NOISE REPORT FOR GRAYS HARBOR ENERGY CENTER

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Acronyms and Abbreviations

CTs	combustion turbines
dB	decibel
dBA	A-weighted decibel
EDNA	environmental designation for noise abatement
EFSEC	Energy Facility Site Evaluation Council
GHEC	Grays Harbor Energy Center
HRSGs	heat recovery steam generators
MTA	Michael Theriault Acoustics, Inc
MW	megawatts
Project	Satsop Combustion Turbine Project
SCA	Site Certification Agreement
STG	steam turbine generator
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

Chapter 1
Summary of Findings

ICF was retained by the Washington Energy Facility Site Evaluation Council (EFSEC) to evaluate community noise issues related to the existing Grays Harbor Energy Center (GHEC) power plant near Satsop, Washington. The existing Phase I operation at GHEC currently uses two combined-cycle gas-fired turbines (Units 1 and 2) with a rated capacity of roughly 650 MWe. The owner and operator, Grays Harbor Energy, LLC (GHE or Invenergy), has submitted an application for Phase II, which would add two additional combined-cycle turbines (Units 3 and 4) and would increase the capacity of the facility to roughly 1,300 MWe.

The results of our evaluation are described in detail in the following sections. Our findings are summarized below:

Invenergy conducted a long-term community noise monitoring study in summer, 2009, as described in the report "Results of Noise Level Monitoring", by Michael Theriault Acoustics, Inc (MTA)., dated November 5, 2009. ICF concludes that study was done well, using state-of-the-practice methodologies and analyses. The study demonstrated that when the GHEC is operating under normal steady-state-conditions, the community noise levels at the closest homes are less than the allowable nighttime limits specified by the Washington Environmental Noise Regulation (Chapter 173-60 Washington Administrative Code (WAC), referred to as the "WAC noise limits"). The study also demonstrated that under routine steady-state operating conditions the community noise levels are governed by local noise sources other than the power plant. However, the study revealed that community noise levels can be adversely impacted during occasional transient events such as plant startup and emergency steam releases.

ICF's site tour and spot-check community noise survey confirmed the steady-state noise levels caused by the power plant are well within the WAC noise limits. However, even during mid-day conditions the power plant is clearly audible at the closest homes and in some cases the power plant dominates the noise environment. Furthermore, the power plant noise at the nearest homes is clearly distinguishable based on its characteristic high-pitched whine, which could have the potential to cause community annoyance even though the overall noise levels are well within WAC regulatory limits.

ICF reviewed community noise complaints that have been sent to EFSEC. Complaints have been sent by several different residents, beginning during facility construction and continuing to the present time. It appears there are multiple industrial noise sources in the area, because some of the noise complaints were sent during periods when the power plant was inactive. However, most of the complaints appear to focus on continuous or intermittent power plant noises. The complaints describe a wide range of qualitative noise characteristics ranging from "pitchy squeal" to "low rumble that rattles the windows". If the majority of noise complaints are in fact related to power plant operations, then the wide variety of qualitative descriptions would indicate there are multiple types of non-steady-state noise sources within the power plant that could occasionally annoy the neighbors.

ICF reviewed the predictive noise modeling for the proposed Phase II expansion. We conclude the modeling was done well, using state-of-the- practice methods and assumptions. The modeling predicts the noise levels caused by the routine steady operation of the combined Phase II turbines Units 1, 2, 3 and 4) would be just below the allowable nighttime limits. ICF supports this overall modeling result, but we believe the Invenergy's modeling was vas very conservative, and predicts noise levels that are substantially higher than what the Phase I facility is producing today and also higher than the facility will actually produce after the expansion. We also believe the proposed Phase II expansion would have the potential to increase the frequency of transient noise events at the power plant that have possibly been the cause of the occasional noise complaints.

ICF and EFSEC toured the Phase I facility and observed some equipment and events that are candidates for possible future retrofit noise control measures. One such item is the un-enclosed combustion turbine transition sections, which emit the continuous, high-pitched whine that is clearly discernible at the neighborhood. Another candidate item is the periodic condensate blowdown system, which results in a substantial short-term noise increase when the system activates twice per hour. Additional examples are provided in the main text of this report.

ICF and EFSEC also toured the Chehalis Power Generating Station in Chehalis, WA, to observe that facility's success with retrofit noise control methods. The plant operators showed examples of several low-cost retrofits that were successful in reducing noise emissions, as well as other high-cost attempts that were unsuccessful. The operators also showed us the facility's continuous noise monitoring system that is used to track real-time community noise levels, and which triggers automatic alarms in the control room if community noise levels exceed trigger levels that indicate the potential for community noise impacts.

1.1 Recommendations

Based on these findings, ICF recommends the following community noise mitigation measures. Our recommendations are categorized into two groups: measures that should be implemented immediately, to conform to SCA conditions that apply to the existing Phase I facility; and measures that should be implemented upon issuance of the new Site Certification Agreement (SCA) for the proposed Phase II expansion.

Corrective Measures That Should Be Implemented Immediately

- Invenergy should immediately take steps to reduce noise emissions from the two combustion turbine transition sections. ICF interprets those sections should have been enclosed as required by Condition IV.F of the SCA.

Corrective Measures That Should Be Implemented Upon Issuance of the SCA for the Proposed Phase II Expansion

- Invenergy should immediately conduct a Best Available Technology acoustical study to identify and prioritize cost-effective retrofit noise measures for Units 1 and 2. Invenergy should then promptly implement the high-priority noise control retrofits for Units 1 and 2.
- Invenergy should implement a similar Best Available Technology study to identify feasible and cost-effective control measures for the Phase II expansion.

- EFSEC should consider project-specific community noise limits that are lower than the Washington Environmental Noise Regulation limits. The project-specific noise limits should be based partly on the community noise monitoring studies that have been done to date, and partly on the results of Invenergy's Best Available Technology noise control study.
- Invenergy should install a continuous noise monitoring system similar to the one currently used at the Chehalis power plant. The main objective of the continuous monitoring system would be to automatically alert operators in the control room in the event of exceptionally loud transient noise events. The continuous monitoring system would also be useful to provide ongoing verification of compliance with Chapter 173-60 Washington Administrative Code and track compliance with any project-specific community noise limits the Council establishes. Invenergy should take immediate corrective action to mitigate all noise events in excess of the project-specific noise limits. Invenergy should archive the data to demonstrate compliance with Chapter 173-60 WAC in the event of neighbor complaints.
- Because many of the noise complaints appear to relate to short-term noise events, Invenergy should immediately initiate a more proactive community noise response system than it has used in the past. Invenergy should be required to immediately respond to reasonable noise complaints from the community, and to report to EFSEC regarding the results of the response.

Chapter 2
Project Background

The EFSEC retained ICF to conduct a study of sound (noise) emissions and community noise impacts associated with the operation of the Satsop Combustion Turbine Project (Project). EFSEC is a Washington State agency with responsibility for environmental regulatory oversight for certain types of energy projects.

The Project is a combined-cycle power plant, currently consisting of two combustion turbine generators (Units 1 and 2) with a single steam turbine generator (STG), with a maximum electrical generation capacity of approximately 650 megawatts (MW). The Project is located on an approximate 22-acre site within the Satsop Redevelopment Park near the town of Elma, in Grays Harbor County, Washington.

Construction and operation of the Project was authorized in 2005 when the governor approved an amendment to the existing SCA that approved the sale of the Project to Grays Harbor Energy, LLC, a subsidiary of Invenergy Inc., from Duke Energy. Grays Harbor Energy LLC restarted construction on the partially completed facility in early 2007 and the Project was completed in the second quarter of 2008 and began commercial operation on April 28, 2008.

On October 30, 2009 the Certificate Holder submitted a Request for Amendment of the Project SCA to pursue the following:

- Add Units 3 and 4 to increase the facility capacity from 650 MW to a total of approximately 1,300 MW;
- Change the name of the Project to the Grays Harbor Energy Center;
- Enlarge the site by 10 acres;

In accordance with its rules, EFSEC has initiated review and processing of the Certificate Holder's request to amend the Project SCA. As noted in the amendment request, impacts associated with site development were considered when the existing Project was originally permitted and the current SCA requires the Certificate Holder to operate the facility in compliance with all federal and state regulations and SCA conditions.

Based on recent citizen complaints related to noise from current Project operations, EFSEC contracted with ICF and initiated this study to review the results of an analysis of noise emissions recently completed by the Certificate Holder; examine noise modeling results for the proposed new units; assess compliance with regulatory and industry standards; and propose possible mitigation measures to minimize community noise impacts.

To complete this assessment, ICF conducted the following tasks, which are described in the following sections of this report:

- Task 1. Provide Peer Review of "Results of Noise Level Monitoring" by Michael Theriault Consultants, Dated November 5, 2009.
- Task 2. Determine If Project is in Compliance With State Environmental Noise Regulations
- Task 3. Determine If Project is in Compliance with Site Certification Agreement Conditions

- Task 4. Examine Community Noise Complaints Reported to EFSEC
- Task 5. Review and Verify Noise Modeling Analysis for Proposed Phase II (Units 3 and 4)
- Task 6. Conduct Site Visits at the Satsop Project and Chehalis Power Plant, and Report on Observations Related to Community Noise Impacts and Mitigation
- Task 7. Conduct Spot-Check Community Noise Measurements at Homes near the GHEC Satsop Project.

Chapter 3
General Description of Sound

3.1 Noise Terminology

Sound is caused by vibration that produces pressure waves that travel outward from the source of the disturbance. Noise is defined as unwanted sound that adversely affects any given receiver location. In general, sound waves travel away from a ground level noise source in a hemispherical pattern. As a result, the energy contained in a sound wave is spread over an increasing area as it travels away from the source. This results in a decrease in loudness at greater distances from the noise source.

The human perception of sound varies according to the characteristics of the sound waves (e.g., period, amplitude, frequency, speed, and wavelength) and the characteristics of the media through which the sound travels (e.g., air, water, and solids). The pitch of a sound is governed by the frequency of the sound waves, while the magnitude of the sound is governed by the amplitude of the sound waves.

Sound level meters measure the air pressure fluctuations caused by sound waves, with separate measurements made for different sound frequency ranges. The decibel (dB) scale used to describe sound is a logarithmic scale, which accounts for the large range of audible sound intensities.

Most sounds consist of a broad range of sound frequencies. Several frequency weighting schemes have been used to develop composite decibel scales that approximate the way the human ear responds to noise levels. The weighting of noise levels at different frequencies accounts for the human perception of noise. The A-weighted decibel (dBA) scale measures the intensity of sound as it is perceived by humans, and is the scale most widely used for community noise purposes. Typical A-weighted noise levels for various types of sound sources are summarized in Table 1.

Table 1. Typical A-Weighted Sound Levels

Sound Source	dBA	Typical Response
Carrier deck jet operation	140	
Limit of amplified speech	130	Painfully loud
Jet takeoff (200 feet) Auto horn (3 feet)	120	Threshold of feeling and pain
Riveting machine Jet takeoff (2,000 feet)	110	
Shout (0.5 foot) New York subway station	100	Very annoying
Heavy truck (50 feet) Pneumatic drill (50 feet)	90	Hearing damage (8-hour exposure)
Passenger train (100 feet) Helicopter (in flight, 500 feet) Freight train (50 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Air conditioning unit (20 feet) Light auto traffic (50 feet)	60	
Normal speech (15 feet)	50	Quiet
Living room Bedroom Library	40	
Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

Community noise typically varies considerably during any given hour. Noise levels that vary with time are often described in terms of the following noise descriptors:

- Equivalent sound level (Leq). The Leq is the "average noise level" in a given period of time. It is the steady noise level that has the same acoustic energy as the time-varying sound level during the same period of time. The Leq data used for these descriptors of average noise exposure are generally based on A-weighted sound-level measurements.
- Percent Exceeded Level (Lxx). Statistical descriptions are also used to characterize noise conditions over specified periods of time. The "percentile exceeded" noise level is the level that was exceeded by the varying noise profile for the stated percentage of time. The following percentile exceeded descriptors are relevant for Washington state projects:
    - L90 is the quiet noise level that was exceeded 90% of the time during the measurement period, and is often referred to as the "background level" or "residual level" that is unaffected by short-term events such as passing cars. In addition to defining residual noise levels, the L90 is useful to describe noise sources that are nearly constant, such as continuous noise from a power plant.
    - L25 is the level that is exceeded 25% of the time during the measurement period. This is equivalent to the "15 minutes per hour" level that is regulated by the WAC noise regulation.

- L8.3 is the level that is exceeded 8.3% of the time during the measurement period. This is equivalent to the "5 minutes per hour" level that is regulated by the WAC noise regulation.
- L2.5 is the level that is exceeded 2.5% of the time during the measurement period. This is equivalent to the "1.5 minutes per hour" level that is regulated by the WAC noise regulation.

Because of the logarithmic decibel scale, sound levels from different noise sources cannot be added directly to give a combined noise level. Instead, the combined noise level produced by multiple sources is calculated logarithmically. For example, if one bulldozer produces a noise level of 80 dBA at a nearby home, then two bulldozers would generate a combined noise level of 83 dBA, not 160 dBA

People generally perceive a 10-dBA increase in a noise source as a doubling of loudness. For example, an average person would perceive a 70 dBA sound level as being twice as loud as a 60 dBA sound. People generally cannot detect differences of 1 to 2 dBA between noise levels of a similar nature (e.g., an increase in traffic noise compared to existing traffic noise). However, under ideal listening conditions, some people can detect differences of 2 or 3 dBA. Under normal listening conditions, most people would likely perceive a 5 dBA change in sounds of a similar nature. When the new sound is of a different nature than the background sound (e.g., backup alarms compared to quiet residential sounds), most people can discern the new noise even if it increases the overall Leq noise by less than 1 dBA.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about 6 dBA for every doubling of distance from the noise source. When the noise source is a continuous line (e.g., vehicle traffic on a highway), sound levels decrease by about 3 dBA for every doubling of distance. Attenuation rate is used to describe the rate at which the intensity of a sound signal declines as it travels outward from its source.

Noise levels can also be affected by several factors other than the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can affect the reduction of noise levels. Atmospheric conditions (e.g., wind speed and direction, humidity levels, and temperatures) can also affect the degree to which sound is attenuated over distance. Echoes off of topographical features or buildings can sometimes result in higher sound levels (lower sound attenuation rates) than normally expected. Temperature inversions and attitudinal changes in wind conditions can also refract and focus sound waves toward a location at considerable distance from the noise source. These effects are usually noticeable only for very intense noise sources, such as blasting operations. As a result, the existing noise environment can be highly variable depending on local conditions.

It is important to note that community annoyance caused by an industrial noise source is generally subjective. The level of annoyance can vary between individuals and is often related more to the character of the emitted sound (the time of day when the intruding noise occurs, the magnitude of the intruding noise compared to background levels, the pitch of the intruding noise, the presence of pure tones, etc.) in addition to the magnitude of the noise. Substantial community annoyance can sometimes occur even if the overall dBA levels of the intruding noise are low.

3.2 Washington Environmental Noise Regulation

Chapter 173-60 of the WAC, Maximum Environmental Noise Levels, limits noise emissions from the facility. A copy of the regulation is provided in Appendix A. Specifically, WAC 173-60 contains noise level limits based on the "environmental designation for noise abatement (EDNA) of the property generating the noise, as well as on the EDNA of the property receiving the noise. EDNA classes are based on land use. The neighboring residences are considered EDNA Class A (residential) while the Project itself is considered a Class C EDNA (industrial).

Given these designation, the noise level limit for continuous noise caused by the Project is 60 dBA during daytime hours (7 am to 10 pm) and 50 dBA during nighttime hours (10 pm to 7 am) at neighboring residential land uses. Note that the code allows for routine short-term excursions compared to the continuous sounds, as follows:

- Additional 5 dBA for up to 15 minutes per hour (L25). The L25 limits are 65 dBA during daytime hours and 55 dBA during nighttime hours.
- Additional 10 dBA for up to 5 minutes per hour (L8.3). The L8.3 limits are 70 dBA during daytime hours and 60 dBA during nighttime hours.
- Additional 15 dBA for up to 1.5 minutes per hour (L2.5). The L2.5 limits are 75 dBA during daytime hours and 65 dBA during nighttime hours.

WAC 173-60-050 contains a list of exemptions to the specified noise limits. The key exemptions relevant for the Project are:

- "Sounds originating from temporary construction sites as a result of construction activity" are exempted from the daytime noise limits.
- ""Sounds created by safety and protective devices where the noise suppression would defeat the intent of the device or is not economically feasible" are exempted at all time.

3.3 Other "Nuisance Regulations"

It is important to note the WAC noise regulation does not consider whether intruding noise is actually disruptive or annoying to nearby residents, but it simply sets noise limits based on the magnitude of the dBA noise levels. However, section 173-60-060 acknowledges that local governments should be allowed to develop their own noise ordinances that prohibit "nuisances":

> **WAC 173-60-060, Nuisance regulations not prohibited**. Nothing in this chapter or the exemptions provided herein, shall be construed as preventing local governments from regulating noise from any source as a nuisance. Local resolutions, ordinances, rules or regulations regulating noise on such a basis shall not be deemed inconsistent with this chapter.

The Grays Harbor County Code does not include any ordinances that regulate annoyance or noise levels caused by industrial facilities or power plants. However, it is interesting to note that Grays Harbor County has implemented "nuisance noise" ordinances applicable to other noise sources. For example Grays Harbor County Ordinance No. 379 applies only to barking dogs:

> "Whereas, the county commissioners find it to be in the public interest and for the protection of the public health, safety, welfare and property of the residents of Grays Harbor County to

> minimize exposure of citizens to noise created by barking dogs that unreasonably annoys or disturbs the peace…"

Most counties in Washington have enacted some form of noise ordinance. Some of them are quantitative and specify allowable dBA noise levels, while others are qualitative "nuisance ordinances". For example, the Spokane County Code noise ordinance is very short and simply prohibits noise disturbances:

> **6.12.010 Noise disturbances prohibited**. It is unlawful for any person to make…any sound which creates a noise disturbance…For purposes of this section, the following sounds are declared to be noise disturbances: (2) Any other sound occurring frequently, repetitively, or continuously which annoy or disturb the peace, comfort or repose of a reasonable person of normal sensitivity…"

Chapter 4

Task 1. Provide Peer Review of "Results of Noise Level Monitoring" by Michael Theriault Consultants, Dated November 5, 2009

4.1 Evaluation of Methodology Used for Long-Term Noise Monitoring Study

ICF reviewed Invenergy's long-term noise monitoring report, "Results of Noise Level Monitoring, Grays Harbor Energy Center". Prepared by MTA, dated November 5, 2009. We conclude the study was well done and was conducted using industry-practice methodologies. Our conclusions are as follows:

Noise monitoring was done at an appropriate number of locations. Figure 1 shows the monitoring locations. Continuous noise readings were taken at three different homes. During each community noise monitoring round, noise readings were also taken at a "control location" immediately west of the power plant, to measure noise levels caused solely by power plant operations.

MTA used noise meters equipped with Type 1 microphones as established by the American National Standards Institute standards. Type 1 monitors are acceptable for use to demonstrate compliance in Washington according to WAC 173-58, Sound Level Measurement Procedures.

Noise monitors were appropriately used to measure broad-band A-weighted noise levels for direct comparison to the WAC noise limits. Hourly-average noise intervals were taken to display the hourly-average Leq (which is not directly regulated by the WAC noise standard) plus the percentile-exceeded noise levels (L25, L8.3 and L2.5) that are directly regulated by the WAC noise standard. The hourly-average L90 was also measured, to provide a relevant indicator of the continuous noise generated by the power plant.

Noise monitors were appropriately used to measure broad-band A-weighted noise levels for direct comparison to the WAC noise limits. MTA also measured the octave-band sound spectrum and the 1/3-octave band spectrum. The octave-band spectrum measurements were used to quantitatively evaluate the limited number of measured events when the community noise levels temporarily exceeded the WAC noise limits. In most cases the octave-band readings confirmed the community noise exceedances were caused by localized noise sources (e.g., lawn mowers) rather than the power plant. The exception was one high-pressure steam release that caused community noise levels to exceed the allowable WAC nighttime noise limits.

Digital audio recordings were appropriately taken simultaneous with the community noise readings. The recordings were used to quantitatively evaluate the limited number of measured events when the community noise levels temporarily exceeded the WAC noise limits. The audio recordings helped to confirm the community noise exceedances were caused by localized noise sources (e.g., lawn mowers) rather than the power plant.

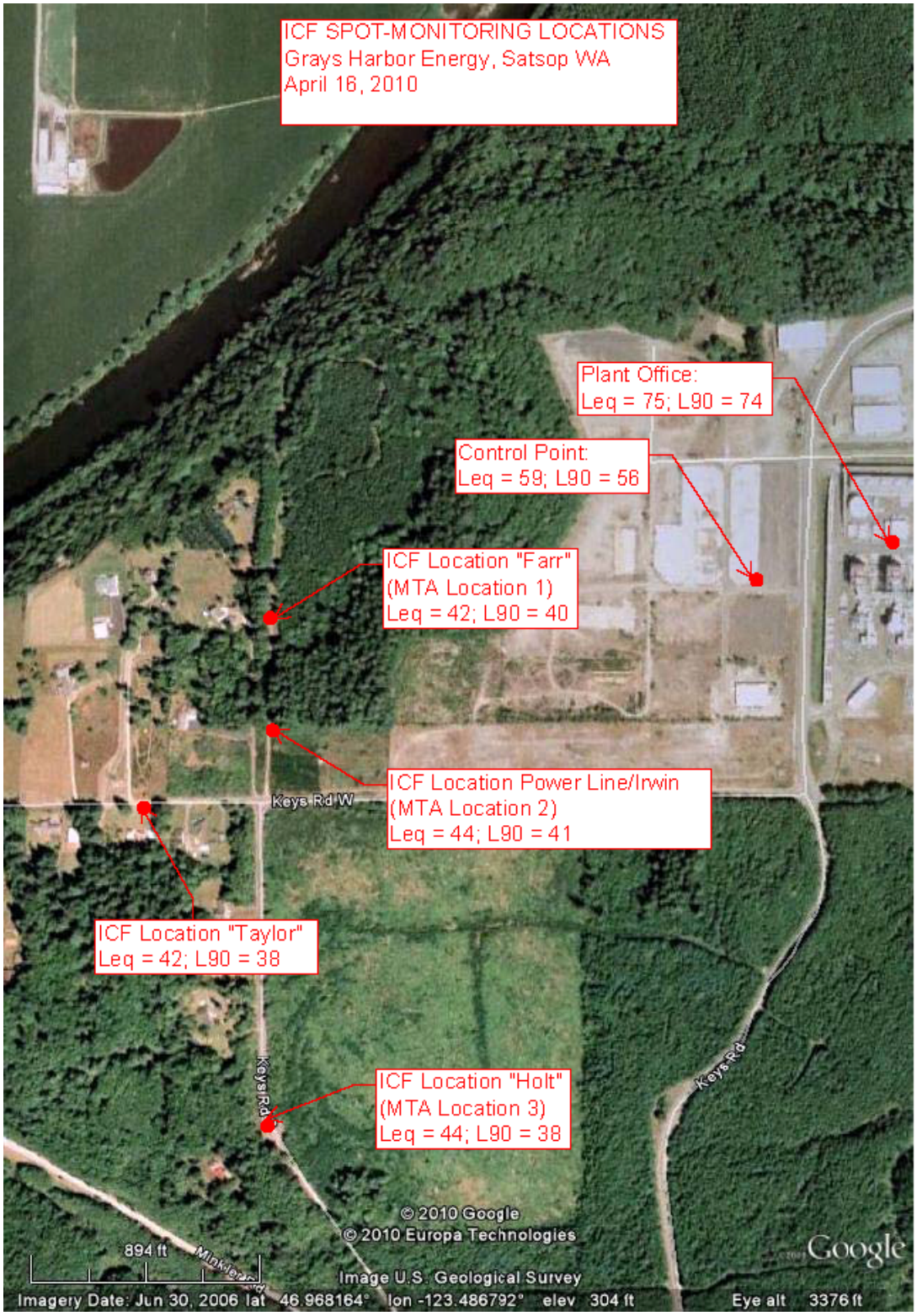

Figure 1. Satsop: Vicinity Map and Noise Monitoring Locations

4.2 Relevance of Long-Term Noise Monitoring Results

This section describes some of the key noise readings that were taken by the MTA long-term noise study, to evaluate how community noise levels are affected by normal steady-state operation and by occasional transient events. Figure 1 shows the noise monitoring locations.

4.2.1 Noise Levels During Normal Steady Operation

The measured noise plots on Figure 2 through Figure 5 of this report demonstrate that when the power plant operates at steady conditions it is only a minor contributor to community noise levels at the nearby homes. However, those measurements also demonstrate that community noise can be adversely impacted by extremely high noise emissions that occur during emergency events. These noise trends are described in the following paragraphs.

The noise measurements on Figure 2 and Figure 3 demonstrate that when the power plant operates under steady conditions, the power plant is a minor contributor to community noise at the houses west of the facility. These two figures show noise levels at Location 1 (the Farr residence). Figure 2 shows the plant output during the measurements and the hourly-average Leq noise levels, while Figure 3 shows the L2.5 noise levels that are regulated by the WAC noise regulation. See the noise patterns on July 5 and July 6 on Figures 2 and 3, when the power plant operated at nearly constant load (the plant load is indicated by the upper, purple plot). During that period the noise levels at the control point, which is dominated by noise from the power plant, were nearly constant at 50 dBA Leq (the control-point noise level is indicated by the middle, black plot). During that same period the community noise level at Location 1 (the Farr residence) averaged about 15 dBA less than the control location, and displayed a typical diurnal pattern with low noise levels at midnight and high levels in the afternoon. The noise level at the control point was nearly constant, while the diurnal pattern at the home varied by nearly 20 dBA. Thus, it is concluded the power plant was only a minor contributor while the plant operated at steady conditions.

This same trend is shown on Figures 4 and 5 for the noise levels measured at Location 2 (the Irwin residence). Figure 4 shows the plant output and the hourly Leq, while Figure 5 shows the short-term L8 noise levels. During the period from July 30 to August 4 the power plant output varied by about 20% on a daily cycle (see the upper, purple curve on Figure 4). During that period the noise levels at the control point where noise was dominated by the power plant (the middle, black plot) was nearly constant, varying by only 3 dBA. However, the community noise level at Location 2 (the lower, green plot) averaged 20 dBA less than the control location, and displayed a typical diurnal pattern, varying by more than 15 dBA between midnight and afternoon. The noise level at the control point was nearly constant, while the diurnal pattern at the home varied by 15 dBA. Thus, it is concluded the power plant was only a minor contributor while the plant operated at steady conditions.

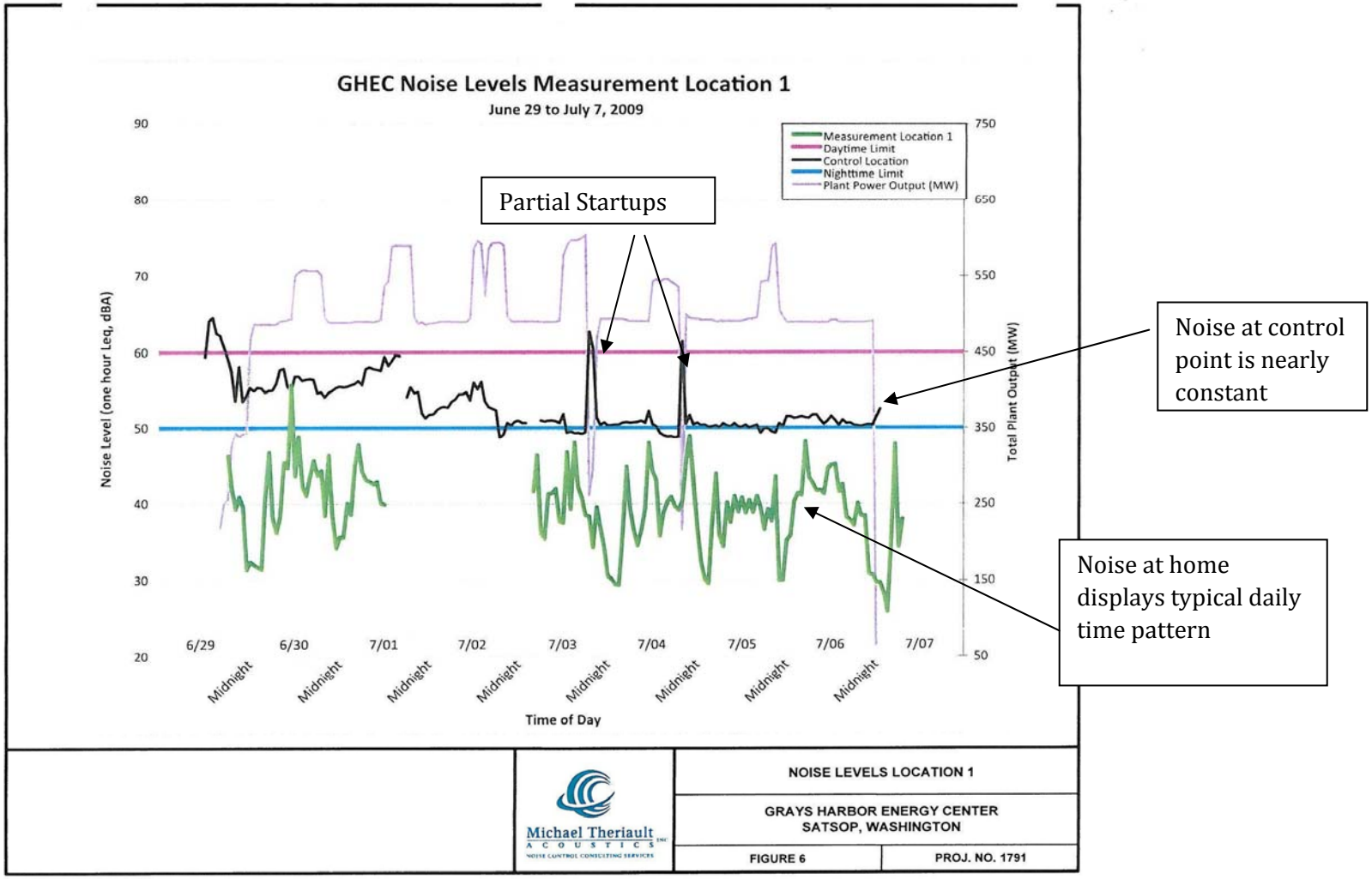

Figure 2. Leq Noise Levels at Location 1 During Partial Startup

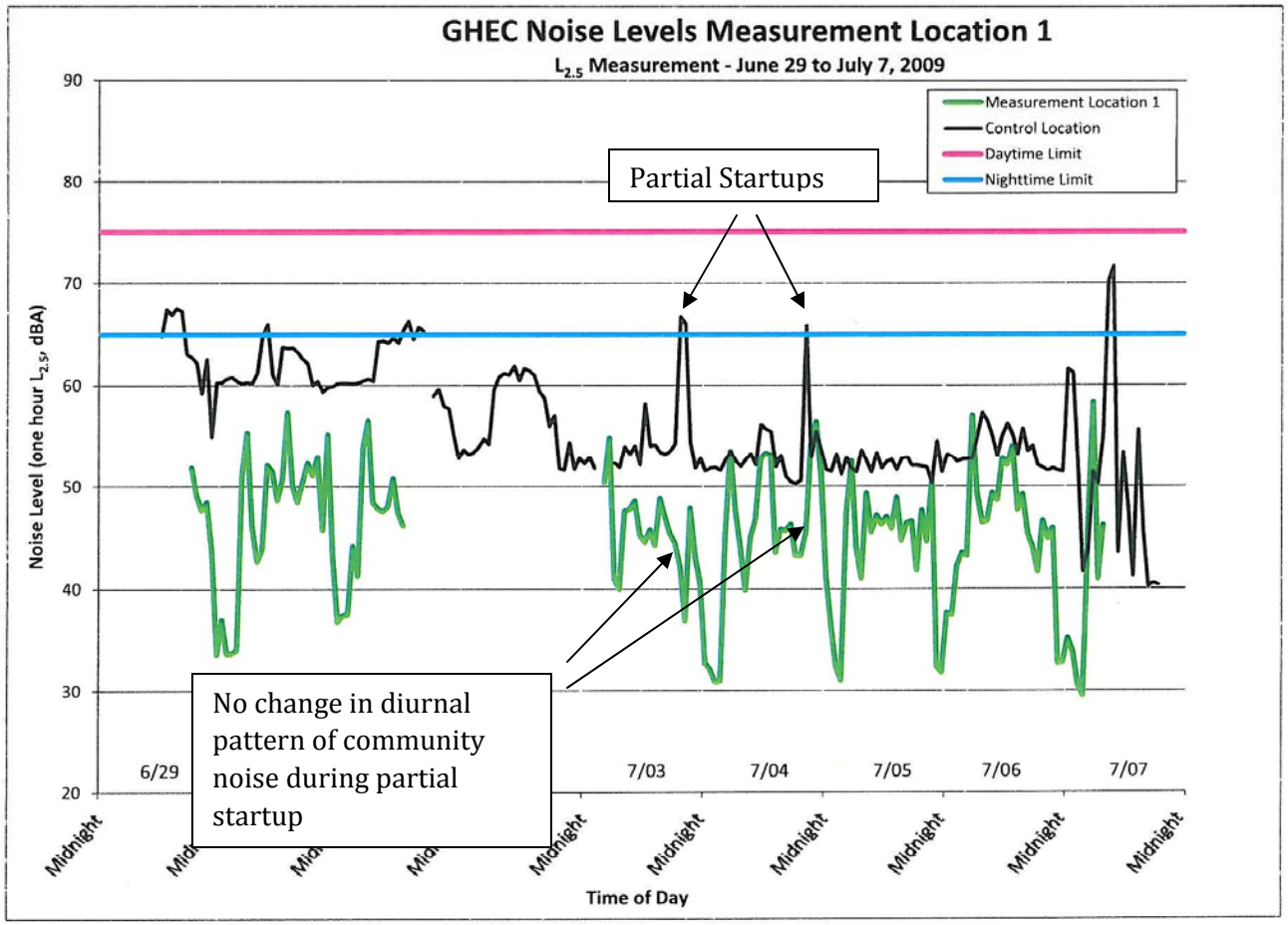

Figure 3. L2.5 Noise Levels at Location 1 During Partial Startup

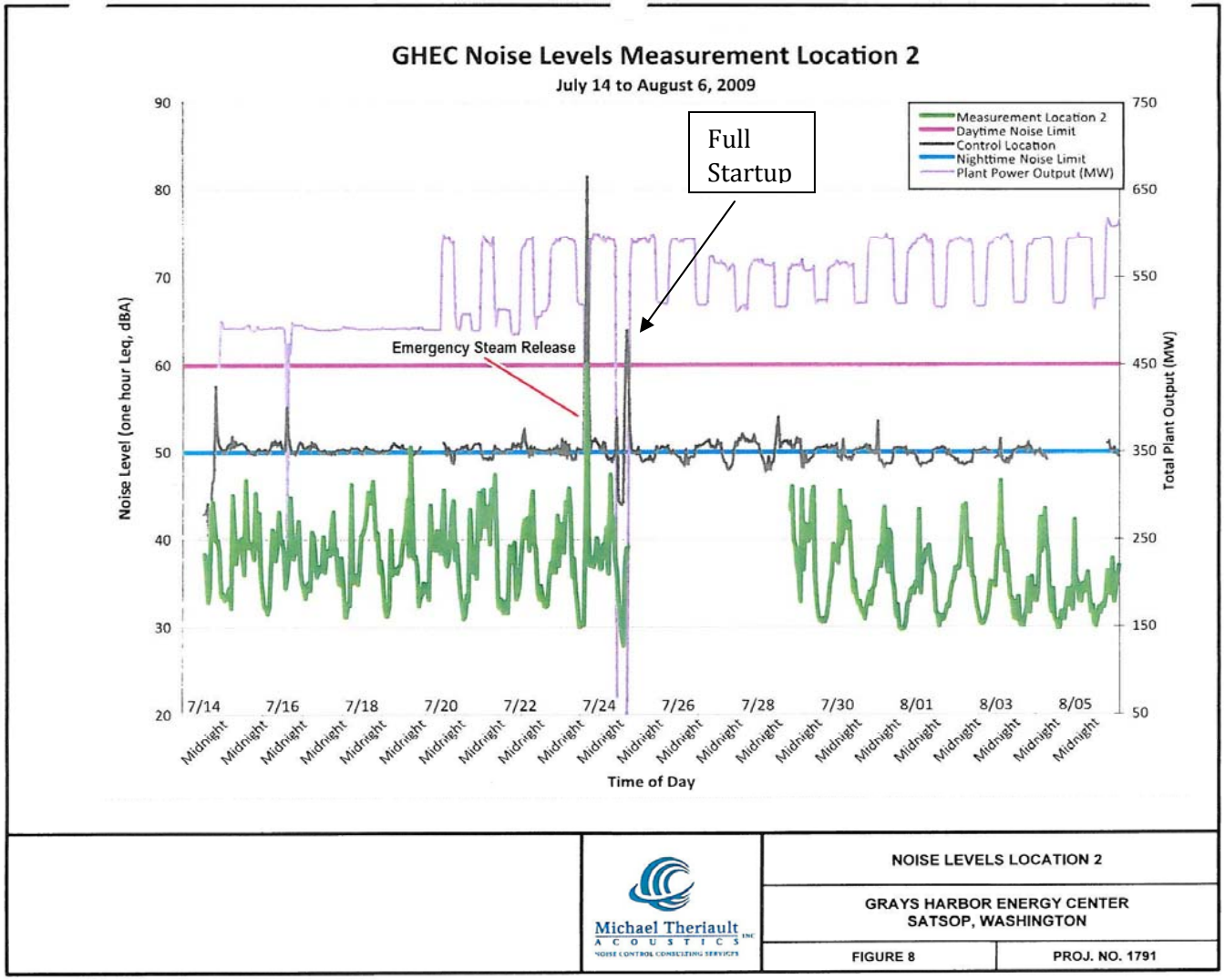

Figure 4. Leq Noise Levels at Location 2 during Emergency Steam Relief, Full Startup, and Steady Operation

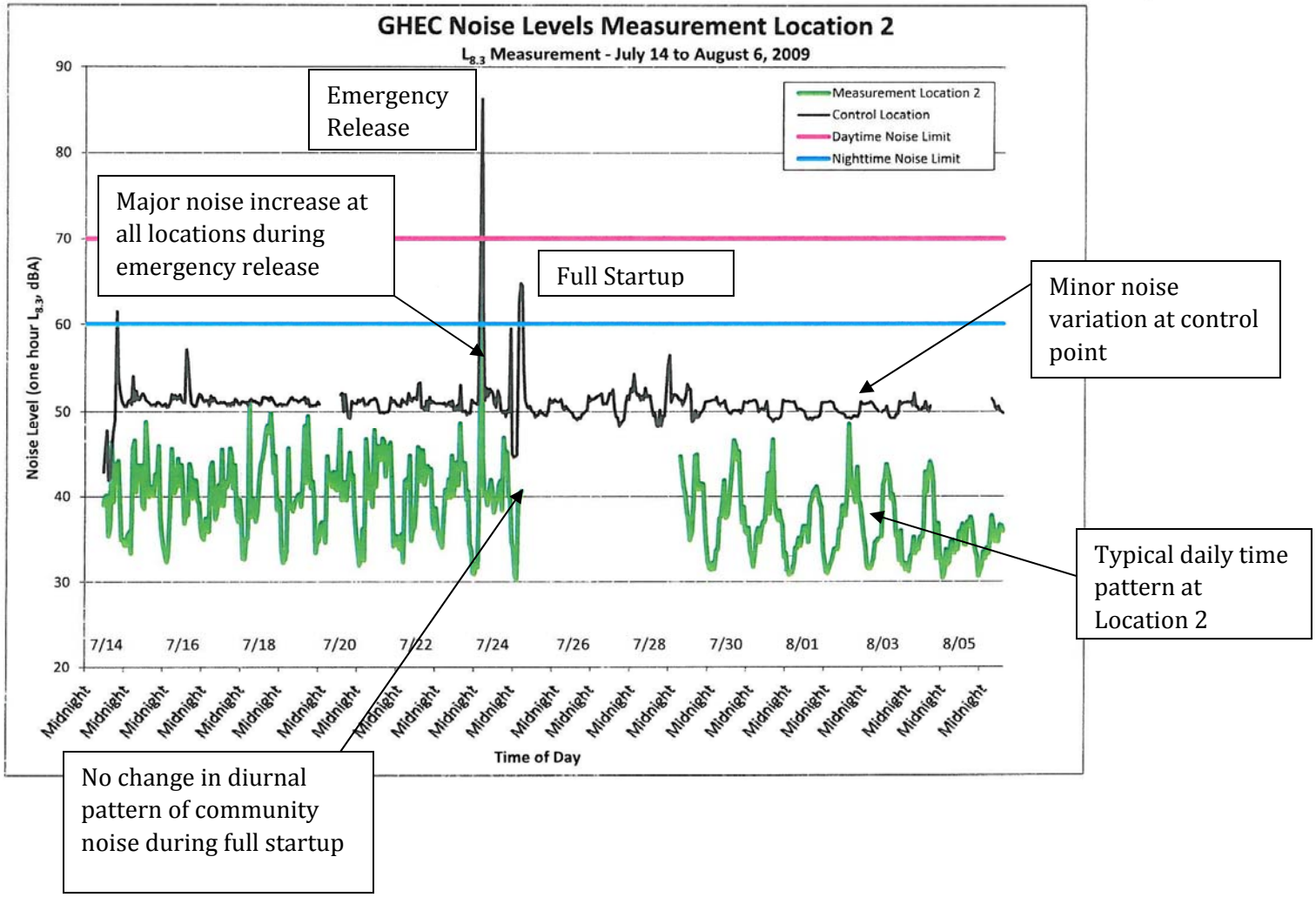

Figure 5. L8 Short-Term Noise Levels at Location 2 During Emergency Relief, Full Startup, and Steady Operation

Figure 4 also provides another demonstration that the power plant contributed little to the overall noise levels at Location 2, when the power plant exhibited at typical 15% daily swing in electricity output. As shown on the upper, purple plot, the plant output systematically varied by about 15% (between 530 to 600 MW) according to a distinct daily pattern with a daily abrupt 15% power increase starting at about 4 am each morning, and an abrupt 15% power decrease at 10 pm each night. The noise levels at the control location (the black plot) displayed a minor daily variation of about only 2 dBA that corresponded to the daily variation in power plant electrical load. However, the lower green plot shows the hourly Leq at the home displayed a very different pattern, with a gradual triangle-shaped noise pattern. The abrupt power increase at 4 am did not correspond to any abrupt change in community noise level increase at 4 am. Similarly, the abrupt 15% electrical output decrease at 10 pm each night did not correspond to any similar abrupt decrease in the community noise level. Therefore, the data confirm that routine daily minor, abrupt changes in power plant electricity output were not a major contributor to the overall Leq community noise level.

The measured noise data shown on Figure 2 and Figure 3 can be used to demonstrate the community noise level at Location 1 caused solely by the power plant. The upper purple plot on Figure 2 shows the power plant operated nearly continuously from June 30 through July 6, then abruptly shut down on midnight July 7. The lower green curve on Figures 2 and 3 show the noise levels at Location 1. The green curves show the typical daily pattern of community nose, with the highest noises (which are caused by local traffic and birds) occurring during the afternoon. The quietest community noise levels occurring at about 2 am each day, when noise caused by traffic and birds cease. Therefore, the noise level caused solely by the power plant can be inferred by inspection of the noise levels at 2 am, with and without the power plant. Table 2 shows how power plant noise can be inferred by inspection of the 2 am noise levels. It is concluded the existing Phase I facility causes steady noise levels of 29 dBA (Leq) and 27 dBA (L90), without any local background sources.

Table 2. Noise Levels at Location 1 Caused Solely by Power Plant

	Noise Levels at 2 am at Location 1 (dBA)	
Plant Operating Conditions	**Leq**	**L90**
June 30 to July 6 With Power Plant Operating	30	28
July 7 With Plant Not Operating	26	25
Inferred Noise Caused Solely by Power Plant	29	27

4.2.1.1 Noise Levels During Non-Steady Events

Figures 2 through 5 also indicate how community noise was affected by non-steady events at the power plant. As shown by the upper, purple curve on Figure 2, at midnight on July 4 and July 5 the power plant abruptly reduced its load by about 50% then increased its load back to the original value (a partial shutdown and startup). During those brief periods the noise level at the control location where noise is dominated by the power plant (the middle black plot) briefly spiked by more than 10 dBA. However, at those same times the typical diurnal community noise patterns at Location 2 were nearly unchanged during the partial startup.

This same pattern during a full plant startup is displayed on Figures 4 and 5, which show the noise levels during a full plant startup at midnight on July 25. As shown by the upper, purple plot the

power plant output quickly ramped from zero load up to full load. At that same time the noise level at the control location where noise is dominated by the power plant (the middle black plot) briefly spiked by more than 15 dBA. However, at that same time the typical diurnal community noise patterns at Location 2 were nearly unchanged. This again demonstrates that the power plant was only a minor contributor to community noise, even during the full startup event.

However, the noise plots on Figures 4 and 5 demonstrate that community noise levels were adversely impacted on one occasion when an emergency steam relief valve lifted during the night. As shown by the measured community noise levels on Figure 4 and Figure 5, early in the morning on July 24, 2009 the plant experienced an upset in which the high pressure relief valve lifted after a steam turbine trip. The steam relief lasted for approximately 30 to 45 minutes, during which time the measured noise levels at the control location (which is dominated by power plant noise) spiked by over 30 dBA. At that same time the noise levels at Receiver 2 (the Irwin residence west of the facility) increased substantially to levels exceeding the allowable WAC noise limits for continuous noise, the L25 (15 minute duration), the L8.3 (5 minute duration) and the L2.5 (1.5 minute duration).

It is important to note that the preceding discussions focus on broad-band dBA noise levels. dBA noise levels at the closest homes were nearly unchanged during normal daily changes in plant output and during a full plant startup. However, simple inspection of the dBA data in from MTA's monitoring data cannot determine whether these routine plant changes might have caused abrupt changes in the character of the community noise (e.g., abrupt changes in noise frequency). For example, the abrupt spike in the dBA noise levels at the control location could correspond to abrupt increases in high-pitched noise frequencies during steam releases, which might be discernible and annoying at the neighborhood even though the overall dBA noise levels were unchanged. EFSEC and Invenergy should consider these possible annoyances when they consider possible retrofit noise controls for high-pressure steam valves.

Chapter 5

Task 2. Determine If Project is in Compliance with State Environmental Noise Regulations

This section evaluates whether Invenergy's long term community monitoring program (described under Task 1) demonstrated the facility has been in continuous compliance with the Washington state environmental noise regulation.

The long-term noise monitoring study conducted by MTA in July-August 2010 demonstrated the community noise levels at the closest homes were, with the notable exception of one single event, lower than the allowable daytime and nighttime WAC noise limits. However, as described below, ICF interprets the Washington noise regulations to indicate that single event during the Summer 2009 community noise sampling study might have been in violation of the WAC noise regulation.

As shown by the measured community noise levels on Figure 4 and Figure 5, early in the morning on July 24, 2009 the plant experienced an upset in which the high pressure relief valve lifted after a steam turbine trip. Invenergy has confirmed that numerous other similar steam relief trips have occurred since the plant began operation. The steam relief on July 24 lasted for approximately 30 to 45 minutes, during which time the measured noise levels at Receiver 2 (the Irwin residence west of the facility) increased substantially to levels exceeding the allowable limits for continuous noise, the L25 (15 minute duration), the L8.3 (5 minute duration) and the L2.5 (1.5 minute duration). The MTA report stated the following regarding regulatory compliance during this event:

> *However, this event is considered exempt from the limits, as stated in Chapter 173-60-050 of the WAC ("Sounds created by safety and protective devices where noise suppression would defeat the intent of the device or is not economically feasible").*

ICF does not automatically agree with this interpretation of the regulation for the following reasons:

- We agree the steam relief valves are "safety and protective devices" that are candidates for exclusion.
- However, ICF believes there might be economically feasible ways to reduce noise emissions from the relief valves at the facility in a manner that would not defeat the intent of the device. For example, Invenergy has not yet evaluated whether individual noise barriers can be installed at the safety relief valves. It might indeed be true that such noise barriers cannot be installed in a safe and cost-effective manner. However, Invenergy has not yet evaluated the full range of possible noise control options. Therefore, ICF concludes it is inappropriate to automatically invoke the WAC exemption for high-pressure relief valves.

Based on these considerations, ICF believes EFSEC should not automatically exempt high-pressure relief valves, or any other intermittent equipment, from the noise regulation based on their definition as "safety and protective devices". Instead, EFSEC should request Invenergy to conduct a Best Available Technology assessment for each major relief valve to determine which equipment can, or cannot, be retrofitted with safe, reliable and cost-effective noise control measures. As described in Task 6, the Chehalis Generating Station successfully installed retrofit noise control

measures on a wide range of equipment at their power plant, and it is possible that similar measures might be reliable and cost-effective at the GHEC Satsop plant.

ICF therefore concludes that Phase I (Units 1 and 2) of the Satsop power project complies with the WAC noise limits when the facility operates under normal steady conditions, but Invenergy has not yet demonstrated that the facility's occasional steam releases qualify for an automatic exemption from the regulation.

Furthermore, the frequency of noise complaints originating from several nearby residents indicates that something that occasionally occurs at the facility is annoying to the neighbors. Although neither EFSEC rules, the Grays Harbor County code nor the WAC noise regulation specifically address qualitative noise nuisances caused by industrial facilities (see Section 3.3 of this report), ICF recommends that EFSEC should consider qualitative noise annoyances in addition to the magnitude of dBA noise levels when the agency develops noise conditions for the SCA for the proposed Phase II expansion.

Chapter 6

Task 3. Determine If Project is in Compliance with Site Certification Agreement Conditions

The following noise conditions are specified by the existing SCA for the Phase I project consisting of Units 1 and 2. ICF evaluated compliance for each item by conducting a site tour on April 16, 2010, and then conducted follow-up discussions with Kevin Warner, Plant Engineer for Invenergy.

6.1 SCA Condition 1

The combustion turbines and other major sources of sound shall be enclosed within structures in which acoustical damping has been installed.

We conclude that Invenergy has complied with most, but not all, of these requirements. The two combustion turbines (CTs), two heat recovery steam generators (HRSGs), and the STG system are enclosed as required by the SCA (see Figure 6 and Figure 7). However, the term "other major sources of sound" is broad, and can be interpreted to include devices like the condensate blowdown tank vents. All of the condensate blowdown vents at the facility (one for each of the HRSGs and one for the STG) are routed to the upper story of the facility and equipped with noise silencers. However, ICF observed the noise emissions caused by operation of the HRSG condensate blowdown vents is substantial, and these vents should be included as candidates for future Best Available Technology retrofit noise controls.

Neither of the two CT transition sections (which emit a distinct high-pitched whine that is clearly audible at the nearby neighborhood) is currently enclosed (see Figure 8). *ICF recommends that the retrofitting of noise control measures to substantially reduce the high-pitched noise emissions from the CT transition sections.*

Figure 6. Satsop: Combustion Turbine (CT), CT Transition Section, and Heat Recovery Steam Generator (HRSG)

Figure 7. Satsop: Steam Turbine Generator (STG) On Third Floor

Figure 8. Satsop: Combustion Turbine (CT) Transition Section Between CT and Heat Recovery Steam Generator

6.2 SCA Condition 2

Acoustically absorptive silencers shall be installed on the combustion turbine air intake system, enclosure ventilating systems, and emergency relief valves

We conclude that Invenergy complies with most, but not all, of the substantive requirements of this condition, as described below.

The CT air intakes are equipped with large silencers (see Figure 9).

Kevin Warner of Invenergy indicated the acoustical enclosures on each of the two CTs are equipped with one ventilation system each, which is equipped with exhaust silencers.

The multiple high-pressure steam relief valves on each of the HRSGs and STG are equipped with silencers However, it might be possible to further reduce noise emissions from those vents. *ICF recommends that the acoustical performance of these silencers should be evaluated as part of the future Best Available Technology noise control cost-effectiveness study.*

The four header relief valves (2 on each of the 2 HRSGs) are not equipped with silencers. However, Kevin Warner indicated all of those relief valves are at low elevation and are shielded behind the massive HRSG enclosures, so it is unlikely that those relief valves are a substantive contributor to community noise levels. *ICF recommends these valves should be included as part of the future Best Available Technology noise control cost-effectiveness study.*

The three high-pressure natural gas emergency relief valves are not equipped with silencers. Kevin Warner indicated the plant recently experienced an emergency release, which generated high noise levels that were the likely cause of a recent noise complaint. However, he indicated Invenergy believes noise silencers on those natural gas relief valves are prohibited by fire codes. *ICF recommends these natural gas relief valves should be included as candidates for Best Available Technology retrofit noise controls, using methods that do not impede the performance of the emergency relief system (e.g., acoustical barriers as opposed to in-line silencers).*

Figure 9. Satsop: Combustion Turbine Air Intake Silencers

6.3 SCA Condition 3

Separate acoustical enclosures shall be installed for major noise sources including each combustion turbine and generator

We conclude that Invenergy complies with most, but not all, of the substantive requirements of this condition, as described below.

The CTs, HRSGs and STG are enclosed (see Figure 6 and Figure 7). However, the term "major noise sources" is broad. The CT transition sections (with their distinct whine that is discernible at the nearby homes) are not enclosed. *ICF recommends the immediate retrofitting of noise control measures to substantially reduce the high-pitched noise emissions from the CT transition sections.*

6.4 SCA Condition 4

Acoustically absorptive insulation shall be installed in duct walls of the combustion turbine air intake and exhaust systems

Kevin Warner of Invenergy indicated the required noise controls are in place. The air intake ductwork and the interior of the combustion turbine transition sections (upstream of the HRSGs) are fitted with perforated metal acoustical absorption panels, which are designed to absorb noise at the characteristic frequencies of the combustion turbines. The interior of the HRSG is equipped with thermal and acoustical insulation consisting of non-perforated metal paneling backed with high-temperature fiberglass insulation.

Chapter 7
Task 4. Examine Community Noise Complaints Reported to EFSEC

Units 1 and 2 were constructed using industry-practice noise controls, and the predictive modeling for the combined Phase I plus Phase II assumed that Units 3 and 4 will also be equipped with industry-practice noise controls. The predictive modeling showed these standard noise controls are expected to reduce community levels to less than the WAC noise limits when the facility operates under stable conditions. A two-week community noise survey conducted by GHE in July-August 2009, which was corroborated by spot-readings by ICF in April 2010, confirmed the steady community noise levels when Units 1 and 2 are operating under stable conditions are well below the WAC limits.

Regardless, EFSEC has frequently received noise complaints from several different residents, starting during facility construction and continuing to the present time. EFSEC provided written documentation of dozens of noise complaints from several residents.

It is important to note the complaints describe the noise impacts at their homes in a variety of diverse terms: "Pitchy squeal", "booms like thunder", "ringing pitch", "scraping fingernails on a blackboard", "noise like an old time steam locomotive", and "rumble that rattles the windows". These are diverse terms that describe a wide range of noise properties ranging from high-pitched squeals to low-frequency noise. This indicates a possibility that there are several distinct noise sources within the power plant contributing to the community noise issues.

Some of the noise complaints occurred during periods when the Satsop Project was not operating, so it is possible there are multiple industrial sources in the area (in addition to power plant) that are causing noise issues. Regardless, the frequency of the complaints, combined with the diversity of the descriptions, indicate a reasonable possibility that the GHE facility might occasionally emit annoying noise when the plant is operating under non-steady conditions (e.g., startup, condensate blowdown, and pressure relief events). Some of the community noise issues might also be related to the steady, high-pitched whine that is discernible at the nearby homes, and appears to be emitted from the currently-unenclosed CT transition sections.

Chapter 8

Task 5. Review and Verify Noise Modeling Analysis for Proposed Phase II (Units 3 and 4)

8.1 Review of Modeling Assumptions

ICF reviewed the predictive noise modeling package that was conducted by MTA. MTA modeled future noise levels for the combined Phase I and Phase II facilities. Our findings are as follows:

- The predictive noise modeling was done using industry-practice methods and assumptions.
- MTA used the SoundPLAN noise model, run using the ISO-9613 prediction package. This calculation method provides a reasonably conservative estimate of sound propagation at various distances from complex industrial facilities. We believe this was a reasonable, and conservative, methodology.
- The SoundPLAN model included approximately 235 individual noise sources for the Combined Phase I and Phase II facilities. ICF's review of the noise modeling indicated that all of the major noise sources at the facility appeared to have been accounted for.
- MTA assumed shielding and reflection from the major buildings and structures at the facility. We believe this is a reasonable assumption.
- MTA included vertical directionality coefficients for some of the noise sources that are directed vertically upward (e.g., the main HRSG exhaust stacks). MTA used industry-standard coefficients taken from the "EPRI Power Plant Noise Guide". We believe this is a reasonable assumption.
- MTA assumed the ground outside the facility boundary exhibits an absorption coefficient of 0.50. We believe this was a reasonable assumption.
- MTA did not include vegetation attenuation that is actually expected to occur as a result of the coniferous forest between the power plant and the western neighborhood. We believe this was a reasonable, and conservative, assumption.

8.2 Evaluation of Overall Modeling Results

MTA's modeling study predicted the community noise levels at the western neighborhood caused by the combined Phase I and Phase II facilities will be 48 dBA to 49 dBA, which is just less than the WAC nighttime noise limit of 50 dBA. ICF believes MTA's predictive modeling over-predicted the actual future community noise levels by a considerable margin. Because MTA modeled the Phase II facility operating immediately east of the existing Phase I facility, we interpret MTA's model predicted the following approximate, general relationship between the modeled noise levels at the western homes for the two facilities:

Noise from existing Phase I facility	46 dBA
Noise from proposed future Phase II facility	45 dBA
Local nighttime background	40 dBA
Combined future Phase I plus Phase II facility	49 dB

We believe MTA's predictive model substantially over-predicted the actual future noise levels, because their modeled noise levels for the existing Phase I facility were much higher than the actual measured noise levels that were measured by MTA's long-term monitoring study. As listed in Section 4.2, Invenergy's long-term monitoring data indicate the actual noise levels at the western homes caused by the existing Phase I facility was roughly 29 dBA (Leq), which is much lower than MTA's predicted value of 46 dBA. ICF discussed this apparent over-prediction with MTA, who indicated the over-prediction was likely the result of the following factors:

- The noise emission data provided by the equipment manufacturers in believed to be inherently conservative.
- The ISO-9613 calculation package that was used by MTA's SoundPLAN model is inherently conservative, because it makes the following conservative assumptions:
- ISO-9613 automatically assumes a wind speed of 5 meters/second with the wind blowing from the facility directly toward each modeling receptor. This conservative assumption can over-predict by several dBA compared to actual wind patterns.
- ISO-9613 assumes default "standard day" weather conditions of 50 degrees F and 70% relative humidity, which automatically results in the minimum amount of atmospheric absorption. The actual temperature and relative humidity at the Satsop areas likely provide considerably more atmospheric absorption and therefore lower noise levels. Note, the ISO-9613 module is not designed to model temperature inversions, nor can it account for different wind directions.
- MTA's modeling did not include the coniferous forest between the power plant and the western neighborhood.

Based on these findings, ICF concludes that MTA's predictive modeling study was conservative and correct in its overall results: the noise levels caused by steady operation of the combined Phase I and Phase II facilities will almost certainly be less than the nighttime residential noise limits set by the WAC noise regulation.

Chapter 9

Task 6. Conduct Site Visits at GHEC Satsop Power Plant and Chehalis Power Plant, and Report on Observations Related to Community Noise Impacts and Mitigation

ICF toured the GHEC power plant and the Chehalis Power Generating Station on May 16, 2010. Our observations during those site tours are provided below.

9.1 GHEC Satsop Power Plant Tour

The site tour was given by Kevin Warner (Plant Engineer) and Todd Gatewood (Plant Manager). The objectives were to qualitatively identify the loudest equipment items at the facility and mitigation measures that have already been implemented, and to consider how future retrofit noise controls might be practical for some of those items. . Key observations were as follows:

The western plant boundary is shielded by an approximately 25-foot tall noise barrier wall (see Figure 10). This wall appears to do a reasonable job of reducing noise propagation from ground-level sources.

However, there is concern that some of the elevated equipment at the plant might be too high to be well shielded by the approximately 25-foot tall western noise wall. For example, the STG is one of the loudest pieces of equipment at the facility, and it is on the third floor at a location that appears to be nearly the same height as the top of the western noise wall. Figure 7 shows the STG, and Figure 11 is a view looking westward from the STG, over the top of the western noise wall, toward the western residential neighborhood. ICF believes the western noise wall might be too short to adequately shield some of the elevated noise sources at the facility, and that noise emitted from the STG and other elevated sources might be able to propagate nearly unabated toward the western homes. ICF acknowledges that, based on our qualitative observations, it appears the noise emissions from the STG consist mainly of mid-frequency, broad-band noise that is relatively innocuous and therefore might not be a major contributor to noise issues at the western neighborhood. Regardless, noise emissions from the STG could be reduced by either raising the height of the western noise wall, or by installing a localized noise barrier on the third floor adjacent to the STG. This same observation applies to many other elevated noise sources at the facility that rely on the western noise wall to reduce noise impacts. *ICF recommends the STG should be included as a candidate for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures.*

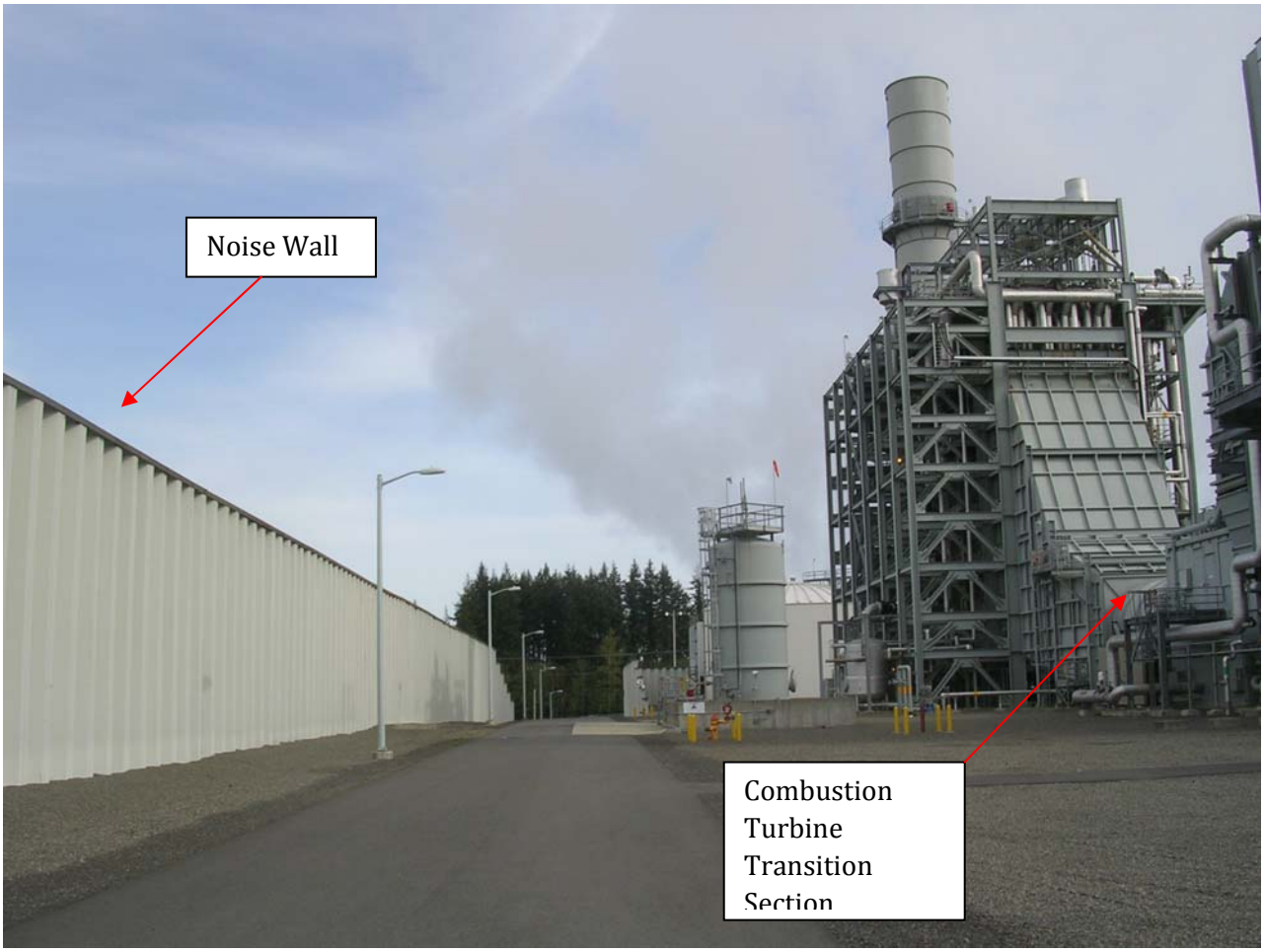

Figure 10. Satsop: Western Noise Barrier Wall

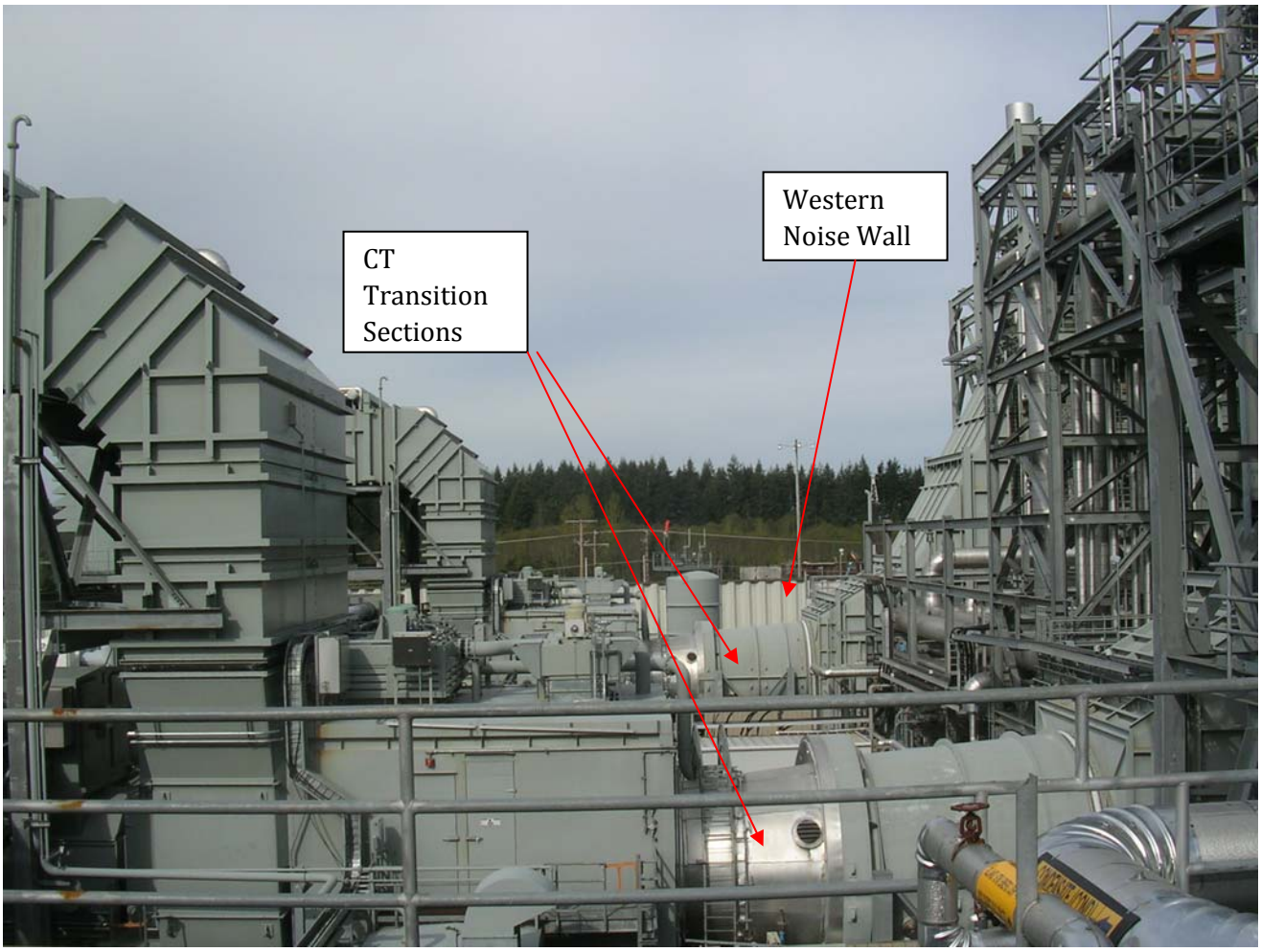

Figure 11. Satsop: View From 3rd-Floor Steam Turbine Generator (STG), Looking West Over Top of Western Noise Barrier Wall

Some of the most noticeable noise sources are the two CTG transition sections between the CTs and the HRSGs (see Figure 8). Those are ground-level items on the western side of the facility. They emit a high-frequency whine, believed to be caused by turbine blades in the CTs. That high-pitched whine is discernible from some of the nearby homes. As described under Task 3, ICF interprets the existing SCA Condition 3 to require enclosure of these transition sections. *ICF recommends that Invenergy immediately retrofit noise control measures to substantially reduce the high-pitched noise emissions from the CT transition sections.*

Steam vents and pressure relief vents are another potential source of noise that could be discernible at the nearest homes. An example of this type of equipment is the condensate blowdown vent systems. While touring the outside of the western noise wall a condensate blowdown event occurred and emitted noise from an elevated vent (see Figure 12). During that 20-second event the blowdown vent emitted mid-frequency broadband noise that was much louder than the normal steady noise emitted by the rest of the facility. *ICF recommends the condensate blowdown systems should be included as a candidate for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures.*

Kevin Warner and Todd Gatewood acknowledged that many of the occasional discharges from the high-pressure relief vents at the facility are not discernible from inside the control room, and they can generate intermittent high noise emissions that often are undetected by plant operators. ICF believes these intermittent pressure relief vents could be one of the causes of the community noise concerns. *ICF recommends all of the high-pressure relief vents should be included as candidates for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures. In addition, ICF recommends that Invenergy install a continuous noise monitoring system to alert the control room in the event of unusually high noise levels at the western plant boundary.*

9.2 Chehalis Generating Station Plant Tour

ICF and EFSEC toured the Chehalis Generating Station on April 16, 2010. The objective was to observe two key items:

- Retrofit noise controls that were installed at the facility to address community noise issues
- The facility's continuous noise monitoring system and handheld noise monitoring surveys that alerts the control room in the event of high measured noise levels.

The exterior noise environment at the Chehalis plant is different from the Satsop Project because the Chehalis plant does not exhibit the high-pitched whine that is noticeable at the Satsop Project. This is because the CTs at Chehalis are indoors, so the CT transition sections that often emit high-pitched turbine noise are shielded. The high-pitched whine is prevalent inside the turbine building, but the whine does not propagate to the outside.

Plant staff showed ICF and EFSEC numerous examples of noise control measures that were installed to address community noise concerns. The facility conducted extensive in-plant noise surveys to identify the loudest pieces of equipment at the facility. The facility then used predictive noise modeling to evaluate the relative community noise benefits that could be achieved by controlling each of the individual pieces of equipment. The facility evaluated the cost-effectiveness for each piece of equipment, and prioritized the relative acoustical benefits for each category of retrofit control method. The facility then retrofitted the highest priority items.

Figure 12. Satsop: Condensate Blowdown Vent As Seen From Noise Monitoring Control Point Outside the Western Noise Wall

Examples of the installed retrofits are described below:

- Most of the retrofits consist of small, acoustically lined noise barriers that were installed to shield individual pieces of loud equipment (Figure 13).
- In other cases, medium-to-large sized acoustical panels were installed to shield areas containing clusters of loud equipment (Figure 14).
- In some cases existing noise silencers on high-pressure relief vents were lengthened or replaced to provide additional noise reduction (Figure 15).
- The facility also attempted to replace some high-pressure steam valves with expensive low-noise valves. However, the facility found that these replacements were largely ineffective. Instead, the facility ended up using localized noise barriers to shield the individual high-noise valves (Figure 16).

The overall noise retrofit program has been successful in reducing community noise levels. The facility reports that noise levels at the facility boundary have been reduced by 10 to 12 dBA.

Chehalis plant staff also provided a tour of the facility's continuous noise monitoring system, which is designed to alert operators inside the control room in the event of unusually high noise levels at one critical facility boundary adjacent to a residential area. The facility installed one continuous noise monitor at the plant gate, and telemeters the continuous noise readings to the control room (Figure 17). Plant technicians programmed the facility's computer data system to continuously record the noise data, and to provide visible and audible alarms if the measured noise levels exceed trigger values. Plant technicians indicated the system was easy to install and has been reliable. However, they did confess one ongoing problem with the system: the single noise monitor was placed adjacent to the entry gate, so it occasionally indicates a "false positive" noise problem if a delivery truck driver parks and idles his rig next to the noise monitor.

The Chehalis power plant staff conducts daily rounds of handheld noise measurements at several nearby homes, to provide a daily combination of quantitative and qualitative noise observations at representative noise-sensitive areas.

Figure 13. Chehalis: Small Retrofit Noise Barriers For Individul Noisy Equipment

Figure 14. Chehalis: Larg Retrofit Noise Barrier to Shield Cluster of Noisy Equipment

Figure 15. Chehalis: Noise Silencer Extension on Steam Relief Vent

Figure 16. Chehalis: Retrofit Noise Barrier to Shield Individual Noisy Steam Valve

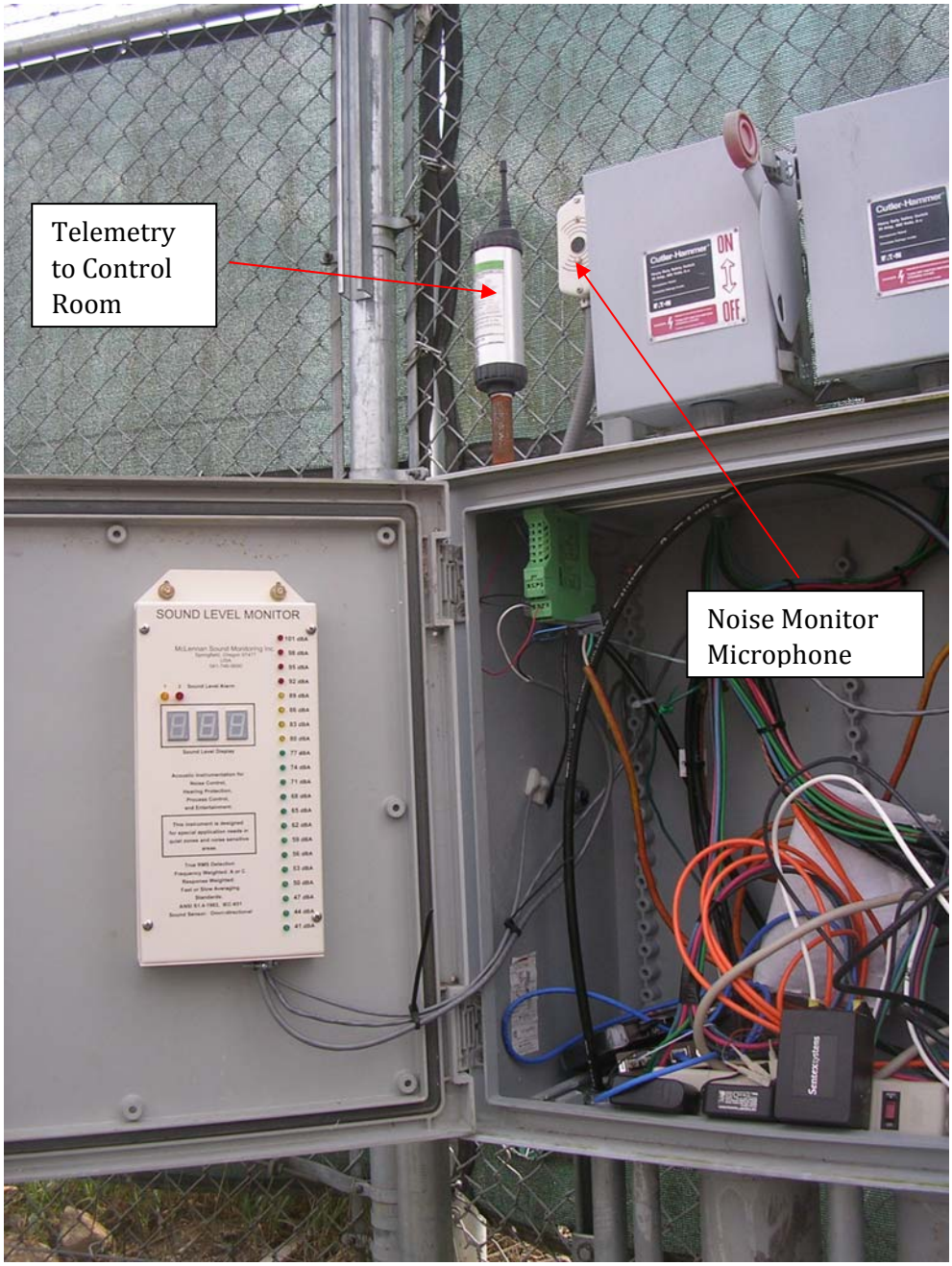

Figure 17. Chehalis: Continuous Noise Monitor at Facility Boundary

Chapter 10

Task 7. Conduct Spot-Check Community Noise Measurements at Homes near the GHEC Satsop Project

ICF conducted spot-check noise readings at some of the key receptors that were evaluated by the MTA noise monitoring study (June-August 2009) and GHE's predictive noise modeling studies. The spot readings were taken on the morning of April 16, 2010 while the power plant was operating at normal load under stable conditions. Noise readings were taken at representative homes west of the power plant, and at the control location that was used for MTA's earlier long-term noise monitoring study (Figure 1).

Weather conditions at that time were ideal for noise measurements: calm, cool and sunny, with low humidity. The noise readings were taken using a Larson Davis Model 720 noise meter. The meter was calibrated in the field before the start of testing and upon completion of testing.

Table 3 summarizes the results of ICF's spot readings, and compares them to the typical daytime L90 noise levels previously measured by the MTA long-term monitoring study.

Table 3. Measured Spot-Check Noise Levels by ICF

ICF Noise Monitoring Location (See Figure 1)	ICF Measured Noise Levels (dBA)		MTA Measured Daytime L90 During Summer 2009 (dBA)	Observations
	Leq	L90		
Control Point	59	56	Control 50	Power plant noise dominated. Activity at nearby WSDOT site affected Leq measurements. Noise increased to 63 dBA during condensate blowdown event, compared to 56-57 dBA during normal plant conditions.
Farr	42	40	MTA-1 40	Power plant (with its high-pitched whine) was clearly discernible. Construction activity at WSDOT site (clanging, backup alarms) also discernible.
Power Line (Irwin)	44	41	MTA-2 38	Power plant noise (with its high-pitched whine) was less discernible.
Holt	44	38	MTA-3 35	Power plant was clearly discernible, with minor high-pitched whine.
Taylor	42	38	Not tested	Power plant noise dominated the background. No high-pitched whine was noticeable.

ICF's spot-check noise readings and qualitative observations indicated the following:

- ICF's noise readings in April, 2010 were similar to those taken by MTA in June-August, 2009, during conditions when the power plant was operating under stable conditions.
- Washington State Department of Transportation (WSDOT) was doing a construction project at a location midway between the power plant and the western homes. During ICF's spot check

noise measurements, clanging sounds and backup beepers emitted from the WSDOT site were often as discernible as the power plant. Note, the WSDOT site was not operating during Invenergy's long-term monitoring during Summer 2009.

- The measured L90 noise levels, which are most indicative of the steady noise levels produced by the power plant, ranged from 38 to 41 dBA, which is much lower than the 50 dBA nighttime limit set by the Washington Environmental Noise Regulation.
- During the calm, late-morning conditions when the noise readings were taken, the power plant was clearly discernible at all of the monitoring locations. A discernible high-frequency whine was noticeable at some of the homes.
- A routine condensate blowdown event occurred during the noise measurements at the control location, just outside the western noise wall. The noise levels increased substantially during that event (from a stead value of 56 dBA up to 63 dBA during the blowdown event). It is unknown how that blowdown event affected community noise levels at the nearby homes.

Chapter 11
Conclusion and Recommendations

11.1 Conclusions

ICF concludes the following regarding community noise issues related to the proposed expansion of the power plant:

- Invenergy's long-term noise monitoring study appropriately characterized community noise levels.
- Invenergy's noise monitoring study demonstrated the Phase I facility complies with the WAC noise limits, except during occasional non-steady events caused by high-pressure steam releases.
- Invenergy's predictive noise modeling used industry-standard methods and assumptions. Their study predicted the proposed Phase II facility (including Units 1, 2, 3 and 4) will produce community noise levels just less than the WAC noise limits. ICF concludes the modeling study substantially over-estimated the actual noise levels.
- The existing Phase I facility was constructed using noise controls that complied with most, but not all, of the SCA conditions. Invenergy should immediately retrofit additional noise control for the non-conforming items.
- ICF's tours of the Satsop and Chehalis power plants indicated there might be several "Best Available Technology" retrofit noise control methods that could be used to reduce community noise levels caused by the existing Phase I power plant. If an SCA is issued for the proposed Phase II expansion, Invenergy should conduct a Best Available Technology study to identify feasible and cost-effectiveness retrofit control methods for Units 1 and 2. Similarly, Invenergy should conduct a Best Available Technology study to define feasible, cost-effective noise control for the proposed Units 3 and 4.
- Invenergy should install a continuous noise monitoring system, to automatically alert the control room about exceptionally loud transient events (e.g., temporary high-pressure relief valves) that might not immediately be noticeable to operators within the plant, but which have the potential to cause annoyance at the nearby homes. The continuous monitoring can be useful to demonstrate compliance with the WAC noise limits.

11.2 Recommendations

ICF recommends that the following measures be implemented immediately.

- Retrofit noise control measures to substantially reduce the high-pitched noise emissions from the CT transition sections. ICF concludes these controls were originally required by the SCA for Phase I.

The following measures should be implemented upon issuance of the new SCA for the proposed Phase II expansion.

- Invenergy should conduct a Best Available Technology assessment to identify feasible and cost-effectiveness retrofit control measures for the existing Units 1 and 2. As soon as practical after completion of that study, Invenergy should install the identified retrofit control measures.
- The natural gas relief valves should be included as candidates for Best Available Technology retrofit noise controls, using methods that do not impede the performance of the emergency relief system (e.g., acoustical barriers as opposed to in-line silencers).
- The STG should be included as a candidate for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures.
- The condensate blowdown systems should be included as a candidate for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures.
- All high-pressure relief vents should be included as candidates for cost-effectiveness evaluations for potential Best Available Technology retrofit noise control measures.
- Invenergy install a continuous noise monitoring system to alert the control room in the event of unusually high noise levels at the southern and western plant boundaries.

The SCA for Phase II should require Invenergy to conduct a Best Available Technology noise assessment for the proposed Units 3 and 4. Invenergy should include all feasible and cost-effective noise control measures in the facility design.

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Appendix A

Washington Environmental Noise Regulation

Chapter 173-60 WAC
Maximum environmental noise levels
WAC Sections

Last Update: 12/6/00

173-60-010 Authority and purpose.
173-60-020 Definitions.
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173-60-010
Authority and purpose.

These rules are adopted pursuant to chapter 70.107 RCW, the Noise Control Act of 1974, in order to establish maximum noise levels permissible in identified environments, and thereby to provide use standards relating to the reception of noise within such environments. Vessels, as defined in RCW 88.12.010(21) and regulated for noise under chapter 88.12 RCW (Regulation of recreational vessels), shall be exempt from chapter 173-60 WAC.

[Statutory Authority: Chapter 70.107 RCW. 94-12-001 (Order 92-41), § 173-60-010, filed 5/18/94, effective 6/18/94; Order 74-32, § 173-60-010, filed 4/22/75, effective 9/1/75.]

173-60-020
Definitions.

(1) "Background sound level" means the level of all sounds in a given environment, independent of the specific source being measured.

(2) "dBA" means the sound pressure level in decibels measured using the "A" weighting network on a sound level meter. The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base 10 of the ratio of the pressure of the sound to a reference pressure of 20 micropascals.

(3) "Department" means the department of ecology.

(4) "Director" means the director of the department of ecology.

(5) "Distribution facilities" means any facility used for distribution of commodities to final consumers, including facilities of utilities that convey water, waste water, natural gas, and electricity.

(6) "EDNA" means the environmental designation for noise abatement, being an area or zone (environment) within which maximum permissible noise levels are established.

(7) "Existing" means a process, event, or activity in an established area, producing sound subject to or exempt from this chapter, prior to the effective date of September 1, 1975.

(8) "Local government" means county or city government or any combination of the two.

(9) "Noise" means the intensity, duration and character of sounds, from any and all sources.

(10) "Person" means any individual, corporation, partnership, association, governmental body, state agency or other entity whatsoever.

(11) "Property boundary" means the surveyed line at ground surface, which separates the real property owned, rented, or leased by one or more persons, from that owned, rented, or leased by one or more other persons, and its vertical extension.

(12) "Racing event" means any motor vehicle competition conducted under a permit issued by a governmental authority having jurisdiction or, if such permit is not required, then under the auspices of a recognized sanctioning body.

(13) "Receiving property" means real property within which the maximum permissible noise levels specified herein shall not be exceeded from sources outside such property.

(14) "Sound level meter" means a device which measures sound pressure levels and conforms to Type 1 or Type 2 as specified in the American National Standards Institute Specification S1.4-1971.

[Statutory Authority: Chapter 70.107 RCW. 94-12-001 (Order 92-41), § 173-60-020, filed 5/18/94, effective 6/18/94; 83-15-046 (Order DE 82-42), § 173-60-020, filed 7/19/83; Order DE 77-1, § 173-60-020, filed 6/1/77; Order 74-32, § 173-60-020, filed 4/22/75, effective 9/1/75.]

173-60-030
Identification of environments.

(1) Except when included within specific prior designations as provided in subsections (2), (3), and (4) of this section, the EDNA of any property shall be based on the following typical uses, taking into consideration the present, future, and historical usage, as well as the usage of adjacent and other lands in the vicinity.

(a) Class A EDNA - Lands where human beings reside and sleep. Typically, Class A EDNA will be the following types of property used for human habitation:

(i) Residential

(ii) Multiple family living accommodations

(iii) Recreational and entertainment, (e.g., camps, parks, camping facilities, and resorts)

(iv) Community service, (e.g., orphanages, homes for the aged, hospitals, health and correctional facilities)

(b) Class B EDNA - Lands involving uses requiring protection against noise interference with speech. Typically, Class B EDNA will be the following types of property:

(i) Commercial living accommodations

(ii) Commercial dining establishments

(iii) Motor vehicle services

(iv) Retail services

(v) Banks and office buildings

(vi) Miscellaneous commercial services, property not used for human habitation

(vii) Recreation and entertainment, property not used for human habitation (e.g., theaters, stadiums, fairgrounds, and amusement parks)

(viii) Community services, property not used for human habitation (e.g., educational, religious, governmental, cultural and recreational facilities).

(c) Class C EDNA - Lands involving economic activities of such a nature that higher noise levels than experienced in other areas is normally to be anticipated. Persons working in these areas are normally covered by noise control regulations of the department of labor and industries. Uses typical of Class A EDNA are generally not permitted within such areas. Typically, Class C EDNA will be the following types of property:

(i) Storage, warehouse, and distribution facilities.

(ii) Industrial property used for the production and fabrication of durable and nondurable man-made goods

(iii) Agricultural and silvicultural property used for the production of crops, wood products, or livestock.

(d) Where there is neither a zoning ordinance in effect nor an adopted comprehensive plan, the legislative authority of local government may, by ordinance or resolution, designate specifically described EDNAs which conform to the above use criteria and, upon departmental approval, EDNAs so designated shall be as set forth in such local determination.

(e) Where no specific prior designation of EDNAs has been made, the appropriate EDNA for properties involved in any enforcement activity will be determined by the investigating official on the basis of the criteria of (a), (b), and (c) of this subsection.

(2) In areas covered by a local zoning ordinance, the legislative authority of the local government may, by ordinance or resolution designate EDNAs to conform with the zoning ordinance as follows:

(a) Residential zones - Class A EDNA

(b) Commercial zones - Class B EDNA

(c) Industrial zones - Class C EDNA

Upon approval by the department, EDNAs so designated shall be as set forth in such local determination. EDNA designations shall be amended as necessary to conform to zone changes under the zoning ordinance.

(3) In areas not covered by a local zoning ordinance but within the coverage of an adopted comprehensive plan the legislative authority of the local government may, by ordinance or resolution designate EDNAs to conform with the comprehensive plan as follows:

(a) Residential areas - Class A EDNA

(b) Commercial areas - Class B EDNA

(c) Industrial areas - Class C EDNA

Upon approval by the department EDNAs so designated shall be as set forth in such local determination. EDNA designations shall be amended as necessary to conform to changes in the comprehensive plan.

(4) The department recognizes that on certain lands, serenity, tranquillity, or quiet are an essential part of the quality of the environment and serve an important public need. Special designation of such lands with appropriate noise level standards by local government may be adopted subject to approval by the department. The director may make such special designation pursuant to the procedures of the Administrative Procedure Act, chapter 34.04 RCW.

[Order 74-32, § 173-60-030, filed 4/22/75, effective 9/1/75.]

173-60-040
Maximum permissible environmental noise levels.

(1) No person shall cause or permit noise to intrude into the property of another person which noise exceeds the maximum permissible noise levels set forth below in this section.

(2)(a) The noise limitations established are as set forth in the following table after any applicable adjustments provided for herein are applied.

EDNA OF NOISE SOURCE		EDNA OF RECEIVING PROPERTY	
	Class A	Class B	Class C
CLASS A	55 dBA	57 dBA	60 dBA

CLASS B	57	60	65
CLASS C	60	65	70

(b) Between the hours of 10:00 p.m. and 7:00 a.m. the noise limitations of the foregoing table shall be reduced by 10 dBA for receiving property within Class A EDNAs.

(c) At any hour of the day or night the applicable noise limitations in (a) and (b) above may be exceeded for any receiving property by no more than:

(i) 5 dBA for a total of 15 minutes in any one-hour period; or

(ii) 10 dBA for a total of 5 minutes in any one-hour period; or

(iii) 15 dBA for a total of 1.5 minutes in any one-hour period.

[Order 74-32, § 173-60-040, filed 4/22/75, effective 9/1/75.]

173-60-050
Exemptions.

(1) The following shall be exempt from the provisions of WAC 173-60-040 between the hours of 7:00 a.m. and 10:00 p.m.:

(a) Sounds originating from residential property relating to temporary projects for the maintenance or repair of homes, grounds and appurtenances.

(b) Sounds created by the discharge of firearms on authorized shooting ranges.

(c) Sounds created by blasting.

(d) Sounds created by aircraft engine testing and maintenance not related to flight operations: Provided, That aircraft testing and maintenance shall be conducted at remote sites whenever possible.

(e) Sounds created by the installation or repair of essential utility services.

(2) The following shall be exempt from the provisions of WAC 173-60-040 (2)(b):

(a) Noise from electrical substations and existing stationary equipment used in the conveyance of water, waste water, and natural gas by a utility.

(b) Noise from existing industrial installations which exceed the standards contained in these regulations and which, over the previous three years, have consistently operated in excess of 15 hours per day as a consequence of process necessity and/or demonstrated routine normal operation. Changes in working hours, which would affect exemptions under this regulation, require approval of the department.

(3) The following shall be exempt from the provisions of WAC 173-60-040, except insofar as such provisions relate to the reception of noise within Class A EDNAs between the hours of 10:00 p.m. and 7:00 a.m.

(a) Sounds originating from temporary construction sites as a result of construction activity.

(b) Sounds originating from forest harvesting and silvicultural activity.

(4) The following shall be exempt from all provisions of WAC 173-60-040:

(a) Sounds created by motor vehicles when regulated by chapter 173-62 WAC.

(b) Sounds originating from aircraft in flight and sounds that originate at airports which are directly related to flight operations.

(c) Sounds created by surface carriers engaged in interstate commerce by railroad.

(d) Sounds created by warning devices not operating continuously for more than five minutes, or bells, chimes, and carillons.

(e) Sounds created by safety and protective devices where noise suppression would defeat the intent of the device or is not economically feasible.

(f) Sounds created by emergency equipment and work necessary in the interests of law enforcement or for health safety or welfare of the community.

(g) Sounds originating from motor vehicle racing events at existing authorized facilities.

(h) Sounds originating from officially sanctioned parades and other public events.

(i) Sounds emitted from petroleum refinery boilers during startup of said boilers: Provided, That the startup operation is performed during daytime hours whenever possible.

(j) Sounds created by the discharge of firearms in the course of hunting.

(k) Sounds caused by natural phenomena and unamplified human voices.

(l) Sounds created by motor vehicles, licensed or unlicensed, when operated off public highways EXCEPT when such sounds are received in Class A EDNAs.

(m) Sounds originating from existing natural gas transmission and distribution facilities. However, in circumstances where such sounds impact EDNA Class A environments and complaints are received, the director or his designee may take action to abate by application of EDNA Class C source limits to the facility under the requirements of WAC 173-60-050(5).

(6) Nothing in these exemptions is intended to preclude the department from requiring installation of the best available noise abatement technology consistent with economic feasibility. The establishment of any such requirement shall be subject to the provisions of the Administrative Procedure Act, chapter 34.04 RCW.

[Statutory Authority: Chapter 70.107 RCW. 94-12-001 (Order 92-41), § 173-60-050, filed 5/18/94, effective 6/18/94; 83-15-046 (Order DE 82-42), § 173-60-050, filed 7/19/83; Order DE 77-1, § 173-60-050, filed 6/2/77; Order 75-18, § 173-60-050, filed 8/1/75; Order 74-32, § 173-60-050, filed 4/22/75, effective 9/1/75.]

173-60-060
Nuisance regulations not prohibited.

Nothing in this chapter or the exemptions provided herein, shall be construed as preventing local government from regulating noise from any source as a nuisance. Local resolutions, ordinances, rules or regulations regulating noise on such a basis shall not be deemed inconsistent with this chapter by the department.

[Order 74-32, § 173-60-060, filed 4/22/75, effective 9/1/75.]

173-60-070
Reserved.

Reserved.

[Statutory Authority: Chapter 70.107 RCW. 00-24-134 (Order 00-24), § 173-60-070, filed 12/6/00, effective 1/6/01; 94-12-001 (Order 92-41), § 173-60-070, filed 5/18/94, effective 6/18/94; Order DE 77-1, § 173-60-070, filed 6/1/77; Order 74-32, § 173-60-070, filed 4/22/75, effective 9/1/75.]

173-60-080
Variances and implementation schedules.

(1) Variances may be granted to any person from any particular requirement of this chapter, if findings are made that immediate compliance with such requirement cannot be achieved because of special circumstances rendering immediate compliance unreasonable in light of economic or physical factors, enroachment [encroachment] upon an existing noise source, or because of nonavailability of feasible technology or control methods. Any such variance or renewal thereof shall be granted only for the minimum time period found to be necessary under the facts and circumstances.

(2) An implementation schedule for achieving compliance with this chapter shall be incorporated into any variance issued.

(3) Variances shall be issued only upon application in writing and after providing such information as may be requested. No variance shall be issued for a period of more than 30 days except upon due notice to the public with opportunity to comment. Public hearings may be held, when substantial public interest is shown, at the discretion of the issuing agency.

(4) Sources of noise, subject to this chapter, upon which construction begins after the effective date hereof shall immediately comply with the requirements of this chapter, except in extraordinary circumstances where overriding considerations of public interest dictate the issuance of a variance.

[Order 74-32, § 173-60-080, filed 4/22/75, effective 9/1/75.]

173-60-090
Enforcement policy.

Noise measurement for the purposes of enforcing the provisions of WAC 173-060-040 shall be measured in dBA with a sound level meter with the point of measurement being at any point within the receiving property. Such enforcement shall be undertaken only upon receipt of a complaint made by a person who resides, owns property, or is employed in the area affected by the noise complained of, EXCEPT for parks, recreational areas, and wildlife sanctuaries. For enforcement purposes pursuant to RCW 70.107.050, each day, defined as the 24-hour period beginning at 12:01 a.m., in which violation of the noise control regulations (chapter 173-60 WAC) occurs, shall constitute a separate violation.

[Order DE 76-5, § 173-60-090, filed 2/5/76; Order 74-32, § 173-60-090, filed 4/22/75, effective 9/1/75.]

173-60-100
Appeals.

Any person aggrieved by any decision of the department in relation to the enforcement of the maximum permissible noise levels provided for herein, the granting or denial of a variance or the approval or disapproval of a local resolution or ordinance for noise abatement and control may appeal to the pollution control hearings board pursuant to chapter 43.21B RCW under the procedures of chapter 371-08 WAC.

[Order 74-32, § 173-60-100, filed 4/22/75, effective 9/1/75.]

173-60-110
Cooperation with local government.

(1) The department conceives the function of noise abatement and control to be primarily the role of local government and intends actively to encourage local government to adopt measures for noise abatement and control. Wherever such measures are made effective and are being actively enforced, the department does not intend to engage directly in enforcement activities.

(2) No ordinance or resolution of any local government which imposes noise control requirements differing from those adopted by the department shall be effective unless and until approved by the director. If approval is denied, the department, following submission of such local ordinance or resolution to the department, shall deliver its statement or order of denial, designating in detail the specific provision(s) found to be objectionable and the precise grounds upon which the denial is based, and shall submit to the local government, the department's suggested modification.

(3) The department shall encourage all local governments enforcing noise ordinances pursuant to this chapter to consider

noise criteria and land use planning and zoning.

[Statutory Authority: Chapter 70.107 RCW. 87-06-056 (Order 86-40), § 173-60-110, filed 3/4/87; Order 74-32, § 173-60-110, filed 4/22/75, effective 9/1/75.]

173-60-120
Effective date.

This chapter shall become effective on September 1, 1975. It is the intention of the department to periodically review the provisions hereof as new information becomes available for the purpose of making amendments as appropriate.

[Order 74-32, § 173-60-120, filed 4/22/75, effective 9/1/75.]