COVERED SOURCE PERMIT REVIEW – 0007-01-C
MODIFICATION – APPLICATION NO. 0007-03

Facility Title: Keahole Generating Station

Applicant: Hawaii Electric Light Company (HELCO)

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Background:
HELCO is currently operating two 20 MW combustion turbines (CTs) at the Keahole Generating Station. The LM 2500 CTs fire on diesel fuel no. 2, use water injection to control nitrogen dioxide, and are permitted to operate 8,760 hours per year. The CTs operate under CSP no. 0007-01-C.

Also operating at the Keahole Generating Station are three 2.5 MW diesel engine generators (DEGs). These DEGs fire on diesel fuel no. 2 and use fuel injection timing retard to control nitrogen dioxides. Two of the three DEGs, unit nos. D22 and D23, are permitted to operate 8,760 hour per year. DEG unit no. D21 has a fuel consumption limit of 70,000 gallons per rolling 12 months. The DEGs are operating under CSP no. 0256-01-C.

Proposed Modification:
HELCO is proposing to install and operate a selective catalytic reduction (SCR) system on combustion turbines CT-4 and CT-5. The SCR will be operated only when the combustion turbine generators are operating in combined cycle mode and at loads greater than or equal to 50 percent of the peakload. At loads less than 50 percent, only water injection will be used to control NO_X emissions because operating the SCR at less than 50 percent peakload will cause ammonium sulfates to form in the catalyst and on the boiler tubes of the heat recovery steam generator.

The temperature of the turbine exhaust gas at the inlet to the SCR catalyst is below 600 degrees F when operating at less than 50 percent peakload. The minimum sustained operating temperature for using SCR systems is recommended to be 650 degrees F. Sulfates and

ammonium salts condense in the catalyst pores and on the boiler tubes at temperatures less than 600 degrees F. This capillary condensation plugs the pores of the catalyst and significantly reduces the performance and life of the catalyst. The efficiency of the boiler tubes is also reduced with the formation of the ammonium sulfates on the tubes. The blocked pores of the catalyst and the build up of ammonium sulfates on the boiler tubes will increase the backpressure of the system which reduces the performance efficiency of the combustion turbines.

The installation of the SCR system is part of a settlement agreement that requires HELCO to install pollution control devices and participate in pollution prevention practices. Under the agreement, HELCO must operate an SCR system when operating the, yet to be built, steam turbine. Since the steam turbine only operates in combined cycle, the SCR system will operate only in combined cycle.

HELCO has not selected a system manufacturer and as such, the type of ammonia and catalyst has not been designed or engineered. The estimated emissions and emission limits are based on the design specifications.

Air Pollution Controls:

The combustion turbines currently use water injection to control NO_X emissions. The proposed modification will add an SCR system to further reduce the NO_x emissions while operating in combined cycle. Water injection will continued to be used while operating in both simple and combined cycles.

Applicable Requirements:

There are no new applicable requirements associated with this modification. However, the current permit conditions will be updated to reflect the revisions to 40 CFR Part 60, NSPS Subpart GG.

Non-Applicable Requirements:

The following are not applicable to the proposed modification.

Hawaii Administrative Rules (HAR):

The proposed change does not affect the applicability of any HAR.

PSD:

PSD is not applicable to this proposed modification because the proposed change is not significant as defined in 40 CFR 51.166.

NSR:

NSR is not applicable since the facility is located in an attainment area and PSD applicability has been reviewed.

CERR (Consolidated Emission Reporting Rule):

40 CFR part 51, Subpart A – Emission Inventory Reporting Requirements, determines applicability based on the emissions of each pollutant from any individual emission point within the facility that emits at the triggering levels. The facility is subject to CERR. The proposed

change does not affect the applicability of the CERR.

NESHAP:

NESHAP for stationary combustion turbines is not applicable because the facility is not a major source of HAPs. The proposed change does not affect the applicability to the NESHAP

NSPS:

The combustion turbines are subject to Subpart GG. The proposed modification does not change the applicability of the subpart. However, the current permit conditions will be updated to incorporate the changes made to Subpart GG.

MACT:

MACT is not applicable because the facility is not a major source of HAPs.

CAM:

The purpose of Compliance Assurance Monitoring (CAM) is to provide a reasonable assurance that compliance is being achieved with large emissions units that rely on air pollution control device equipment to meet an emissions limit or standard. Pursuant to 40 Code of Federal Regulations, Part 64, for CAM to be applicable, the emissions unit must: (1) be located at a major source; (2) be subject to an emissions limit or standard; (3) use a control device to achieve compliance; (4) have potential pre-control emissions that are 100% of the major source level; and (5) not otherwise be exempt from CAM. The proposed change does not change the CAM applicability of the combustion turbines or the major source status of the facility.

BACT:

A Best Available Control Technology (BACT) analysis is required for new or modified emission units if the net increase in pollutant emissions exceeds significant levels as defined in HAR §11-60.1-1. The addition of an SCR unit will decrease the emissions of NO_X. As such, there will be no net emissions increase for this modification and thus, BACT does not apply.

Synthetic minor:

A synthetic minor is a facility that without limiting conditions, physical or operational, emits above the major triggering levels as defined by HAR 11-60.1-1 for either criteria pollutant(s) or hazardous air pollutant(s). This facility is a major source.

Insignificant Activities/Exemptions:

No new insignificant activities were listed. However, SCR systems use ammonia as a reactant to convert NO_X into nitrogen and water. Depending on the type of ammonia used with the SCR system, one or more storage and reactor tanks will be needed to produce and/or store the ammonia. These tanks will be less than 40,000 gallons and are typically pressurized. As such, these tanks will be considered an insignificant activity.

Alternate Operating Scenarios:

No new alternate operating scenarios were proposed with this modification.

Project Emissions:

The proposed modification to add a selective catalytic reduction system will reduce the NO_x emission rate when the combustion turbines operate in combined cycle mode and at load equal to or greater than 50 percent of the peakload. Unreacted ammonia will be emitted when the SCR system is in operation and the quantity of ammonia emissions is proportional to the ammonia slip. The ammonia slip varies as the catalyst ages and degrades.

Since a manufacturer for the SCR system has not been selected yet, the estimated emissions are based on design criteria. The design criteria for the SCR system is based substantially on the permitted emission limits of Hamakua Energy Partners, CSP No. No. 0243-01-C, which operates an SCR system on similar combustion turbines.

The SCR system will be designed for a maximum NO_X emission limit of 15 ppmvd at 15 percent O_2 for each combustion turbine while operating in combined cycle at loads equal to or greater than 50 percent peakload with water injection and the SCR system. This equates to 15.1 pounds per hour or 66.1 tons per year of NO_X per turbine. The design criteria for ammonia slip will have a maximum ammonia emission limit of 10 ppmvd at 12 percent O_2 for each combustion turbine. This is equivalent to 4.3 pounds per hour or 18.8 ton per year of ammonia per turbine.

When the combustion turbines are operating in combined cycle at less than 50 percent peakload or operating in simple cycle mode, the NO_X emission limit remains unchanged at 42 ppmvd at 15 percent O_2 or 42.3 pounds per hour.

Air Quality Assessment:

Since there are no increases in emissions, an ambient air quality analysis is not required for the criteria pollutants. However, ammonia is a new substance being emitted. Although ammonia is not a criteria pollutant, there is a threshold limit value (TLV) set by the American Congress of Governmental Industrial Hygienists (ACGIH). The TLV is a concentration level which the ACGIH believes that workers may be repeatedly exposed to day after day without any adverse health effects. The TLV concentrations are time-weighted averages (TWA) for an eight hour day. The ACGIH TLV-TWA for ammonia is 25 ppm, or 17.7 mg/m^3.

Although not listed as a hazardous air pollutant (HAP), the Department at its' discretion will treat ammonia as a non-carcinogenic HAP and assess the emission concentration in accordance with §11-60.1-179(c) of the HAR. Under that portion of the HAR, emission concentrations of non-carcinogenic HAPs are compared to fractions of the TLV-TWA. Because the TLV-TWA is based on a healthy worker and not the general public, the Department requires the 8-hour average emission concentration of a HAP to be lower than 1/100 of the TLV-TWA and the annual average emission concentration to be lower than 1/420 of the TLV-TWA. In other words, the 8-hour ammonia concentration must be below 177 $\mu g/m^3$ and the annual average ammonia concentration must be below 42.2 $\mu g/m^3$.

The 8-hour concentration for ammonia was estimated by proportioning the 8-hour CO concentration and the CO pound per hour emission rate with the ammonia pound per hour

emission rate. The CO concentration, 1,078 $\mu g/m^3$, was taken from Table 5 of Supplement A to the Ambient Air Quality Impact Report. The scenario for the ambient air quality analysis of Table 5 assumed a full structure build out of the Keahole Generating Station and the permanent retirement of diesel engine generators D18 and D19. This scenario best describes the Keahole Generating Station when the SCR system will be operating. The CO emission rate, 954 lb/hr, is from Table 1 of the Ambient Air Quality Impact Report. The emission rate for ammonia is from the design criteria for the ammonia slip of 10 ppmvd, or 4.3 lb/hr.

<u>8-hour average</u>

NH_3 $\mu g/m^3$ / NH_3 lb/hr = CO $\mu g/m^3$ / CO lb/hr, or

NH_3 $\mu g/m^3$ = NH_3 lb/hr x CO $\mu g/m^3$ / CO lb/hr

NH_3 $\mu g/m^3$ = 4.3 [NH_3] lb/hr x 1,078 [CO] $\mu g/m^3$ / 954 [CO] lb/hr

NH_3 $\mu g/m^3$ = 4.9 $\mu g/m^3$

The predicted 8-hour average for ammonia is much less than the 1/100th TLV-TWA.

4.9 $\mu g/m^3$ << 177 $\mu g/m^3$

For the annual average, PM_{10} was used to proportion the ammonia concentration because it resulted in the highest annual average of all pollutants modeled. The PM_{10} concentration, 5 $\mu g/m^3$, and emission rate, 40 lb/hr, were taken from the same tables listed above.

<u>Annual average</u>

NH_3 $\mu g/m^3$ / NH_3 lb/hr = PM_{10} $\mu g/m^3$ / PM_{10} lb/hr, or

NH_3 $\mu g/m^3$ = NH_3 lb/hr x PM_{10} $\mu g/m^3$ / PM_{10} lb/hr

NH_3 $\mu g/m^3$ = 4.3 [NH_3] lb/hr x 5 [PM_{10}] $\mu g/m^3$ / 40 [PM_{10}] lb/hr

NH_3 $\mu g/m^3$ = 0.54 $\mu g/m^3$

The predicted annual average for ammonia is also much less than the 1/420th TLV-TWA

0.54 $\mu g/m^3$ << 42.2 $\mu g/m^3$

The predicted 8-hour average and annual average ammonia concentrations are much less than the significant ambient air concentration specified in HAR §11-60.1-179. As such, it can be concluded that the ammonia emissions will not adversely impact the surrounding ambient air quality.

Conclusion and Recommendation:

The proposed modification to install an SCR system at the Keahole Generating Station will reduce the NO_X emissions from the combustion turbines while operating in combined cycle. The ammonia emissions from the SCR system will not adversely affect the ambient air quality of the surrounding area.

Recommend issuance of modification.