70

[a]Sound levels in dB(A).

Notes:
EDNA = Environmental Designation for Noise Abatement
Class A = Residential areas or lands where human beings reside and sleep; such as residential areas, multiple family living areas, recreational and entertainment areas (e.g., camps, parks, resorts), community service areas (e.g., retirement homes, hospitals, health and correctional facilities).
Class B = Commercial areas or land uses requiring protection against noise interference with speech; such as commercial living and dining areas, motor vehicle services, retail services, banks, office buildings, and commercial and recreational areas not used for human habitation (e.g., theaters, stadiums, fairgrounds, amusement parks, and educational, religious, governmental, and cultural facilities).
Class C = Industrial areas or lands involving economic activities; such as agricultural, storage, warehouse, production, and distribution facilities.
Source: Washington State Department of Ecology, Noise Regulations, Chapter 173-60

Although not specifically stated in the code, the noise abatement criteria are assumed to be presented as equivalent sound levels (L_{eq}). For noise-sensitive areas or areas which fall under Class A (residential areas), the noise abatement criterion is an L_{eq} of 60 dB(A) when the noise originates from a Class C site. For areas which fall under Class B (commercial areas), the noise abatement criterion is an L_{eq} of 65 dB(A), when the noise originates from a Class C (industrial) site. And, for areas which fall under Class C, the noise abatement criterion is an L_{eq} of 70 dB(A)

when the noise originates from a Class C site. Between the hours of 10:00 P.M. and 7:00 A.M. the noise limitations in Table B-7-1 are reduced by 10 dB(A) for receiving property within Class A areas. Additionally, at any hour of the day or night, the applicable noise limitations may not be exceeded in any 1-hour period by more than 5 dB(A) for a total of 15 minutes, 10 dB(A) for a total of 5 minutes, or 15 dB(A) for a total of 1.5 minutes.
These correspond to the L25 (25 percent of 1 hour, or 15 minutes), L8.3, and L2.5 sound levels, respectively. Assuming the worst-case conditions of the proposed Phase II plant running 24 hours per day, these time-weighted adjustments would not apply for this project. Rather, the steady-state WAC 173-60 L_{eq} limits are pertinent without adjustment.

The Phase II expansion site is located within Grays Harbor County's Industrial (I-2) zoning designation (see Figure B-7-1). Based on this information, the plant site and the surrounding areas are categorized as Class C. Current existing residences are located in General Development District Five (GD-5), which, for purposes of this analysis, are assumed to be Class A. These applicable noise level limits, as well as the pertinent existing conditions are summarized in Table B-7-2.

Table B-7-2
Pertinent Allowable Sound Levels for Proposed Phase II Plant

Location[(a)]	2001 Nighttime Ambient Noise Level, L_{eq} dB(A)	WAC 173-60 Nighttime Noise Level Limit, L_{eq} dB(A)
Plant_W (#1)	42.8	70
Plant_S (#2)	35.8	70
Plant_N (#3)	34.7	70
Plant_E	No data	70
#4	42.4	50
#5	32.4	50
#6	41.2	50
#7	35.0	50

(a) Locations are shown in Figure B-7-2.

B-7.2 NOISE EVALUATION AND ANALYSIS

B-7.2.1 Methods

A computerized noise prediction program was used to simulate and model the noise propagation from the Phase II plant. The modeling program uses industry-accepted propagation algorithms based on standards written by CONCAWE[1]. The calculations account for classical sound wave divergence (spherical spreading loss with adjustments for source directivity from point sources) plus attenuation factors due to air absorption, minimal ground effects, and barrier/shielding (including reductions from vegetation/forestation)[2].

Calculations are performed using octave band sound power levels (abbreviated PWL or Lw) as inputs from each noise source. The computer outputs are in terms of octave band and overall A-weighted noise levels (sound pressure levels, abbreviated SPL or L_p) at discrete receptor positions or at grid map nodes (in preparation for computing a contour map). The output listing is ranked by relative noise contribution from each noise source. This model has been validated over the years via noise measurements at several operating plants that had been previously modeled during the engineering design phases.

The project site plan drawing, Figure A-12-4, was used to establish the position of the noise sources. The plant configuration drawing, Figure A-12-3, and previous 1995 application drawings were used to locate receptor locations with respect to the facility layout. The receptor locations were chosen to match, as closely as possible, the positions used in the 1995 application, and the 2001 ambient survey. These approximate receptor locations are shown in Figure B-7-2. Both the source locations and receptor locations were translated into input x, y, z coordinates for the noise modeling program.

B-7.2.2 Procedures, Inputs, and Assumptions

For conservatism, and as is standard practice in the description of environmental noise, the modeling assumed stable atmospheric conditions suitable for reproducible measurements (under "standard day" conditions of 59°F and 70 percent relative humidity), that are favorable for propagation. These inherently conservative factors and assumptions result in a noise model that will tend be biased to higher predicted values than would be expected in the actual environment around the proposed project.

All continuous-operation equipment items that were deemed to be significant noise sources at the Phase II plant were included in the noise model. The set of modeled sources included turbines (gas and steam), heat recovery steam generators (HRSGs) pumps, motors (taken to be TEFC or

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[1] CONCAWE is the oil companies' European organization for environment, health, and safety, headquartered in Brussels, Belgium. The noise propagation standard was originally published in 1981 under the title "The propagation of noise from petroleum and petrochemical complexes to neighboring communities." Parts of this method are also included in the ISO 9613, ISO 1913 (Part 1), ANSI 126, or ISO 3891 standards.

[2] For ease of use and computational efficiency, the model does not provide for advanced ground attenuation definitions, special screening effects, or complex meteorological variables.

WPII[3] type, depending on horsepower rating[4]), main transformers, air compressors, fans and blowers (including roof-top ventilators and HVAC units), cooling tower cells, and chiller modules. Only the currently planned Phase II set of power generation equipment was modeled.

The plant was assumed to operate 24 hours per day, which means its noise output would be constant regardless of time of day. Given the early stages of the project, project-specific vendor data is not available. The modeling inputs used noise emission values that were obtained from equipment vendors on several recent Duke/Fluor-Daniel (D/FD) design efforts for similar-sized plant configurations, and data used for the Phase I design.

No special noise control options were initially assumed. These "standard design" levels from the significant noise sources were converted into sound power levels (in decibels re 1 pico Watt) to serve as inputs for the noise modeling program. Major buildings were included as barriers, as were the HRSG's bodies and some large storage tanks. However, for conservatism, only the end caps of the cooling tower were considered as barriers. The analysis included the benefits of Phase I barriers and structures that will be in place prior to the start-up of Phase II. Specifically, the Keys Road sound wall along the entire length of the west site boundary, as well as several Phase I retaining walls, equipment, and buildings were included in the Phase II model.

Sound emissions values were modeled to calculate the expected noise levels at the selected receptor locations. For several receptors, initial noise estimates produced noise levels that were above regulatory requirements. To achieve compliance, noise contributing equipment was evaluated. An iterative process of reducing the highest noise contributors, via the effective application of noise control treatments such as installing silencers on exhausts or using low-noise equipment, was performed. This process achieved an efficient, cost-effective, and reasonably achievable mix of noise source characteristics (see Section B-7.4 below).

B-7.3 IMPACTS

B-7.3.1 Construction

Areas adjacent to the proposed project will be exposed to construction sounds produced by construction equipment and activities. Figure B-7-3 shows the typical range of sound levels for construction equipment that may be used for this project.

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[3] TEFC is totally-enclosed, fan-cooled and WPII is weather-proof, Type II.

[4] Small equipment items, such as pumps less than 20 horsepower, were excluded since they were considered as insignificant sources.

Construction activities are excluded from Ecology noise ordinances. However, the following construction sound abatement measures which are included in the existing Phase I SCA, will be included in the project construction specifications to mitigate construction sound impacts:

- Construction will not be performed within 1,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 10:00 P.M. and 6:00 A.M. on other days.
- All construction equipment will have sound control devices no less effective than those provided on the original equipment. Equipment will not be operated with unmuffled exhaust systems.
- Pile driving or blasting operations, if required, will not be performed within 3,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 8:00 P.M. and 8:00 A.M. on other days.

Despite inclusion of the measures described above, areas adjacent to the project will be exposed to increased sound levels during active periods of construction. This will be a short-term impact. The Certificate Holder will notify nearby residents in advance of the anticipated schedule for construction activities.

B-7.3.2 Operation

B-7.3.2.1 Model Results

The site boundary and nearby community noise levels that are predicted from the Phase II plant operations (only) are summarized in Table B-7-3 along with the pertinent noise level limit and information (for reference) on the ambient noise environment at each receptor location.

Table B-7-3
Summary of Modeling Results for Proposed Phase II Plant

Location	2001 Nighttime Ambient Noise Level, L_{eq} dB(A)	Maximum Allowable Contribution from Proposed Phase II Plant, dB(A)	Predicted Contribution from Proposed Phase II Plant, dB(A)	Total Predicted Future Noise Environment (Measured Ambient plus Proposed Phase II Plant Contribution), dB(A)	Difference between Total Future Noise Environment and Allowable Noise Level Contribution, dB
Plant_W (#1)	42.8	70	42	45	-28
Plant_S (#2)	35.8	70	68	68	-2
Plant_N (#3)	34.7	70	44	44	-26
Plant_E	No data	70	75	75	+5

#4	42.4	50	36	43	-7
#5	32.4	50	37	38	-12
#6	41.2	50	35	42	-8
#7	35.0	50	38	40	-10

Table B-7-3 shows that the critical analysis locations are the adjacent properties to the south and east. This is because these locations are quite close to the gas turbine generator/HRSG, the steam turbine generator, the chiller modules, and the cooling tower array. Further, these locations receive little benefit from barrier shielding from either Phase II equipment or from Phase I equipment, buildings, and/or walls (as do the receptor locations to the north and west). Therefore, the south and east property line locations served as the primary design points for controlling noise emissions from the Phase II project.

The set of Phase II noise sources was then used to create a noise contour map of the proposed facility. Figure B-7-4 presents constant, A-weighted sound level contours in 5-dB increments on the currently planned project site from just the Phase II equipment (including the measured ambient environment). Note that this Phase II-only contour would be applicable only in the situation where Phase II was operating and Phase I was idle.

As with Phase I, the Certificate Holder is negotiating an agreement under which the neighboring property owner (Grays Harbor Public Development Authority) has consented to noise levels in excess of the otherwise applicable 70-dB(A) noise limit.

B-7.3.2.2 Cumulative Impacts

Since the expectation is to generate power with both Phase I and Phase II in operation, an assessment of the combined noise emissions from the entire site was undertaken. The separate modeling files for the Phase I project and the Phase II project were combined such that the total allotment of site equipment with the common physical barriers could be analyzed. The results are as shown in Table B-7-4.

Since the cumulative impacts would be due to the addition of the Phase II project, the relevant noise level limits for the combined facility are the WAC 173-60 nighttime limits as shown in Table B-7-4. A noise contour map of this cumulative set of compliant site noise sources was created for the proposed facility. Figure B-7-5 shows the constant, A-weighted sound level contours in 5-dB increments on the currently planned project site from the combined Satsop CT Project, Phase I plus Phase II (including the contributions from the measured ambient noise levels).

Figure B-7-4 (Phase II only) shows that the project's contribution on the west side of the plant can be expected to be in the mid-40s dB(A), owing primarily to the benefit from the 25-foot-high sound wall along the west side and the cooling tower retaining walls along the north and west sides of the project site. The north and south sides of the plant are expected to be in the high 60s dB(A) due to the proximity of major equipment, coupled with the lack of significant barrier

Table B-7-4
Summary of Modeling Results for the Cumulative Phase I and Phase II Plants

Location	2001 Nighttime Ambient Noise Level, L_{eq} dB(A)	Maximum Allowable Contribution from Combined Project Site, dB(A)	Predicted Contribution from just Ph. I Project (for reference only), dB(A)	Predicted Cumulative Contribution from Combined Projects Ph. I + Ph. II), dB(A)	Total Predicted Future Noise Environment (Measured Ambient plus Proposed Combined Projects, (Ph. I + Ph. II), dB(A)	Difference between Predicted Site Cumulative and Allowable Contribution, dB
Plant_W (#1)	42.8	70	51	52	52	-18
Plant_S (#2)	35.8	70	66	70	70	-0
Plant_N (#3)	34.7	70	53	53	53	-17
Plant_E	No data	70	61	75	75	+5
#4	42.4	50	37	40	44	-6
#5	32.4	50	38	41	42	-8
#6	41.2	50	34	37	43	-7
#7	35.0	50	36	40	41	-9

shielding. Likewise, the proximity of major equipment to the eastern boundary will result in noise levels, generally around 75 dB(A), with a small area around the circulating water pumps that may be expected to be approximately 80 dB(A). More importantly, the 70-dB(A) contour would protrude only marginally into the adjacent wooded land. The distant residential receptors are predicted to receive contributions from Phase II in the mid- to upper-30s dB(A), which is comparable to the contributions from just the Phase I project at these locations.

Figure B-7-5 (cumulative of Phase I plus Phase II) shows combined site contributions in the mid-50 dB(A) range along the west property line and 70 dB(A) or just above along portions of the north and south property lines. The east boundary will generally have noise levels around 75 dB(A) with only a relatively small area in the adjacent wooded parcel exceeding 70 dB(A). The distant residential receptors are predicted to receive total site contributions in the upper-30s to low-40s dB(A).

The most notable noise sources include the HRSG, the GTG and STG casings and generators, the main cooling water pumps/motors, and the cooling tower fans (including water splash noise). Other sources that are nearly as important for community levels include the chiller modules, the boiler feedwater pumps/motors, and the main transformers.

B-7.4 INDICATED EQUIPMENT NOISE LEVEL LIMITS AND CONCEPTUAL MITIGATION MEASURES

The mitigated noise emission levels were calculated into near-field and far-field noise level specifications for individual equipment items. These individual levels will be used for specification requirements during equipment procurement to ensure that the aggregate plant noise levels are within the project's noise predictions. The equipment noise level specifications, as well as the associated noise control methodologies, are summarized in Table B-7-5.

In addition to the equipment noise control measures listed in Table B-7-5, modeling results for Phase I and Phase II are predicated on additional noise control features. These additional features are a collection of barriers and walls that were installed as part of Phase I and are detailed in Table B-7-6.

Table B-7-5
Summary of Noise Levels and Potential Control Measures

Noise Source	Noise Level Specification And Proposed Noise Control Measure
Gas Turbine (including turbine casing, generator, accessory bay, load compartment, and support skids)	Near-Field Limit: 85 dB(A) at 3'
	Far-Field Limit: 60 dB(A) at 400' composed of the components: Casing: 55 dB(A) at 400' Generator: 55 dB(A) at 400' Accessory Bay: 54 dB(A) at 400' Exhaust Plenum: 49 dB(A) at 400' Inlet Plenum: 47 dB(A) at 400' Load Compartment: 45 dB(A) at 400' Air Inlet: 44 dB(A) at 400'
	Noise Control: An acoustical enclosure on the turbine, noise treatment of the generator, and a local wall system around the outlet plenum.
Steam Turbine/Condenser (including turbine casing, generator, and support skids)	Near-Field Limit: 85 dB(A) at 3'
	Far-Field Limit: 60 dB(A) at 400' composed of the components: Casing: 56 dB(A) at 400' Generator: 55 dB(A) at 400' Condenser: 53 dB(A) at 400'
	Noise Control: An acoustical enclosure on the turbine and noise treatment of the generator as well as acoustical insulation on the condenser and related piping.
HRSG	Near-Field Limit: 85 dB(A) at 3'

Table B-7-5 (Continued)
Summary of Noise Levels and Potential Control Measures

Noise Source	Noise Level Specification And Proposed Noise Control Measure
	Far-Field Limit: 58 dB(A) at 400' composed of the components: Transition: 57 dB(A) at 400' Boiler Section: 50 dB(A) at 400' Stack Wall: 38 dB(A) at 400' Stack Exit: 44 dB(A) at 400'
	Noise Control: A stack silencer as well as quiet drum and vent systems.
Cooling Tower	Near-Field Limit: 85 dB(A) at 3' (grade level & on the fan deck).
	Far-Field Limit: 62 dB(A) at 400'
	Noise Control: Specification of a special design, including attention to fan tip speed, blade design, drive mechanisms, and splash control.
Air Inlet Chiller Modules	Near-Field Limit: 85 dB(A) at 3' (grade level).
	Far-Field Limit: 55 dB(A) at 400'
	Noise Control: Use of a special design, including attention to fan tip speed, blade design, drive mechanisms, and splash control.
Main Transformers	Near-Field Limit: 85 dB(A) at 3'
	Far-Field Limit: 55 dB(A) at 400'
Aux. Transformers	Near-Field Limit: 72 dB(A) at 3'
	Far-Field Limit: 39 dB(A) at 400'
Air Compressors	Instrument air compressors should be limited to 80 dB(A) at 3'
Pumps	Specification of pump and driver trains such that they will be nominally limited to 85 dB(A) at 3'; per the following: Boiler Feedwater: 90 dB(A) for the combined train Cooling Tower Circ'n: 88 dB(A) for the combined train Vacuum Condensate: 90 dB(A) for the combined train Closed Loop Cooling Water: 88 dB(A) for the combined train All other pumps (>25 hp): 85 dB(A) for the combined train All other pumps (<25 hp): 80 dB(A) for the combined train
Control valves	Noise Control: Specification of low-noise valves and/or use of acoustical insulation on valve case and related piping, as appropriate.
Atmospheric Vents	Noise Control: Use of low-noise valves (see above) as well as vent discharge silencers, as appropriate, to attain project noise limits and OSHA noise exposure compliance for plant personnel.
Piping	Noise Control: Insulation materials and application methods for both acoustical and thermal qualities.
Other General Equipment Items (including material handling equipment)	Noise Control: All equipment, stationary and mobile, deemed to be significant noise sources would have noise limits included in the supplier bid conditioning and procurement process. All necessary noise control treatments will be made part of each supplier's scope.

Table B-7-6
Summary of Additional Noise Control Measures
Installed as Part of Phase I

Item	Description	Function
West Sound Wall	The sound wall system is a height of 25’ above plant grade.	Shields the majority of plant equipment for both Phases I and II from the sensitive residential receptors to the west.
North Cooling Tower Wall (north of Phase I Cooling Tower)	The retaining wall is +20’ above plant grade.	Shields cooling tower noise for both Phases I and II.
West Cooling Tower Wall (west of Phase I Cooling Tower)	The retaining wall is +20’ above plant grade.	Shields cooling tower noise for both Phases I and II.

Figure B-7-1 Existing Zoning and Noise Monitoring Locations

Figure B-7-2 Location of Receptor Analysis Points

Figure B-7-3 Typical Range of Sound Levels for Construction Equipment

Figure B-7-4 Predicted Phase II (Only) Noise Level Contours (With Ambient) at Project Site

11x17; allow 2 pages, start on odd-no. page.

Figure B-7-4 continued

Figure B-7-5 Predicted Phase I plus Phase II Noise Level Contours (With Ambient) at Project Site

11x17; allow 2 pages, start on odd-no. page.

Figure B-7-5 continued