EXAMPLE COST-EFFECTIVENESS CALCULATIONS FOR NO_x CONTROLS

The following pages provide example calculations for determining the cost-effectiveness of NO_x control options for steam generating boilers. These calculations provide guidance for the applicability of BACT 1, the more stringent, technologically feasible and cost-effective category. Keep in mind that BACT 2, the achieved in practice category, requires no such cost-effectiveness evaluation (see the discussion in Interpretation of BACT and TBACT of this *BACT/TBACT Workbook*). Please refer to Cost Effectiveness Determination for BACT and Maximum Cost Guidelines for BACT for a review of the cost methodology used in this *BACT/TBACT Workbook.*

Table C1-1 is a useful summary chart that can be used for general guidance in determining whether a particular capacity boiler operating a certain number of hours per year could be cost-effectively controlled with a combination of low NO_x burners, flue gas recirculation, and selective catalytic reduction (SCR) to reduce NO_x emissions to 9 ppmv, dry at 3% O_2. For example, a glance at Table C1-1 will show that a 50 MMBTU/hr heat input boiler must be operated at least the approximate equivalent of 2454 hours full load per year (i.e., about a 30 percent capacity factor) to justify the costs of an add-on exhaust gas control such as SCR. For such an application, the cost to control is less than the cost-effective guideline of $17,500 per ton of NO_x controlled, and thus deemed cost-effective.

A less stringent control level (e.g., 20 ppmvd @ 3 % O_2) using combustion modification NO_x controls (without SCR) could possibly be a candidate for BACT consideration if the applicant were willing to accept a permit condition limiting annual fuel consumption to substantially less than that corresponding to a 30 percent capacity factor (see Interpretation of BACT and TBACT*)*.

Please keep in mind that these cost tables are only general cost guidelines to be used in the absence of specific application and operating scenario information.

Sample Cost Effectiveness Calculation for 50 MMBtu/hr Boiler

The control equipment required to reduce NO_x emissions from baseline emissions of 118 ppmvd (@ 3% O_2) to 9 ppmvd (@ 3% O_2) include low NO_x burners, FGR and SCR. Capital and operating costs for this equipment are summarized below:

I. Annualized Capital Equipment Costs

The total installed capital equipment costs are:	
SCR	$245000
CEM (NOx and O2)	48000
Low NOx Burner (Incremental Costs)	49000
FGR (Piping and Burner Mods)	14000
FGR Fan	36000

Controls For FGR/SCR	72000
Increased Capacity FD Fan (Incremental Costs)	1200
Labor	53000
Engineering	25000
Total	$543200

Using the simplified formula (Ref. Cost Effectiveness Determination for BACT) to calculate the annualized equipment cost:

Annualized Equipment Cost = $543,200 [CRF (0.163) + Tax (0.01) + Ins. (0.01) + G&A (0.02)] = **$110,270**

II. Annualized Operating Costs for boiler operating at 4380 hours/yr (half load)

Ammonia (NH3) Cost = (1 lb NH3/hr)(4380 hr/yr)($0.15/lb)	657
SCR Heater/Pump Cost = (4380 lb NH3/yr)(0.57 kW/lb NH3)($0.11/kWhr)	275
FGR Fan Operating Cost = (40 HP)(0.7457 kW/HP)(4380 hr/yr)($0.11/kWhr)	14,371
FD Fan Cost = (50 - 25 HP)(0.7457 kW/HP)(4380 hr/yr)($0.11/kWhr)	8,982
Fuel Consumption Cost = (0.01)(219000 MMBtu/yr)($4/MMBtu)	8,760
SCR/CEM Maintenance	10,000
Total Annualized Operating Cost	43,045

Total Annualized Operating Cost = 43,045

Calculating cost effectiveness:

NO_x reduction = 0.14 lb/MMBtu (118 ppmvd) - 0.0107 lb/MMBtu (9 ppmvd) = 0.1293 lb/MMBtu

Mass reduction = (0.1293 lb/MMBtu)(50 MMBtu/hr)(4380 hr/yr) = 28,317 lb/yr = 14.16 ton/yr

Cost effectiveness = $(110,270 + 43,045)/14.16 ton = **$10,828/ton**

The BACT maximum limit for cost effectiveness is $17,500/ton of NO_x reduced. Therefore, controlling this boiler to 9 ppmvd NO_x at 3% O_2 using Low NO_x burners, SCR, and flue gas recirculation would be considered cost effective.

Notes:

Increased FD (forced draft) fan sizing required due to greater mass flow from recirculating flue gas and additional pressure drop across the SCR unit.

FD fan horsepower increased from 25HP to 50HP due to the addition of FGR and SCR. This is the incremental increase in cost to