Appendix D. Noise Modeling and Assessment

Hessler Associates, Inc.
WORLDWIDE CONSULTING IN ENGINEERING ACOUSTICS

3862 Clifton Manor Place
Haymarket, Virginia 20169 USA
703-753-1602 (O)
703-753-1522 (F)
www.hesslernoise.com

TECHNICAL MEMORANDUM

Title: Assessment of Compliance with Regulatory Noise Limits after Plant Expansion

Project: Mankato Energy Center Expansion
Location: Mankato, MN
Prepared For: Calpine
Prepared By: David M. Hessler, P.E., INCE
Revision: 0
Issue Date: June 22, 2015
Reference No: TM-2018-061915-0

Attachments: -

1.0 Introduction

The planned expansion of the Mankato Energy Center, which is currently a 1 on 1 combined cycle plant, to a 2 on 1 configuration has raised the question of whether the built-out facility will naturally remain in compliance with State of Minnesota noise regulations or whether additional noise controls might be required to meet the applicable noise limits. In order to definitively understand the plant's current sound emissions and determine if additional noise from the second CTG powertrain would jeopardize compliance, a field monitoring survey was carried out from May 21 to June 9, 2015 to measure the existing operational sound levels at several key property line positions where current or future sound levels will be maximum. Given the surroundings and circumstances of this site, the State noise regulations effectively apply at the site boundaries. A somewhat lengthy survey using automated monitors was required to capture intermittent and largely unpredictable periods of operation. Four typical runs of roughly 17 hours each were measured, including two cold starts and two warm starts.

In general, the test results confirm that the existing facility is in full compliance the applicable noise limits and the measured levels indicate that sufficient headroom exists for the additional equipment to be installed without the need for any special or non-standard noise controls.

2.0 Regulatory Noise Limits

Minnesota Noise Pollution Statute and Rule 7030.0040 "Noise Standards" essentially limits the permissible daytime and nighttime sound levels at the boundaries of adjoining land uses based on their Noise Area Classifications, as detailed in Subpart 2 of Section 7030.0050 of the Rule. In this instance, the plant is completely surrounded by industrial land uses (Noise Area Classification 3) for quite some distance in all directions. For example, there is another power plant immediately to the east, a capped landfill to the north and light manufacturing in other directions. Consequently, operational noise from the facility is effectively limited to **80 dBA L10(1 hr)** and **75 dBA L50(1 hr)** at the site property line, irrespective of time of day.

No receptors that might actually be sensitive to noise, such as residences, schools, churches, etc., are evident from current aerials of the site vicinity nor were any observed during a ground inspection of the site environs out to about a half a mile. The facility currently receives no noise complaints, nor has received any for some time.

Somewhat unusually the Minnesota noise limits are expressed as the L10 and L50 statistical sound levels. These metrics are the sound levels exceeded 10 and 50%, respectively, of each hourly measurement period, or for 6 and 30 minutes. The L10 sound level tends to measure the near-maximum sound level that occurred only briefly during the measurement interval and the L50 sound level largely measures the "average" level. The L10 limit is of relevance to short-duration, high amplitude noise, such as can be produced during normal start-ups and shutdowns.

3.0 Survey Methodology

3.1 Measurement Locations

Figure 3.1.1 on the following page shows the site area and the monitoring positions.

The control position inside the ST building was on the mezzanine level near where the HRH and LP bypass lines enter the condenser. This meter was set up to record when the plant was generally operational and, specifically, when ST bypass was occurring during start-up.

Position 1 was due north of the existing CTG at the northern fence line. This and the remaining site boundary positions were intended to measure existing noise at the points where it is currently maximum or where it will be maximum after the build-out.

Position 2 was on the northern fence line close to the end of the cooling tower

Position 3 was near but not on the southern property line in the area where the cooling tower is going to be extended. Once completed the expanded cooling tower will generally approach the southern property line in a manner similar to how it currently approaches the northern boundary.

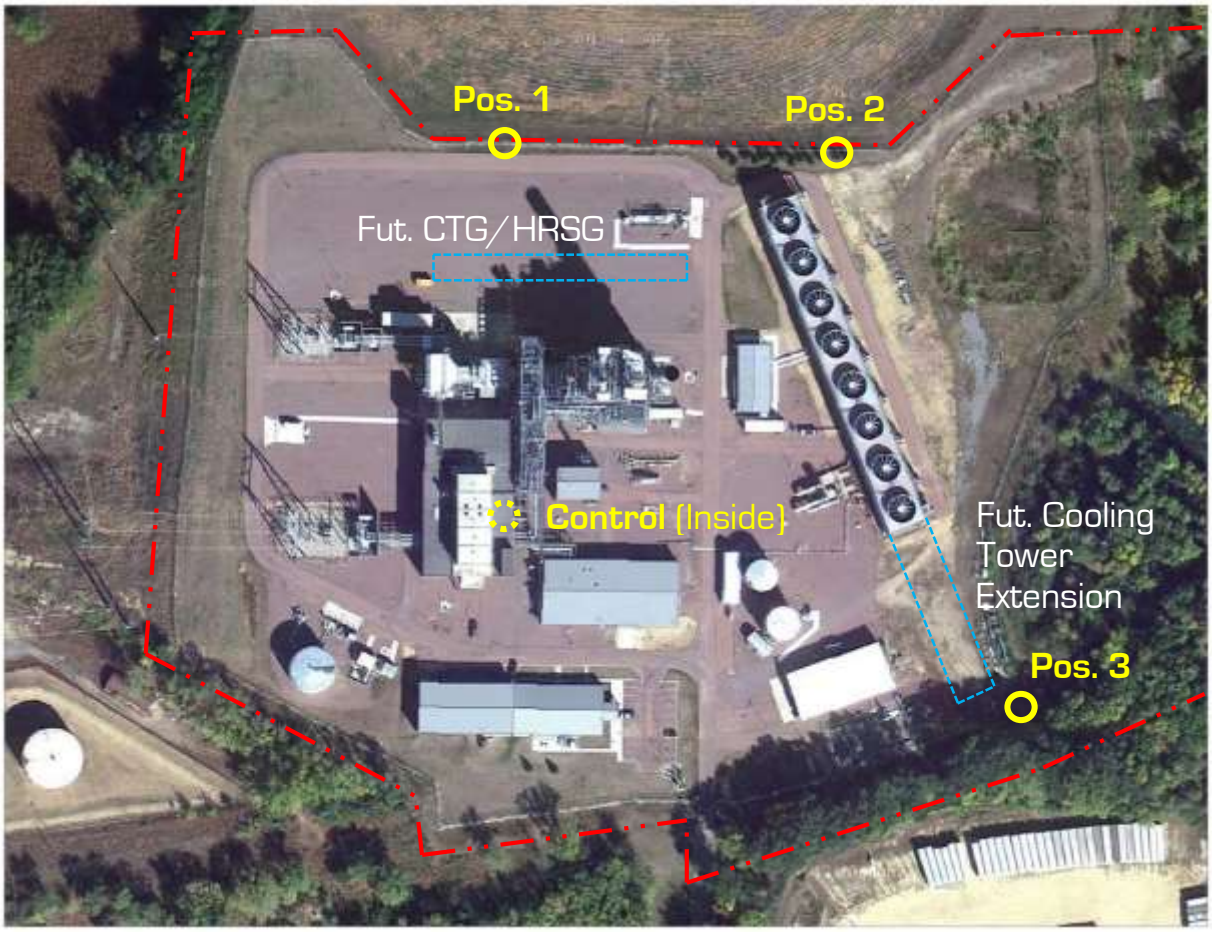

Figure 3.1.1
Site Area Showing Approx. Property Line and Survey Monitor Positions

3.2 Measurement Equipment and Parameters

Rion Model NL-22, ANSI Type 2 sound level data loggers, were used at each position and set to record and store a variety of statistical measures, including the L10 and L50 levels, on an hourly basis over the entire survey period. The instruments were field calibrated and synchronized at the beginning of the survey and checked at the end. The calibration drift was within the -0.2/+0.3 dB range on all instruments. At Positions 1 through 3 the microphone was mounted on the property line chain link fence at a height of about 5 ft. above grade. The meter and batteries were in weather-tight cases on the ground. The control position inside the steam turbine building was on the mezzanine level near where to the HRH and LP steam turbine bypass lines entered the condenser.

3.3 Survey Conditions

During the survey period the plant ran over the following four intervals:

Table 3.3.1
Plant Operations during the Survey Period

Plant Start		Plant Shutdown	
Date	Time	Date	Time
5/26	4:09 a.m.	5/26	10:25 p.m.
5/27	6:07 a.m.	5/27	10:23 p.m.
6/8	5:04 a.m.	6/8	11:25 p.m.
6/9	5:07 a.m.	6/9	10:25 p.m.

Consequently, the starts on 5/26 and 6/8 were cold, while the starts on 5/27 and 6/9 occurred after outages of only a few hours and were warm/hot restarts.

The general weather parameters during the two operational periods are plotted below.

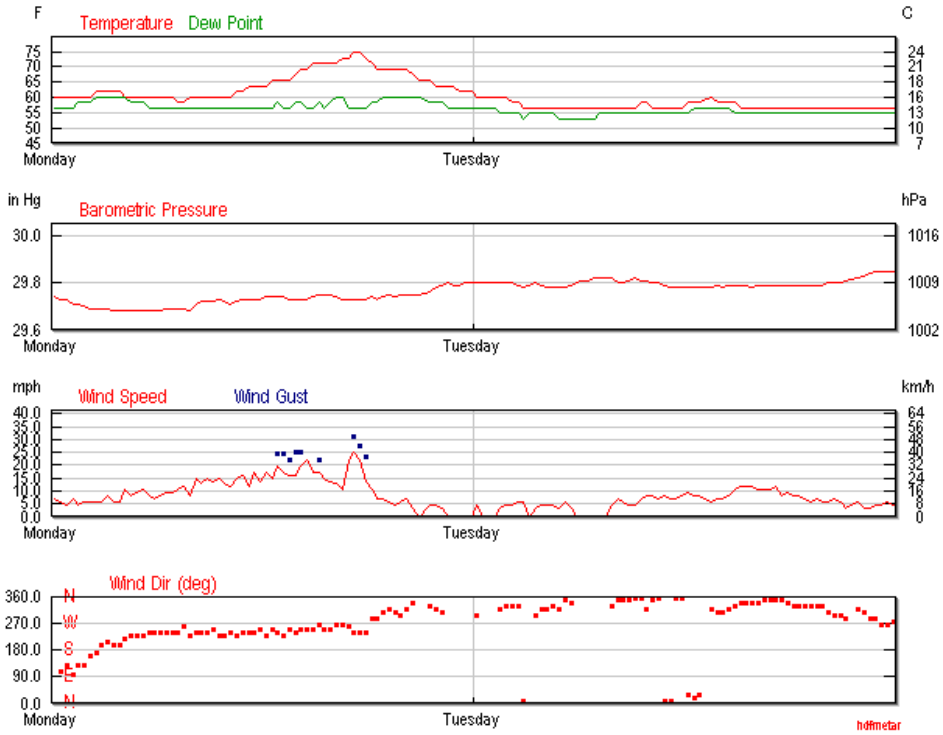

Figure 3.3.1
Weather Conditions in Mankato, MN May 26 to 27

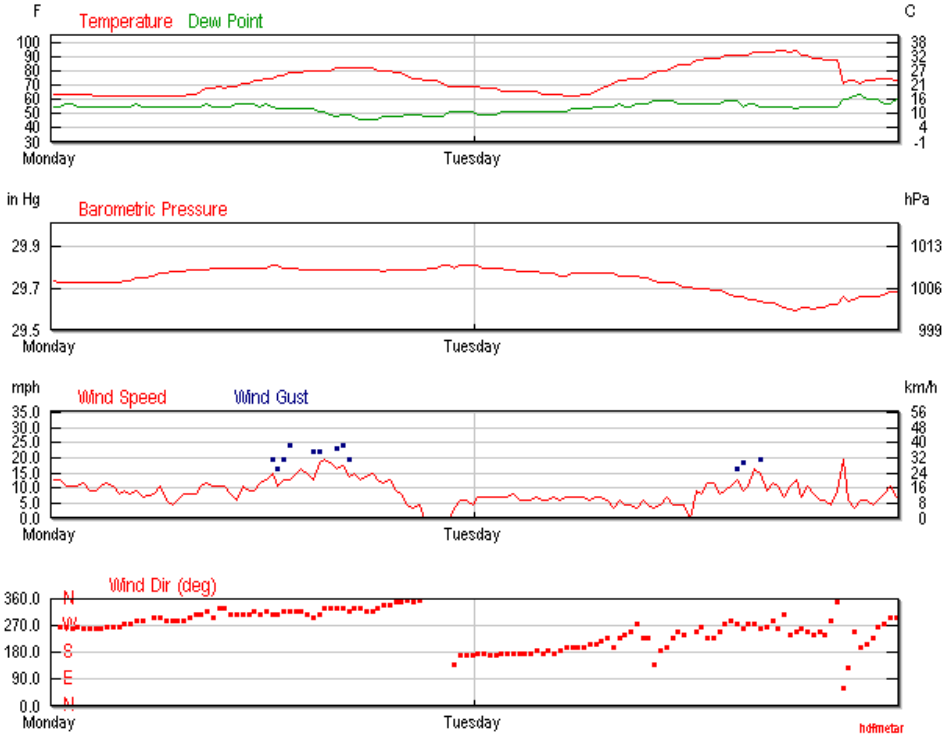

Figure 3.3.2
Weather Conditions in Mankato, MN June 8 to 9

During the first run on May 26 it was overcast and fairly windy. A thunderstorm occurred around 6:30 p.m. On May 27th the winds subsided considerably.

Over the June operational period (June 8 and 9) it was generally clear with moderate winds.

4.0 Survey Results

4.1 Control Position

The L10 and L50 sound levels measured inside the ST building near the condenser and bypass lines are plotted below for the entire survey period.

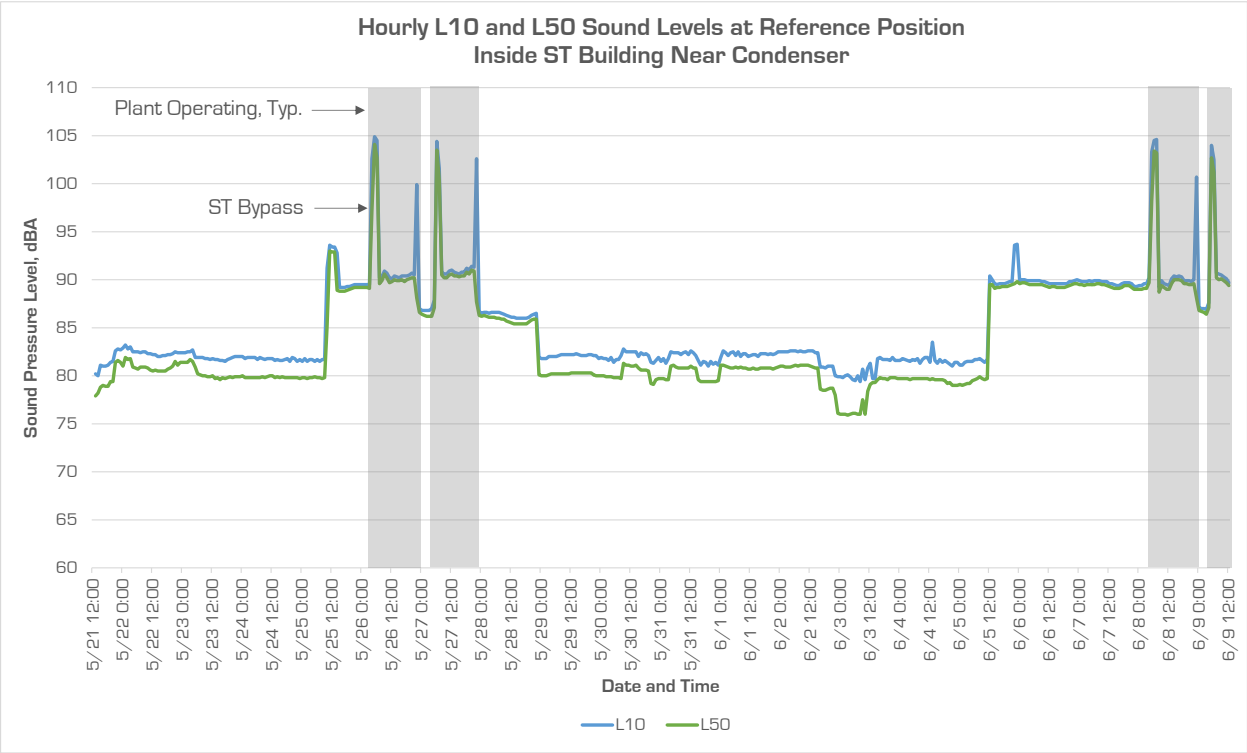

Figure 4.1.1

This plot provides a graphic history of plant operation and agrees with the on/off times obtained from plant operations after the survey. The noise spikes at the beginning of each run are ST bypass activity, which was bit longer (about 3 hours) during the cold starts than during the subsequent warm starts (about 2 hours). The sound level at this particular monitoring location was sustained at about 104 dBA during bypass. The blue (L10) spikes at end of each run are brief noise events at shutdown apparently lasting only a few minutes.

4.2 Position 1 – Boundary North of Existing CTG

The hourly L10 and L50 sound levels measured at Position 1 are plotted below along with the permissible noise limits.

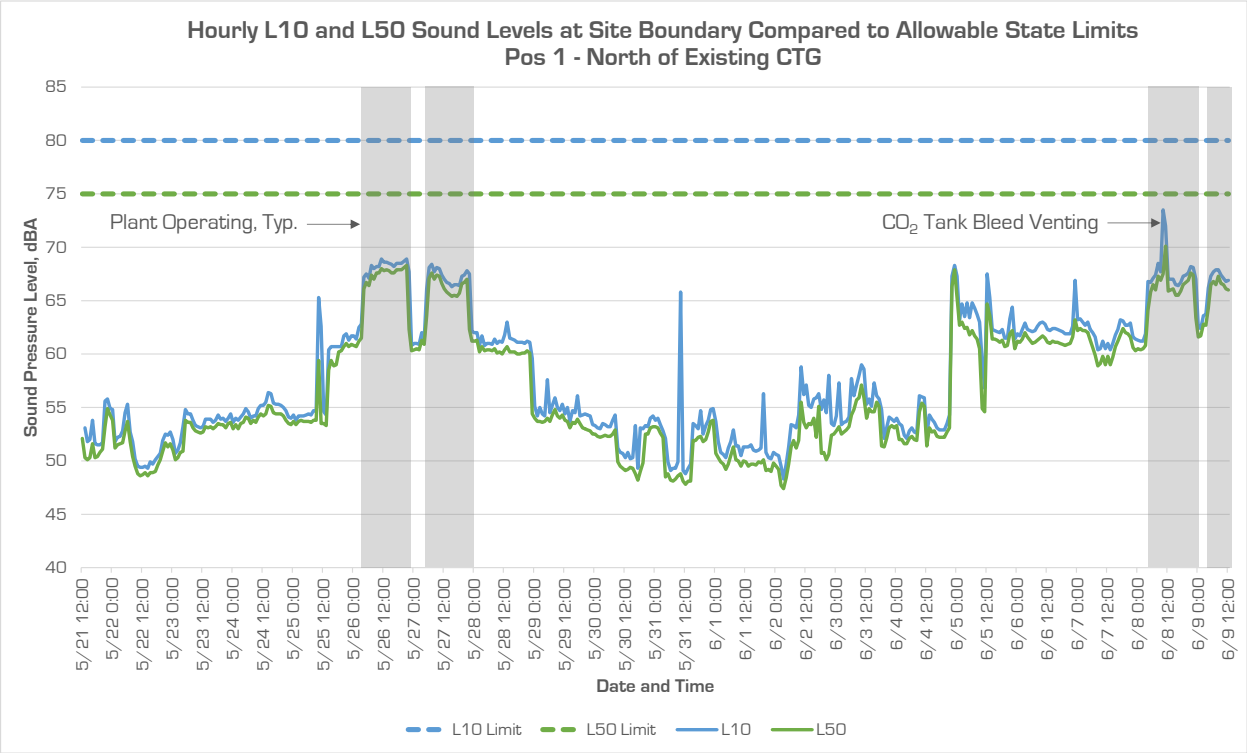

Figure 4.2.1

In general, these results show that the existing plant is certainly in compliance with the allowable sound levels at the northern site boundary. Neglecting the results on 5/26, which may have been elevated by high winds and a thunderstorm, the measured level during the other three runs generally fluctuates around 67 dBA with little difference between the L10 and L50 statisticals. This is well below the respective limits of 80 and 75 dBA. The noise spike on 6/8 around 10:45 a.m. is associated with some short duration venting noise to draw down the pressure in the CTG fire protection CO_2 tank during the offloading of more gas. This plot also shows that, despite the sound levels of 104 dBA observed inside the ST building, transient noise during start-up and shutdown has no significant influence on the overall facility level at this position.

What these results suggest in terms of regulatory compliance is that an increase in the L50 facility sound emissions of about 8 dBA can be tolerated before the level would exceed the permissible limit of 75 dBA. The installation of the second turbine to the north of the existing unit would essentially have the effect of moving the principal noise source closer to this measurement position by about 120 ft. Most of the noise from the existing powertrain would be blocked and replaced by the new powertrain. The contribution from the cooling tower would remain unchanged. This

translation in the main noise source from about 250 ft. away to roughly 130 ft. would theoretically result in an increase of about 6 dBA. Consequently, an L50 sound level after build-out of about 73 dBA is expected. While this is fairly close to the limit it would still be compliant. A similar L10 level of roughly 74 dBA would probably go along with this, so no issue is anticipated with maintaining the L10 limit of 80 dBA.

4.3 Position 2 – Boundary North of Existing Cooling Tower

The hourly L10 and L50 sound levels measured at Position 2 at the northern end of the cooling tower are plotted below.

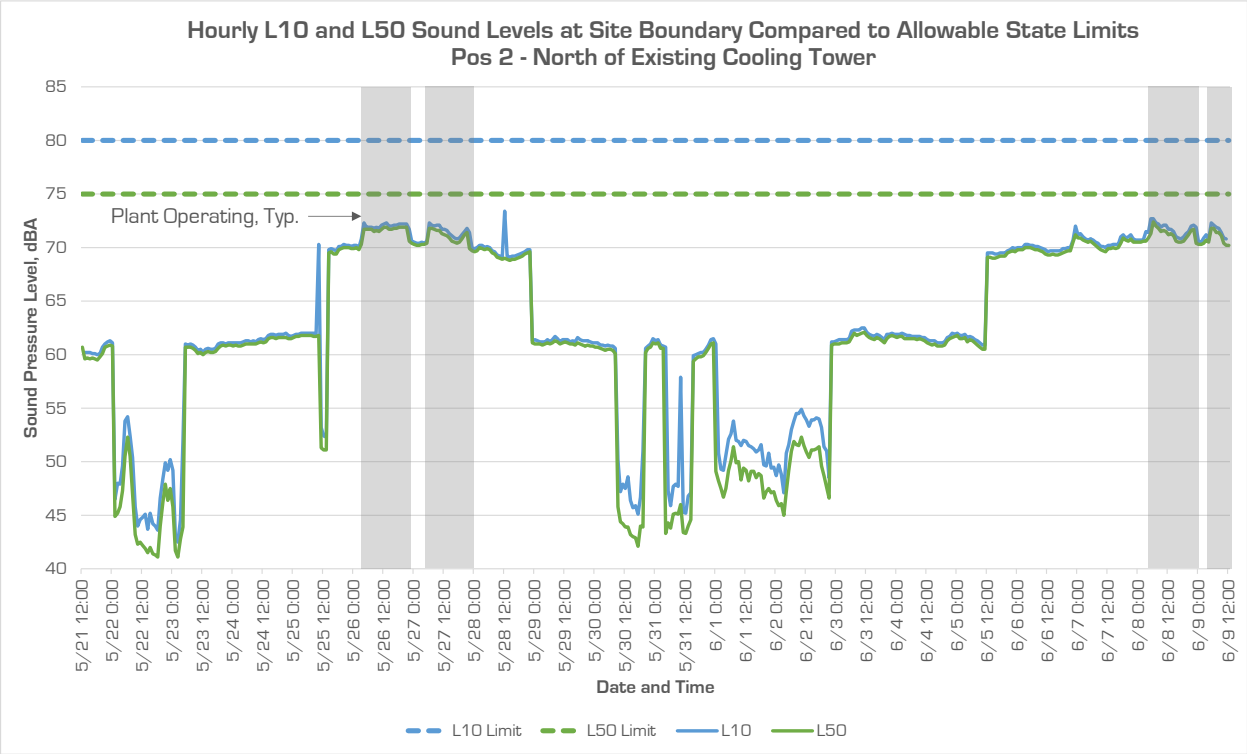

Figure 4.3.1

This position is dominated by cooling tower noise; principally water fall and basin splash. A fairly constant L10/L50 level of about 72 dBA occurs at this location during operation demonstrating compliance with the State noise limits. The sound level at this location is not expected to change in any meaningful way after the build-out. Additional noise from the new CTG powertrain should be significantly less than 72 dBA at this location and therefore should not have any real influence on the total sound level.

4.4 Position 3 – Boundary South of Future Cooling Tower Extension

The hourly L10 and L50 sound levels measured at Position 3 beyond the southern end of the cooling tower are plotted below.

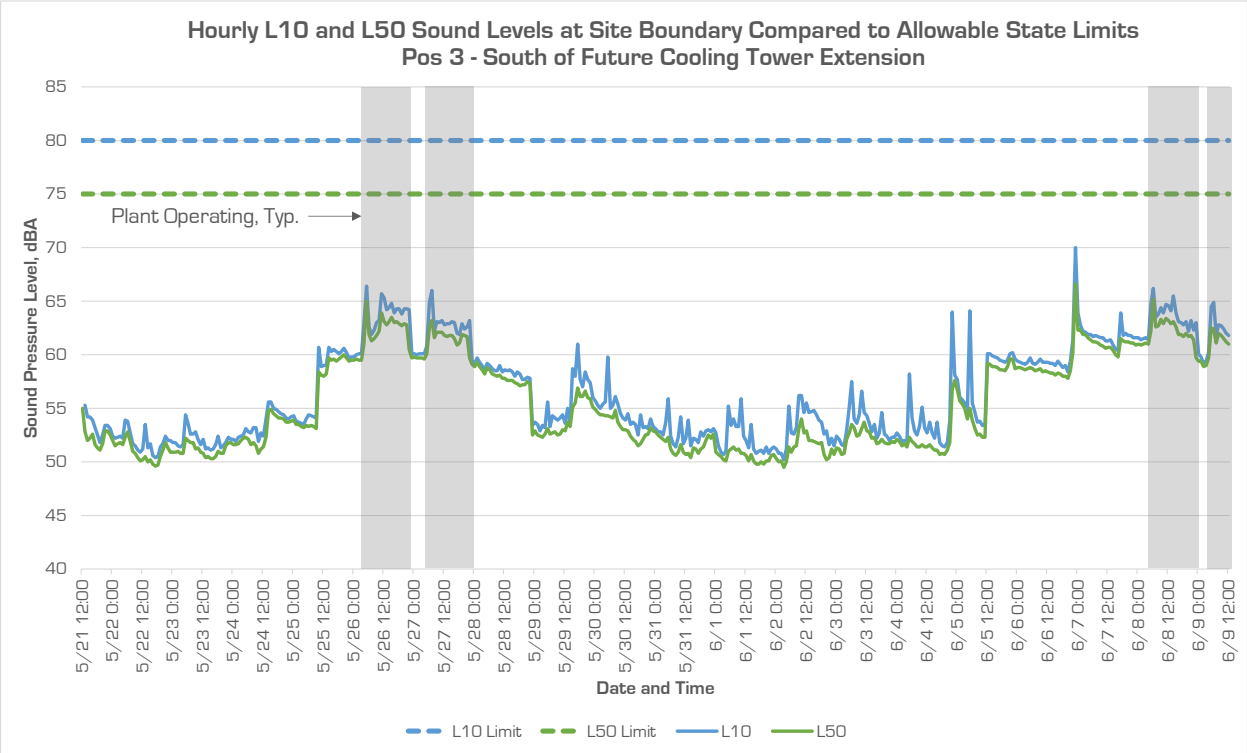

Figure 4.4.1

While the existing sound level at this location is fairly low during plant operation in the 63 to 65 dBA range, it is expected to increase substantially once four more cells are added to the cooling tower. Once the build-out is complete the sound level at the property line beyond Position 3 is likely to be somewhat similar to the existing sound level at Position 2 but probably a little lower due to the slightly greater distance from the tower to the property line. A conservative estimate of the future sound level during normal plant operation can be made by adding the current L50 level of about 63 dBA to the 72 dBA measured at Position 2 to get a total of 72.5 dBA. This suggests that compliance will be maintained after the cooling tower is extended.

One additional comment on Figure 4.4.1 is that steam turbine bypass noise during each plant start-up is clearly evident at this location, which is more or less exposed to the east side of the ST building where the many ventilation louvers allow interior noise to escape. The L50 sound level during this operating mode reaches a maximum of 65 dBA during cold starts. Combined with the Position 2 level, this would put the total estimated level at the southern boundary during start-up at about 73 dBA. While this is close to the L50 limit compliance is still expected.

4.0 Conclusions

A due diligence survey of the existing property line sound levels at the Mankato Energy Center was carried out to determine how much, if any, headroom was left between the current sound emissions of the plant and the permissible State noise limits to accommodate additional noise from the planned expansion. The survey, which was executed using automated continuously recording sound monitors over a 19 day period at key fence line positions, captured four typical plant runs, including two cold starts and two warm starts.

The results unequivocally demonstrate that the plant is currently in compliance with the noise limits of 75 dBA L50 and 80 dBA L10, which apply to the industrial land uses surrounding the site property. Measurements at the points of maximum current or future noise show that sufficient margin exists at all points to accommodate the estimated increase in noise associated with the addition of a second CTG/HRSG powertrain and four more cells to the cooling tower. The estimated maximum L50 sound level after expansion at each of the three worst-case test points is, coincidentally, about 73 dBA. While close to the effective L50 limit of 75 dBA compliance is anticipated during both normal and transient operation. Only slightly higher L10 levels (say 74 to 75 dBA) are expected at the design points based on the survey results so compliance is also anticipated with the L10 noise limit of 80 dBA.