12011 NE 1st St., Suite 308 Bellevue, WA 98005
425.223.4253 FAX 425.454.1739

May 1, 2014

David Warner
Director of Permit Services
San Joaquin Valley Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno, CA
93726-0244

RE: Public Notice of Authority to Construct
District Facility # N-1237
Project # N-1133659
RULE 4694 Evaluation Determination and Achieved in Practice Evaluation

CC Mike Tollstrup, CARB (w/enclosure) via email
Gerardo Rios, EPA (s/enclosure) via email

Mr. Warner,

This document is submitted pursuant to the public notice regarding San Joaquin Valley District facility # N-1237 project # N-1133659. The District BACT analysis related to Rules 2201 and 4694 reveals erroneous methodology on economic factors specified in the EPA Control Cost Manual Sixth Edition (EPA/452/B-02-001).

The District neglected to modify the effective tax rate from 8.225% to 3.3% per California Law, an equipment amortization period from 10 to 15 years, and an effective interest rate from 10% to 7% (and potentially 4% given today's economic factors) per CARB and EPA.

A summary revision of the analysis applying current CARB and EPA economic factors is illustrated in **Appendix A**.

In addition, the BACT analysis reveals incomplete understanding of the costs related to the NoMoVo system design, installation and operation. NoMoVo is a patent pending invention, with which NohBell Corporation, in cooperation with wineries operating in varying environments throughout California has been capturing fugitive ETOH since 2009. Proven, replicated, documented, verifiable test results should have preferential influence in evaluating the proposed cost effectiveness of the project, rather than the opinions of third party engineering firms without knowledge of the NoMoVo invention and its design, capability or operation.

A summary revision of the analysis applying proven cost estimates generated from 5 years of representative empirical cost data is illustrated in **Appendix B**. Below is a summary of the cost analysis based on reasonably adjusted capital costs and an adjustment of the Economic Factors noted in Appendix A.

Selected Cost Effectiveness Calculations

Note: Revised Costs

Equipment Amortization	Discount Rate	Amortization Factor	Total Capital Cost	Annualized Capital Investment	Annual Costs	Total Annual Cost	Cost Effectiveness (Per ton-VOC)
10	10	0.1627	$ 1,617,453	$ 263,233	$ 248,617	$ 511,850	**$ 14,879**
10	7	0.1424	$ 1,617,453	$ 230,289	$ 248,617	$ 478,906	**$ 13,922**
10	4	0.1233	$ 1,617,453	$ 199,417	$ 248,617	$ 448,034	**$ 13,024**
15	10	0.1315	$ 1,617,453	$ 212,653	$ 248,617	$ 461,270	**$ 13,409**
15	7	0.1098	$ 1,617,453	$ 177,588	$ 248,617	$ 426,205	**$ 12,390**
15	4	0.0899	$ 1,617,453	$ 145,476	$ 248,617	$ 394,093	**$ 11,456**

The data NohBell is submitting in this response to the public notice is based on empirical data recorded in tests throughout California. These tests were conducted in commercial wineries on multiple tanks and operating environments representative those in the San Joaquin Valley from 2009 through 2013.

NoMoVo has been in continuous operation for 5 complete crush seasons at commercial wineries in California, with many successful applications capturing volumes of 50,000 gallons fermenting simultaneously. Successful tests were completed on similar tanks to those indicated in this project description; 60,000 gallon tank, high-rate, short cycle red wine fermentations and which control efficiency was achieved and replicated. In the 5 years of NoMoVo operations, there has never been an instance of negative impact on wine quality, style characteristics, or cross contamination of wine batches, either when controlling single tanks or multiple tanks with a single control device. The systems are cleaned in place and have demonstrated all industry standards for sanitation. A summary of recorded work to date is assembled in an Addendum to this document titled Achievements In Practice (AIP).

Based on the points noted above and supported by the information provided in the addendum, we contend that the NoMoVo system has demonstrated and meets Achieved In Practice requirements.

If the District would have applied the suggested modifications related to the actual operation of the NoMoVo units, as well as realistic economic factors used by CARB, EPA and the other California State Air Districts, the cost per ton would be $ 11,456 as noted in the table above.

Sincerely,

Daniel Belliveau
CEO
NohBell Corporation

Appendix A: EPA and CARB Economic guidelines

Appropriate Tax Rate 2014:

Effective in July 2014, the sales tax in the state of California is being reduced from 8.225% to 3.3% for certain items. Among qualifying expenses are: "Tangible personal property used in pollution control that meets standards established by this state or any local or regional governmental agency within this state." Accordingly, the state tax rate used in cost effectiveness calculations related to NoMoVo should be reduced to this rate.

http://www.boe.ca.gov/sutax/manufacturing_exemptions.htm#Overview

SJVUAPCD Economic Guidelines and Justification for Application of Current Economic Factors:

At issue is the policy currently in use by the SJVUAPCD utilizes discount rates and amortization schedules that were recommended in 1999, when economic conditions were quite different from today. Due to the current low interest rate environment and the expected useful life for wet scrubber systems, the District neglected to apply the tax rate, amortization period, and interest rate, "representative of the specific operation" as outlined in the Valley Air policy:

http://www.valleyair.org/policies_per/policies/apr%201305.pdf

> i = interest rate (use 10%, or demonstrate why alternate is more representative of the specific operation).
>
> n = equipment life (assume 10 years or demonstrate why alternate is more representative of the specific operation).

EPA Cost Manual Amortization Schedule and Interest Rate for Scrubber Technologies:

The District has stated that the BACT analysis is conducted under EPA Control Cost Manual, Sixth Edition (EPA/452/B-02-001) http://www.epa.gov/ttncatc1/dir1/c_allchs.pdf . Despite this, several recommendations described by the manual were neglected.

On page 2-12 of Section 1, there is a directive to follow the social interest rate established by the Office of Management and Budget (OMB) for the analysis of public policy issues. In the OMB Circular A-94, the social rate of interest in approximated to be 7%.

http://www.whitehouse.gov/sites/default/files/omb/assets/a94/a094.pdf

The 10 year amortization period used by The District is applicable to all emissions units that are subject to BACT requirement. On page 2-51 of Section 6 of the EPA Control Cost Manual, an amortization period of 15 years is applied specifically to wet scrubber systems:

"Administrative costs, property tax, and insurance are assumed to be percentages of the TCI [12].

Overhead is assumed to be equal to 60% of the sum of operating, supervisory, and maintenance labor, and maintenance materials [12]. Capital recovery cost is based on the anticipated equipment lifetime and the annual interest rate employed. Table 2.9 gives suggested factors of these items.

An economic lifetime of 15 years is assumed for the wet scrubber system. For a 15-year life and an interest rate of 7 percent, the capital recovery factor, CRF, is equal to 0.1098. The system capital recovery cost is then estimated by:

CRF = 0.1098 TCI (2.47)"

Applying the appropriate amortization period (15 years) as directed by the EPA, a discount rate of 7%, and a tax rate of 3.3%, the annualized capital cost using numbers provided by the SJVUAPCD are:

Annualized Capital Investment = $2,524,306 x 0.1098 = $277,155

Total Annual Cost = Scrubber System + Annual Cost
= $277,155 + $283,668
= $560,824

Cost Effectiveness = $560,824/year ÷ 34.4 tons-VOC/year
= $16,303/ton-VOC

On page 2-12 of Section 1 of the EPA Cost Control Manual, there is further clarification as to the basis of the social rate of interest:

"Like a nominal or real interest rate, a social rate of interest compensates for the foregone benefits associated with spending a dollar today; but for slightly different reasons. Society as a whole has a collective rate of time preference that equates the value of future benefits with an equivalent level of benefits enjoyed now. This rate of preference (interest) would be the same as that which the market would assign to a completely riskless investment. In practice, that riskless investment is represented by the long-term interest rate on government bonds and securities."

In Appendix C of Circular A-94, which was most recently updated in December 2013 by the OMB, the nominal interest rates on 10- and 20-year Treasuries were quoted at 3% and 3.6% per annum, respectively: http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

The California Air Resources Board revised its discount rate for NoMoVo similar pollution control cost-effectiveness to 1% in April of 2013:

http://www.arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmp_appg_3_27_13.pdf

To keep a conservative leaning, a 4% discount rate and a 10 year amortization period will be used to measure cost effectiveness. Applying the current economic discount rate and amortization period results in an amortization factor of:

$$\left[\frac{0.1(1.04)^{10}}{(1.04)^{10}-1}\right] = 0.1233$$

Using this amortization factor, the annualized capital cost using numbers provided by the SJVUAPCD are:

Annualized Capital Investment = $2,524,306 x 0.1233 = $311,224

Total Annual Cost = Scrubber System + Annual Cost
= $311,224 + $283,668
= $594,892

Cost Effectiveness = $594,892/year ÷ 34.4 tons-VOC/year
= $17,293/ton-VOC

Applying a more appropriate 15-year amortization period, we arrive at an amortization factor of:

$$\left[\frac{0.1(1.04)^{15}}{(1.04)^{15}-1}\right] = 0.0899$$

Using this amortization factor, the annualized capital cost using numbers provided by the SJVUAPCD are:

Annualized Capital Investment = $2,521,306 x 0.0899 = $227,039

Total Annual Cost = Scrubber System + Annual Cost
= $227,039 + $283,668
= $510,707

Cost Effectiveness = $510,707/year ÷ 34.4 tons-VOC/year
= $14,846/ton-VOC

Appendix B: SJVAPCD Conclusions and Revised Calculations:

This Appendix includes the SJVAPCD summary assumptions and calculations table published in the public notice in normal case font.

NohBell Corporation's responses are illustrated in bold italics. The Adjusted Costs** are recalculated in the summary table.

District Analysis - Design Basis

• Although the NoMoVo units have not been demonstrated at the scale of operation as proposed by this project the District will conservatively assume that the proposed equipment and equipment cost proposed by NohBell will meet the duty requirements for the project.

- ***NohBell asserts the units have been demonstrated at the scale of operation as proposed by this project, that the system has been achieved in practice on this scale of winery and accepts the District's determination that the equipment and cost will meet the duty requirements for the project. An Addendum to this analysis has been submitted clearly demonstrating efficiency and control consistent with this type of source and scale of operation.***

• The District will consider the average control efficiency of the unit to be 81% for purposes of this project, consistent with the District's BACT Guideline for this class and category.

- ***The results of source testing conducted by the BAAQMD was 96.4% in 2011, and 99.2% in 2013. NohBell accepts the District's use of 81% as the guideline for analysis. BAAQMD source test results are included in the Achieved In Practice Addendum to this document.***

• The EPA Control Cost Manual Sixth Edition (EPA/452/B-02-001) is used for this analysis with modifications to account for project-specific conditions.

- ***NohBell concurs with the use of EPA cost protocols, and insists that modifications to account for project-specific conditions be applied. Specifically, that operational data collected during 2009 – 2013, 5 complete years of testing and operation, be accepted as empirical fact rather than hypothesis. Additionally, the EPA direction stipulating a 15 year amortization period and a 7% interest rate for scrubber type technology be applied along with the modified tax rate of 3.3% for this type of equipment in California. Modifications should be considered subjectively to decrease as well as increase the cost estimates.***

• Instrumentation allowance of $2,000 per NoMoVo unit has been included for a pressure transmitter and a temperature transmitter for monitoring pressure of the collection header and vent stream and temperature from the NoMoVo unit.

- ***There are multiple and redundant cost items inserted in this analysis related to hardware and software required to installing the NoMoVo systems. On page 3 of the public notice document, each fermentation tank is described as having pressure release valves. All of the NoMoVo installations to date have been successfully concluded without pressure or temperature transmitters. The winery has decided this option is desirable, but it is not necessary nor required equipment to operate NoMoVo systems.***

• Sales tax = 8.225% based on California location 12 E & J Gallo Winery N-1237 1133659.

- ***New CA sales tax for certain manufacturing activities goes into effect in July 2014 with a reduction to 3.3%. Among qualifying expenses: "Tangible personal property used in pollution control that meets standards established by this state or any local or regional governmental agency within this state."***
- ***http://www.boe.ca.gov/sutax/manufacturing_exemptions.htm#Overview***

• Foundations and supports are not required. Each unit is supported from either a tank or the pipe rack structure Equipment price includes required attachments and clips.

- ***NohBell concurs with this estimate.***

• Since the units are mobile which are ready for operation upon delivery Handling and Erection is taken to be 2% of Purchased Equipment Cost as an allowance for pre-commissioning.

- ***NohBell concurs with this estimate.***

• Piping is taken to be 1% of Purchased Equipment Cost based on the only requirements being Tee fittings for the tank discharge.

- ***NohBell concurs with this estimate.***

• Gallo has indicated that consistent with their current plant and corporate operating philosophy programmable logic controls and data logging as well as integration with existing digital control systems will be required for any fermentation control system installed. The district has added an allowance of $10,000 per unit to cover the expected hardware and programming cost of this item.

- ***Further to the above comment regarding programmable temperature and pressure controls, this cost estimate is redundant and at the winery's option. It is not required to operate the NoMoVo units.***

• Insulation and painting are not required.

- ***NohBell concurs with this estimate.***

• Recovered ethanol storage tank = $40,000 (installed)

- ***NohBell concurs with this estimate.***

• Due to the unsteady state operation of fermentation tanks initial source testing is expected to be a significant technical operation with significant expense, conducted over the fermentation cycle rather than the typical three 30-minute steady state measurements An additional cost of $15,000 per unit will be assumed for initial source testing.

- ***The units proposed for this installation are identical in construction and operation. Each unit is interchangeable with the each other. NohBell accepts source testing is required and should be***

continued over an extended time as recommended. However, testing of one unit is indicative of the performance of all of the other units. There are no moving parts or differing instruments in the units. The design and operation of the NoMoVo systems inherently perform 100% real time ongoing source testing. By collecting, measuring and logging the captured ETOH, implicit source testing is being completed every moment the systems are operating. NoMoVo operating procedures, emission inventory and record keeping were deemed by the SBCAPCD to, "meet or exceed all requirements."

• Engineering costs will be assumed to be 5% of total direct cost exclusive of city/county plan check costs. The District believes that this value reflects a typical minimum for any significant industrial project and believes that this is consistent with standard estimating and good engineering practice.

- ***NohBell concurs with this estimate.***

• An allowance of $10,000 will be added to cover plan check and building permit fees.

- ***This allowance should be included as part of the above engineering cost estimate.***

• Owners Cost: The District considers a value of $100,000 as a minimum value to cover the project management, internal engineering and operations planning required to implement a significant new process technology of this scale in a commercial winery.

- ***This cost should be considered as part of the above mentioned engineering costs in accordance with EPA cost manual. Either as a percentage or included in the total.***

• Project Contingency: Good engineering practice and accepted norms of the engineering industry when applied to a conceptual estimate of this type require a project contingency exceeding 20%. Contingencies less than 10% are only achieved when preliminary engineering has been completed (all major equipment fully specified and firm quotations received approved piping and instrumentation diagrams plot plans and equipment layouts) plus a preliminary design basis and/or preliminary design sketches with material take-off for all significant cost components of the project. Contingencies less than 5% are only applicable to projects for which all engineering is completed and approved for construction Based on this discussion, the District will apply a conservative project contingency of 20% to the estimated capital investment for this project.

- ***This project is not a concept and contingency should not be applied to the equipment cost of the NoMoVo systems. The system price provided in the Direct Cost calculation (below) is firm and committed by NohBell. A unit contingency is included by the insertion of 18 units satisfying the potential to emit and this number will allow for offline systems to be relocated to tanks with pending fermentations. In addition, contingencies have the possibility of being greater or less than the estimate. In testing and operations to date, the actual cost of operating the systems is less than the cost methodology used in this analysis. If the guiding policy is the EPA cost manual with modifications specific to this analysis, the District should accept what has been achieved to date.***

• Operating labor is estimated based on 2 operator hours per day per operating unit over a 90 day crush season and an hourly cost of $18.50 per hour.

- ***NohBell concurs with this estimate.***

• An allowance for annual maintenance cost was included as 1% of Total Capital Investment.

- ***NohBell concurs with this estimate.***

• Connected electrical load for each unit is 2.5 horsepower which is assumed to operate continuously for 90 days.

- ***NohBell concurs with this estimate.***

• Electric power cost = $0.102/kWh

- ***NohBell concurs with this estimate.***

• Captured ethanol is recovered as a 10% solution suitable for disposal to an ethanol distillery at a cost of $0.08 per gallon 13 E & J Gallo Winery N-1237 1133659.

- ***There are many uses for the recovered solution, however NohBell accepts this cost estimate.***

• Annual source testing will be required. It is assumed that only one representative unit will require testing each year. An annual charge of $15,000 has been included.

- ***NohBell concurs with this cost estimate.***

Scrubber	
Cost Description	Cost ($)
Refrigerated Scrubber System (18 NoVoMo Units)	$1,215,000
The following cost data is taken from EPA Control Cost Manual, Sixth Edition (EPA/452/B-02-001).	
Direct Costs (DC)	
Base Equipment Costs (Scrubber System) See Above	$1,215,000
Systems price includes instrumentation PLC & Programming	
Instrumentation ($2,000 per unit)	$40,000
Instrumentation included in system price*	***$0***
Sales Tax 8.225%	$99,934
Sales Tax 3.3%	***$40,095***
Freight (included)	-
Purchased equipment cost	**$1,354,934**
Accurate Purchased equipment cost*	***$1,255,095***
Foundations & supports (not required)	-

Handling & erection 2%	$27,099
Adjusted Handling & erection cost 2%	***$25,102***
Electrical 1%	$13,549
Adjusted Electrical Cost 1%	***$12,551***
Piping 1%	$13,549
Adjusted Piping Cost 1%	***$12,551***
Painting (not required)	-
Insulation (not required)	-
PLC & Programming	180,000
Adjusted PLC & Programming Cost	***$0***
Recovered Ethanol Storage Tank (installed)	$40,000
Direct installation costs	**$274,197**
Adjusted Direct Installation Costs	***$90,204***
Total Direct Costs (TDC)	**$1,629,131**
Adjusted Direct Costs (adjusted TDC)	***$1,345,299***
Indirect Costs (IC)	
Engineering (5% of TDC)	$81,457
Adjusted Engineering Costs ** (5% of TDC)	***$67,265***
Construction and field expenses (2% of TDC)	$32,583
Adjusted Construction and field expenses** (2% of TDC)	***$26,906***
Permits (Building Department) (Allowance)	$10,000
Contractor fees (2% of TDC)	$32,583
Adjusted Contractor fees** (2% of TDC)	***$26,906***
Start-up (1% of TDC)	$16,291
Adjusted Start-up costs** (1% of TDC)	***$13,453***
Source Testing (18 units x $15,000/unit)	$270,000
***Adjusted Source Testing one unit X $15,000/unit **	***$15,000***
Owner's Cost (Allowance)	$100,000
Adjusted Owner's Cost** (5% of TDC)	***$67,265***
Total Indirect Costs	**$542,914**
Adjusted Total Indirect Costs	***$226,795***
Subtotal Capital Investment (SCI)	**$2,172,045**
Adjusted SCI	***$1,572,094***
Project Contingency (20% of SCI)	$434,409
Adjusted Project Contingency 20% of Indirect Costs Only	***$45,359***
Total Capital Investment (TCI) (DC + IC)	**$2,606,454**
Adjusted Total Capital Investment ** (TCI) (DC+IC)	***$1,617,453***

Annualized Capital Costs

Annualized Capital Investment = Initial Capital Investment x Amortization Factor

Amortization Factor = $\left[\frac{0.1(1.1)^{10}}{(1.1)^{10}-1}\right]$ = 0.1627, amortizing over 10 years at 10%

Therefore,

Annualized Capital Investment = $2,606,454 x 0.1627 = $424,188

Adjusted Annualized Capital Investment** = $1,617,453 x 0.1627 = $263,233

Wastewater Disposal Costs

Additionally, the water scrubber will generate ethanol-laden wastewater containing 34.4 tons-ethanol annually (84,864 lb/year (uncontrolled fermentation emissions) x 0.81 ÷ 2000). Assuming a 10% solution, approximately 103,837 gallons of waste water (34.4 ton-ethanol x 2000 lb/ton x gal/6.62 lb ÷ 0.10) will be generated annually. Per NohBell Corporation, an allowance of $0.08 per gallon is applied for disposal costs.

Annual disposal costs = 103,837 gallons x $0.08/gallon = $8,307

Annual Costs

Annual Costs			
Direct Annual Cost (DC)			
Operating Labor			
Operator	2 hr/day x 18 units x 90 days = 3,240 hr/year	$18.50/h	$59,940
Supervisor	15% of operator		$ 8,991
Maintenance			
Labor	1% of TCI		$26,065
Adjusted Labor**			***$16,175***
Wastewater Disposal			
	10% Solution = 103,455 gal	$0.08/gal	$ 8,307
	Adjust to include water cost…**		***$ 9,530***
Utility			
Electricity	18 units x 2.5 hp x 0.746 kW/hp x 2,160 hr/yr = 72,511 kWh/yr	$0.102/kWh	$ 7,396
Total DC	**(this should have been $110,699)**		$101,022
Adjusted Total DC**			***$111,922***
Indirect Annual Cost (IC)			
Overhead	60% of Labor Cost	0.6 x ($59,940 + $8,991 + $26,065)	$56,998
Adjusted Overhead**		*0.6 x ($59,940 + $8,991 + **$16,175**)*	***$56,997***

Administrative Charge	2% TCI		$52,129
Adjusted Admin*			***$32,349***
Property Taxes	1% TCI		$26,065
Adjusted Prop Tax*			***$16,175***
Insurance	1% TCI		$26,065
Adjusted Insurance*			***$16,175***
Annual Source Test	One representative test/year @ $15,000		$15,000
Total IC			$176,257
Adjusted Total IC*			***$136,695***
Annual Cost (DC + IC)			**$277,279**
Adjusted Annual Cost*			***$248,617***

Total Annual Cost = Scrubber System + Annual Cost
= $424,188 + $277,279
= $701,467

Total Annual Cost** = Scrubber System + Annual Cost
= $263,233 + $248,617
= $511,850

Emission Reductions

The District's BACT Guideline identifies an overall collection and control efficiency of 81% for absorption systems.

Annual Emission Reduction = Fermentation Emissions x 0.81
= 84,864 lb-VOC/year x 0.81
= 68,740 lb-VOC/year
= 34.4 tons-VOC/year

1. ***Cost Effectiveness given understanding of cost and price of NoMoVo***

Cost Effectiveness = Total Annual Cost ÷ Annual Emission Reductions

Cost Effectiveness = $701,467/year ÷ 34.4 tons-VOC/year
= $20,409/ton-VOC

Cost Effectiveness** = $511,850 /year ÷ 34.4 tons-VOC/year
= $14,879 /ton-VOC

The above calculations were performed with a 10% discount rate over a 10 year amortization period. As stated in Appendix A, NohBell believes that different figures should be considered

for these economic metrics. The following table demonstrates the cost effectiveness of NoMoVo units under various scenarios:

Selected Cost Effectiveness Calculations

Note: Revised Costs

Equipment Amortization	Discount Rate	Amortization Factor	Total Capital Cost	Annualized Capital Investment	Annual Costs	Total Annual Cost	Cost Effectiveness (Per ton-VOC)
10	10	0.1627	$ 1,617,453	$ 263,233	$ 248,617	$ 511,850	**$ 14,879**
10	7	0.1424	$ 1,617,453	$ 230,289	$ 248,617	$ 478,906	**$ 13,922**
10	4	0.1233	$ 1,617,453	$ 199,417	$ 248,617	$ 448,034	**$ 13,024**
15	10	0.1315	$ 1,617,453	$ 212,653	$ 248,617	$ 461,270	**$ 13,409**
15	7	0.1098	$ 1,617,453	$ 177,588	$ 248,617	$ 426,205	**$ 12,390**
15	4	0.0899	$ 1,617,453	$ 145,476	$ 248,617	$ 394,093	**$ 11,456**

The following table contains similar calculations to those above, but using the cost figures that were originally proposed by the SJVUAPCD:

Selected Cost Effectiveness Calculations

Note: Base Costs

Equipment Amortization	Discount Rate	Amortization Factor	Total Capital Cost	Annualized Capital Investment	Annual Costs	Total Annual Cost	Cost Effectiveness (Per ton-VOC)
10	10	0.1627	$ 2,524,306	$ 410,819	$ 283,668	$ 694,487	**$ 20,189**
10	7	0.1424	$ 2,524,306	$ 359,404	$ 283,668	$ 643,072	**$ 18,694**
10	4	0.1233	$ 2,524,306	$ 311,224	$ 283,668	$ 594,892	**$ 17,293**
15	10	0.1315	$ 2,524,306	$ 331,880	$ 283,668	$ 615,548	**$ 17,894**
15	7	0.1098	$ 2,524,306	$ 277,155	$ 283,668	$ 560,823	**$ 16,303**
15	4	0.0899	$ 2,524,306	$ 227,039	$ 283,668	$ 510,707	**$ 14,846**

Appendix C: Control Efficiency for High Rate Fermenters

Volume of CO2 Equation for wine fermentation…

$$Volume\ of\ CO_2 = \frac{gas\ volume}{mol\ CO_2} * \frac{moles\ CO_2}{litre} * Temperature\ term$$

$$Volume\ of\ CO_2 = [22.4\ L\ mol\ CO_2] * \left[\frac{210\ g}{L} * \frac{1\ mole\ sugar}{180\ g} * \frac{2\ moles\ CO_2}{1\ mole\ sugar}\right] * \left[\frac{(273.2 + T_g)}{273.2}\right]$$

$$Volume\ of\ CO_2 = 56.0\ L\ CO_2\ per\ L\ of\ juice\ at\ 20℃$$

And using, **Principles and Practices of Winemaking** (hardcover) **by Roger B. Boulton (Author), Vernon L. Singleton (Author), Linda F. Bisson (Author), Ralph E. Kunkee (Author)**

- As the reference on page 198 shows, there is a maximum exhaust rate of 57.9 liters of CO_2 per liter of must at 30 C (57.9 gallons of CO_2 per gallon of must at 86F)

- Using a 56,000 gallon tank at 80% full nets 44,800 gallons usable (typical fill to avoid spillage)
    - In turn, 44,800 gallons at 57.9 gallons of CO_2 per gallon of must yields 2,593,920 gallons CO_2 or 346,757 cubic feet of CO_2 emitted
    - Using an average 46 hour fermentation cycle, the average flow rate is 125.6 scfm

- The kinetic model of the facility indicates double the average flow (2.3 times or 288.6 scfm) and the calculation compounds maximum flow to occur simultaneously for a total of 6926 scfm.
    - The likely outcome is approximately 24 tanks * 125.6 scfm = 3014.4 scfm

- Assuming 81% as average efficiency, NoMoVo average efficiency improves when managing peak flows.
    - At the stated 288 scfm NoMoVo efficiency will be below optimum, but the period prior to, and post peak flow (using a peak of 3 hours at 288 scfm) will drop the flow rate to 114 scfm on average.
    - In turn, the NoMoVo efficiency will be much higher as evidenced by BAAQMD source test results 99.2%.
    - This enables achieving the required 81% less burdensome on the systems.
    - Captured ETOH and recorded tests completed on high rate 60,000 gallon tanks confirm this analysis.

- For Gallo Project N # 1133659 stated planned operation is 5-8 days. Using 5 days, the average flow rate decreases to:
    - 48 scfm average, or 1155 scfm for all tanks combined
        - (only 16.6% of the stated flow rate of 6926 scfm)