

County of Ventura  
Resource Management Agency / APCD  
Memorandum

To: Interested Parties

Date: January 4, 1990

From: Karl E. Krause

Subject: Cost Effectiveness Calculations for Control Equipment

The following is the method for calculating cost effectiveness (CE) in dollars per pound for a single emission control strategy.

- A. Obtain "A'" from Page Three of this form. \_\_\_\_\_
- B. Calculate the expected emissions reduction (R), in pounds per year, by subtracting the expected emission rate from the uncontrolled emission rate.

Uncontrolled emission rate = \_\_\_\_\_

Expected emission rate --- = \_\_\_\_\_

Emission reduction (R) ----- = \_\_\_\_\_

C.  $CE = \frac{\text{Annual Cost in Dollars per year (A')}}{\text{Emission reduction in Lb per yr (R)}} = \underline{\hspace{2cm}}$

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Notes:

- 1) PEC = Purchased Equipment Cost, shown in Line 6.  
TCI = Total Capital Investment, shown in Line 30.
- 2) (Parenthetical) notes are suggested estimating ranges.  
[Bracketed] notes are definitions.
- 3) Capital Recovery Factor (CRF):

$$CRF = \frac{I}{(1 - ((1+I)**(-N)))}$$

where I = Interest Rate  
N = Economic Life of item

TOTAL CAPITAL INVESTMENT	Dollars
1. Primary Control Device -----	_____
2. Auxiliary Equipment -----	_____
3. Instrumentation -----	_____
4. Sales Taxes -----	_____
5. Freight -----	_____
6. PURCHASED EQUIPMENT (PEC) [Add 1 thru 5] Subtotal	_____
7. Foundations and Supports (include with 8) --	_____
8. Handling And Erection -----	_____
9. Electrical -----	_____
10. Piping -----	_____
11. Insulation -----	_____
12. Painting -----	_____
13. DIRECT INSTALLATION [Add 7 thru 12] ---- Subtotal	_____
14. Site Preparation -----	_____
15. Buildings -----	_____
16. DIRECT COST [Add 6+13+14+15] ----- TOTAL	_____
17. Engineering -----	_____
18. Construction/Field Expenses -----	_____
19. Contractor Fee -----	_____
20. Start-up -----	_____
21. Performance Test -----	_____
22. Lost Production (during tie-in) -----	_____
23. Contingencies -----	_____
24. INDIRECT COST [Add 17 thru 23] ----- TOTAL	_____
<div style="border: 1px solid black; padding: 5px;">25. "Battery Limits" Cost [Add 16+24] ----- TOTAL _____</div>	
26. Off-site Facilities -----	_____
<div style="border: 1px solid black; padding: 5px;">27. Depreciable Investment [Add 25+26] ----- TOTAL _____</div>	
28. Land (Nondepreciable) -----	_____
29. Working Capital (Nondepreciable) -----	_____
<div style="border: 3px double black; padding: 5px;">30. CAPITAL INVESTMENT (TCI) [Add 27+28+29] TOTAL (P) _____</div>	

Notes:

- 17. Engineering costs include construction design and engineering, drafting, purchasing, accounting, construction and cost engineering, travel, reproductions, communications and home-office overhead expense.
- 18. Construction and field expenses include temporary construction and operation, construction tools and rentals, home-office personnel at site, construction payroll, travel and living, taxes and insurance, and other field overhead.
- 19. The Contractor Fee is a flat percentage mark-up.

**TOTAL ANNUAL COST**

	Quantity	Dollars/Year
31. Raw Materials -----	_____	_____
32. Utilities		
> Electricity -----	_____	_____
> Fuel -----	_____	_____
> Water -----	_____	_____
> Water Treatment/Disposal-----	_____	_____
> Other -----	_____	_____
33. VARIABLE COSTS [Add 31+32] -----	TOTAL	_____
34. Labor		
> Operating -----	_____	_____
> Supervisory -----	_____	_____
> Maintenance -----	_____	_____
35. Maintenance Materials -----	_____	_____
36. Replacement Parts -----	_____	_____
37. SEMI-VARIABLE COSTS [Add 34+35+36] -----	TOTAL	_____
38. DIRECT ANNUAL COSTS [Add 33+37] -----	TOTAL	_____
39. Overhead [Payroll+Plant] -----	_____	_____
40. Property Taxes -----	_____	_____
41. Insurance -----	_____	_____
42. Administration Charges -----	_____	_____
43. Capital Recovery -----	_____	_____
44. INDIRECT ANNUAL COSTS [Add 39 thru 43] -----	TOTAL	_____
<b>RECOVERY CREDITS</b>		
45. Material -----	_____	--- (-) _____
46. Energy -----	_____	--- (-) _____
47. ANNUAL COST [Add 38+44+45+46] ----- TOTAL (A') _____		

CRF \* P

**Notes:**

- 33. Variable costs are a direct function of exhaust flow rate and/or production rate.
- 34. Labor is for control system only.
- 36. This capital recovery factor (CRF) may be different from the one on Line 43 since the economic life of replacement parts is usually shorter than that of primary equipment.
- 37. Semi-variable costs are partially dependent on exhaust flowrate and/or production rate.
- 44. Indirect costs are independent of exhaust flowrate and production rate.
- 45,46. Material or energy sold, recycled or reused elsewhere.

## CAPITAL RECOVERY FACTORS

## INTEREST RATE

YEARS (N)	INTEREST RATE				
	8.0%	9.0%	10.0%	12.0%	15.0%
1	1.0800	1.0900	1.1000	1.1200	1.1500
2	0.5608	0.5685	0.5762	0.5917	0.6151
3	0.3880	0.3951	0.4021	0.4163	0.4380
4	0.3019	0.3087	0.3155	0.3292	0.3503
5	0.2505	0.2571	0.2638	0.2774	0.2983
6	0.2163	0.2229	0.2296	0.2432	0.2642
7	0.1921	0.1987	0.2054	0.2191	0.2404
8	0.1740	0.1807	0.1874	0.2013	0.2229
9	0.1601	0.1668	0.1736	0.1877	0.2096
10	0.1490	0.1558	0.1627	0.1770	0.1993
11	0.1401	0.1469	0.1540	0.1684	0.1911
12	0.1327	0.1397	0.1468	0.1614	0.1845
13	0.1265	0.1336	0.1408	0.1557	0.1791
14	0.1213	0.1284	0.1357	0.1509	0.1747
15	0.1168	0.1241	0.1315	0.1468	0.1710
16	0.1130	0.1203	0.1278	0.1434	0.1679
17	0.1096	0.1170	0.1247	0.1405	0.1654
18	0.1067	0.1142	0.1219	0.1379	0.1632
19	0.1041	0.1117	0.1195	0.1358	0.1613
20	0.1019	0.1095	0.1175	0.1339	0.1598
21	0.0998	0.1076	0.1156	0.1322	0.1584
22	0.0980	0.1059	0.1140	0.1308	0.1573
23	0.0964	0.1044	0.1126	0.1296	0.1563
24	0.0950	0.1030	0.1113	0.1285	0.1554
25	0.0937	0.1018	0.1102	0.1275	0.1547
26	0.0925	0.1007	0.1092	0.1267	0.1541
27	0.0914	0.0997	0.1083	0.1259	0.1535
28	0.0905	0.0989	0.1075	0.1252	0.1531
29	0.0896	0.0981	0.1067	0.1247	0.1527
30	0.0888	0.0973	0.1061	0.1241	0.1523
31	0.0881	0.0967	0.1055	0.1237	0.1520
32	0.0875	0.0961	0.1050	0.1233	0.1517
33	0.0869	0.0956	0.1045	0.1229	0.1515
34	0.0863	0.0951	0.1041	0.1226	0.1513
35	0.0858	0.0946	0.1037	0.1223	0.1511
36	0.0853	0.0942	0.1033	0.1221	0.1510
37	0.0849	0.0939	0.1030	0.1218	0.1509
38	0.0845	0.0935	0.1027	0.1216	0.1507
39	0.0842	0.0932	0.1025	0.1215	0.1506
40	0.0839	0.0930	0.1023	0.1213	0.1506
41	0.0836	0.0927	0.1020	0.1212	0.1505
42	0.0833	0.0925	0.1019	0.1210	0.1504
43	0.0830	0.0923	0.1017	0.1209	0.1504
44	0.0828	0.0921	0.1015	0.1208	0.1503
45	0.0826	0.0919	0.1014	0.1207	0.1503
46	0.0824	0.0917	0.1013	0.1207	0.1502
47	0.0822	0.0916	0.1011	0.1206	0.1502
48	0.0820	0.0915	0.1010	0.1205	0.1502
49	0.0819	0.0913	0.1009	0.1205	0.1502
50	0.0817	0.0912	0.1009	0.1204	0.1501