Acoustic Impact Assessment

Expedition Combined Cycle Power Plant

Scottsville, VA

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HGC Project #: 020001234

Prepared for:

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EXECUTIVE SUMMARY

Expedition Generation Holdings, LLC ("Expedition") retained HGC Noise Vibration & Acoustics to assess the potential environmental sound emissions from the proposed Expedition combined cycle power plant in Virginia and to investigate conceptual options for noise control.

The sound emission levels of each component of the power generating system were used as input to develop a computational acoustical model of the proposed facility and surrounding area. For the majority of the equipment that will be located at the site, the sound emission levels were available as published data from the manufacturers. For equipment selections that were not yet finalized or where manufacturers' data were unavailable, the projected sound emission levels were based on past measurements by HGC at similar operating power plants. The model was used to determine sound levels offsite points of reception, and to determine the contribution of each individual component to the anticipated overall offsite sound levels.

In the absence of an established noise ordinance in the area, acoustical assessment targets of 60 dBA at the facility's future property line and 50 dBA at nearby residences were applied, consistent with the Special Use Permit ("SUP") granted by the County, for the nearby, existing Tenaska Virginia Partners, LP ("TVP") power plant. These sound level limits are in line with Federal guidance, ordinances in local jurisdictions and municipalities through the US and international bodies.

Modelling results show that the combined sound levels of the proposed Expedition facility, and the existing TVP plant, will remain within the existing TVP plant SUP limits. Sound levels at residences in closest proximity to the proposed Expedition facility are expected to range from 39 to 50 dBA with the standard noise control equipment from the generation equipment manufacturers.

Additional noise control measures for the proposed facility were investigated. Recommended noise controls focus on key equipment, including turbine intakes, ducts, transformers, and auxiliary cooling fans. With these measures in place, sound levels at the residences would be reduced and are predicted to be between 37 and 47 dBA. Details are provided in the following sections.

Table of Contents

1 INTRODUCTION

The proposed Expedition facility is proposed in Fluvanna County, Virginia. Figure 1 shows a scaled location map of the surrounding area and the location of the proposed facility. An aerial photo is included as Figure 2.

The lands surrounding the proposed facility consist of woodland, farmland, open space, mountains, and areas of low density residential development.

Tenaska currently operates an existing power plant approximately ¾ of a mile to the southeast of the proposed facility. For this assessment, the sound emission levels of the proposed facility and the existing TVP plant are combined cumulatively, such that the sound level presented herein reflect the total sound emissions of both facilities.

The focus of this study is to assess, prior to the construction of the proposed Expedition facility, the future sound levels of the proposed Expedition facility and the existing TVP plant at the neighboring properties and homes, and to provide guidance on noise control measures.

This assessment deals with environmental sound, referring to sound in the community around the facility, rather than to workplace or occupational noise within the facility itself.

2 FACILITY DESCRIPTION

The Expedition plant will be a "2 x 1 x 1" configuration in which there will be two separate power generation sets, each consisting of a natural gas combustion turbine generator ("CTG") and a heat-recovery steam generator ("HRSG"). The CTGs and HRSGs will each have a nominal generating capacity of 750 MW and 750 respectively, for a total combined capacity of 1,500 MW.

Each of the two generating sets will entail ancillary equipment including combustion-air intake and exhaust systems, cooling fans, lubrication systems,

electrical transformers and transmission lines. The proposed facility is capable of operating 24/7 and is assessed as such.

3 ACOUSTIC ASSESSMENT CRITERIA

The existing TVP plant operates under a Special Use Permit from the County of Fluvanna, which limits plant-generated sound levels to 60 dBA at the site boundary and to 50 dBA at nearby residences. These sound level limits are in line with Federal guidance, ordinances in local jurisdictions and municipalities throughout the US, and international bodies. Details of relevant assessment criteria are included in Appendix A.

Accordingly, a limit of 50 dBA at the nearby residences and 60 dBA at the property line has been adopted as the quantitative criteria for the purpose of this assessment.

4 POINTS OF RECEPTION

As shown in Figure 2, there are residences located in proximity to the proposed facility. These homes are considered as noise-sensitive points of reception in this report, and are labelled as R##, with ## representing sequential numbers from 01 to 38.

Four points of reception on the property line of the proposed facility in each cardinal direction are labelled as P01 through P04.

All points of reception represent an outdoor location at a height of 1.5 m.

5 ASSESSMENT METHODOLOGY

Conceptually, the simplest way to determine the sound of an existing industrial facility at nearby residences is to measure the sound level directly at those residences. Since such measurements are not possible for a proposed facility that has yet to be built, acoustical modelling can be employed to predict sound levels of the proposed facility at nearby points of reception. Modelling results

can also be employed to determine the individual contribution of each item of equipment at the facility to the off-site sound levels, allowing the ranking of sound sources for possible investigation of noise reduction strategies.

For the proposed facility, sound emission levels provided by the manufacturer, as well as measured sound levels of similar equipment from other combined cycle power plants, were used to develop a sound source inventory. This inventory of sound emission levels was then used as input to develop a computational acoustical model of the site, the details of which are presented in Appendix B.

Since this assessment considers the cumulative impact of the proposed and the existing TVP plant, sound emission levels of the existing TVP plant were included in the model, based on previous measurements by others [1, 2] around the perimeter of the existing plant and at off-site locations surrounding the existing plant. These previous measurements were also used to calibrate the model.

The model was used to determine cumulative sound levels of the two facilities at the points of reception under "predictable worst-case" propagation conditions, which are detailed in Appendix B.

It is noted that this assessment considers the typical operation of the proposed facility at a steady operating state. Facility start-up and shut-down activities are expected to be infrequent. Activities during start-up and shut-down operations have not been assessed at this stage, which may include additional sound emissions from steam venting processes.

Some types of sound have a special quality which may tend to increase their audibility and potential for disturbance or annoyance. For tonal sound, an adjustment of +5 dBA is to be added to the measured source level based on international standards for assessment of environmental noise [3]. A tonal sound is typically defined as one which has a "pronounced audible tonal quality such as a whine, screech, buzz or hum". In this assessment, the tonal adjustment has been added to sound levels for the steam turbine transformers

and CTG transformers (CT-Trans and ST-Trans), based on HGC's experience with similar equipment.

6 SOUND SOURCES

For brevity, the various sound sources at the facility have been given short identifier codes in the figures and tables, and in parentheses in the list below. Since the proposed facility will have two sets of identical power generating equipment, each source ID is prefixed by "S1-" or "S2-" to denote the northern or southern set at the proposed Expedition facility, respectively (e.g. S1-CT-1 to denote source CT-1a in the power generating set to the north).

Figure 3 shows the location of each sound source.

For each of the two sets of power generating equipment, there are the following sources:

- Inlet air filter (CT-1) and associated housing (CT-2) for the CTG, located at the east end of the power generation assembly;
- Ducting (CT-3, CT-5) and built-in silencer (CT-4) from the air inlet to the CTG;
- Enclosure (CT-6) and housing (CT-7) for the CTG;
- Ducting from the CTG to the HRSG (CT-8);
- Ventilation fans (CT-9) and ventilation duct outlets (CT-10) at the top of the CTG enclosure;
- Sounds emanating off the body of the HRSG (HRSG-Bd);
- Duct heater at the side of the HRSG body (HRSG-Heat);
- HRSG outlet stack at the west end of the assembly (HRSG-Out);
- Various cooling equipment surrounding the CTG and HRSG footprint (CT-11, CT-12, and CT-13);
- Air cooled condenser fans to the south of the HRSG (ACC);
- Auxiliary cooling fans to the west of the HRSG outlet stack (AuxFans);
- Steam turbine building located south of the CTG, with sound emanating through the walls of the building (ST-Bldg) and from rooftop exhaust fans (ST-RF);
- Steam turbine transformer located west of the steam turbine building (ST-Trans);

- Auxiliary transformer package (CT-14) and CTG transformer (CT-Trans), located to the southeast of the air intake filter.

7 PREDICTED SOUND LEVELS WITHOUT ADDITIONAL NOISE CONTROL MEASURES

It is noted that that manufacturer's published sound emission levels include only standard noise control measures. These standard noise control measures include a silencer in the CTG intake and may include other measures built into the original design of the equipment, and are not specifically selected for this installation. Off-site sound levels with only the standard noise control measures were modelled initially, for reference, and to whether further sound control measures may be warranted.

The modelled sound levels at the four property line locations and four residences with highest sound level exposure in each cardinal direction are shown below in Table 1.

Table 1: Sound Level Results without Additional Noise Control Measures

Receptor	Description	Modelled Sound Level	Existing SUP Limit	Meets Existing SUP Limits? (Y/N)
P01	Property line to the east	57	60	Y
P02	Property line to the north	53	60	Y
P03	Property line to the west	47	60	Y
P04	Property line to the south	43	60	Y
R32	Residence to the east	50	50	Y
R14	Residence to the north	46	50	Y
R08	Residence to the west	46	50	Y
R21	Residence to the south	49	50	Y

At other residences not shown in the table above, sound levels range from 39 to 49 dBA.

8 NOISE CONTROL RECOMMENDATIONS

The predicted sound levels without additional noise control measures meet the existing SUP limits of 60 dBA at the property line and 50 dBA at the residential points of reception.

Additional noise control measures were investigated, in addition to the standard noise control equipment from the generation equipment manufacturers.

The computational acoustical model was used to determine the individual contributions of each individual source to the overall offsite sound levels and to investigate additional noise control measures. Recommended noise controls focus on key equipment, including turbine intakes, ducts, transformers, and auxiliary cooling fans.

9 PREDICTED SOUND LEVELS WITH ADDITIONAL NOISE CONTROL MEASURES

The modelled sound levels with the benefit of the additional noise control measures, as described in Section 8, are shown below in Table 2 at the four property line locations and four residences with highest sound levels in each cardinal direction. Figure 4 shows the modelled sound level contours around the vicinity of the proposed facility.

Table 2: Sound Level Results with Additional Noise Control Measures

Receptor	Description	Modelled Sound Level	Existing SUP Limits	Meets Existing SUP Limits? (Y/N)
P01	Property line to the east	52	60	Y
P02	Property line to the north	50	60	Y
P03	Property line to the west	45	60	Y
P04	Property line to the south	41	60	Y
R32	Residence to the east	47	50	Y
R14	residence to the north	44	50	Y
R08	Residence to the west	44	50	Y
R21	Residence to the south	46	50	Y

At other residences not shown in the table above, sound levels range from 37 to 47 dBA.

10 CONCLUSIONS & RECOMMENDATIONS

The results of the acoustical modelling show that sound levels of the proposed facility, assessed cumulatively with the existing TVP plant, are less than the existing SUP limits of 60 dBA at the property line and 50 dBA at the residences.

Modelling results also show that there are feasible noise control strategies that can further reduce the sound levels of the facility.

11 REFERENCES

1. Foster Wheeler Environmental Corp., "Fluvanna Energy Facility, Fluvanna County, Virginia, Noise Study", June 25, 2001

2. ATCO Noise Management, "Sound Compliance Measurement Report, Fluvanna Generating Station, Scottsville, Virginia", April 23, 2005

3. International Organization for Standardization, "Acoustics – Description, Measurement and Assessment of Environmental Noise – Part 2: Determination of Sound Pressure Levels, ISO-1996-2", Switzerland, 2017

4. US Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", 1974.

5. US Environmental Protection Agency, "Model Community Noise Control Ordinance, Washington DC", 1975.

6. Les Blomberg, "Preliminary Results of an Analysis of 491 Community Noise Ordinances", Presented at NoiseCon 2016, Providence, RI

7. Les Blomberg, "Noise Ordinance noise level limits, an update of the EPA's 1975 findings", Presented at Inter-noise 2018, Chicago, IL.

8. World Health Organization, "Guidelines for Community Noise", Switzerland, 1999.

9. International Organization for Standardization, "Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation, ISO-9613-2", Switzerland, 1996.

10. Malcom J. Crocker (Editor), "Encyclopedia of Acoustics", John Wiley & Sons, Inc., New York, 1997, p.1050

11. Google Maps and Aerial Imagery, Internet application: maps.google.com

Figure 1 - Location Map

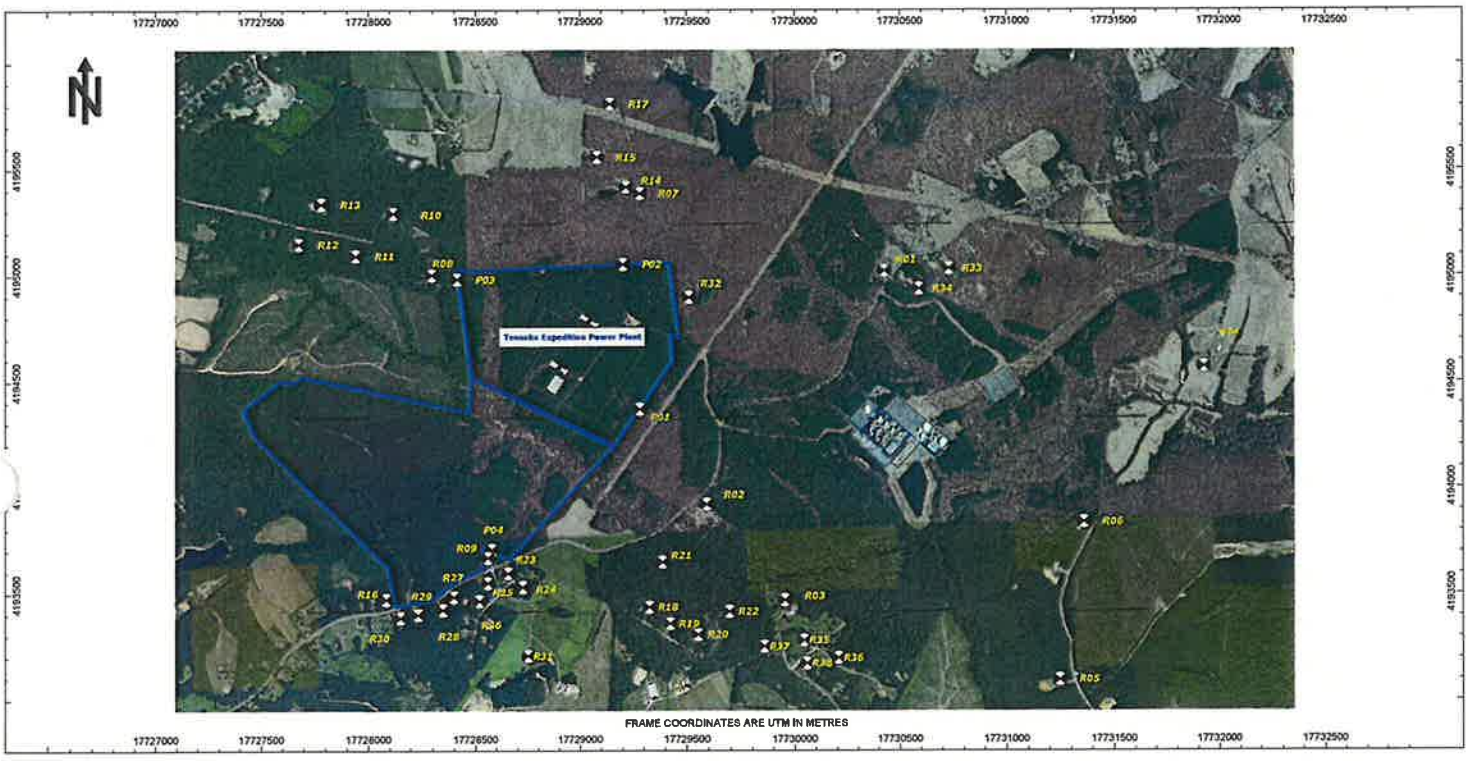


Figure 2 - Nearby Points of Receptions

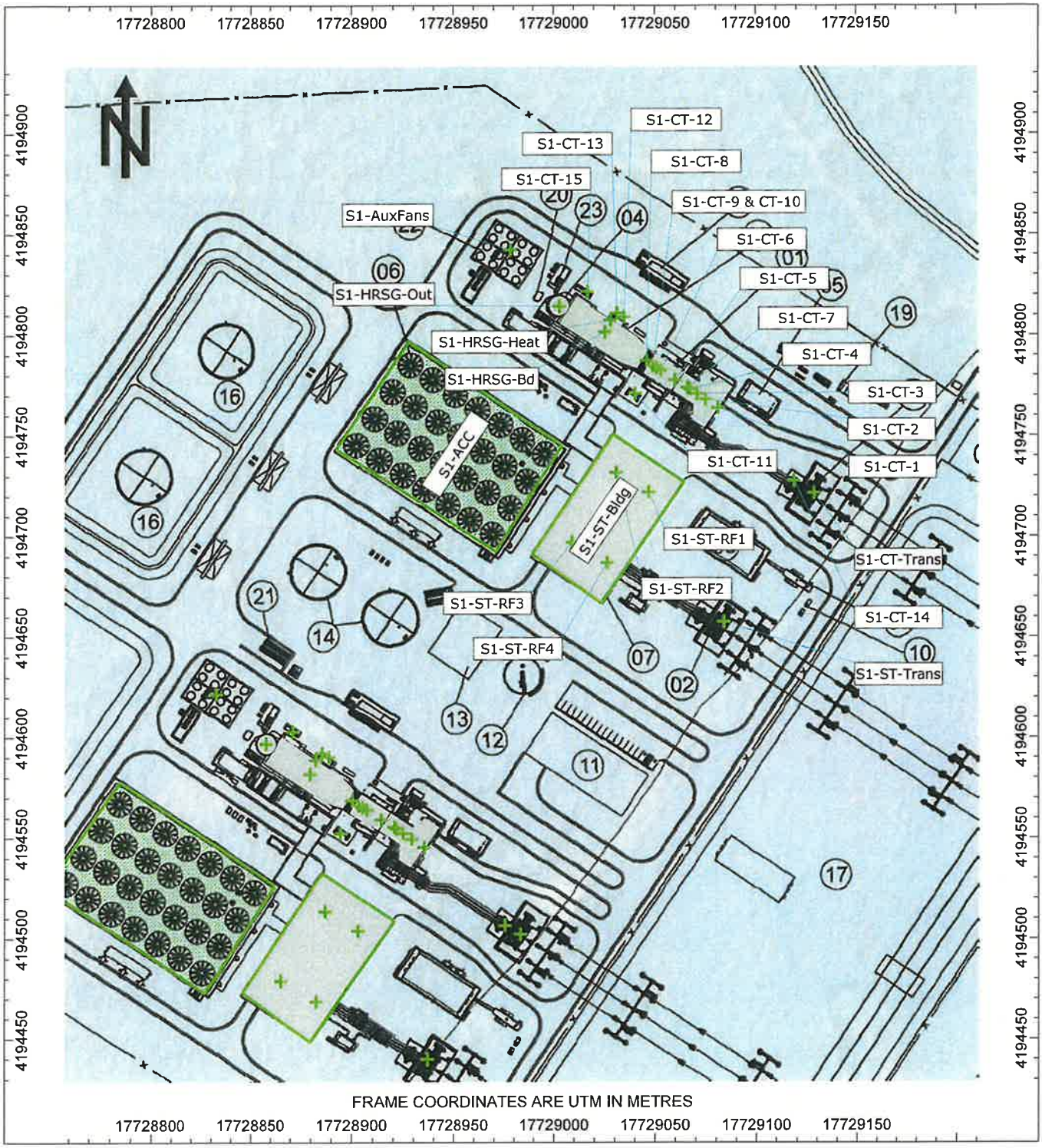
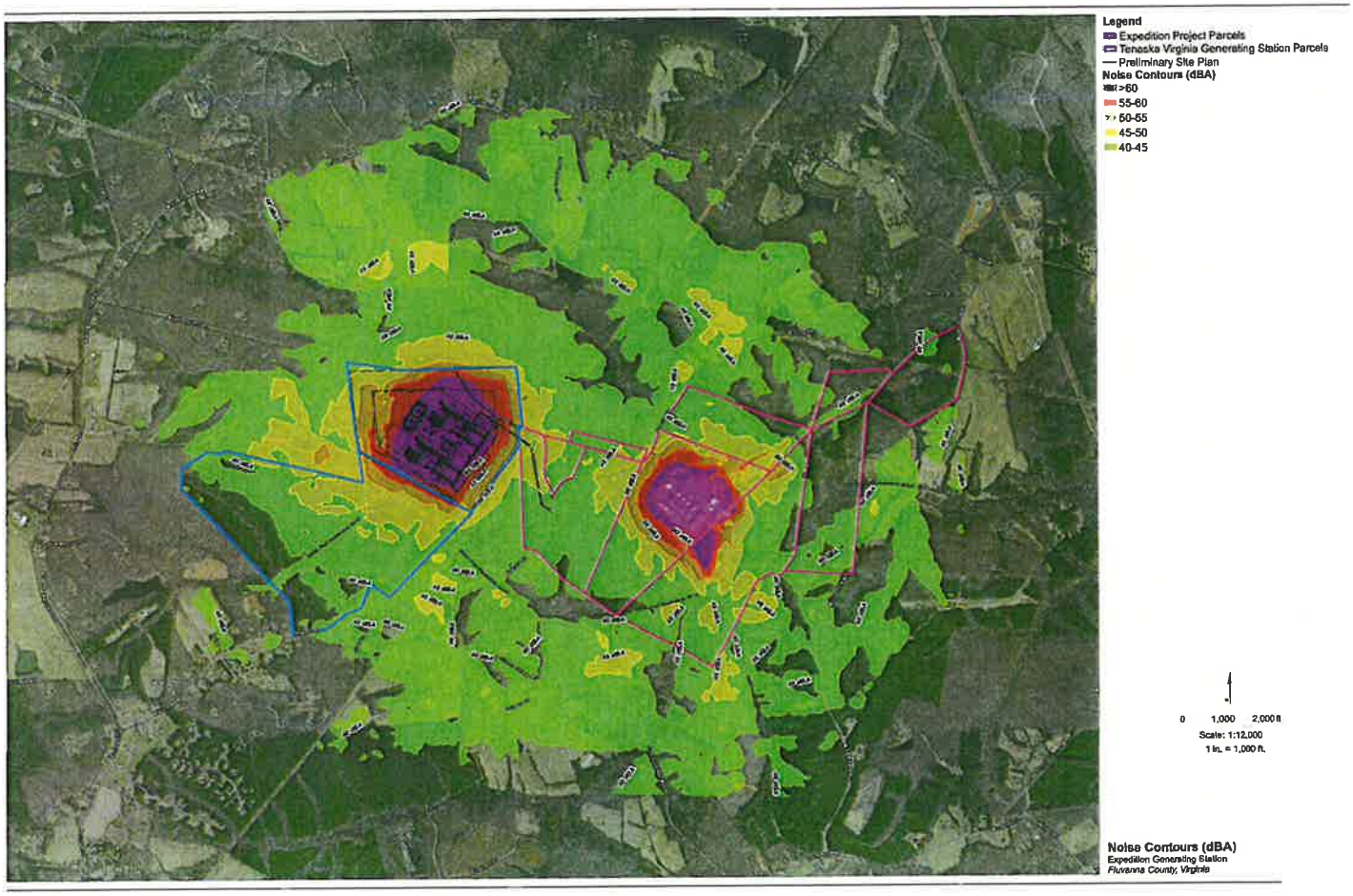


Figure 3 - Locations of Sound Sources
Labels shown for one of the two identical power generating sets


Legend
Expedition Project Parcels
Tenaska Virginia Generating Station Parcels
Preliminary Site Plan
Noise Contours (dBA)
>60
55-60
50-55
45-50
40-45
0
1,000
2,000 ft
Scale: 1:12,000
1 in. = 1,000 ft.
Noise Contours (dBA)
Expedition Generating Station
Fluvanna County, Virginia

APPENDIX A
Discussion of Acoustic Assessment Criteria

In many jurisdictions globally, environmental noise from industry is governed by regulations or ordinances by the federal government, state or province, or local municipalities – or some combination of all of these. In the absence of jurisdictional noise limits there is also guidance from agencies such as the World Health Organization supranational organizations such as the European Union. In most cases, applicable limits differ between daytime and nighttime, with lower (more restrictive) limits applying at night.

In the United States, there are no regulations for noise from energy infrastructure, at the Federal level, nor in many States, including Virginia. This section discusses industrial noise limits from nearby or related contexts, that can be adopted for general assessment purposes.

Federal Environmental Protection Agency (EPA)

In the 1970s, the Federal government began an environmental noise control program, aimed at uniform noise emission standards, while recognizing State and Local governments as being primarily responsible regulation. The Noise Control Act of 1972 was intended to "promote an environment for all Americans free from noise that jeopardizes their public health and welfare".

As part of that program, the EPA's Office of Noise Abatement and Control (which was phased out in the 1980s), published the guideline in March 1974 [4], Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. For outdoor noise present "in residential areas and farms", a day-night sound level (L_{DN}) limit of 55 dBA at any existing noise-sensitive area including residences is used. The L_{DN} descriptor is a combined daytime and nighttime sound level which applies a +10 dBA adjustment to the nighttime sound (from 22:00 to 07:00) and combines with the daytime sound on a time-weighted basis. For equipment which has a steady, continuous noise emission during all hours of the day or night, it can be shown mathematically that an L_{DN} sound level of 55 dBA is equivalent to a continuous, steady, L_{EQ} sound level of about 50 dBA.

Another document developed by the Office of Noise Abatement and Control was the Model Community Noise Control Ordinance published in 1975 [5], which was intended to "be a basic tool which communities, both large and small, can use to construct noise control ordinances suited to local needs and conditions". The model ordinance stopped short of suggesting specific limits but included preamble citing a wide variety of noise limits from over U.S. 110 cities, applicable at residential property lines. These ranged enormously but had average values of about 57 dBA during the day and about 52 dBA at night.

Review of US City Ordinances

In 2016, the independent organization, "Noise Pollution Clearinghouse" updated the EPA's 1975 summary of city ordinances [6, 7], to include over 500 cities. Those limits applicable to residential properties averaged 61 dBA during the day and 54 dBA at night although the majority of city ordinance were in the range of 55 dBA during the day, and 50 dBA during the night. Local noise ordinances were found to vary greatly in many respects and can be challenging to compare.

World Health Organization

The World Health Organization has released various environmental noise guidelines over the years, including the widely referenced 1999 document, "Guidelines for Community Noise" [7]. That guideline cites a sound level of 55 dBA as a target for outdoor living areas of a residence to protect against "serious annoyance" in daytime or evening. To mitigate against "moderate annoyance", a level of 50 dBA for outdoor areas of a residence is indicated during the same period.

Fluvanna County

Fluvanna County's Noise Control Code (The Fluvanna County Code, Chapter 15.2 – Noise Control) prohibits excessive or plainly audible noise from specific activities such as construction, refuse collection, and vehicle operation during certain hours. However, the code does not establish quantitative sound level

limits for continuous operation of equipment at facilities such as power plants. Accordingly, no quantitative, decibel-based criteria apply to the proposed facility under the County Code.

Special Use Permit for Existing TVP Plant

As a condition of the permit to construct the existing TVP plant, sound level limits for plant-generated noise levels of 60 dBA at the site boundary and 50 dBA at nearby residences were adopted into the SUP.

Summary

Considering all of the above, targets of 55 dBA during the day and 50 dBA during the night at a residence can be considered to best typify the limits throughout the U.S. Given that the proposed Expedition power plant will have similar operations during daytime and nighttime hours and therefore have similar noise emissions day and night, the more restrictive nighttime criterion of 50 dBA at residences has been adopted here as the criterion for assessment.

APPENDIX B

Details of Computational Sound Level Modelling

The model used for this Assessment (*Cadna-A version 2025*) is based on methods from ISO Standard 9613-2.2 "Acoustics - Attenuation of Sound During Propagation Outdoors" [9], which accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures, topography and foliage. This modeling technique is internationally recognized and has been widely adopted to model environmental noise in the industry.

High resolution LiDAR-derived topography data was obtained from the United States Geological Survey for the surrounding area and was used to model the ground elevations in the vicinity of the site.

Ground attenuation was assumed to be spectral for all sources, with a ground factor (G) assumed to be 0.25 in paved areas in the yard of the facility and roadways, 0 for bodies of water, and 1.0 in all other areas, representative of soft cover/grassy areas. The temperature and relative humidity were assumed to be 10° C and 70%, respectively. Shielding/reflections by structures were modelled with spectral absorptive characteristics applied to each structure as appropriate, with values representative of steel. The model assumes predictable worst-case propagation conditions, which effectively considers downwind conditions from the facility to offsite locations in all directions.

The mechanical sources at the facility were predominately modelled as point sources, shown as crosses in the appropriate figures. Sounds emanating from walls of the steam turbine buildings were modelled as vertical area sources. Sounds emanating from the main air cooled condensers were modelled as horizontal area sources. These point and area sources are shown as green lines in the appropriate figures.