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Ref: D0392/D0381.10.01

June 28, 2007

Thomas J. Christofk Air Pollution Control Officer Placer County Air Pollution Control District 3091 County Center Drive, Suite 240 Auburn, CA 95603

Re: Union Pacific Comments Regarding the Advanced Locomotive Emissions Control System (ALECS) Final Report

Dear Mr. Christofk,

TIAX LLC ("TIAX") would like to respond to Union Pacific Railroad's (UPRR) comments to you (UPRR letter dated May 29, 2007 from Lanny Schmid, Director of Environmental Field Operations), concerning TIAX's final report "Evaluation of the Advanced Locomotive Emissions Control System (ALECS): ALECS Proof-of-Concept Testing at the Union Pacific J. R. Davis Rail Yard in Roseville, California" (Report).

Addressing UPRR's three key concerns:

(1) UPRR's concern of the emissions capture subsystem (ECS) not being tested under actual yard operating conditions coincides with the Report's concerns.

The Report's proposed "Next Steps" for the ALECS included a demonstration of a one-half size (6 trolley/bonnets) subsystem under actual yard operating conditions to evaluate automated connect/disconnect of multiple locomotives, impacts on the yard workflow/efficiency, and durability of the ECS components.

(2) UPRR's concern that the 96% system utilization rate may be too optimistic as a baseline.

This is the reason that a sensitivity analysis in the Report was performed to show that a decrease in the system utilization rate to 70% resulted in a 30% increase in cost effectiveness. Given that UPRR and TIAX do not have a reason to doubt ACTI's (Advanced Cleanup Technologies, Inc.) estimate of the ALECS being available 96% of the time, then the critical factor is how much locomotive emissions are available to be treated by the ALECS. The amount of emissions available can vary widely from yard to



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yard as well as from different areas of just one yard. This is the reason that the Report recommended the "Next Step" for UPRR to identify potential locations for the ALECS installation. This needs to include detailed time/motion analyses of the activity at the site (including parameters such as number and type of locomotives, operating modes, and the amount of time at operating modes) and identify any operational changes that could improve the efficiency of the site operation using the ALECS. It is a goal to have the ALECS minimally affect the regular operations of the yard. Since locomotive emissions can adversely affect the health and welfare of local communities, it is expected that some change to the yard's regular operations will be required. However, these changes could improve yard operations. The in-depth time/motion analysis of actual potential sites by UPRR will provide a better estimate of how much emissions are available to ALECS for treatment and the ECS demonstration will provide insight into needed yard operation changes.

(3) UPRR's concern about different cost/effectiveness calculation methods. UPRR suggests that the calculation of cost/effectiveness is based on a discounted present value cash flow analysis which is not consistent with the techniques used in EPA's control cost manual or the Air Resources Board's guidelines for determining cost/effectiveness under the Moyer program.

As discussed with UPRR at our March 14, 2007 final report review meeting, we agreed that the ARB's Moyer methodology would result in very low cost effectiveness since on going O&M costs are not included. Only upfront, incremental costs are included in the Moyer cost effectiveness calculation. Fuel costs or savings, operational labor and other expenses/costs are not included. For this reason, we recommended that discounted cash flow analysis be used.

EPA's control cost manual¹ describes the discounted cash flow (DCF) model as do the South Coast Air Quality Management District's Best Available Control Technology Guidelines² and the Department of Energy's Life-Cycle Costing Manual for the Federal Energy Management Program.³ All these agencies recommend using DCF analysis for estimating total project costs. DCF analysis discounts all future costs over the life of the project to the present value for a total net present value (NPV). The total cost for projects like ALECS (where there are non-constant annual costs and/or costs that occur over a

¹ "EPA Air Pollution Control Cost Manual," 6th Edition, Report #EPA/452/B-02-001, January 2002

² Kay, M., Baez, A., Lange, H., "Best Available Control Technology Guidelines," South Coast Air Quality Management District, July 14, 2006

³ Fuller, S., Petersen, S., *Life-Cycle Costing Manual for the Federal Energy Management Program*, 1995 Edition, February 1996



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period longer than the standard one year interval, such as catalyst replacements every 5 years) can be determined as shown below: 4,5

NPV Project Cost Estimate = {initial capital costs} + {discounted NPV of O&M costs}

Cost Effectiveness = {NPV Project Cost Estimate} / {total life time emission reductions}

Although this is the recommended approach by EPA, SCAQMD, and DOE we added the additional costs of the lost investment opportunity (or the costs of serving the debt) of the initial ALECS capital costs as well as any subsequent capital replacement costs such as SCR catalyst replacement. This added cost results in higher overall project costs and as a result increases the cost effectiveness of the ALECS.

UPRR suggests that the capital and operating costs be annualized and the cost effectiveness determined by summing these annualized costs and dividing by total life emission reductions. This method accounts approximately for the lost investment opportunity or the cost of capital but does not account for discounting future year expenses.

Table 1. Comparison of Life-Cycle Costing Methodologies

	Life-Cycle Costing Methodology		
	DCF	TIAX (Report)	UPRR
Total Project Costs (2007\$)	21,080,454	25,165,221	31,032,743
Tier 0 Cost Effectiveness (\$/ton)	6,112	7,297	8,998
Tier 2 Cost Effectiveness (\$/ton)	15,445	18,437	22,736
Difference from the Report	-16%	_	23%

Table 1 shows a comparison of the above methodologies. The lowest cost effectiveness is obtained by performing a NPV or DCF analyses. The approach used by TIAX increases the costs and therefore increases the cost effectiveness. UPRR's approach, which is not recommended for trying to capture non-uniform annual costs, provides the highest costs and cost effectiveness. Interestingly, regardless of the financial method used the cost effectiveness estimates do not vary all that much from \$6,100 to \$7,300 to \$9,000. Far more important, as discussed above, is how often ALECS is used and how much emissions are reduced. This is the reason we developed Figure 1 (which is from our final

⁴ "EPA Air Pollution Control Cost Manual," 6th Edition, Report #EPA/452/B-02-001, January 2002, Section 1, Chapter 2, pages 2-34 through 2-37

⁵ Fuller, S., Petersen, S., *Life-Cycle Costing Manual for the Federal Energy Management Program*, 1995 Edition, February 1996, pages 5-4 through 5-6



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report's executive summary) which shows the sensitivity of costs and emission reductions to the ALECS cost effectiveness.

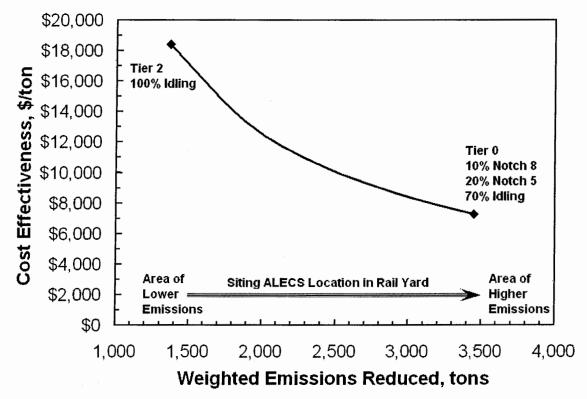


Figure 1. ALECS Cost Effectiveness

General Response to UPRR's other "Substantive Comments":

UPRR also made several "substantive comments". We have only addressed those additional comments that were not addressed in their "three key concerns" above.

1. Even though Tier 2 locomotives are equipped with auto start/stop technology, the Tier 2 scenario used in the Report could represent the auto start/stop technology temporarily disabled (due to testing requirements in maintenance areas). The assumption was that the ALECS would be installed in an area where there are locomotives running and, thus, the lower bound of locomotive emissions available is assumed to only be from relatively "clean" Tier 2 level locomotives (although in reality there are probably a mix of locomotives with some engines possibly operating out of specification and producing abnormally high emissions, but the Report did not make any assumptions on the population of abnormally operating



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locomotives).

- 2. The assumption of development costs of the ECS allocated over multiple marine and locomotive installations are ACTI estimates. The ECS costs are roughly 22% of the total project costs and better estimates can be made after ACTI completes the ECS demonstration that is recommended in the "Next Steps" of the Report.
- 3. Executing a time/motion study with the demonstration of the ECS will provide a better understanding of the operation. As emphasized above and in the "Next Steps" section of our report, further work is needed in order to quantify possible emissions and cost effectiveness:
 - a. UPRR needs to perform a time/motion study to determine possible siting locations and operational changes to maximize, as much as possible, locomotive exhaust emissions.
 - b. ACTI in cooperation with UPRR needs to demonstrate a fully functioning ECS in actual rail yard operations.

Addressing UPRR's "Technical/Editorial Comments":

TIAX appreciates and agrees with UPRR's technical and editorial comments on the final report. These changes would not make any significant changes to the final report.

Best regards,

Michael D. Jackson Senior Director