

**Engineering Evaluation
Southern Energy California LLC
Application # 1119
Plant # 18**

BACKGROUND

Southern Energy California (SECAL) has submitted an application for an Authority to Construct to retrofit boiler S-10 to comply with the requirements of District Regulation 9, Rule 11 (Nitrogen Oxides and Carbon Monoxide from Utility Electric Power Generating Boilers). The company has proposed retrofitting S-10 with selective catalytic reduction (SCR). S-10 is a Babcock and Wilcox 3,400 MMBtu/hr boiler that provides steam to a 345 MW steam turbine generator (Unit 7). The entire Contra Costa Power Plant has a generating capacity of 690 MW of electricity.

SCR is a post-combustion flue gas treatment that destroys NO_x after it is formed. This technology uses a reducing agent, urea or ammonia, to reduce the NO_x molecules to elemental nitrogen and water. The SCR process uses a catalyst to increase the reaction rate and thus improves the NO_x removal efficiency at a required temperature typically lower than 800 degrees F. The SCR reactor will be installed in the S-10 boiler exhaust duct downstream of the boiler economizer and upstream of the air preheater.

The proposed retrofit is part of SECAL's compliance plan under the Advanced Technology Alternative Emission Control Plan ("system-wide emissions bubble") of Section 9 of District Regulation 9, Rule 11. Under the ATAECF, S-10 does not have a specific emission limit, but its emissions contribution will be entered into the SECAL system-wide average (consisting of the Potrero, Pittsburg, and the Contra Costa power plants). The current system-wide average NO_x limit in 2000 is 0.105 lb/MMBtu; pursuant to District Regulation 9-11-309.1, this limit will ratchet down to 0.057 lb/MMBtu in 2002, 0.037 lb/MMBtu in 2004, and 0.018 lb/MMBtu in 2005.

In 1997, S-10 was retrofitted with TODD Dynaswirl-LN burners that utilized advanced fuel staging techniques to reduce the formation of NO_x. This retrofit decreased emissions of NO_x to approximately 30 ppmvd at three percent oxygen (0.0357 lb/MMBtu). Thus, the installation of the low NO_x burners helped bring down the system-wide emission rate to meet the requirements of the ATAECF. SECAL proposes to install SCR (selective Catalytic Reduction) on S-10 in the year 2000 and in the future on several other units in order to comply with the future ATAECF requirements. The installation of SCR at S-10 is expected to reduce NO_x emissions to at three percent oxygen (0.012 lb/MMBtu) when firing natural gas.

The proposed modifications will not increase the rated capacity of the boiler and is expected to comply with District Regulation 9-11-310 for CO emissions. Furthermore, the two existing boilers at this facility (S-9 and S-10) and the new combined cycle plant will be fired exclusively on natural gas. Emissions of other criteria pollutants as well as the toxic emissions, with exception of ammonia, are expected to remain unchanged or be decreased. This permit application covers the retrofit of Boiler S-10 at the Contra Costa Power Plant with the following description:

S-10 Boiler No. 10 – Electric Generation, Babcock and Wilcox, 3400 MMBtu/hr maximum heat input; to be retrofitted with A-10 Selective Catalytic Reduction (SCR).

The Title V Permit for this facility (#A0018) will be amended to include A-10 SCR. The installation of the A-10 SCR is expected to result in a significant decrease in emissions of NO_x while emissions of other combustion byproducts such as CO, SO₂, PM₁₀, POC, and toxic compounds are expected to remain unchanged. Therefore, the installation of A-10 is considered a minor Title V permit revision pursuant to Regulation 2-6-215.

EMISSIONS CALCULATIONS

I. NO_x RACT Reduction

The combustion modifications proposed are expected to reduce NO_x emissions at this facility. NO_x emissions reduction estimates are calculated based on a reduction from the current baseline of 30 ppmvd (3% O₂) to the post-retrofit level of 10 ppmvd (3% O₂) resulting in a reduction factor of 20 ppmvd (3% O₂) or approximately 0.0238 lb/MMBTU. Fuel usage is based on actual historical fuel use data (averaged from 1996 to 1998).

Source Number	Actual Fuel Usage MMBTU/year	Reduction Factor lb NO_x/MMBTU	NO_x Reduction ton NO_x/year
10	8,033,063	0.0238	95.59

II. CO Emissions

Regulation 9, Rule 11 requires CO limits to prevent any tradeoff of NO_x for CO since some NO_x control technologies have the potential to increase CO emissions while reducing NO_x. The Permit Conditions will require a CO concentration of no more than 400 ppmvd during steady state operation for source testing since District source tests indicate that CO concentrations at S-10 range from 0 to 350 ppmvd. During normal operating conditions, these boilers are subject to load swings which may increase CO concentrations above 400 ppmvd. It is expected that there will be no increase nor reduction in CO emissions from retrofitting the boilers with SCR systems.

III. Ammonia Emissions

Ammonia Slip

Ammonia emissions are estimated based on the required maximum "ammonia slip" of 10 ppmvd (3% O₂).

$$(10 \text{ ppmvd}/10^6)(21/21-3)((8600 \text{ scdf/MMBTu} \div 386.9 \text{ scdf/lb mol})(17.03 \text{ lbNH}_3/\text{lb mol}) = 0.0044 \text{ lb NH}_3/\text{MMBTu}$$

$$\text{NH}_3 = (3400 \text{ MMBtu/hr})(0.0044 \text{ lb NH}_3/\text{MMBTu})(8760 \text{ hr/yr}) = 131,536 \text{ lb/yr}$$

Ammonia Storage Tank Emissions

Aqueous ammonia will be stored in three horizontal steel storage tanks. Although these tanks are sealed and pressurized, ammonia emissions from these tanks are conservatively estimated using fixed roof tank formula from AP-42 as follows:

Breathing losses:

$$L_B = 2.26E-2 M_V (P/P_a - P)^{0.68} D^{1.7} H^{0.51} d T^{0.50} F_p C K_C$$

where:

M_V = vapor molecular wt. = 17 lb/lb-mol

P_A = atmospheric pressure = 14.7 psia

P = liquid TVP @ 61F, 13.86 psia from *Chemical Engineering Handbook, Table 3-24, 80 F, 30% molal concentration*

D = tank diameter = 11 ft
H = average vapor height = 5.5 ft
dT = avg diurnal temp change, 30F
F_p = paint factor = 1
C = small diameter adjustment = 1
K_C = product factor = 1

Using a programmed spreadsheet (attached),

$$L_b = 2486 \text{ lb/year}$$

Working losses:

$$L_w = 2.40E-5 M_v P V N K_n K_C$$

where:

M_v = vapor molecular wt., 17 lb/lb-mole
P = liquid TVP @ 61F, 13.86 psia
V = tank capacity, 30,000 gallons
N = turnovers/year, 365,000/30,000 = 12
K_n = turnover factor = 1
K_C = product factor = 1

$$L_w = 2035 \text{ lb/year}$$

$$L_b + L_w = 2436 + 2036 = 4,472 \text{ lb/yr (per tank)}$$

PLANT CUMULATIVE EMISSIONS

Not Applicable

BACT

Not Applicable

OFFSETS

Not Applicable

TOXICS RISK SCREENING ANALYSIS

A risk screen was performed by the Toxics Section for emissions of ammonia from the boiler stacks. The hazard index was found to be less than one for the closest residential receptor. The risk screen passed and no further analysis is required.

Ammonia emissions from the storage tanks do not trigger a risk screen.

CEQA

This project is exempt from CEQA under District Regulations 2-1-312.2 (installation of abatement equipment) and 2-1-312.3 (compliance with newly adopted District Regulation). These regulations categorically exempt this project subject to permit review by the District from CEQA review.

The District Board of Directors adopted (on February 14, 1994) and amended (on May 17, 2000) Regulation 9, Rule 11 to establish Best Available Retrofit Control Technology emissions limit for NO_x from utility boilers. This NO_x reduction project for Contra Costa Unit 7 is proposed in response to the requirements of this Regulation. A CEQA Initial Study prepared for Regulation 9, Rule 11 indicate that no significant environmental effects will result in implementation of the requirements. This project therefore is exempt from CEQA review pursuant to District Regulations 2-1-312.2 and 2-1-312.3.

Furthermore, the applicant's Environmental Information Form (Appendix H) indicate that the proposed project will have "no possibility of any significant environmental effect in connection with any environmental media or resources other than air quality (Regulation 2-1-312.11).

The District Toxic Section performed a risk screen for operating ammonia emissions (ammonia slip and tank emissions) and concluded that the risk is not significant.

STATEMENT OF COMPLIANCE

The boiler modifications are expected to be in compliance with all applicable federal, state, and District rules and regulations. Regulation 9, Rule 11 requirements for NO_x and CO control will be met.

Per Regulation 1, Section 115, these sources are not subject to NSR requirements.

PSD, NSPS, and NESHAPs do not apply.

PERMIT CONDITIONS

Boiler S-10 and other boilers in the SECAL system are subject to the requirements of District Regulation 9, Rule 11. No additional permit are required for under this permit application.

RECOMMENDATIONS

It is recommended that an Authority to Construct be issued to SECAL for:

S-10 Boiler No. 10 – Electric Generation, Babcock and Wilcox, 3400 MMBtu/hr maximum heat input; to be retrofitted with A-10 Selective Catalytic Reduction (SCR).

EXEMPTIONS

The following ammonia tanks are exempt per Regulation 2-1-123.2 for tanks storing and dispensing aqueous solutions which contain less than 1% organic compounds.

**Aqueous Ammonia Storage Tank #1, Horizontal Aboveground, 20000 gallon capacity.
Aqueous Ammonia Storage Tank #2, Horizontal Aboveground, 20000 gallon capacity.
Aqueous Ammonia Storage Tank #3, Horizontal Aboveground, 20000 gallon capacity.**

by: _____ Date: _____
Weyman Lee
Air Quality Engineer II