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CH2MHILL

February 12, 2010

382914

Mr. Craig Hoffman
Project Manager
California Energy Commission
1516 Ninth Street, MS 15
Sacramento, CA 95814-5512

Subject: Mariposa Energy Project (09-AFC-03)
Data Response Set 1C, Responses to CEC Staff
Data Requests 2, 5, 8, 9, 48, 56, 59, 61, and 65

Dear Mr. Hoffman:

Attached please find one hard copy and one electronic copy on CD-ROM of the Mariposa Energy Project's Data Response Set 1C. These data responses are supplementary to the responses provided in the November 30, 2009, document Mariposa Energy Project (MEP) (09-AFC-03) Data Response Sets 1A and 1B, Responses to CEC Staff Data Requests 1 through 68. These supplemental responses provide additional information that either was not yet available for the November 30 filing or was requested during the December 15, 2009, Data Response workshop.

If you have any questions about this matter, please contact me at (916) 286-0348.

Sincerely,

CH2M HILL

Doug Urry
AFC Project Manager

Attachment

cc: J. Salamy, CH2M HILL
B. Buchynsky, Mariposa Energy, LLC.

APPLICATION FOR CERTIFICATION

DATA RESPONSES, SET 1C

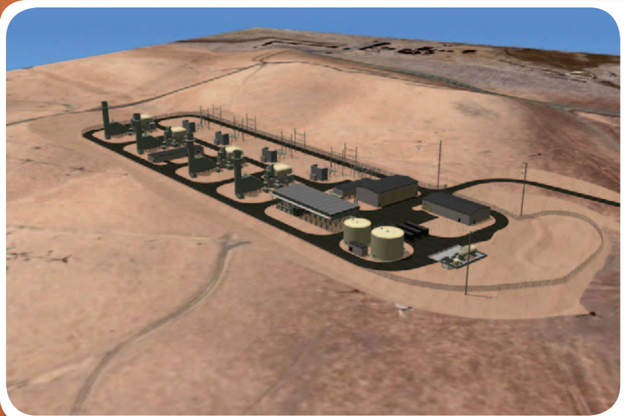
(RESPONSE TO DATA REQUESTS 2, 5, 8, 9, 48, 56, 59, 61, AND 65)

SUBMITTED TO THE

California Energy Commission

FOR THE

Mariposa Energy Project



SUBMITTED BY

Mariposa Energy, LLC

TECHNICAL ASSISTANCE BY

CH2MHILL

FEBRUARY 2010

EY012009005SAC

Mariposa Energy Project

(09-AFC-03)

Data Responses, Set 1C

(Response to Data Requests 2, 5, 8, 9, 48, 56, 59, 61, and 65)

Submitted to

California Energy Commission

Submitted by

Mariposa Energy, LLC

With Assistance from

CH2MHILL

2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

February 2010

Contents

Section **Page**

Introduction

Attached are Mariposa Energy's supplemental responses to the California Energy Commission (CEC) Data Request Sets 1A and 1B (numbers 2, 5, 8, 9, 48, 56, 59, 61, and 65) regarding the Mariposa Energy Project (MEP) (09-AFC-03) Application for Certification (AFC). These data responses are supplementary to the responses provided in the November 30, 2009, document Mariposa Energy Project (MEP) (09-AFC-03) Data Response Sets 1A and 1B, Responses to CEC Staff Data Requests 1 through 68. These supplemental responses provide additional information that either was not yet available for the November 30 filing or was requested during the December 15, 2009, Data Response workshop.

The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as the CEC presented them and are keyed to the Data Request numbers (2, 5, 8, 9, 48, 56, 59, 61, and 65). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 36 would be numbered Table DR36-1. The first figure used in response to Data Request 42 would be Figure DR42-1, and so on.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of each discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

Air Quality (2, 5, 8, and 9)

Background: BACT Analysis

In AFC Section 5.1.6.2.2 BACT Analysis, the AFC states, "A summary of the Best Alternative Control Technology analysis is presented in Appendix 5.1E". However, Appendix 5.1E is the permit application sent to BAAQMD. Of special concern is the proposal for BACT of carbon monoxide (CO), which is at an emission rate (6.0 parts per million) that is higher than other proposals Energy Commission staff is currently reviewing (namely 4.0 ppm CO proposed by Turlock Irrigation District for the Almond 2 Power Plant).

Data Requests

2. Please provide the summary of the BACT analysis.

Response:

In addition to Staff's request, the Bay Area Air Quality Management District (BAAQMD) also requested an expanded analysis to determine the appropriate BACT emission limits for the combustion turbines. Based on this expanded analysis, the proposed CO and PM_{10} emission limits have been reduced from 6.0 ppm to 4.0 ppm CO and from 3.0 lb/hr to 2.5 lb/hr PM_{10}. A summary of the revised BACT determinations proposed for MEP are presented in Table DR2-1. The expanded BACT analysis was submitted to the BAAQMD on January 28, 2010, and a copy of the BAAQMD submittal has also been included as Attachment DR2-1.

TABLE DR2-1
Summary of Proposed BACT for MEP

Pollutant	Combustion Turbines
NOx	Water injection and SCR with NOx emissions of 2.5 ppmvd (1-hour) at 15% O_2
CO	Good combustion design and oxidation catalyst with CO emissions of 4.0 ppmvd (3-hour) at 15% O_2
VOC	Good combustion design and oxidation catalyst with VOC emissions of 2.0 ppmvd (3-hour) at 15% O_2
SO_2	Use of pipeline quality natural gas less than or equal to 1.0 grain of sulfur per 100 dscf
PM_{10}	Use of pipeline quality natural gas and inlet combustion air filtration with PM_{10} emissions of 2.5 lb/hr (0.0052 lb/MMbtu)

Background: Initial Commissioning

The initial commissioning values according to AFC Table 5.1-11 (per turbine) seem to exceed the maximum low-load and startup emissions expected for the LM6000s. For nitrogen oxides (NOx), the hourly emission rate expected during commissioning (51 lb/hr) exceeds even the uncontrolled NOx emissions shown (44 lb/hr) on the vendor sheet (AFC Appendix 5-1B, Table 5.1B.2). Additionally, the initial commissioning steps described in the AFC do not contain information regarding how emissions would be monitored during the phase. The AFC (p. 5.1-24 and Table 5.1-25) describes how up to three turbines may simultaneously undergo commissioning and that the fire pump engine was not included in the commissioning impact analysis.

Data Request

5. Please provide an explanation of how the hourly NOx, carbon monoxide (CO), and volatile organic compound (VOC) commissioning emission rates for the LM6000s were derived.

Response:

During the preparation of the AFC, the turbine vendor confirmed the commissioning schedule and associated oxides of nitrogen (NOx), CO, and VOC emissions used for other LM6000PC SPRINT projects would be applicable for MEP. The NOx emissions presented in Table 5.1-11 of the AFC exceed the maximum emission rates presented in Table 5.1B.2 because the uncontrolled commissioning emissions assume no water injection would be occurring during the initial turbine commissioning phases. In contrast, the emission rates shown on Table 5.1B.2 of Appendix 5-1B of the AFC present the turbine emissions with water injection, which controls the NOx concentration to 25 parts per million by volume (ppmvd) corrected to 15 percent oxygen or a maximum of 44 lb/hr.

Background

The applicant proposes to offset NOx and VOCs to comply with BAAQMD local requirements by securing emission reduction credits. Because the project is likely to also affect air quality in the San Joaquin Valley Air Basin, Energy Commission staff may require additional specific mitigation for particulate matter (PM10) and sulfur oxides (SOx) to ensure localized benefits to the area impacted directly by the Mariposa Energy Project. A complete mitigation strategy would provide one-to-one emission reductions for proposed PM10 and SOx emission increases.

Data Request

8. Please identify and quantify a complete package of proposed mitigation, especially for PM10. For example, if proposed by MEP, strategies to reduce emissions in the San Joaquin Valley and the effectiveness of such strategies would need to be explicitly identified by MEP and preferably developed in consultation with Energy Commission staff before staff makes the information available in the staff assessment.

Response:

Mariposa Energy, LLC, entered into an agreement with the San Joaquin Valley Air Pollution Control District (SJVAPCD) on December 17, 2009, to generate emission reductions of non-attainment pollutants and their precursors in sufficient quantities to mitigate potential

MEP impacts on the San Joaquin Valley Air Basin. This agreement is provided as Attachment DR8-2. As outlined in the agreement, Mariposa Energy, LLC, agrees to provide $644,503 to fund localized air emission reductions in the Northern Region of the San Joaquin Valley Air Basin, particularly within or near the Mountain House Community Service District, City of Tracy, and San Joaquin County. The mitigation total was based on the cost associated with the mitigation of PM_{10} and SOx using the SJVAPCD Burn Cleaner Woodstove Retrofit Program and the cost effectiveness criteria for NOx and VOC under the Carl Moyer Program.

In addition to the SJVAPCD mitigation agreement, Mariposa Energy, LLC, has also purchased BAAQMD emission reduction credits (ERC) to offset the NOx and VOC emissions as required by BAAQMD Regulation 2, Rule 3. A copy of the ERC certificates are provided as Attachment DR8-3. The updated BAAQMD ERC certificates are now in the name of Diamond Generating Corporation.

Data Request

9. Please identify and quantify a mitigation strategy for proposed SOx emissions to ensure that MEP avoids contributing to additional PM10 violations of ambient air quality standards.

Response:

As noted in the response to Data Request #8, Mariposa Energy has entered into an agreement with the SJVAPCD to fund the generation of sufficient emission reductions to mitigate non-attainment pollutant impacts associated with the proposed project.

Attachment DR2-1
BAAQMD BACT Analysis Submittal

Mariposa Energy, LLC
333 S. Grand Ave., Suite 1570, Los Angeles, CA 90071
Tel: (213) 473-0080 Fax: (213) 620-1170

January 27, 2010

Brian Bateman
Director of Engineering
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Subject: Mariposa Energy Project – Application No. 20737 Plant No. 19730
Reductions in the Number of Hours Required for Commissioning, the Startup and Shutdown Emission Rates, and the CO and $PM_{10/2.5}$ Combustion Turbine Emission Rates

Dear Mr. Bateman:

Based on our meeting with you and your staff on November 12, 2009, and a subsequent review of the turbine technology chosen for the Mariposa Energy Project (MEP), Mariposa Energy LLC proposes the following refinements to the MEP:

- Reduction of the number of hours required for commissioning activities
- Reduction of the startup and shutdown emission rates on a per-event basis
- Reduction in the combustion turbine normal operations CO and $PM_{10/2.5}$ emission rates included in the Authority to Construct application.

Reduction of the Number of Hours Required for Commissioning Activities

As discussed in Section 5.1.4.1 of the Application for Certification (AFC), the combustion turbines are required to operate at various load rates during the commissioning phase without the benefit of the emission-control systems. The initial estimate for the MEP commissioning phase was approximately 440 hours per turbine over a 6-month period. As requested by BAAQMD, Mariposa Energy LLC re-evaluated the number of hours required for the commissioning period. Based on this review, the emissions for the final tuning period (240 hours per turbine) are expected to be at or below the best available control technology (BACT) levels established for the project. Therefore, Mariposa Energy LLC proposes to reduce the number of turbine operating hours during commissioning (i.e., period with emissions greater than the BACT emission levels) to 200 hours per turbine.

The revised maximum hourly and total commissioning period emissions are presented in Table 5.1-11R. The maximum hourly emissions remain unchanged because the maximum hourly emission rates will occur during the initial load testing and engine checkout, and the pre-catalyst initial tuning commissioning activities. The detailed emission calculations for commissioning are provided in Attachment 1 (Table 5.1B.1R).

TABLE 5.1-11R
MEP Turbine Commissioning Emission Rate

	NO_x	CO	VOC	SO_2*	PM_{10}*	$PM_{2.5}$*
Maximum Hourly, lb/hr (per turbine)	51	45	4.48	0.91	2.5	2.5
Total Commissioning Period, tons (all turbines)	16.3	8.7	1.0	0.36	1.0	1.0

*Not emitted in amounts greater than normal operating rates.
lb/hr = pound(s) per hour

Reduction of the Startup and Shutdown Emission Rates on a Per-event Basis

As described in Section 5.1.4.1 of the AFC, it was conservatively assumed that during a turbine startup the selective catalytic reduction (SCR) and oxidation catalyst systems would not achieve BACT control levels until 20 minutes after the turbine reached full load (i.e., a total of 30 minutes after initiating a startup sequence). Similarly, it was conservatively assumed that the shutdown duration would be 30 minutes. As requested by BAAQMD, Mariposa Energy LLC re-evaluated the startup and shutdown assumptions to determine if lower emission rates for the startup and shutdown events[1] are feasible.

Based on further review, Mariposa Energy LLC estimates the SCR control system will be fully functional 14 minutes after the turbine reaches full load, and it is expected the oxidation catalyst efficiency will increase linearly from full load to 20 minutes after full load is achieved. As a result, the startup emission rates for NOx, CO, and VOC would be reduced to 14.2, 14.1, and 1.1 pounds per event (lb/event), respectively. Similarly for shutdowns, the shutdown period can be reduced from 30 minutes to 15 minutes. As a result, the shutdown emission rates for NOx, CO, and VOC would be reduced to 3.2, 2.9, and 0.2 lb/event, respectively. However, a startup and shutdown could occur within 1 hour with the balance of the hour at steady state. Therefore, the maximum hourly emission rates associated with startup and shutdown events for NOx, CO, and VOC would be 18.5, 18.1, and 1.7 lb/hr, respectively.

Therefore, Mariposa Energy LLC proposes the revised maximum facility startup and shutdown emission rates presented in Table 5.1-12R, on a pound per event and a pound per hour basis. The maximum facility hourly startup and shutdown emission rates are based on the maximum uncontrolled emission rates for all temperature scenarios, with the remainder of the hour consisting of steady-state operations at base load with air inlet chiller. The detailed estimates of the facility startup and shutdown emissions are provided in Attachment 1 (Table 5.1B.3R).

[1] According to the Title V permits for Goose Haven, Lambie, Creed, Los Esteros, and Gilroy, the startup applicable period begins with the turbine's initial firing and continues until the unit meets the emission concentration limits. Shutdown begins with initiation of the turbine shutdown sequence and ends with the cessation of turbine firing.

As a result of the reduction in the duration of the turbine startup/shutdown events, the annual natural gas usage, turbine greenhouse gas (GHG) emissions, and toxic air contaminant (TAC) emissions would also be reduced. The detailed estimates of the revised natural gas usage, the subsequent GHG emissions and the combustion turbine TAC emissions are provided in Attachment 1 (Tables 5.1B.5R, 5.1B.6R, 5.1B.8R, and 5.1B.9R).

TABLE 5.1-12R
Facility Startup/Shutdown Emission Rates [a]

	NO_x	CO	VOC	SO_2 [b]	PM_{10}	$PM_{2.5}$
Startup (lb/event/turbine)	14.2	14.1	1.1	—	—	—
Shutdown (lb/event/turbine)	3.2	2.9	0.2	—	—	—
Startup (lb/hr/turbine)	16.4	16.3	1.7	≤0.91	≤2.5	≤2.5
Shutdown (lb/hr/turbine)	6.5	6.1	1.1	≤0.91	≤2.5	≤2.5
Maximum Hourly Startup/Shutdown Emission (lb/hr/turbine) [c]	18.5	18.1	1.7	≤0.91	≤2.5	≤2.5

[a]Emissions are based on the following BACT emission levels: 2.5 parts per million (ppm) NOx, 4.0 ppm CO, 2.0 ppm VOC, and 2.5 lb/hr PM_{10} and $PM_{2.5}$

[b]Maximum SO_2 hourly emission rate based on the 0.66 grains of sulfur per 100 dry standard cubic feet (dscf) of natural gas.

[c]The maximum NOx and CO hourly emission represents one 30-minute turbine startup, 15 minutes of steady-state operation at full capacity with air inlet chillers operating, and one 15-minute turbine shutdown. The maximum VOC hourly emission rate represents one 30-minute start-up with 30 minutes of steady-state operation at full capacity with air inlet chillers operating.

Reduction in the Combustion Turbine Normal Operations CO and $PM_{10/2.5}$ Emission Rates

Per conversations with the BAAQMD permitting staff, the BACT levels for the GE LM6000 PC Sprint turbines may be less than the emission levels identified as BACT in the AFC. Therefore, Mariposa Energy LLC conducted a BACT analysis for NOx, CO, VOC, PM_{10}, and SOx to determine the appropriate BACT levels, which included a search of the BAAQMD, South Coast Air Quality Management District, San Joaquin Valley Air Pollution Control District, the California Air Resources Board, and the U.S. Environmental Protect Agency BACT clearinghouse databases. (A copy of the BACT analysis is included in Attachment 2)

Based on the results of the BACT analysis, Mariposa Energy LLC proposes a revised emission level of 4 ppm for CO and 2.5 lb/hr for PM_{10}/$PM_{2.5}$. However, based on the results of the top-down analysis, the NOx, VOC, and SOx emission rates identified in the MEP AFC are less than or equal to the lowest emission levels achieved in practice for other simple-cycle combustion turbines less than 50 MW. Therefore, Mariposa Energy LLC proposes to maintain a BACT level of 2.5 ppm for NOx, 2.0 ppm for VOC, and a natural gas sulfur content of less than 1.0 grain of sulfur per 100 dscf of natural gas (i.e., the use of PUC-grade natural gas).

Table 5.1-16R presents the revised hourly, daily, and annual facility emission totals. The revised emission estimates include the proposed changes to the startup emissions, the reduction of the CO emission level from 6 ppm to 4 ppm, and the reduction of the $PM_{10}/PM_{2.5}$ emission level from 3.0 lb/hr to 2.5 lb/hr. The detailed estimates of the revised hourly, daily, and annual turbine emission rates are provided in Attachment 1 (Tables 5.1B.3R and 5.1B.4R).

TABLE 5.1-16R
MEP Facility Emissions

	NO_x	SO_2	VOC	CO	$PM_{10}/PM_{2.5}$
Maximum Hourly Emissions, lb/hr					
Turbine (per turbine)[a]	18.51	0.91	1.72	18.1	2.5
Emergency Fire Pump	0.37	0.0008	0.009	0.18	0.016
Total Project (lb/hr)	**18.9**	**0.91**	**1.72**	**18.3**	**2.5**
Maximum Facility Daily Emissions, lb/day					
Turbines[b]	1099.2	87.3	134.1	1074.8	240
Emergency Fire Pump	0.37	0.0008	0.009	0.18	0.016
Total Project (lb/day)	**1100**	**87.3**	**134**	**1075**	**240**
Maximum Annual Emissions, lb/yr					
Turbines[c]	91,209	6,210	20,628	89,029	42,250
Emergency Fire Pump	4.5	0.01	0.1	2.1	0.2
Total Project (lb/yr)	**91,213**	**6,210**	**20,628**	**89,032**	**42,250**
Total Project (tpy)	**45.6**	**3.1**	**10.3**	**44.5**	**21.1**

TABLE 5.1-16R
MEP Facility Emissions

	NO_x	SO_2	VOC	CO	$PM_{10}/PM_{2.5}$

[a] The maximum NOx and CO hourly turbine emission rates represent one 30-minute turbine startup, 15 minutes of steady-state operation at full capacity with air inlet chillers operating, and one 15-minute turbine shutdown. The maximum VOC hourly turbine emission rate represents one 30-minute start-up with 30 minutes of steady-state operation at full capacity with air inlet chillers operating.

[b] Daily NO_x, CO, and VOC emissions were estimated assuming 12 startup events, 12 shutdown events and the balance of steady-state operation at full capacity with air inlet chillers operating. Daily SO_2, and $PM_{10/2.5}$ emissions are based on 24 hours of steady-state operation at full capacity with air inlet chillers operating.

[c] Annual emissions were estimated assuming each turbine would start up and shut down 300 times per year and operate 4,000 hours at full capacity with air inlet chillers operating. The annual SO_2 turbine emissions are based on 4,000 hours of operation and an average natural gas fuel sulfur content of 0.25 grains per 100 dscf and 300 startup and shut down events based on an average natural gas fuel sulfur content of 0.66 grains per 100 dscf.

tpy = ton(s) per year

Because of the significant number of changes to the emission profile for the MEP, Mariposa Energy LLC respectfully requests to meet with you and your staff to discuss the details of this letter within the next two weeks, if possible. If you have any questions in the interim, please contact me at (213) 473-0092 or Jerry Salamy at (916) 286-0207.

Sincerely,
Mariposa Energy LLC

Bo Buchynsky

Bo Buchynsky
Executive Director

Attachments: 1 Revised AFC Emissions Calculations
2 Best Available Control Technology Review

c: Craig Hoffman/CEC
Madhav Patil/BAAQMD Permit Engineer
CH2M HILL

Attachment 1
Revised AFC Emissions Calculations

Mariposa Energy Project
Table 5.1B.1R
Commissioning Emission Estimates
January 2010

Expected Commissioning Phases and Emissions for a Single GE LM6000 Turbine[1]

Phase (each turbine)	Hours/Day	Days	Load Range	NOx lbs/hr	CO lbs/hr	VOC lbs/hr	SOx[2] lbs/hr	PM10[2] lbs/hr
Initial Load Testing and Engine Checkout[3]	<=4	<=2	<= 10%	51	45	4.48	0.91	2.5
Pre-Catalyst Initial Tuning[4]	<=8	<=9	50-100%	51	45	4.48	0.91	2.5
Post-Catalyst Tuning[4]	<=8	<=15	50-100%	34	6.2	1.2	0.91	2.5

Notes:

[1] Assumes SCR and oxidation catalyst will limit emissions to BACT levels during the final tuning period, which includes pre-witness performance testing.

[2] Steady state controlled emission rates for SOX and PM10 are 0.91, and 3.0 lbs/hr respectively. These rates have been used to conservatively estimate hourly and total emissions during commissioning.

[3] Unsynchronized operation followed by low load engine check.

[4] Includes the periods both before and after SCR and CO catalyst loading. Post-catalyst period includes water injection for NOx and CO catalyst use.

Phase	Hours/Day	Days	# of turbines	NOx Total lbs	CO Total lbs	VOC Total lbs	SOx Total lbs	PM10 Total lbs
Initial Load Testing and Engine Checkout	4	2	4	1632	1440	143	29	80
Pre-Catalyst Initial Tuning	8	9	4	14688	12960	1290	262	720
Post-Catalyst Initial Tuning	8	15	4	16320	2976	576	437	1200
			Facility Total (lbs)	**32640**	**17376**	**2010**	**728**	**2000**
			Facility Total (tons)	**16.3**	**8.7**	**1.0**	**0.36**	**1.0**

Mariposa Energy Project
Table 5.1B.3R
Startup and Shutdown Emission Estimates
January 2010

Assumptions	Value	Units	Notes
Total Start Up Duration	30	minutes	Includes 10 minutes of turbine startup to full load (GE Curve) and an additional 20 minutes for SCR/Oxidation Catalyst warm up.
Total Shutdown Duration	15	minutes	Includes 7 minutes prior to the 8 minute turbine shutdown period (GE Curve).
SCR/Ox Cat Start Up Duration	20	minutes	SCR/Ox Cat warm up period after turbine start of 10 minutes.
SCR/Ox Cat Shutdown Duration	7	minutes	Additional SCR/Ox Cat shutdown period in addition to the 8 minute GE shutdown curve.
Starts/Shutdowns/Day	12	each	
Starts/CTG/Year	300	each	
Shutdown/CTG/Year	300	each	

	Emission Rate (pound per period)			
Intial Startup/Shutdown	**NOx**	**CO**	**VOC**	**Reference**
Startup Emission Data	3.5	3.0	0.058	Initial 10 minutes - GE LM6000 Start Curve at ISO Conditions
Shutdown Emission Data	2.7	2.4	0.047	Final 8 minutes - GE LM6000 Shutdown Curve at ISO Conditions

Maximum Hourly Emission Rate (Steady State)

	NOx (lb/hr)	**CO (lb/hr)**	**VOC (lb/hr)**	**NOx (lb/min)**	**CO (lb/min)**	**VOC (lb/min)**
without SCR/Ox Cat control	43.950	66.800	6.370	0.733	1.113	0.106
with SCR/Ox Cat control	4.395	4.287	1.191	0.073	0.071	0.020

	Start up/Shutdown Emissions Estimate per CTG								
	Start	Shutdown	Single Start[d]	Single Shutdown[d]	Combined Start-up/Shutdown[e]	Starts Only[f]	Shutdowns Only[f]	Starts Only[g]	Shutdowns Only[g]
Pollutant	Lb/Event[a, b]	Lb/Event[c]	Lb/Hour	Lb/Hour	Lb/Hr	Lb/Day	Lb/Day	Lb/Year	Lb/Year
NOx	14.2	3.2	16.4	6.5	18.5	170.3	38.6	4258.4	963.8
CO	14.1	2.9	16.3	6.1	18.1	169.6	34.8	4240.0	870.0
VOC	1.1	0.2	1.7	1.1	1.6	13.4	2.2	335.9	55.8

[a] NOx lb/event is calculated as: (3.5 pounds during initial period + (14 minutes*uncontrolled NOx emission rate)+(6 minutes * controlled emission rate))
[b] The CO and VOC lb/event value assumes the control efficiency of the oxidation catalyst increases linearly from minute 10 through minute 30 of the startup event.
[c] Shutdown lb/event values are calculated as ((7 minutes * controlled emission rate) + (emissions during final 8 minutes))
[d] The single start and shutdown hourly emission rates assumes one start or one shutdown per hour with the remainder of the hour at the maximum controlled emission rate.
[e] The combined start-up/shutdown emission rate represents the 1-hour emission rate assuming one 30-minute turbine start-up, 15 minutes of the maximum controlled emission rate (i.e., steady-state operation at full capacity with inlet chillers operating), and one 15-minute turbine shutdown.
[f] Daily emission rate only includes the emissions for 12 startup or 12 shutdown events (i.e., does not include hours for steady-state operation)
[g] Annual emission rate only includes the emissions for 300 startup or 300 shutdown events (i.e., does not include hours for steady-state operation)

	Start up/Shutdown Emissions Estimate for 4 CTG				
	Start	Shutdown	Start	Shutdown	Start/Stop
Pollutant	Lb/Day	Lb/Day	Lb/Year	Lb/Year	TPY
NOx	681.3	154.2	17033.4	3855.3	10.4
CO	678.4	139.2	16960.0	3480.2	10.2
VOC	53.7	8.9	1343.6	223.2	0.8

Mariposa Energy Project
Table 5.1B.4R
Turbine Criteria Pollutant Emission Estimates
January 2010

Daily Emissions based on Maximum daily operation of 24 hours/day
Annual Emissions based on Maximum annual operation of 4000 hours/year

Normal Operation Scenario(1)				Fuel Input[1,3]		Emissions[1,3] (Per Turbine) NOx			CO			VOC			Particulates			SO_2[2]			
Ambient	GE	RH	Load	Per CT	Per CT	lb/hr	lb/day	lb/yr	lb/hr	lb/day	lb/yr	lb/hr	lb/day	lb/yr	lb/hr	lb/day	lb/yr	Max lb/hr	lb/day	Avg lb/hr	lb/yr
Temp F	Date	%	%	MMBtu/hr (HHV)	lb/hr																
17	1/29/2009	80	100	465	22,108	4.24	102	16,960	4.1	99	16,519	1.16	28	4,633	2.5	60	10,000	0.88	21.1	0.33	1,302
46	1/27/2009	95	100	481	22,891	4.40	105	17,580	4.3	103	17,147	1.19	29	4,765	2.5	60	10,000	0.91	21.8	0.34	1,348
59	1/27/2009	60	100	465	22,117	4.25	102	16,988	4.1	99	16,533	1.16	28	4,626	2.5	60	10,000	0.88	21.1	0.33	1,302
59	12/9/2008	60	50	282	12,364	2.6	62	10,400	2.4	59	9,790	0.78	19	3,120	2.5	60	10,000	0.53	12.8	0.20	790
93	1/27/2009	26	100	391	18,591	3.6	86	14,276	3.5	84	13,945	0.97	23	3,896	2.5	60	10,000	0.74	17.7	0.27	1,095
93	12/9/2008	26	50	270	11,842	2.4	58	9,600	2.3	56	9,324	0.71	17	2,840	2.5	60	10,000	0.51	12.3	0.19	757
112	1/29/2009	15	100	338	16,092	3.09	74	12,348	3.0	72	12,041	0.84	20	3,374	2.5	60	10,000	0.64	15.3	0.24	947

50% load

(1) Source: GE Gas Turbine Performance Sheets for 17, 46, 59, 93 and 112F.
Data for 17 and 112F (Base Load) are based on January 29, 2009 data.
Data for 46, 59, and 93F (Base Load) are based on January 27, 2009 data.
Data for 59 and 93F (50% Load) are based on December 9, 2008 data
(2) Maximum SO2 Emissions based on a emission factor of 0.00189 lb SO2 per MMbtu natural gas - Source: 0.66 gr sulfur/100 cf natural gas, using method in AP-42 ch.1 table 1.4-2 and natural gas heat value of 1047 btu/scf.
(3) Per CTG, assuming BACT levels of 2.5 ppm NOx, 4 ppm CO, and 2 ppm VOC. Daily emissions represent 24 hours per day per CTG. Annual emissions represent 4000 hours per CTG per year.

Modeling Scenarios

Normal Operation Scenario(1)				Exhaust Stack Conditions: Stack Temp	Flow		Stack Height	Stack Diameter	Velocity	Maximum Exhaust Emissions Rates (pound per hour)(per turbine): NOx		CO		SOx				PM10		PM2.5	
Ambient	GE	RH	Load	F	lb/hr	ACFM[a]	Feet	Feet	ft/s	1-Hour[b]	Annual[c]	1-Hour[b]	8-Hour[d]	1-Hour[b]	3-Hour[e]	24-Hour[f]	Annual[c]	24-Hour[f]	Annual[c]	24-Hour[f]	Annual[c]
Temp F	Date	%	%																		
17	1/29/2009	80	100	780	1127562	607693	79.5	12.0	89.6	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
46	1/27/2009	95	100	840	1083789	612224	79.5	12.0	90.2	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
59	1/27/2009	60	100	848	1051375	597341	79.5	12.0	88.0	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
59	12/9/2008	60	50	743	842305	440226	79.5	12.0	64.9	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
93	1/27/2009	26	100	861	930219	533924	79.5	12.0	78.7	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
93	12/9/2008	26	50	781	787723	424813	79.5	12.0	62.6	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206
112	1/29/2009	15	100	863	845007	485749	79.5	12.0	71.6	18.506	2.493	18.105	9.737	0.910	0.910	0.910	0.1625	2.50	1.206	2.50	1.206

50% load

[a] Assumes exhaust gases have an average molecular weight of 28.0 lb/lbmol, pressure of 1 atm, and gas constant equal to 0.7302 atm ft^3/(lbmol R).
[b] Maximum 1-hr scenario assumes one startup lasting 30 minutes, 15 minutes of steady state operation, and one shutdown lasting 15 minutes.
[c] Annual emission rate for NOx, SOx, PM10, and PM2.5 were conservatively based on 4,000 hours of turbine operation at full capacity with air inlet chiller operating, plus 300 startup and shutdown events. The annual SO2 emission rate is based on
[d] 8-Hour Scenario assumes 3 startups, 3 shutdowns, and the balance of steady-state
[e] 3-Hour Scenario assumes 3 hours of steady-state operation
[f] 24-hour PM10/PM2.5 emission rate estimate based on the worst-case 1-hour emission rate (full capacity with air inlet chiller operating).

Mariposa Energy Project
Table 5.1B.5R
Turbine TAC Emission Estimates
January 2010

Assume:
Maximum Heat Input Case: Full Load Simple Cycle Operating Condition with Mechanical Chillers Operating

Unfired Operations Hours/Year	4225	Hours/Year (4,000 hours of normal operations plus 300 startup and shutdown events)
Gas Heat Content =	1020	MMBtu/MMSCF
Hourly CTG Heat Input (per unit)	481.3	MMBtu/Hr high heating value (HHV)
Hourly CTG Heat Input (per unit)	0.472	MMCF/Hr
Annual CTG Heat Input (per unit)	1994	MMCF/Yr

Compound	Emission Factor (Lb/MMCF)[a]	Maximum CTG and DB Heat Input (mmBtu/hr)	Gas Input (MMCF/hr)	Turbine Emissions					
				lb/hr/CT	lb/hr/4-CT	lb/yr/CT	TPY/CT	lb/yr/4-CT	TPY/4-CT
Ammonia[b]	5 ppm	481	0.472	3.3	13.1	13841	6.9	55365	27.7
Acetaldehyde	0.137	481	0.472	0.06	0.259	273	0.1	1093	0.55
Acrolein	0.00369	481	0.472	0.002	0.007	7.4	0.00	29	0.015
Benzene	0.0133	481	0.472	0.006	0.025	27	0.01	106	0.05
1,3-Butadiene	0.000127	481	0.472	0.00006	0.000	0.3	0.0001	1	0.0005
Ethylbenzene	0.0179	481	0.472	0.008	0.034	36	0.02	143	0.07
Formaldehyde	0.917	481	0.472	0.4	1.731	1828	0.9	7313	3.7
Hexane	0.259	481	0.472	0.12	0.489	516	0.3	2065	1.0
Naphthalene	0.00166	481	0.472	0.0008	0.003	3.3	0.002	13	0.007
PAHs[c]	0.000014	481	0.472	0.00001	0.000	0.03	0.00001	0	0.00006
Propylene	0.771	481	0.472	0.36	1.455	1537.1	0.8	6148	3.1
Propylene Oxide	0.0478	481	0.472	0.023	0.090	95	0.05	381	0.19
Toluene	0.071	481	0.472	0.034	0.134	142	0.1	566	0.28
Xylene	0.0261	481	0.472	0.012	0.049	52	0.03	208	0.10
TOTAL HAPs						4517	2.3	18067	9.0

Notes:

[a] Obtained from the California Air Toxics Emission Factors (CATEF) database with the exception of acrolein. According to the ARB CATEF website, the ARB does not recommend using the acrolein emission factors until the questions related to the acrolein sampling method are resolved. Therefore, the acrolein emission factor from AP-42 (April 2000) was used (Table 3.1-3)

[b] Based on the simple cycle operating exhaust NH_3 limit of 5 ppmv @ 15% O_2 and a F-factor of 8710.

[c] Carcinogenic PAHs only; naphthalene considered separately. Emission Factor based on two separate source tests (2002 and 2004) from the Delta Energy Center located in Pittsburg, CA.

Mariposa Energy Project
Table 5.1B.6R
Turbine GHG Emission Estimates
January 2010

Turbine Natural Gas Use: 8,133,970 MMBtu/yr

	Emission Factor (kg/MMBtu)	Emissions (metric tons/year)
CO2	53.06	431,588
CH4	0.0059	48
N2O	0.0001	0.8

CO2 emission factor from CCAR General Reporting Protocol (version 3.0, April 2008) Table C.6.
CH4 and N2O emission factors from CCAR General Reporting Protocol (version 3.0, April 2008) Table C.7.

Mariposa Energy Project
Table 5.1B.8R
Facility Wide Greenhouse Gas Emission Summary
January 2010

Source	Emissions (Metric tons per year)			
	CO_2	CH_4	N_2O	CO_2e
Turbines	431,588	48	0.8	432,848
Fire Pump	0.5	0.00001	0.00000	0.5
Total	431,589	48	1	432,849

CO_2 Equivalent Emissions (metric tons/year) =[CO_2 Emissions] + [CH_4 Emissions x CH_4 GWP] + [NO_2 Emissions x NO_2 GWP]

Global Warming Potential

CH_4	21
N_2O	310

Reference: Intergovernmental Panel on Climate Change, Second Assessment Report (SAR) (IPCC, 1996).

Mariposa Energy Project
Table 5.1B.9R
Facility Wide Maximum Natural Gas Fuel Use
January 2010

Total annual heat input per unit		
Turbine	481.3	MMBtu/Hr

Hours/Year	
Turbine	4225

Hours/Year include 300-30 minute startups and 300-15 minutes shutdowns

Max Fuel Use	**Turbine (per unit)**	**Total All Units**
Per Hour (MMBtu)	481	1,925
Per Day (MMBtu)	11,551	46,205
Per Year (MMBtu)	2,033,493	8,133,970

Maximum daily fuel use is based on the maximum rated heat capacity multiplied by 24 hours/day

Attachment 2
Best Available Control Technology Review

Final

Mariposa Energy Project

(09-AFC-03)

Best Available Control Technology Review

Submitted to

Bay Area Air Quality Management District

Submitted by

Mariposa Energy, LLC

With Assistance from

CH2MHILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

January 2010

Contents

Acronyms and Abbreviations

°F	degrees Fahrenheit
AFC	Application for Certification
ARB	Air Resource Board
BAAQMD	Bay Area Air Quality Management District
BACT	Best Available Control Technology
BCPP	Bosque County Power Plant
CAPCOA	California Air Pollution Control Officers Association
CEC	California Energy Commission
CO	carbon monoxide
CPUC	California Public Utilities Commission
CTG	combustion turbine generator
DLE	dry low NOx
dscf	dry standard cubic feet
EPA	U.S. Environmental Protection Agency
GE	General Electric
LAER	Lowest Achievable Emission Rate
lb/hr	pound(s) per hour
lb/MMBtu	pound(s) per million British thermal unit
MEP	Mariposa Energy Project
MMBtu/hr	million British thermal units per hour
MW	megawatt(s)
NOx	nitrogen oxides
O_2	oxygen
PG&E	Pacific Gas and Electric Company
$PM_{2.5}$	particulate matter less than 2.5 micrometers in aerodynamic diameter
PM_{10}	particulate matter less than 10 micrometers in aerodynamic

	diameter
PPA	Power Purchase Agreement
ppm	parts per million
ppmvd	parts per million dry volume
RACT	Retrofit Available Control Technology
RFO	Request for Offers
SCAQMD	South Coast Air Quality Management District
SCR	selective catalytic reduction
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_2	sulfur dioxide
SOx	sulfur oxides
TCEQ	Texas Commission on Environmental Quality
VOC	volatile organic compound
WDNR	Wisconsin Department of Natural Resources

Mariposa Energy Project Best Available Control Technology Review

The Mariposa Energy Project (MEP) will be a nominal 200-megawatt (MW) (194 MW net at 59 degrees Fahrenheit [°F]), simple-cycle peaking facility. The facility will be located southeast of the intersection of Bruns Road and Kelso Road in an unincorporated portion of northeastern Alameda County, within the boundaries of the Bay Area Air Quality Management District (BAAQMD). The generating facility will consist of four natural-gas-fired combustion turbine generators (CTG) and each CTG will generate approximately 50 MW (gross) at full load under average ambient conditions.

As discussed in the Application for Certification (AFC) submitted to the California Energy Commission (CEC), the uncontrolled CTG emissions of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), and particulate matter (PM_{10} and $PM_{2.5}$) would exceed the daily BAAQMD Best Available Control Technology (BACT) emission thresholds (BAAQMD Rule 2-2-301). Therefore, the project is required to reduce emissions through the installation of BACT. This document presents an assessment of the appropriate BACT levels for MEP and includes the following components:

- Description of the project objectives
- Summary of the gas turbine selection process
- Outline of the procedure used to conduct the BACT determination analysis
- Discussion of the available technology options for controlling NOx, CO, VOC, PM_{10}, $PM_{2.5}$, and sulfur oxides (SOx)
- Presentation of the BACT emission levels identified for MEP

Project Objectives

The California Public Utilities Commission (CPUC) Decision 07-12-052 identified the need for Pacific Gas and Electric Company (PG&E) to acquire between 800 and 1,200 MW of new electric generation resources, with a preference for dispatchable and operationally flexible resources. In response to this decision, PG&E issued a Request for Offers (RFO) on April 1, 2008, indicating that additional peak electric generation capacity was needed (PG&E, 2008). The RFO contained criteria for new conventional peaking generation that drove Mariposa Energy LLC's turbine selection process. For instance, the RFO required projects to have a minimum dispatchable electrical generation capacity of 25 MW with low minimum output level relative to the maximum output as a key selection criterion (PG&E, 2008).

Mariposa Energy LLC's participation in PG&E's RFO process resulted in the signing of a Power Purchase Agreement (PPA) between PG&E and Mariposa Energy LLC. The MEP contractual terms of the PPA requires the generation of megawatts into the PG&E electrical system on demand to support system reliability. This is demonstrated in the PPA by the inclusion of significant penalty provisions for missing a gas turbine start request.

Therefore, MEP has the following PPA contractual requirements:

- A minimum dispatchable electrical capacity of 184 MW (at a peak July temperature of 93°F and 26 percent relative humidity)
- High degree of unit turndown (a low minimum operating rate relative to the maximum output) with the minimum generation rate of 24.9 MW.
- Up to 300 "on-demand" system starts and 4,000 hours of peaking operation per turbine per year.

Gas Turbine Selection Process

Two types of gas turbines are commonly used in the power generation industry: the large frame heavy-duty design and the aero-derivative gas turbines typically found in the aircraft industry. Both gas turbines have been widely used and the selection of the turbine is determined by the amount of energy needed to be generated and the anticipated cycling duty and load profile.

Large Industrial Turbines. An industrial frame gas turbine consists of an axial flow compressor with multiple can-annular combustors each connected by cross flame tubes. The turbine has a firing temperature of around 2500°F with anticipation that future advanced industrial frame turbines will reach 3000°F to achieve higher efficiencies. The advantages of the large frame industrial gas turbines are their long life, reliable operation and low combustion emissions. Since the 1990s, the industrial frame gas turbines have been the primary machine used in combined-cycle power plants.

Large industrial frame gas turbines are able to use a can-annular configuration because the combustion chamber is large enough to use a multiple combustion nozzle approach in a confined space, known in the industry as a "basket." These multiple baskets are in a circumferential configuration in the center of the gas turbine and can be controlled independently to improve the combustion process. In many cases a ring of nozzles is placed in the "basket" concentrating the process in a primary zone for combustion. The ability to configure the nozzles in this design leads to a dry low NOx combustion process where water injection is not necessary. However, a can-annular configuration requires increased cooling of circulating air around the baskets and results in a lower achievable firing temperature. The lower firing temperature also lowers efficiency of the large industrial frame turbine when compared to an aero-derivative design.

Mariposa Energy LLC considered the use of heavy-duty (i.e., industrial) turbines for MEP. However, industrial gas turbines, such as the General Electric (GE) Frame 7 or Siemens SGT6-5000 units, typically have electrical-generation capacities in the 80 to 190 MW range and are not capable of operating at load rates of less than 50 percent or 40 to 85 MW. For example, a review of the Mirant Marsh Landing Generating Station AFC Amendment shows that each of the Siemens 5000F gas turbines is rated at approximately 190 MW with a minimum operating rate of 60 percent or 114 MW (CEC, 2009a). In contrast, the aero-derivative turbine technology offers efficient operation over the entire operating range and varies in size from 14.3 to 43.9 MW (GE, 2010). Therefore, in order to meet the minimum dispatch requirements of 25 MW, Mariposa Energy LLC selected the aero-derivative turbine technology.

Aero-derivative Gas Turbines. Aero-derivative gas turbines are also known as aircraft-derivative gas turbines. Aero-derivative gas turbines consist of two basic components: an aircraft-derivative gas generator and a free power generator. The gas generator serves as a producer of gas energy or gas horsepower where the high-pressure turbine section extracts enough energy to drive the high-pressure compressor section connected to the same shaft. Hot gases pass to the low-pressure turbine section that in turn drives the low-pressure compressor section on a separate but concentric shaft inside the shaft connecting the high-pressure compressor and turbine sections. The concentric shafts are able to operate at independent speeds thus optimizing the efficiency of the turbine. In an aircraft engine application, the low-pressure turbine exhaust would be available to provide forward propulsion thrust. In a stationary application for power generation, the energy in the exhaust gases is captured by a power turbine and used to drive an electrical generator.

Aero-derivative gas turbines are generally smaller in size and power output than the industrial frame turbines and are used in applications less than 100 MW. These turbines are used in both combined-cycle and simple-cycle mode and have favorable maintenance considerations due to modular design features developed for aircraft engine applications. The aero-derivative gas turbine is designed to withstand many stops and starts and is very adaptable to frequent load changes making it an ideal choice for load following plant applications that demand the highest level of operating flexibility.

In contrast to the industrial gas turbine, the aero-derivative gas turbine consists of an annular combustor. Annular combustors are used mainly in aero-derivative gas turbines because the use of concentric rotating shafts and a low- and high-pressure turbine section requires the ignition to be in the frontal position. This design uses individual multiple fuel nozzles providing combustion and is usually a straight-through-flow type with the outside casing radius the same size as the compressor casing, resulting in a more streamlined design. The annular combustor requires less cooling air (compared to the can-annular design), which supports a higher firing temperature resulting in better efficiency. The higher firing temperature is an advantage, but leads to higher NOx formation.

The GE LM6000 turbine is a common aero-derivative turbine chosen for peaking facilities in California, with an operating range from approximately 25 to 50 MW at 50 percent load and full load, respectively. Mariposa Energy LLC considered three LM6000 models available at the time of the release of the RFO (April 2008). The three LM6000 models included the LM6000PC (water injected), the LM6000PD (dry low-NOx or DLE), and the LM6000PF (DLE). The LM6000 turbines also have a SPRINT (Spray Inter-cooled Turbine) technology option. The GE SPRINT technology is GE patented technology that reduces compressor discharge temperature by injecting atomized water into the low- and high-pressure compressors. According to GE product materials, the SPRINT power augmentation feature results in an increased generating output of approximately 15 percent and 11 percent at ISO conditions for the water-injected and DLE models, respectively (GE, 2010). For example, the GE LM6000PC and LM6000PD turbines have a full load electrical capacity of approximately

43.4 and 42.3 MW at ISO conditions. Therefore, the maximum output for the LM6000PC and LM6000PD turbines is increased to approximately 50 and 47 MW, respectively, with the inclusion of the SPRINT power augmentation.

As part of the turbine selection process, the turbine vendor provided performance data for both the water-injected and DLE LM6000 SPRINT gas turbines (see Table 1). As presented in Table 1, the water-injected LM6000 gas turbine (LM6000PC) would result in a higher electrical production rate compared to the DLE models. For example, the electrical output for the PC model would be approximately 2.6 MW more than the DLE models at 93°F, or approximately 10.4 MW for the project. Although the LM6000PF turbine would have a lower NOx emission rate than the PC or PD models, the DLE models would have higher hydrocarbon and CO emission rates (except at the 17°F temperature case) compared to the water-injected PC turbine. Furthermore, the use of selective catalytic reduction (SCR) would effectively reduce the NOx emission rate for all three turbines to 2.5 parts per million (ppm) (see discussion on the feasible NOx control technologies). Therefore, the lower LM6000PF NOx emission rate would not counter the overall benefit of an additional 10.4 MW of electric generation produced by the LM6000PC turbine under the same ambient conditions.

Because of the reliability requirements of the RFO, Mariposa Energy LLC also researched the reliability of each LM6000 model. According to GE, more than 600 LM6000 power generation packages collectively have been sold worldwide, which have accumulated more than 10 million operating hours at 98.8 percent documented gas turbine availability and 97.7 percent gas turbine and generator set availability (GE, 2010). Of the approximately 600 LM6000 packages sold, approximately 500 have been the LM6000PC (water injected) turbine and approximately 100 have been the LM6000 PD turbine. At the time of the RFO fewer than five LM6000 PF turbines had been sold worldwide. Therefore, the LM6000PF turbine would be less desirable than the LM6000PC and LM6000PF turbines for meeting the "on demand" and reliability requirements of the RFO.

Overall, all three of the LM6000-based gas turbines would have met the project contractual requirements of dispatchable and high degree of unit turndown. However, the LM6000PD and LM6000PF gas turbines do not meet the project objective of being capable of generating 184 MWs during peak July conditions. Furthermore, the limited hours of operating data available for the LM6000PF turbine increases the risk the turbine may not be available "on demand," which would lead to penalty provisions subject to the PPA. Therefore, the LM6000PC turbine was selected by Mariposa Energy LLC for MEP in order to meet the electrical output and reliability requirements outlined in the Mariposa Energy LLC PPA with PG&E.

TABLE 1
Comparison of GE LM6000 SPRINT Water-injected and DLE Combustion Technologies

Combustion Technology	PC	PD	PF	PC	PD	PF	PC	PD	PF	PC	PD	PF
Ambient Temperature, °F	17.0	17.0	17	46	46	46	59	59	59	93	93	93
Inlet Conditioning	HEAT	HEAT	HEAT	NONE	NONE	NONE	EVAP	EVAP	EVAP	EVAP	EVAP	EVAP
Load Rate, Percent	100	100	100	100	100	100	100	100	100	100	100	100
Electrical Production, MW	50.2	48.3	47.9	50.7	47.8	47.7	49.7	46.9	46.8	46.3	43.8	43.7
Heat Rate*, Btu/kW-hr, LHV	8461	8115	8128	8548	8238	8248	8566	8276	8283	8647	8407	8414
NOx Control	Water	DLE	DLE	Water	DLE	DLE	Water	DLE	DLE	Water	DLE	DLE
Emissions Rates												
NOx ppmvd Ref 15% O_2	25	25	15	25	25	15	25	25	15	25	25	15
CO ppmvd Ref 15% O_2	53.2	25	25	20.9	25	25	15	25	25	7.6	25	25
HC ppmvd Ref 15% O_2	8.2	15	15	2.2	15	15	2.1	15	15	2.1	15	15

PC = GE LM6000PC SPRINT Turbine
PD = GE LM6000PD SPRINT Turbine
PF = GE LM6000PF SPRINT Turbine
Water = water injected
DLE = dry low NOx
ppmvd Ref 15% O_2 = parts per million by volume dry corrected to 15% oxygen
HC = precursor organic compounds
* estimated

Methodology for Evaluating the Turbine BACT Emission Levels

The BAAQMD Regulation 2-2-206 defines BACT as the following:

> **Best Available Control Technology:** For any new or modified source, except cargo carriers, the more stringent of:
>
> > 206.1 The most effective emission control device or technique which has been successfully utilized for the type of equipment comprising such a source; or
> >
> > 206.2 The most stringent emission limitation achieved by an emission control device or technique for the type of equipment comprising such a source; or
> >
> > 206.3 Any emission control device or technique determined to be technologically feasible and cost-effective by the APCO; or
> >
> > 206.4 The most effective emission control limitation for the type of equipment comprising such a source which the EPA states, prior to or during the public comment period, is contained in an approved implementation plan of any state, unless the applicant demonstrates to the satisfaction of the APCO that such limitations are not achievable. Under no circumstances shall the emission control required be less stringent than the emission control required by any applicable provision of federal, state or District laws, rules or regulations.
>
> The APCO shall publish and periodically update a BACT/TBACT Workbook specifying the requirements for commonly permitted sources. BACT will be determined for a source by using the workbook as a guidance document or, on a case-by-case basis, using the most stringent definition of this Section 2-2-206.

In order to determine the appropriate BACT requirements for MEP, a BACT determination was conducted using the following steps:

Step 1: Conducted a search of the various federal, state, and local BACT, Retrofit Available Control Technology (RACT), and Lowest Achievable Emission Rate (LAER) databases to identify the emission levels reported for natural-gas-fired, simple-cycle turbines. The search included the following databases:

a. Bay Area Air Quality Management District BACT/TBACT Guidelines (BAAQMD, 2010)

   – Search included the BACT determinations for simple-cycle turbines equal to or greater than 40 MW in Section 2, Combustion Sources in the BAAQMD BACT Guidelines.

b. CAPCOA/California Air Resources Board (ARB) BACT Clearinghouse (ARB, 2010)

   – Search included the BACT determinations listed in CARB's BACT Clearinghouse for simple-cycle turbines between 2 MW and 50 MW from all California air districts. No data are available for simple-cycle turbines greater than 50 MW in CARB's BACT Clearinghouse database.

c. U.S .Environmental Protection Agency (EPA) BACT/LAER Clearinghouse (EPA, 2009)

   – Search included the NOx, CO, VOC, PM, and sulfur dioxide (SO_2) BACT/LAER determinations for simple-cycle, large combustion turbines (greater than 25 MW) in

EPA's database with permit dates for the years 2004 through 2009. Combined-cycle turbines were not included in the BACT summary for this analysis.

- In addition to the search above, the search included the lowest emissions levels of CO and NOx turbines greater than 25 MW and permitted from 1999 through 2009.

d. South Coast Air Quality Management District (SCAQMD) BACT Guidelines (SCAQMD, 2010)

- Search included the BACT determinations for gas turbines listed in SCAQMD BACT Guidelines for major sources.

e. San Joaquin Valley Air Pollution Control District (SJVAPCD) BACT Clearinghouse (SJVAPCD, 2010)

- Search included the BACT determinations listed under the SJVAPCD BACT Guideline Section 3.4.8 (simple-cycle, uniform-load gas turbines less than 50 MW).

Exhibit 1 (at the end of this report) provides a summary of the complete list of projects indentified in the BACT, RACT, LAER databases.

Step 2: Compared the previous and current natural-gas-fired, simple-cycle turbines permit emission limits to the proposed MEP turbine emission limits of 2.5 parts per million (ppm) NOx at 15 percent oxygen (O_2) (1-hour average), 4.0 ppm CO at 15 percent O_2 (3-hour average), 2.0 ppm VOC at 15 percent O_2 (3-hour average), 2.5 pounds per hour (lb/hr) $PM_{10/2.5}$, and 0.66 grains of sulfur per 100 dry standard cubic feet (dscf) of natural gas. A table of projects with emission limits less than the proposed MEP emission limits was compiled for each pollutant. The individual tables are included in the control technology discussion for each pollutant.

Step 3: The permitting agencies for each of the facilities with an emission limit less than the proposed MEP emission rate were contacted to determine if the facilities had been constructed and if so, to determine if the facilities had exceeded the permitted levels.

Step 4: The MEP BACT control technologies and emission levels were selected.

Feasible Combustion Turbine NOx Emissions Control Technologies

Several potential technologies exist for controlling combustion turbine NOx emissions. These are categorized into pre-combustion controls and post-combustion controls. The following is a discussion of the potential control technologies and a discussion of their technical feasibility for simple-cycle combustion turbines.

Pre-combustion NOx Control Technologies

Water or Steam Injection. The injection of water or steam into the combustor of a gas turbine quenches the flame and absorbs heat, reducing the combustion temperature. This temperature reduction reduces the formation of thermal NOx. Water or steam injection also allows more fuel to be burned without overheating critical turbine parts, increasing the combustion turbine's maximum power output.

The use of water or steam injection can reduce NOx emissions to a vendor-guaranteed level of 25 ppmvd at 15 percent O_2 when firing natural gas under most ambient conditions, except during very cold ambient air temperatures. Under very cold ambient air temperatures, the effectiveness of water injection is reduced.

Dry Low NOx (DLE) Combustors. There are two types of DLE combustors on the market: lean premix and catalytic technologies. The lean premix type is the most popular DLE combustor available. Conventional combustors are diffusion controlled. The fuel and air are injected separately with combustion occurring at the stoichiometric interfaces. This method of combustion results in combustion "hot spots," which produce higher levels of NOx. In the lean premix combustor, the air and fuel are mixed before they enter the combustor. Lean premix combustors have only been developed for gas-fired turbines and the more advanced designs are capable of achieving a 70 to 90 percent NOx reduction with a vendor-guaranteed NOx concentration of 15 to 25 ppmvd for aero-derivative gas turbines.

As discussed previously in the Gas Turbine Selection Process section, Mariposa Energy LLC selected the use of water injection due to the balance of the same proposed NOx emission level, lower CO and VOC emission levels, and higher electrical generation capacity.

Post-combustion NOx Control Technologies

Two post-combustion controls exist for combustion turbines: SCR and SCONOx™ (now called EMx). Both SCR and EMx control technologies use a catalyst bed to control the NOx emissions and, combined with DLE or water injection, are capable of achieving NOx emissions levels of 2.5 ppmvd for simple-cycle gas turbines. However, EMx uses a hydrogen regeneration gas to convert the NOx to elemental nitrogen and water.

Selective Catalytic Reduction. SCR is a post-combustion control technology applicable to control NOx emissions from gas turbines. The SCR is placed inside the exhaust ductwork and consists of a catalyst bed with an ammonia injection grid located upstream of the catalyst. The catalyst consists of a support system with a catalyst coating typically of titanium dioxide, vanadium pentoxide, or zeolite.

SCR is capable of over 90 percent NOx removal. Therefore, when combined with DLE combustors or water or steam injection, NOx emissions levels of 2.5 ppmvd at 15 percent O_2 when firing natural gas are achievable. This technology is considered feasible for MEP.

EMx System. The EMx system, distributed by Emerachem, uses a coated catalyst to oxidize and adsorb NOx onto the catalyst. The system consists of a catalyst bed installed in the exhaust duct at a location where the temperature is between 280°F and 700°F. NOx emissions are oxidized to nitrogen dioxide, and then adsorbed onto the catalyst. The catalyst requires periodic regeneration, up to several times per hour, using a regeneration gas containing 4 percent hydrogen, 3 percent nitrogen, and 1.5 percent carbon dioxide. The regeneration gas is created by reacting natural gas with air in the presence of a nickel oxidation catalyst, which is electrically heated to 1,900ºF. This gas is then mixed with steam (produced by the heat recovery steam generator) and passed over a second catalyst to form the regeneration gas.

Because MEP is a simple-cycle peaking facility, it would not produce the steam needed for use of the EMx system. Therefore, the project would need to add an auxiliary boiler to generate steam for the EMx technology to function, adding more emissions and counteracting the purpose of the EMx control system. Also, an EMx configuration with an auxiliary boiler has never been demonstrated commercially and is therefore not considered practical or feasible. This technology would not be feasible with the current project configuration.

Combustion Turbine NOx Control Technology Ranking

Based on the preceding discussion, the use of water injection and SCR are two technically feasible simple-cycle combustion turbine control technologies available to control MEP NOx emissions to 2.5 ppm. A review of applicable BACT clearinghouse determinations was conducted, consistent with the BAAQMD procedure manual to determine if NOx emission rates less than 2.5 ppm have been achieved in practice for other natural-gas-fired, simple-cycle turbine projects. The results of this review are presented below.

A review of the BACT clearinghouse/workbooks for the BAAQMD, CARB, SCAQMD, and SJVAPCD identified simple-cycle gas turbine BACT levels between 2.5 and 5.0 ppmvd. Exhibit 1 provides the results of this review.

Table 2 presents the results of a search of the EPA BACT/RACT/LAER clearinghouse recent NOx determinations for simple-cycle gas turbines. A review of these recent determinations identified one project, the Bosque County Power Plant, with an NOx emission rate of 2.0 ppmvd, which is less than the proposed MEP emission rate of 2.5 ppm. Therefore, the Texas Commission on Environmental Quality (TCEQ) was contacted (Hamilton, 2009) regarding the Bosque County Power Plant (BCPP) permit. The TCEQ explained that the BCPP is capable of operating in simple- and combined-cycle mode using a bypass stack to direct exhaust gases from the gas turbine exhaust to the atmosphere, bypassing the heat recovery steam generator. The TCEQ indicated that the initial permit limit for the combined-cycle mode would be 3.5 ppm on a 3-hour basis with a goal of 2.0 ppm on a 24-hour basis after a 24-month optimization period using pre-combustion DLE controls and SCR. When operating in simple-cycle mode, the permit limit would be 9 ppmvd NOx using pre-combustion controls (DLE). Therefore, the 24-hour combined averaging period would not be directly comparable to the 1-hour averaging period proposed for MEP, and the 1-hour BCPP simple-cycle NOx emission rate of 9 ppm would be greater than the 1-hour 2.5 ppm emission limit proposed for MEP. Therefore, the proposed emission rate of 2.5 ppm for MEP would meet the BACT requirements.

TABLE 2
EPA NOx BACT/RACT/LAER Clearinghouse Emission Levels Less than the Proposed MEP Emission Rates

Facility ID/Description	Permit Date	Permit Number	Turbine Rating	Permit Limits (ppmvd @ 15% O_2) NOx
Proposed MEP Limits			**49 MW**	**2.5 ppm (1-hour)**
TX-0540 Bosque County Power Plant*	02/27/2009	40620	170 MW (Industrial Turbine)	**2.0 ppm (24-hour)**

*Simple-cycle turbine has a nominal rating of 170 MW. When operating in simple-cycle mode, BACT is 9 ppmvd at 15% O_2 using DLE combustors. When operating in a combined-cycle mode, the initial BACT level will be 3 ppmvd at 15% O_2 annually, and 3.5 ppmvd at 15% O_2 on a 3-hour rolling average using DLE combustion and SCR. A 24-month optimization period will begin upon commercial operation during which time additional efforts will be made to control the combined-cycle NOx concentration to 2.0 ppmvd corrected to 15 percent O_2 on a 24-hour rolling average.

Table 3 presents the results of a search of the NOx emission limits proposed for simple-cycle gas turbines that have been recently permitted or are currently in the CEC licensing process. As shown in Table 3, three projects would achieve NOx emissions less than the proposed MEP emission rates if the projects were successfully constructed and operated according to the permit requirements. The three projects are the the Marsh Landing Generating Station Project, the Riverside Energy Resource Center Unit 3 & 4 Project, and the Saguaro Power Company Permit Modification #8.

TABLE 3
Simple-cycle Turbine NOx Emission Limits Recently Permitted or Currently in the CEC Licensing Process

Facility/Location	Reference	Turbine Model	Combustor Type	Operating Mode	NOx (ppm @ 15% O_2)
Almond 2 Peaking Plant-TID/SJVAPCD	PDOC, December 2, 2009	LM6000 (Aero)	Water Injection	Simple Cycle	2.5 (1-hour)
Canyon Power Plant/SCAQMD	FSA, October 8, 2009	LM6000 (Aero)	Water Injection	Simple Cycle	2.5 (1-hour)
GWF Hanford Combined Cycle Power/SJVAPCD	Major Amendment Staff Assessment October 14, 2009	LM6000 (Aero)	Water Injection	Simple Cycle Combined Cycle	2.5 (1-hour) 2.0 (1-hour)
GWF Henrietta Combined Cycle Power/SJVAPCD	Major Amendment Staff Assessment November 4, 2009	LM6000 (Aero)	Water Injection	Simple Cycle Combined Cycle	2.5 (1-hour) 2.0 (1-hour)
Marsh Landing Generating Station/BAAQMD	AFC Amendment September 2009	SGT6-5000F (Industrial)	Ultra Low-NOx	Simple Cycle	2.5 (1-hour)
Miramar Energy Facility II/SDAQMD	CEQA Neg Dec Submitted June 2008	LM6000 (Aero)	Water Injection	Simple Cycle	2.5 (ND)
Nevada Power Company (NV Energy) Clark Generating Station/ Clark Co. Nevada	ATC/PTO Issued March 20, 2007	Pratt & Whitney FT-8 (Aero)	Water Injection	Simple Cycle	5.0 (3-hour)
Orange Grove Energy/SDAQMD	Final Decision April 2009	LM6000 (Aero)	Water Injection	Simple Cycle	2.5 (1-hour)
Riverside Energy Resource Center Units 3 & 4 /SCAQMD	Final Decision, January 2009	LM6000 (Aero)	Water Injection	Simple Cycle	2.3 (1-hour)
Saguaro Power Company- Source #393, Modification #8 /Clark Co. Nevada	Permit App Submitted December 2008	LM6000 (Aero)	Dry Low-NOx	Simple Cycle	2.0 (3-hour)
San Francisco Electric Reliability Project/BAAQMD	Final Decision October 2006	LM6000 (Aero)	Water Injection	Simple Cycle	2.5 (1-hour)

FSA – CEC Final Staff Assessment
FDOC – Final Determination of Compliance
ND – averaging period was not defined in the document

The Marsh Landing Generating Station project proposes the use of an industrial gas turbine. As previously discussed, the industrial gas turbines use can-annular, DLE combustors, whereas the aeroderivative-type turbine uses an annular combustor. The can-annular combustor employed on the industrial gas turbines allows for more precise control of the DLE system. This precision decreases the turbine exhaust emission rates for NOx, CO, and VOC. However, the can-annular combustor is not available for the GE LM6000 SPRINT gas turbine. Furthermore, the Marsh Landing turbine is not feasible for use at MEP because it is not capable of operation at electrical production rates of 25 MW (minimum reported operating rate is 114 MW). Lastly, because the project is in the early stages of licensing, the proposed NOx emission rates have not been demonstrated in practice. Therefore, the proposed 1-hour 2.5 ppm NOx emission limit for MEP would meet the current BACT requirement of "achieved in practice."

The Riverside project initially proposed a NOx emission rate of 2.5 ppmvd, consistent with BACT determinations in the SCAQMD. However, during the permitting process, the SCAQMD adopted Priority Reserve Rule 1309.1 to provide Electrical Generating Facilities with access to purchase emission reduction credits from the SCAQMD's Priority Reserve Bank Credits. To meet the Rule 1309.1 NOx emission rate applicability requirements and obtain eligibility to purchase from the priority reserve (on a pounds per megawatt-hour basis), the applicant was required to reduce its NOx emission rate to 2.3 ppmvd. However, the SCAQMD considers a 2.5 ppmvd NOx emission rate to be BACT for simple-cycle combustion turbines, as evidenced by the 2.5 ppmvd NOx emission rate included in the Canyon Power Plant Final Determination of Compliance issued by the SCAQMD on June 24, 2009. The Riverside project commenced construction in January 2010 and has not demonstrated compliance with a 2.3 ppmvd NOx emission rate. Therefore, the proposed 1-hour 2.5 ppm NOx emission limit for MEP would meet the current BACT requirement of "achieved in practice."

The proposed Saguaro Power Company Permit Modification #8 project would be located at the existing Saguaro Power Plant in Henderson, Nevada and would add three LM6000PD simple-cycle gas turbines to the existing air quality permit. The existing facility consists of a cogeneration facility with two GE Frame 6 gas turbines operated in combined-cycle mode, two auxiliary boilers, and ancillary equipment (starter engines, cooling tower, fuel tanks, etc.) and is considered a federal major source for NOx and CO. The permit modification request would reduce the existing combined-cycle gas turbine emission rates to accommodate emissions from the peaking gas turbines while maintaining the post-project potential to emit below the major modification thresholds for the non-attainment pollutants of NOx, CO (serious), and PM_{10} (serious). This strategy avoids the need to offset emission increases of non-attainment pollutants. The applicant has also proposed the use of a 3-hour averaging period compared to a 1-hour averaging period proposed for MEP, which would result in a less restrictive short-term NOx emission rate compared to MEP. Lastly, as of January 2010, a permit has not been issued for this project (Nowinski, 2009). Therefore, the 3-hour average 2.0 ppmvd NOx emission limit presented in the permit application has not been demonstrated in practice and the proposed 1-hour 2.5 ppm NOx emission limit for MEP would meet the current BACT requirement of "achieved in practice."

The proposed MEP NOx emission rate of 2.5 ppmvd is consistent with recent BACT determinations, therefore, an assessment of the economic and environmental impacts is not provided.

Summary of the Proposed NOx BACT

The MEP combustion turbines will employ water injection with SCR to control NOx emissions to 2.5 ppmvd.

Feasible Combustion Turbine CO and VOC Control Technologies

Effective combustor design and post-combustion control using an oxidation catalyst are two feasible technologies for controlling CO and VOC emissions from a combustion turbine. The EMx catalyst system previously discussed under the NOx control technologies is also designed to control CO and VOC emissions. However, as noted previously in the NOx discussion, this technology would not be feasible with the current project configuration. Therefore, the two technologies considered for controlling CO and VOC emissions at MEP are effective combustor design and post-combustion control using an oxidation catalyst.

Good Combustor Control

CO and VOC are formed during the combustion process as a result of incomplete combustion of the carbon present in the fuel. The formation of CO and VOC is limited by designing the combustion system to completely oxidize the fuel carbon to CO_2. This is achieved by ensuring that the combustor is designed to allow for complete mixing of the combustion air and fuel at combustion temperatures (in excess of 1,800°F) with an excess of combustion air. Higher combustion temperatures tend to reduce the formation of CO and VOC, but increase the formation of NOx. The application of water injection or staged combustion tends to lower combustion temperatures (in order to reduce NOx formation), increasing CO and VOC formation. A good combustor design will minimize the formation of CO and VOC while reducing the combustion temperature and NOx emissions. The MEP combustion turbines incorporate this control technology into the design, controlling CO and VOC emissions to 64.7 ppmvd, and 11 ppmvd, respectively.

Oxidation Catalyst

The oxidation catalyst is typically a precious metal catalyst bed located in the exhaust duct. The catalyst enhances oxidation of CO and VOC to CO_2, without the addition of any reactant. Oxidation catalysts have been successfully installed on numerous simple-cycle combustion turbines, achieving high levels of control. Therefore, oxidation catalysts are considered feasible.

Combustion Turbine CO and VOC Control Technology Ranking

Based on the preceding discussion, the use of good combustor control and the installation of an oxidation catalyst are two technically feasible simple-cycle combustion turbine control technologies available to control MEP CO and VOC emissions to 4.0 ppm and 2.0 ppm, respectively. A review of applicable BACT clearinghouse determinations was conducted, consistent with the BAAQMD procedure manual to determine if CO and VOC emission rates less than 4.0 ppm and 2.0 ppm, respectively, have been achieved in practice for other natural-gas-fired, simple-cycle turbine projects. The results of this review are presented below.

A review of the BACT clearinghouse/workbooks for the BAAQMD, CARB, SCAQMD, and SJVAPCD identified simple-cycle gas turbine BACT levels of 6.0 ppmv CO and 2.0 ppmv VOC. Exhibit 1 provides the results of this review.

Table 4 presents the results of an EPA BACT/RACT/LAER clearinghouse search of recent CO determinations for simple-cycle gas turbines. A review of these recent determinations shows one project, the Wisconsin Electric Company Germantown project, with a CO emission rate of 1.8 ppm, is lower than the proposed MEP emission rate of 4.0 ppm. Therefore, the Wisconsin Department of Natural Resources (WDNR) was contacted to discuss the compliance status of the project. Based on a review of the current Title V permit provided by WDNR, it was determined that the 371 MMBtu/hr simple-cycle turbine listed in the EPA database as process number 38 (P38) is not included on the current permit. Rather, P38 is listed on the existing Title V permit as an 85 MW GE 7EA simple-cycle turbine with a CO emission rate between 25 ppmvd (at 100 percent load) and 100 ppmvd (at 60 percent load) when firing natural gas. Therefore, the MEP emission rate of 4 ppm would be less than the Title V CO emission rates for P38 and the proposed 3-hour 4.0 ppm CO emission limit for MEP would meet the current BACT requirement of "achieved in practice."

TABLE 4
EPA CO BACT/RACT/LAER Clearinghouse Emission Levels Less than the Proposed MEP Emission Rates

Facility ID/Description	Permit Date	Permit Number	Turbine Rating (MMBtu/hr)	Permit Limits (ppmvd @ 15% O_2) CO
Proposed MEP Limits			**481 MMBtu/hr**	**4.0 ppm**
WI-0177 Wisconsin Electric Company – Germantown	6/26/2000	00RV-027	371 MMBtu/hr (GE 7EA Industrial Turbine)	1.8 ppm

Note: The Wisconsin Electric Company Germantown Title V permit shows a CO emission rate of between 25 ppmvd (at 100 percent load) and 100 ppmvd (at 60 percent load).
MMBtu/hr = million British thermal unit per hour

Table 5 presents the results of an EPA BACT/RACT/LAER clearinghouse search of recent VOC determinations for simple-cycle gas turbines. A review of these recent determinations identified two projects, the Rohm & Hass Chemical Facility and the Progress Bartow Power Plant, that have emission rates lower than the proposed MEP emission rate of 2.0 ppm or 1.19 lb/hr. Therefore, the permitting agencies were contacted to discuss the compliance status of each of the projects.

After discussions with the TCEQ (Hamilton, 2009), it was determined the permitted Rohm & Haas unit with a 0.59 lb/hr VOC limit has a maximum heat input equivalent to 38 MMBtu/hr. This results in a VOC emission rate of 0.016 lb/MMBtu or approximately 4 ppmvd, which is higher than the MEP VOC emission rate of 0.0025 lb/MMBtu or 2 ppmvd.

TABLE 5
EPA VOC BACT/RACT/LAER Clearinghouse Emission Levels Less than the Proposed MEP Emission Rates

Facility ID/Description	Permit Date	Permit Number	Turbine Rating	Permit Limits (ppmvd @ 15% O_2) VOC
Proposed MEP Limits			**49 MW** **481 MMBTU/hr**	**2.0 ppm** **1.19 lb/hr**
FL-0265 Progress Bartow Power Plant[a]	01/26/2007	PSD-FL-381 and 1030011-010-AC	195 MW (Siemens 5000F Industrial Turbine)	1.2 ppmvd
TX-0487 Rohm & Haas Chemicals[b]	03/24/2005	PSD-TX-828M1	38 MMBTU/hr	0.59 lb/hr

[a] The simple-cycle combustion turbine electrical generator will have a nominal rating of 195 MW at ISO conditions.
[b]Per email from Randy Hamilton/TCEQ, the unit is a chemical processing gas turbine (hot air generator) with a rating of 15,000 horsepower (roughly equivalent to 38 MMBtu/hr).

The Pinellas County Department of Environmental Management's Air Division was contacted (Martin, 2009) to discuss the Progress Bartow Power VOC emission rate of 1.2 ppmvd. The Bartow facility permit included a 1,280 MW combined-cycle facility and a single 195 MW simple-cycle unit (both based on the Siemens 5000F gas turbine). While the single 195 MW simple-cycle unit was never constructed, the combined cycle units were constructed and demonstrated compliance with a 1.2 ppmvd emission limit during the initial compliance test in July 2009. However, the permit condition only requires an initial compliance test and then VOC compliance is based on the 24-hour rolling average CO continuous emissions monitoring compliance data. Therefore, the on-going compliance demonstration is based on a 24-hour rolling average compared to a 3-hour averaging period proposed for MEP. Also, as discussed for the Marsh Landing Project, the Siemens 5000F technology is not feasible for use at MEP because of the inability to produce a minimum electrical output requirement of 24.9 MW. Therefore, a VOC limit of 2.0 ppm for MEP would meet the BACT emission level achieved in practice for a simple-cycle turbine less than 50 MW.

Table 6 presents the results of a search of the CO and VOC emission limits proposed for simple-cycle gas turbines that have been recently permitted or are currently in the CEC licensing process. The table indicates five projects would achieve CO or VOC emission rates less than the proposed MEP emission rates if the projects were successfully constructed and operated according to the permit requirements. The five projects are the NV Energy Clark Generating Station, the GWF Hanford Combined Cycle Power – Major Modification Project, the GWF Henrietta Combined Cycle Power – Major Modification Project, the Marsh Landing Generating Station Project, and the Saguaro Power Company Permit Modification #8.

The GWF Hanford and Henrietta projects are a conversion of simple-cycle gas turbines to a hybrid project using a once-through steam generator. This system offers the capability of operating the plant as a simple- or combined-cycle plant. The proposed CO emission concentration of 3.0 ppmvd has not been demonstrated in practice because these projects are still in the permitting process.

The Marsh Landing project has proposed lower CO and VOC emission rates of 2.0 and 1.0 ppmvd respectively. However, as noted in the NOx Ranking section above, the use of the same turbine technology proposed for the Marsh Landing project (i.e., a larger industrial gas turbine) is not feasible for use at MEP and because the Marsh Landing project is in the early stages of licensing, the proposed CO and VOC emission rates have not been demonstrated in practice. Therefore, the proposed CO and VOC emission limits for MEP would meet the current BACT requirement of "achieved in practice."

The NV Energy (formerly Nevada Power Company) Clark Generating Station facility consists of twelve Pratt & Whitney FT-8 swift-pac peaking turbines. These units include SCR and oxidation catalyst to control NOx, CO, and VOC emissions. NV Energy decommissioned three steam generating units (Units 1, 2 and 3) at the time of installation of the twelve natural-gas-fired peaking units to maintain a post-project potential to emit below the major modification thresholds for the non-attainment pollutants of NOx, CO, and PM_{10}. As discussed for the Saguaro Power Plant modification, this netting strategy avoids the need to offset emission increases of non-attainment pollutants. As a result, NV Energy proposed a CO emission rate of 2.0 ppm CO, in conjunction with a NOx and ammonia emission level of 5.0 ppmvd. Therefore, NV Energy agreed to accept a lower CO emission limit to address a specific CO non-attainment issue that does not apply in the Bay Area. Furthermore, the lower CO level necessitated a lower NOx control water injection rate, resulting in a higher controlled NOx of 5 ppmvd, double the NOx concentration level being proposed by MEP.

As noted in the NOx BACT discussion, the permit for the proposed Saguaro Power Plant modifications has not been issued. Therefore, the 2.0 ppmvd CO emission limit presented in the permit application has not been demonstrated in practice (Nowinski, 2009).

Based on the results of the clearinghouse reviews, the proposed MEP CO and VOC emission levels of 4.0 and 2.0 ppmvd at 15 percent O_2 are less than or equivalent to the demonstrated CO and VOC emission levels achieved in practice for similar technologies. Therefore, an economic, energy, and environmental impacts analyses were not required.

Summary of the Proposed CO and VOC BACT

MEP will employ good combustion design, combined with the installation of an oxidation catalyst system to comply with the CO and VOC BACT requirements. The combustion turbine CO and VOC emissions will be controlled to 4.0 and 2.0 ppmvd, respectively.

TABLE 6
Simple-cycle Turbines Recently Permitted or Currently in the Permitted Process CO and VOC Levels

Facility/Location	Reference	Turbine Model	Combustor Type	Operating Mode	CO (ppmvd @ 15% O_2)	VOC (ppmvd @ 15% O_2)
Almond 2 Peaking Plant-TID/SJVAPCD	PDOC, December 2, 2009	LM6000 (Aero)	Water Injection	Simple Cycle	4.0 (3-hour)	2.0 (3-hour)
Canyon Power Plant/SCAQMD	FSA, October 8, 2009	LM6000 (Aero)	Water Injection	Simple Cycle	4.0 (1-hour)	2.0 (1-hour)
GWF Hanford Combined Cycle Power/SJVAPCD	Major Amendment Staff Assessment October 14, 2009	LM6000 (Aero)	Water Injection	Simple Cycle Combined Cycle	3.0 (3-hour) 3.0 (3-hour)	2.0 (3-hour) 2.0 (3-hour)
GWF Henrietta Combined Cycle Power/SJVAPCD	Major Amendment Staff Assessment November 4, 2009	LM6000 (Aero)	Water Injection	Simple Cycle Combined Cycle	3.0 (3-hour) 3.0 (3-hour)	2.0 (3-hour) 2.0 (3-hour)
Marsh Landing Generating Station/BAAQMD	AFC Amendment September 2009	SGT6-5000F (Industrial)	Ultra Low-NOx	Simple Cycle	2.0 (ND)	1.0 (ND)
Miramar Energy Facility II/SDAQMD	CEQA Neg Dec Submitted June 2008	LM6000 (Aero)	Water Injection	Simple Cycle	6.0 (ND)	2.0 (ND)
Nevada Power Company (NV Energy) Clark Generating Station/Clark Co. Nevada	ATC/PTO Issued March 20, 2007	Pratt & Whitney FT-8 (Aero)	Water Injection	Simple Cycle	2.0 (3-hour)	2.0 (3-hour)
Orange Grove Energy/SDAQMD	Final Decision April 2009	LM6000 (Aero)	Water Injection	Simple Cycle	6.0 (1-hour)	2.0 (ND)
Riverside Energy Resource Center Units 3 & 4/SCAQMD	Final Decision, January 2009	LM6000 (Aero)	Water Injection	Simple Cycle	6.0 (1-hour)	2.0 (ND)
Saguaro Power Company-Source #393, Modification #8/Clark Co., Nevada	Permit App Submitted Dec. 2008	LM6000 (Aero)	Dry Low-NOx	Simple Cycle	2.0 (3-hour)	2.0 (3-hour)
San Francisco Electric Reliability Project/BAAQMD	Final Decision October 2006	LM6000 (Aero)	Water Injection	Simple Cycle	4.0 (3-hour)	0.0025 lb/MMBtu (ND)

ND – averaging period was not defined in the document.

Feasible Combustion Turbine SO_2 Control Technologies

No feasible add-on SO_2 controls have been used on pipeline-quality, natural-gas-fired combustion turbines or natural–gas-fired heaters.

A review of the BAAQMD, CARB, SJVAPCD, SCAQMD, and EPA RACT/LAER/BACT clearinghouse for recent SO_2 BACT determinations for combustion turbines identified low sulfur natural gas as BACT for all of the recent project BACT determinations. MEP will emit a total of 3.1 tons of SO_2 per year at a maximum hourly emission rate of 0.91 lb/hr. The project's SO_2 emissions are directly proportional to the sulfur content of the pipeline-quality natural gas used by the project, which is based on an expected maximum fuel sulfur content of 0.66 grains per 100 dry standard cubic feet (dscf) of natural gas. The expected annual average natural gas sulfur content is expected to be approximately 0.25 grains per 100 of natural gas. Therefore, the use of clean-burning, low-sulfur, pipeline-quality natural gas is below the 1 grain/100 dscf natural gas sulfur content identified as BACT by the BAAQMD, (CEC, 2006) and an analysis of the economic, environmental, or energy impacts are not warranted.

Feasible Combustion Turbine PM_{10} Emission Control Technologies

The primary PM_{10} emission control technology for combustion turbines is the use of low-sulfur fuels and filtration of turbine inlet air. Based on the current MEP design, the expected maximum fuel sulfur content will be 0.66 grains per 100 dscf of natural gas, which is below the 1 grain/100 dscf natural gas sulfur content identified as BACT by the BAAQMD (CEC, 2006). MEP will also employ inlet air filtration to achieve a proposed combustion turbine emission rate of 2.5 pounds of PM_{10} per hour, which is lower than the vendor PM_{10} guarantee of 3.0 pounds per hour.

Table 7 presents the results of an EPA BACT/RACT/LAER Clearinghouse search of recent PM_{10} determinations for simple-cycle gas turbines. A review of these recent determinations identified four projects—the Creole Trail LNG Import Terminal, Louisiana; Rohm & Haas Chemicals, Texas; the Arvah B. Hopkins Generating Station, Florida; and the Wisconsin Electric Company Germantown Generating Station, Wisconsin—with a lower emission rate than the proposed MEP emission rate of 2.5 lb/hr. Therefore, the permitting agencies were contacted to discuss the compliance status of each of the projects.

The Creole Trail facility BACT determination indicated that the unit is a 30 MW (290 MMBtu/hr) combustion turbine with a PM_{10} emission limit of 2.11 lb/hr. This equates to an emission limit of 0.0073 lb/MMBtu, which is higher than the MEP PM_{10} emission rate of 0.0052 lb/MMBtu.

The Rohm & Haas facility has a PM_{10} emission limit of 2.09 lb/hr and after discussions with the TCEQ (Hamilton, 2009), it was determined the unit has a maximum heat input equivalent to 38 MMBtu/hr. This results in a PM_{10} emission rate of 0.055 lb/MMBtu, which is an order of magnitude higher than MEP.

TABLE 7
EPA BACT/RACT/LAER Clearinghouse PM_{10} Emission Levels Less than the Proposed MEP Emission Rates

Facility ID/Description	Permit Date	Permit Number	Turbine Rating (MW or MMBtu/hr)	Permit Limits
Proposed MEP Limits			**49 MW** **481 MMBtu/hr**	**2.5 lb/hr** **0.0052 lb/MMBtu**
LA-0219 Creole Trail LNG Import Terminal[a]	08/15/2007	PSD-LA-714	30 MW (290 MMBtu/hr)	2.11 lb/hr max (0.00727 lb/MMBtu)
TX-0487 Rohm & Haas Chemicals[b]	03/24/2005	PSD-TX-828M1	38 MMBtu/hr	2.09 lb/hr (0.055 lb/MMBtu)
FL-0261 Arvah B. Hopkins Generating Station	10/26/2004	PSD-FL-343	50 MW (445 MMBtu/hr) (LM6000PC – Aero Turbine)	2.45 lb/hr (0.005 lb/MMBtu)
WI-0177 Wisconsin Electric Company – Germantown	6/26/2000	00RV-027	371 MMBtu/hr	1.5 lb/hr

[a] PM_{10} emission rate in lb/hr is less than 2.5 lb/hr. However, the PM_{10} lb/MMBtu emission rate is greater than the proposed MEP emission rate.
[b] Per email from Randy Hamilton (Texas Commission on Environmental Quality-TCEQ), the unit is a chemical processing gas turbine (hot air generator) with a rating of 15,000 horsepower (roughly equivalent to 38 MMBtu/hr).

The Arvah B Hopkins Generating Station has a 2.45 lb/hr PM_{10} emission limit at a maximum heat input of 445 MMBtu/hr. The resulting PM_{10} emission rate for the facility is 0.0055 lb/MMBtu, which is approximately the same as the emission rate proposed for MEP.

The Germantown Generating Station's BACT record is in error in the database (as noted in the CO BACT Ranking above). In review of the facility's Title V permit, the PM_{10} emission rate for the combustion turbine is 10 lb/hr (or 0.27 lb/MMBtu).

A review of BAAQMD, CARB, SCAQMD, and SJVAPCD BACT determinations identified a PM_{10} emission rate of 0.01 grains per dscf of exhaust gas. The MEP has proposed a PM_{10} emission significantly below this level.

Because all of the recent BACT determinations are equivalent or higher than the proposed MEP PM_{10} emission rate, no further analysis is required.

BACT Summary

Table 8 presents the control technologies determined to represent BACT for MEP.

TABLE 8
Summary of Proposed BACT for MEP

Pollutant	Combustion Turbines
NOx	Water injection and SCR with NOx emissions of 2.5 ppmvd (1-hour) at 15% O_2
CO	Good combustion design and oxidation catalyst with CO emissions of 4.0 ppmvd (3-hour) at 15% O_2
VOC	Good combustion design and oxidation catalyst with VOC emissions of 2.0 ppmvd (3-hour) at 15% O_2
SO_2	Use of pipeline quality natural gas with 1.0 grain of sulfur per 100 dscf or less
PM_{10}	Use of pipeline quality natural gas and inlet combustion air filtration with PM_{10} emissions of 2.5 lb/hr (0.0052 lb/MMbtu)

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Exhibit 1
Summary of Existing BACT Emission Levels

Mariposa Energy Project
January 2010
Exhibit 1 - Summary of Existing BACT Emission Levels

RBLC ID	CORPORATE/COMPANY &	FACILITY NAME	DESCRIPTION	PERMIT DATE	PERMIT NUMBER	MW	type	NOx	CO	VOC	PM	SO2	Note	Contact
BAAQMD, SCAQMD, SJVAPCD, and CARB BACT Determinations														
BAAQMD			Turbine, simple cycle >=40 MW	7/18/2003		>=40	Simple	2.5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	Natural Gas Fuel	Natural Gas Fuel	High Temperature SCR + Water or Steam Injection Oxidation Catalyst	
SCAQMD	Los Angeles Dept of Water & Power	Los Angeles Dept of Water & Power	LM6000 (Enhanced Sprint)	12/18/2001	374502	47.4 MW	Simple	5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	0.01 gr/scf	Natural Gas Fuel	inlet air evaporative cooling and steam or water injection for NOx control. SCR System and Oxidation Catalyst	Chris Perri 909-396-2696
SCAQMD	Indigo Energy Facility (Wildflower Energy LP)	Indigo Energy Facility (Wildflower Energy LP)	LM6000 (Enhanced Sprint)	12/18/2001	383044	45 MW (450 MMBtu/hr)	Simple	5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	0.01 gr/scf, 11 lb/hr (0.024 lb/MMBtu)	Natural Gas Fuel	Includes inlet air evaporative cooling and steam or water injection for NOx control NOXCAT-VNX-HT, high-temperature SCR catalyst, with tempering air system to control gas temperature entering catalyst. Aqueous ammonia (max. 20 wt. %) is used.	Knut Beruldsen 909-396-3137
SCAQMD	El Colton, LLC	El Colton, LLC	LM6000 (Enhanced Sprint)	2/10/2004	406065	48.7 MW (456.5 MMBtu/hr)	Simple	3.5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	0.01 gr/scf, 11 lb/hr (0.024 lb/MMBtu)	Natural Gas Fuel	Includes inlet air evaporative cooling and steam or water injection for NOx control High temperature (825F design) SCR catalyst with tempering air system to control gas temperature entering catalyst. Aqueous ammonia (max. 19 wt. %) is used.	John Dang 909-396-2427
SJVAPCD			Turbine without Heat Recovery	10/1/2002		> or < 50 MW	Simple	5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	Air inlet cooler/filter, lube oil vent coalescer (or equal) and either PUC regulated natural gas, LPG, or non-PUCregulated gas with < 0.75 grams S/100 dscf.	PUC-regulated natural gas, LPG, or Non-PUC-regulated gas with = or < 0.75 grams S/100 dscf.	high temp SCR, or equal Oxidation catalyst, or equal	
BAAQMD	Lambie Energy Center	Lambie Energy Center	LM6000PC	12/15/2002	6510	49.9 MW	Simple	2.5 ppmv, Dry @ 15%O2	6.0 ppmv, Dry @15% O2	2.0 ppmv, Dry @ 15%O2	3 lb/hr	1.39 lb/hr	SCR, oxidation catalyst The concentration limit on NOx was volunteered by the applicant. The concentration limit on CO was more stringent than BAAQMD BACT, but is consistent with 1999 CARB guidelines for power plants.	Dennis Jang (415) 749-4707
SDAPCD	CalPeak Power El Cajon LLC	CalPeak Power El Cajon LLC	FT-8 DLN Twin Pac	9/29/2004	976021	24.75 MW	Simple	3.5 ppmv, Dry @ 15%O2 (1-hour)	50 ppmv, Dry @15% O2 (3-hour)	2.0 ppmv, Dry @ 15%O2 (3-hour)			SCR, oxidation catalyst, source test results: NOx: 2.4 ppmv @15% oxygen CO: 4.5 ppmv @15% oxygen VOC: <0.5 ppmv @15% oxygen	San Diego County APCD Alta Stengel (858) 586-26000
EPA BACT/RACT/LAER Determinations														
*TX-0540	BOSQUE POWER COMPANY LLC	BOSQUE COUNTY POWER PLANT	ELECTRICAL GENERATION	02/27/2009	40620	170	Simple or Combined	**2.0000 PPMVD 24-HOUR 15% O2**	92.0000 PPMVD 3-HOUR 15% O2	4.0000 PPMVD 3-HOUR 15% O2	0.0100 LB/MMBTU 3 HR ROLLING		Based on the Permit Renewal & Amendment Source Analysis & Technical Review provided by Randy Hamilton at TCEQ, BACT is 9 ppmvd at 15% O2 through the use of dry low-NOx (DLN) combusters when the combustion turbine is operating in the simple cycle mode. When operating in a combined cycle mode, BACT is the use of dry low-NOx combustion and SCR to achieve 3 ppmvd at 15% O2 annually, and 3.5 ppmvd at 15% O2 on a three hour rolling average. An optimization period of 24 months to begin upon commercial operation will be permitted during which time additional efforts will be made to operate the units such that the concentration of NOx in the stack gases shall not exceed a 24-hour rolling average of 2 ppmvd corrected to 15 percent O2.	Agency: TX001 - TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) Contact: RANDY HAMILTON Address: AIR PERMITTING DIVISION TX COMMISSION ON ENVIRONMENTAL QUALITY P. O. BOX 13087 (MC-163) AUSTIN, TX 78711-3087 Phone: (512) 239-1512 Other Agency Contact Info: MS. BRIDGET MALONE (512) 239-4286
MN-0075	GREAT RIVER ENERGY	GREAT RIVER ENERGY - ELK RIVER STATION	COMBUSTION TURBINE GENERATOR	07/01/2008	14100003-004	2169.00 MMBTU/H	Simple	9.0000 PPM 4 HR ROLLING AVG, NG, >/= 60% LOAD 25.0000 PPM 4 HR ROLLING AVG, NG, <60% LOAD 96.0000 PPM 4 HR ROLLING AVG, <75% LOAD	4.0000 PPM 4 HR ROLLING AVG, NG, >/= 70% LOAD 10.0000 PPM 4 HR ROLLING AVG, NG, 60% - 70% LOAD 150.0000 PPM 4 HR ROLLING AVG, NG, <60% LOAD	NA	NA	NA	SEPARATE LIMITS FOR NATURAL GAS OR FUEL OIL COMBUSTION, AND AT DIFFERING LOADS	
OK-0127	WESTERN FARMERS ELECTRIC COOPERATIVE	WESTERN FARMERS ELECTRIC ANADARKO	COMBUSTION TURBINE PEAKING UNIT(S)	06/13/2008	2005-037-C(M-2) PSD	50□462.7 MMBTU/HR	Simple	25.0000 PPM ADJUSTED 15% O2	63.0000 PPM CORRECTED TO 15% O2	NA	4.0000 LB/H (0.0086 lb/MMBTU)	NA	LM6000 SPRINT SIMPLE CYCLE AERODERIVATIVE COMBUSTION TURBINE GENERATORS Water injection	
*CO-0064	PLATTE RIVER POWER AUTHORITY	RAWHIDE ENERGY STATION	UNIT F COMBUSTION TURBINE	08/31/2007	07LR0017	150	Simple	9.0000 PPMVD 3-HR ROLLING AVE, 15% O2 100.0000 PPMVD STARTUP & SHUTDOWN, TUNING	NA	NA	0.0135 LB/MMBTU	NA	DRY LOW NOX COMBUSTION SYSTEM	COLORADO DEPT OF HEALTH - AIR POLL CTRL (Agency Name) JACKIE JOYCE (Agency Contact) JACKIE.JOYCE@STATE.CO.US
LA-0219	CREOLE TRAIL LNG, LP	CREOLE TRAIL LNG IMPORT TERMINAL	GAS TURBINE GENERATOR NOS. 1-4	08/15/2007	PSD-LA-714	30 (290 MM BTU/HR)	Simple	25.0000 PPMVD @ 15% O2	25.0000 PPMVD @ 15% O2	1.2100 LB/H HOURLY MAXIMUM	2.1100 LB/H HOURLY MAXIMUM (0.00727 LB/MMBTU)	NA	DRY LOW EMISSIONS (DLE) COMBUSTION TECHNOLOGY WITH LEAN PREMIX OF AIR AND FUEL PM10 emission rate in lb/hr is less than 2.5 lb/hr. However, the PM10 lb/MMBTU PM10 emission rate is greater than the proposed MEP emission rate	Agency: LA001 - LOUISIANA DEPARTMENT OF ENV QUALITY Contact: MR. KEITH JORDAN Address: LA DEPT. OF ENV. QUALITY OFFICE OF ENV. SERVICES P. O. BOX 4313 BATON ROUGE, LA 70821-4313 Phone: (225)219-3613 Other Agency Contact Info: PERMIT WRITER: MS. PAM HARTLEY, (225) 219-3181
OK-0120	PUBLIC SERVICE CO OF OKLAHOMA	PSO RIVERSIDE JENKS POWER STA	COMBUSTION TURBINES	03/22/2007	2003-360-C M-1 PSD	NA	NA	9.0000 PPMVD @15% O2	59.0000 LB/H SHORT-TERM		10.0000 LB/H SHORT-TERM		DRY-LOW NOX BURNERS	Agency: OK001 - OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY Contact: MR. JERRY GOOCHEY Address: OK DEPT. OF ENV. QUALITY AIR QUALITY DIVISION P. O. BOX 1677 OKLAHOMA CITY, OK 73101-1677 Phone: (405)702-4189 Other Agency Contact Info: EST/ACT DATE Permit Number: 2003-360-C M-1 PSD
FL-0285	PROGRESS ENERGY FLORIDA (PEF)	PROGRESS BARTOW POWER PLANT	SIMPLE CYCLE COMBUSTION TURBINE (ONE UNIT)	01/26/2007	PSD-FL-381 AND 1030011-010-AC	195 MW (1972.00 MMBTU/I	Simple	15.0000 PPMVD 4-HOURS BASIS - NATURAL GAS UNCORRECTED	4.1000 PPMVD @ 15% O2 - GAS	**1.2000 PPMVD @ 15% O2 - GAS**		2.0000 GR/100SCF NATURAL GAS	Unit 5 is a simple cycle turbine with a permitted limit of 1.2 ppm of VOC. According to Wayne Martin at Pinellas County Department of Environmental Management (Air Division), Unit 5 has not been built.	Agency: FL001 - FLORIDA DEPT. OF ENVIRONMENTLA PROTECTION Contact: MS. TERESA HERON Address: FL DEPT. OF ENVIRON. PROTECTION AIR RESOURCE DIVISION 2600 BLAIR STONE RD., MS-5505 TALLAHASSEE, FL 32399-2400 Phone: (850)921-9529
FL-0300	JACKSONVILLE ELECTRIC AUTHORITY	JACKSONVILLE ELECTRIC AUTHORITY/JEA	SIMPLE CYCLE TURBINE 172 MW	12/22/2006	0310047-015-AC AND PSD-FL-386	172 MW (1804.00 MMBTU/I	Simple	15.0000 PPM @ 15% 02 (GAS) 4-HR ROLLING 42.0000 PPM @ 15% 02 (OIL) 4-HR ROLLING				2.0000 GR/100 SCF (GAS)	NATURAL GAS AS PRIMARY FUEL WITH 0.05% SULFUR DISTILLATE AS BACKUP. USES WATER INJECTION WHEN FIRING OIL.	
FL-0287	OLEANDER POWER PROJECT, L.P	OLEANDER POWER PROJECT	SIMPLE CYCLE COMBUSTION TURBINE	11/17/2006	PSD-FL-377 AND 0090180-003-AC	190 MW	Simple	9.0000 PPM @15% O2 24-HR ROLLING (NG) 42.0000 PPM @ 15% O2 4-HR ROLLING (OIL)			1.5000 GR S/100 SCF NATURAL GAS	1.5000 GR S/100 SCF NATURAL GAS	DLN COMBUSTORS WATER INJECTION	
*NV-0046	KERN RIVER GAS TRANSMISSION COMPANY	GOODSPRINGS COMPRESSOR STATION	LARGE COMBUSTION TURBINE - SIMPLE CYCLE	05/16/2006	468	11.5 MW	Simple	25.0000 PPMVD 15% OXYGEN	16.0000 PPMVD 15% OXYGEN BASED ON A 3	0.0069 LB/MMBTU	0.0066 LB/MMBTU	0.0034 LB/MMBTU 15% OXYGEN	DRY LOW-NOX TECHNOLOGY	Contact: MR. DAVID LEE Address: CLARK CO. DEPT. OF AIR QUALITY AND ENVIRONMENTAL MANAGEMENT P. O. BOX 555210 500 S. GRAND CENTRAL PARKWAY LAS VEGAS, NV 89155-5210 Phone: (702) 455-1673

RBLC ID	CORPORATE/COMPANY &	FACILITY NAME	DESCRIPTION	PERMIT DATE	PERMIT NUMBER	MW	type	NOx	CO	VOC	PM	SO2	Note	Contact
FL-0279	TAMPA ELECTRIC COMPANY (TEC)	TEC/POLK POWER ENERGY STATION	SIMPLE CYCLE GAS TURBINE	04/28/2006	PSD-FL-363	1834.00 MMBTU/H	Simple	9.0000 PPMVD @ 15% O2 EFFICIENCY 88% FROM 75 PPM.			10.0000 % OPACITY	2.0000 SCF GRAINS SCF PER 100	DRY LOW NOX	Agency: FL001 - FLORIDA DEPT. OF ENVIRONMENTLA PROTECTION Contact: MS. TERESA HERON Address: FL DEPT. OF ENVIRON. PROTECTION AIR RESOURCE DIVISION 2600 BLAIR STONE RD., MS-5505 TALLAHASSEE, FL 32399-2400 Phone: (850)921-9529 Other Agency Contact Info: JEFF KOERNER PHONE 850-921-9536 JEFF.KOERNER@DEP.STATE.FL.US
WI-0240	WISCONSIN ELECTRIC POWER	WE ENERGIES CONCORD	COMBUSTION TURBINE, 100 MW, NATURAL GAS	01/26/2006	05-SDD-320	100 MW	NA	25.0000 PPMDV @ 15% O2	20.0000 LB/H OPERATE AT 75% MAX OUTPUT OR HIGHER 300.0000 LB/H BELOW 75% MAX OUTPUT	5.0000 LB/H AT 75% LOAD OR GREATER 16.0000 LB/H BELOW 75% LOAD	39.0000 LB/H HOURLY (0.039 lb/MMBtu)	0.0068 LB/MMBTU NATURAL GAS USAGE	WATER INJECTION	Agency: WI001 - WISCONSIN DEPT OF NATURAL RESOURCES Contact: MR. JEFFREY C. HANSON Address: WI DEPT. OF NATURAL RESOURCES BUR. OF AIR MANAGEMENT, PERMITS SECTION P. O. BOX 7921 MADISON, WI 53707 Phone: (608)266-6876
OH-0304	ROLLING HILLS GENERATING, LLC	ROLLING HILLS GENERATING PLANT	NATURAL GAS FIRED TURBINES (5)	01/17/2006	06-07747	209 MW	Simple	15.0000 PPMVD BY VOLUME ON A DRY BASIS AT 15% O2	119.0000 LB/H EXCEPT DURING STARTUP/SHUTDOWN	3.2000 LB/H	0.0084 LB/MMBTU	5.9000 LB/H	SIEMENS WESTINGHOUSE POWER CORP W501F, SIMPLE CYCLE, NATURAL GAS FIRED TURBINES (5) WITH DRY LOW-NOX COMBUSTERS.	Agency: OH001 - OHIO ENVIRONMENTAL PROTECTION AGENCY Contact: MS. CHERYL SUTTMAN Address: OH ENV. PROTECTION AGENCY DIV OF AIR POLLUTION CONTROL LAZARUS GOVERNMENT CENTER P. O. BOX 1049 COLUMBUS, OH 43215-1049 Phone: (614)644-3617
TX-0487	ROHM AND HAAS TEXAS INCORPORATION	ROHM AND HAAS CHEMICALS LLC LONE STAR PLANT	L-AREA GAS TURBINE	03/24/2005	PSD-TX-828M1	NA	NA	27.4600 LB/H	38.5300 LB/H	0.5900 LB/H	2.0900 LB/H	0.0300 LB/H	Per email from Randy Hamilton (Texas Commission on Environmental Quality -TCEQ), the unit is a chemical processing gas turbine (hot air generator) with a rating of 15,000 hp (roughly equivalent to 38 MMBTU/HR). Therefore, the PM_{10} emission rate would be approximately 0.055 lb PM_{10} / MMBTU, which is greater than the MEP emission rate of 0.0052 lb/MMBTU.	Agency: TX001 - TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) Contact: RANDY HAMILTON Address: AIR PERMITTING DIVISION TX COMMISSION ON ENVIRONMENTAL QUALITY P. O. BOX 13087 (MC-163) AUSTIN, TX 78711-3087 Phone: (512) 239-1512
AL-0208	EXXON MOBIL PRODUCTION CO.	EXXON MOBILE BAY -- NORTHWEST GULF FIELD	TURBINE, SIMPLE CYCLE	02/01/2005	503-0013-X00	6000 hp	Simple	25.0000 PPM @ 15% O2	50.0000 PPM @ 15% O2				SOLONOX COMBUSTOR	
AL-0209	EXXON MOBIL PRODUCTION CO.	EXXON MOBILE -- MOBILE BAY - BON SECURE BAY FIELD	TURBINE, SIMPLE CYCLE	02/01/2005	503-0012-X005	3600 hp	Simple	25.0000 PPM @ 15% O2	50.0000 PPM @ 15% O2				SOLONOX COMBUSTOR	Agency: AL001 - ALABAMA DEPT OF ENVIRONMENTAL MGMT Contact: MR. ANTHONY SMILEY Address: AL DEM AIR DIVISION P. O. BOX 301463 MONTGOMERY, AL 36130-1463 Phone: (334) 271-7803
MO-0067	AQUILA, INC.	SOUTH HARPER PEAKING FACILITY	TURBINES, SIMPLE CYCLE, NATURAL GAS, (3)	12/29/2004	122004-017	1455.00 MMBtu/h	Simple	15.0000 PPM @ 15% O2	25.0000 PPMVD 1 HOUR ROLLING AVG.				DRY-LOW NOX BURNERS	Agency: MO001 - MISSOURI DNR, AIR POLL CONTROL PROGRAM Contact: MS. KYRA MOORE Address: MO DEPT. OF NATURAL RESOURCES AIR POLLUTION CONTRL PROG. PERMIT SECTION P. O. BOX 176 JEFFERSON CITY, MO 65102-0176 Phone: (573) 526-3835
MS-0072	TVA - KEMPER COMBUSTION TURBINE PLANT	TVA - KEMPER COMBUSTION TURBINE PLANT	EMISSION POINT AA-003	12/10/2004	1380-00015	1,278 MMBTU/Hr General Electric	Simple	12.0000 PPM @ 15% 02 NATURAL GAS	25.0000 PPM @ 15% 02	70.0000 LB/H NATURAL GAS	7.3500 LB/H NATURAL GAS	4.8500 LB/H NATURAL GAS	See downloaded TV permit	Agency: MS001 - MISSISSIPPI DEPT OF ENV QUALITY Contact: MS. CARLA BROWN Address: MS DEPT. OF ENV. QUALITY OFFICE OF POLLUTION CONTROL ENVIRONMENTAL PERMITS DIV. P.O. BOX 10385 JACKSON, MS 39289-0385 Phone: (601) 961-5235
			EMISSION POINT AA-002				Simple	12.0000 PPM @ 15% O2	25.0000 PPM @ 15% 02	70.0000 LB/H NATURAL GAS	7.3500 LB/H	4.3500 LB/H NATURAL GAS		
			EMISSION POINT AA-004				Simple	12.0000 PPM @ 15% O3	25.0000 PPM @ 15% 03	70.0000 LB/H NATURAL GAS	7.3500 LB/H	4.3500 LB/H NATURAL GAS		
			EMISSION POINT AA-001				Simple	12.0000 PPM @ 15% O4	25.0000 PPM @ 15% 04	70.0000 LB/H NATURAL GAS	7.3500 LB/H	4.3500 LB/H NATURAL GAS		
MS-0074	SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION	MOSELLE PLANT	COMBUSTION TURBINE, GAS-FIRED, SIMPLE-CYCLE	12/10/2004	1360-00035A	1143.30 MMBTU/H	Simple	9.0000 PPM VD @ 15% O2 3 H ROLLING AVERAGE	20.0000 PPM @ 15% O2		10.0000 LB/H (0.0087 lb/MMBtu)		DRY, LOW-NOX BURNER WITH INLET GAS COOLING	Agency: MS001 - MISSISSIPPI DEPT OF ENV QUALITY Contact: MS. CARLA BROWN Address: MS DEPT. OF ENV. QUALITY OFFICE OF POLLUTION CONTROL ENVIRONMENTAL PERMITS DIV. P.O. BOX 10385 JACKSON, MS 39289-0385 Phone: (601) 961-5235
OK-0104	OG & E	HORSEHOE LAKE GENERATING STATION	TURBINE, SIMPLE CYCLE, (2)	11/23/2004	97-137-C (M-3) PSD	45 MW	Simple		62.5000 PPM @ 15% O2					Agency: OK001 - OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY Contact: MR. JERRY GOOCHEY Address: OK DEPT. OF ENV. QUALITY AIR QUALITY DIVISION P. O. BOX 1677 OKLAHOMA CITY, OK 73101-1677 Phone: (405)702-4189
OH-0291	FIRST ENERGY	OHIO EDISON CO.- WEST LORAIN PLANT	SIMPLE CYCLE COMBUSTION TURBINES (5) W/ NATURAL GAS	11/17/2004	02-13376	85 MW	Simple	9.0000 PPM @ 15% O2 ON DRY BASIS, ROLLING 12-MO	83.0000 LB/H	10.0000 LB/H	5.0000 LB/H (estimated 0.006 lb/MMBtu)	0.6000 LB/H	DRY LOW NOX BURNERS	Agency: OH001 - OHIO ENVIRONMENTAL PROTECTION AGENCY Contact: MS. CHERYL SUTTMAN Address: OH ENV. PROTECTION AGENCY DIV OF AIR POLLUTION CONTROL LAZARUS GOVERNMENT CENTER P. O. BOX 1049 COLUMBUS, OH 43215-1049 Phone: (614)644-3617
FL-0261	CITY OF TALLAHASSEE	ARVAH B. HOPKINS GENERATING STATION	TURBINE, SIMPLE CYCLE, NATURAL GAS, (2)	10/26/2004	PSD-FL-343	50 MW (445 MMBTU/H)	Simple	5.0000 PPMVD @15% O2 24 H AVERAGE	6.0000 PPM @ 15% O2	3.0000 PPMVD @15% O2	**2.4500 LB/H (0.0055 lb/MMBtu)**	1.1300 LB/H (0.0025 lb/MMBtu)	According to Jeff Koerner (Florida Department of Environmental Protection, (850) 921-9536), source testing is not required for the equipment. Therefore, no source test data or compliance data are available.	Agency: FL001 - FLORIDA DEPT. OF ENVIRONMENTLA PROTECTION Contact: MS. TERESA HERON Address: FL DEPT. OF ENVIRON. PROTECTION AIR RESOURCE DIVISION 2600 BLAIR STONE RD., MS-5505 TALLAHASSEE, FL 32399-2400 Phone: (850)921-9529 Other Agency Contact Info: PROJECT ENGINEER: MIKE HALPIN, PROFESSIONAL ENGINEER BUREAU OF AIR REGULATION PHONE NO. 850/921-9519
LA-0191	ENTERGY NEW ORLEANS, INC.	MICHOUD ELECTRIC GENERATING PLANT	COMBUSTION GAS TURBINES 4 & 5 (SIMPLE CYCLE)	10/12/2004	PSD-LA-700	1595.00 MMBTU/H (coverted to 170 MW)	Simple				7.8500 LB/H HOURLY MAXIMUM (converted to 0.0049 lb/MMBtu)			Agency: LA001 - LOUISIANA DEPARTMENT OF ENV QUALITY Contact: MR. KEITH JORDAN Address: LA DEPT. OF ENV. QUALITY OFFICE OF ENV. SERVICES P. O. BOX 4313 BATON ROUGE, LA 70821-4313 Phone: (225)219-3613 Other Agency Contact Info: PERMIT WRITER: KERMIT WITTENBURG, 225-219-3181
MN-0053	MN MUNICIPAL POWER AGENCY	FAIRBAULT ENERGY PARK	TURBINE, SIMPLE CYCLE, NATURAL GAS (1)	07/15/2004	13100071-001	187 MW (1663.00 MMBTU/H)	Simple	25.0000 PPMVD @ 15% 02 3 HOUR AVERAGE	10.0000 PPMVD @ 15% 02 3 HOUR AVERAGE		0.0100 LB/MMBTU 3 HOUR AVERAGE		MITSUBISHI 501F. DRY LOW-NOX COMBUSTORS OPERATING IN LEAN PREMIX MODE	

RBLC ID	CORPORATE/COMPANY &	FACILITY NAME	DESCRIPTION	PERMIT DATE	PERMIT NUMBER	MW	type	NOx	CO	VOC	PM	SO2	Note	Contact
NE-0021	Omaha Public Power	CASS COUNTY POWER PLANT	2-173 MW COMBUSTION TURBINES	06/22/2004	70919C01	173	NA	20.0000 PPM @ 15% 02	15.0000 PPM @ 15% 02		0.1200 LB/MMBTU	2.5 lb/hr (Fuel Sulfur content limited to 0.8% S)		Agency: NE001 - NEBRASKA DEPT. OF ENVIRONMENTAL QUALITY Contact: MR. CLARK SMITH Address: NE DEPT. OF ENV. QUALITY AIR QUALITY DIV. P. O. BOX 98922 LINCOLN, NE 68509-8922 Phone: (402) 471-4204 Other Agency Contact Info: CLARK SMITH SUITE 400, THE ATRIUM, 1200 N STREET, PO BOX 98922 LINCOLN, NE 68509 402-471-2186
NE-0022	Grand Island Utilities	C. W. BURDICK GENERATING STATION	GAS-FIRED COMBUSTION TURBINE	06/22/2004	54712C01	1.00 MILLION SCF/H	NA	15.0000 PPM @ 15% O2	40.0000 PPM @ 15% O2		10.0000 LB/H (1.25 lb/MMI	2.5000 LB/MMBTU		Agency: NE001 - NEBRASKA DEPT. OF ENVIRONMENTAL QUALITY Contact: MR. CLARK SMITH Address: NE DEPT. OF ENV. QUALITY AIR QUALITY DIV. P. O. BOX 98922 LINCOLN, NE 68509-8922 Phone: (402) 471-4204 Other Agency Contact Info: CLARK SMITH SUITE 400, THE ATRIUM, 1200 N STREET, PO BOX 98922 LINCOLN, NE 68509 402-471-2186
EPA NOx and CO Rankings with Emission Limits Lower than 4 ppm CO or 2.5 ppm NOx (1999 - Present)														
WI-0177	WISCONSIN ELECTRIC COMPANY - GERMANTOWN	WISCONSIN ELECTRIC COMPANY - GERMANTOWN	COMBUSTION TURBINE, SIMPLE CYCLE, GENERATOR (NG)	6/26/2000	00-RV-027	371 MMBtu/hr	Simple	25.0000 PPM @ 15% O2	**1.8000 PPM @ 15% O2**	25.0000 PPM @ 15% O2	**1.5000 LB/H**	1.0000 LB/H	DRY LOW NOX COMBUSTOR AND GOOD COMBUSTION CONTROL The value for the Wisconsin Electric Company Germantown Plant doesn't appear correct as the project appears in USEPA Region IV national turbine data base with a 25 ppmvd CO limit and the other CO RBLC listings for the two turbines at this facility do not conform to the 1.8 ppmvd value.	Agency: WI001 - WISCONSIN DEPT OF NATURAL RESOURCES Contact: MR. JEFFREY C. HANSON Phone: (608)266-6876 RAJ VAKHARIA (608) 267-2015
ID-0010	GARNET ENERGY LLC	MIDDLETON FACILITY	GAS TURBINES WITHOUT DUCT BURNERS	10/19/2001	027-00081	1699.00 MMBTU/H (based on oil fuel)	Simple	3.0000 PPM @ 15% O2 EA, 24 H AV Standardized: 2.5000 PPM @ 15% O2 EA, CONSECUTIVE 12 MO AV	5.0000 PPM @ 15% O2 EA, 1 H AV□2.0000 PF	4.0000 LB/H EA	15.8000 LB/H		1-hour CO limit is 5.0000 PPM @ 15% O2. The 2 ppm limit applies to annual average LOW NOX BURNERS, SELECTIVE CATALYTIC REDUCTION OXIDATION CATALYST	Other Agency Contact Info: DAN SALGADO ID 208-373-0431

Attachment DR8-2
SJVAPCD Mitigation Agreement

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

December 21, 2009

Mariposa Energy LLC
c/o Diamond Generating Corporation
ATTN: Mr. Bohdan "Bo" Buchynsky, Executive Director
333 S. Grand Ave., Suite 1570
Los Angeles, CA 90071

Dear Mr. Buchynsky,

Enclosed please find the fully executed agreement titled "Mariposa Energy LLC Peaking Power Plant Project Air Quality Mitigation Settlement Agreement", dated December 17, 2009. I have also enclosed a copy of the Agenda Memo for this agreement which was approved by our Governing Board on December 17, 2009.

Should you have any questions, or need any further assistance please do not hesitate to contact me at our Fresno Office at (559) 230-6001.

Sincerely,

Michelle L. Franco

Michelle L. Franco
Operations and Program Support Supervisor

Seyed Sadredin
Executive Director/Air Pollution Control Officer

Northern Region
4800 Enterprise Way
Modesto, CA 95356-8718
Tel: (209) 557-6400 FAX: (209) 557-6475

Central Region (Main Office)
1990 E. Gettysburg Avenue
Fresno, CA 93726-0244
Tel: (559) 230-6000 FAX: (559) 230-6061

Southern Region
34946 Flyover Court
Bakersfield, CA 93308-9725
Tel: 661-392-5500 FAX: 661-392-5585

www.valleyair.org www.healthyairliving.com

MARIPOSA ENERGY LLC PEAKING POWER PLANT PROJECT
AIR QUALITY MITIGATION SETTLEMENT AGREEMENT

This Air Quality Mitigation Settlement Agreement ("Agreement") is entered into this 17th day of December, 2009 by and between Mariposa Energy LLC ("Mariposa"), and the San Joaquin Valley Unified Air Pollution Control District (the "District"). Mariposa and the District may be referred to individually as a "Party" or collectively as the "Parties."

RECITALS

WHEREAS, on June 15, 2009, Mariposa filed an Application for Certification ("AFC") with the California Energy Commission ("CEC") for the Mariposa Energy Project, a nominal 200 megawatt simple cycle electrical generating facility (the "Project"). Mariposa is seeking approval from the CEC to construct and operate the Project; and

WHEREAS, the Project site is located on a 10-acre portion of a 158-acre parcel southeast of the intersection of Bruns Road and Kelso Road, in Alameda County within the Bay Area Air Quality Management District ("BAAQMD"); and

WHEREAS, though the Project site is located within the BAAQMD, the Project will be positioned near the border of the Northern Region of the San Joaquin Valley Air Basin (the "Northern Region"); and

WHEREAS, the District is concerned about the general migration of air pollutants from the BAAQMD region and the migration's effect on the ability of the District to meet its air quality attainment goals; and

WHEREAS, the District believes that due to the proximity of the Project to the District, the emissions from the Project will mostly impact the District without corresponding benefits from offsets provided from sources within the BAAQMD; and

WHEREAS, Mariposa believes that any and all air quality impacts from the Project will be fully mitigated by the project's design and incorporated construction and operation mitigation measures, including, but not limited to fugitive dust control, diesel-fueled engine control plan, implementation of best available control technology (BACT) and its BAAQMD emission reduction credit offset package; and

WHEREAS, while under no obligation to do so, Mariposa desires to cooperate with the District to address the District's air quality concerns and assist the District by entering into this Agreement to provide additional air quality benefits; and

WHEREAS, the District and Mariposa have determined that payment of an air quality mitigation fee to be used for air quality benefit programs within the San Joaquin Valley, and particularly in the Northern Region, within or near the Mountain House Community Services District, City of Tracy and San Joaquin County is the appropriate method for Mariposa to address District concerns and to ensure localized benefits within the District.

NOW THEREFORE, for good and valuable consideration, including the mutual covenants set forth herein, Mariposa and the District hereby agree as follows:

1. Air Quality Mitigation Fee. Subject to the conditions precedent set forth in Section 2 below, Mariposa agrees to contribute to the District the sum of six hundred forty-four thousand five hundred and three dollars ($644,503) to ensure localized benefits in the Northern Region, particularly within or near the Mountain House Community Service District, City of Tracy, and San Joaquin County (the "Air Quality Mitigation Fee"). An outline of the methodology used to determine the Air Quality Mitigation Fee is attached hereto as Part A-1 of Attachment A, incorporated herein by reference. The calculation of the Air Quality Mitigation Fee is attached hereto as Part A-2 of Attachment A, incorporated herein by reference. Mariposa agrees to pay the Air Quality Mitigation Fee to the District within thirty (30) days after physical delivery of the first combustion turbine generator to the Project site. If Mariposa ceases to be the owner of the Project and a new owner of the Project has made the payment contemplated in this Agreement to the District, then Mariposa shall be relieved of any further obligations under this Agreement.

2. Conditions Precedent. The Parties acknowledge and agree that Mariposa's obligation to pay the Air Quality Mitigation Fee shall be subject to the fulfillment or waiver (such waiver to be in Mariposa's sole discretion) of both of the following conditions precedent:

(a) Issuance of the final CEC certification for the Project; and

(b) Physical delivery of the first combustion turbine generator to the Project site.

Notwithstanding the above, if the AFC with the CEC has been cancelled, withdrawn or denied, or if the Mariposa Energy Project is certified but not constructed during the term of the CEC's certification, then this Agreement shall automatically terminate, and neither Party shall have any further obligations hereunder.

3. Use of Air Quality Mitigation Fee. The District agrees to set up a specific account into which the Air Quality Mitigation Fee will be deposited. The District agrees to use the Air Quality Mitigation Fee exclusively to establish specific programs that create contemporaneous air quality benefits. The final mitigation measures to be implemented will be selected by the District, can include the District's Burn Cleaner woodstove retrofit and fireplace replacement program, the Carl Moyer Program, heavy duty engine retrofit/replacement program, agricultural engine replacement program, and/or other similar programs approved by the District. In expending funds from the Air Quality Mitigation Fee, the District shall give preference to cost-effective programs in or near the Mountain House Community Service District, City of Tracy, San Joaquin County, and the Northern Region of the San Joaquin Valley Air Basin, in that order.

The District agrees not to place the Air Quality Mitigation Fee into any operating account, or to use the Air Quality Mitigation Fee for any purpose other than those designated in this Agreement.

4. Only Mitigation Payment Required. The District acknowledges and agrees that payment of the Air Quality Mitigation Fee pursuant to this Agreement is the appropriate method for Mariposa to address the District's concerns relating to migration of pollutants from the Project and to ensure localized benefits in the Northern Region, and that payment of such Air Quality Mitigation Fee is the only action requested by the District in connection with the development, construction, operation and maintenance of the Project. Nothing in this Agreement shall be deemed a waiver of any cause of action or remedies the District may pursue against other entities related to transport of air pollution from the Bay Area into the San Joaquin Valley. Further, the District acknowledges and agrees that Mariposa believes that, notwithstanding this Agreement, any and all air quality impacts from the Project have been fully mitigated and that nothing in this Agreement can or should be interpreted as an admission by Mariposa to the contrary.

5. Cooperation. The Parties agree to cooperate with each other with respect to any requests or actions related to this Agreement from the CEC, the Environmental Protection Agency, BAAQMD, the California Air Resources Board, and/or any interveners in the Project, and to do or cause all things necessary, proper or advisable to help consummate and make effective the transaction contemplated by this Agreement, including, but not limited to providing written and oral testimony in furtherance of this Agreement as part of the CEC licensing process. The Parties agree to seek a condition of certification in the CEC license for the Project which incorporates the terms of this Agreement.

6. Governing Law. This Agreement shall be governed by, construed under and enforced in accordance with the laws of the State of California.

7. Authority. Each Party acknowledges and agrees that it has the full right, power and authority to execute this Agreement, and to perform its obligations hereunder.

8. No More Favorable Terms. With respect to any other applicant for an energy license before the CEC as of the date of this Agreement which is similarly situated near the Northern Region, the District agrees not to enter into any air quality mitigation agreement based on methodology which utilizes a lower calculation value (expressed in dollars per ton) than the value set forth in Part A-2 of Attachment A to this Agreement, without also offering such an arrangement to Mariposa.

9. Relationship of the Parties. Nothing herein is intended to create or is to be construed as creating a joint venture, partnership, agency or other taxable entity between the Parties. The rights and obligations of the Parties shall be independent of one another and shall be limited to those expressly set forth herein and, except as expressly provided to the contrary, shall not be construed to apply to any affiliate of the Parties.

10. No Third Party Beneficiary. The Parties mutually agree that this Agreement is for their sole benefit and is not intended by them to be, in part or in whole, for the benefit of any third party.

11. Notices. All notices necessary to be given under the terms of this Agreement, except as herein otherwise provided, shall be in writing and shall be communicated by prepaid mail, telegram or facsimile transmission addressed to the respective Parties at the address below or to such other address as respectively designated hereafter in writing from time to time:

To Mariposa: Mariposa Energy LLC
c/o Diamond Generating Corporation
333 S. Grand Ave., Suite 1570
Los Angeles, CA 90071
Attn: Mr. Bohdan "Bo" Buchynsky, Executive Director
Phone: (213) 473-0080
Fax: (213) 620-1170

To District: 1990 East Gettysburg Avenue
Fresno, CA 93726-0244
Attn: Mr. David Warner
Phone: (559) 230-5900
Fax: (559) 230-6061

12. Assignment. This Agreement shall be binding upon, and inure to the benefit of, each of the Parties and their respective successors and permitted assigns. No Party shall assign this Agreement or its rights or interests hereunder without the prior written consent of the other Party, such consent not to be unreasonably withheld or delayed. Notwithstanding the above, the Parties agree that Mariposa may freely assign its rights and duties under this Agreement, without District's prior written consent, to: (a) an affiliate of Mariposa; (b) a successor-in-interest by merger, consolidation or reorganization; (c) a purchaser or other transferee of the Project; or (d) a lender for purposes of financing the project.

13. Entire Agreement. This Agreement, together with the Exhibits attached hereto, contains the entire understanding between the Parties with respect to the subject matter herein. This Agreement may not be amended except by an instrument in writing signed by each Party.

14. Joint Effort. The Parties acknowledge and agree that each Party and its counsel have read this Agreement in its entirety, fully understand it, and accept its terms and conditions. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party is not applicable and therefore shall not be employed in the interpretation of this Agreement or any amendment of it.

15. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original but all of which together shall constitute one and the same agreement.

* * *

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement the day and date first above written.

Mariposa Energy LLC

By: [signature] Dated: December 9, 2009
Name: Bohdan Buchynsky
Title: Executive Director

SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT

By: [signature] Dated: 12-17-09
Chris Vierra, Chair
Governing Board
San Joaquin Valley Unified APCD

Approved:

By: [signature] Dated: 12/17/09
Seyed Sadredin
Executive Officer/Air Pollution Control Officer
San Joaquin Valley Unified Air Pollution Control District

Approved as to Legal Form:

By: [signature]
Philip M. Jay
District Counsel

Approved as to Accounting Form:

By: [signature]
Cindi Hamm, Director
Administrative Services

ATTACHMENT A

PART A-1

Outline of Methodology for Determining SJV Net Mitigation Value

For NOx and VOC emissions, the full potential to emit will be mitigated, partly by using Bay Area emission offsets that are within 50 miles of the San Joaquin Valley Air Basin at the offset ratios specified in District Rules. The remainder of emissions will be the mitigation balance (see Table 1 of Part A-2).

For PM10 and SOx emissions, the maximum expected emissions during the PM10 non-attainment season (Quarters 4 and 1) will be mitigated (see Table 2 of Part A-2). These emissions are based on an expected usage of 600 hours during this time, with 100 startups and shutdowns. The 600 hours was selected to be conservative, as the California Energy Commission has found that a typical peaker plant will only operate 600 hours total per year, mostly outside of the PM10 non-attainment season. Bay Area emission offsets will not be used; therefore no offset ratios from District Rules will be utilized and the entire amount of emissions will be the mitigation balance.

The mitigation fee is then calculated by multiplying the mitigation balance by a mitigation value (see Table 3 of Part A-2). For NOx and VOC, the mitigation value is $16,000 per ton, based on the Carl Moyer program cost effectiveness threshold, plus 5% for administrative costs, for a total value of $16,800 per ton. For PM10 and SOx, the mitigation value is determined from the District's Burn Cleaner wood stove retrofit/fireplace replacement program, which offered a rebate of $750 per wood stove or fireplace retrofit/replacement. Table 4 of Part A-2 shows the calculations used to determine the number of wood stoves/fireplace requiring retrofit/replacement and the cost of such mitigation. This works out to $52,865 per ton. Adding 5% for administrative costs results in a total value of $55,508 per ton.

PART A-2

Table 1 – NOx and VOC Mitigation Balance

Pollutant	Potential to Emit - PTE (tpy)	PTE w/ offset ratio (tpy)	Bay Area offsets (tpy)	Mitigation Balance (tpy)
NOx	48.6	72.9	55.9	17.0
VOC	11.1	16.65	11.1	5.55

Table 2 – PM10 and SOx Mitigation Balance

Pollutant	PTE during non-Attainment quarters (tpy)	Mitigation Balance (tpy)
PM10 + Sox	4.786	4.786

Table 3 – Mitigation Fee

Pollutant	Mitigation Balance (tpy)	Mitigation Value ($/ton)	Mitigation Fee ($)
NOx	17.0	16,800	285,600
VOC	5.55	16,800	93,240
PM10 + SOx	4.786	55,508	265,663
Total			644,503

Part A-2

Table 4
MEP: PM10 Mitigation Fee Determination
Burn Cleaner Program Emission Calculation

Cords of Wood Burned Each Winter Season		0.92	Using the equation in Section 7.1 Residential Wood Combustion document (ARB Emission Inventory Methodology)
Volume of a Cord of Wood (ft3)		90	CEC Consumer Energy Center Firewood Document
Weight of Cord of Wood (pounds)		4058	Average weight of Oak woods - dry (Live, Black, and White) CEC Consumer Energy Center Firewood Document
Annual Wood Usage (lbs/year/unit)		3718	(weight x average annual consumption)
Oak Heating Value		30.67	MMBtu/cord (see below)
Average Cords/hr		0.00040	(see below)
PM10 Emission Rate for Existing Wood Stoves		31.1	lb/ton (Section 7.1 Residential Wood Combustion document (ARB Emission Inventory Methodology))
Average Annual Emissions per unit		57.8	lbs/unit/year
Annual Average Hours of operation		2302	calculated based on the annual cords per year divided by the average cords/hr
Average Hourly Emission per Unit		0.025	lbs/hour
Average Hourly Emission per Unit		11.4	grams/hour
EPA Hourly Emission Standard		5.8	grams/hour (average of the U.S. EPA emission standards for catalytic and non-catalytic wood heaters)
Average Reduction in PM10		28.4	lbs/year/unit
Mitigation Requirement		9572	lbs/year (4.2 tons/year of PM10 + 0.6 tons/year of SO2 - represents 600 hours of operation and 100 startup/shutdowns at 3.0 lb/hr during the PM10 season (Oct-Mar))
Number of Retrofits Required		337.3	
Per Unit Cost	$	750	SJVAPCD Burn Cleaner Program/Wood Stove Replacement
Mitigation Cost (PM10)	**$**	**253,012**	
Mitigation Cost with Administrative Fee	**$**	**265,662**	

Heating Content MMBTU/cord	Heating Content (MMBTU/cord)	Weight (pounds - dry)
Oak, Black	27.4	3625
Oak, Live	36.6	4840
Oak, White	28.0	3710
Average	**30.7**	**4058**

Reference: CEC Consumer Energy Center Firewood Document

Heating Degree Days

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Stockton Fire Station #4	616	419	332	195	77	14	1	1	12	105	365	601	2738
Tracy Carbona	609	409	320	189	73	13	1	1	9	91	346	596	2657
Average	613	414	326	192	75	14	1	1	11	98	356	599	2698

Energy Requirement (Annual)	0.92 cords	Using the equation in Section 7.1 Residential Wood Combustion document (ARB Emission Inventory Methodology)
Energy Requirement (January)	0.21 cords	Using the equation in Section 7.1 Residential Wood Combustion document (ARB Emission Inventory Methodology)
Hourly Consumption Rate	0.00040 Cords per Hour	

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Northern Region Office
4800 Enterprise Way
Modesto, CA 95356-8718
(209) 557-6400 • FAX (209) 557-6475

Central Region Office
1990 East Gettysburg Avenue
Fresno, CA 93726-0244
(559) 230-6000 • FAX (559) 230-6061

Southern Region Office
34946 Flyover Court
Bakersfield, CA 93308-9725
(661) 392-5500 • FAX (661) 392-5585

www.valleyair.org

DATE: December 17, 2009

TO: SJVUAPCD Governing Board

FROM: Seyed Sadredin, Executive Director/APCO
Project Coordinator: Dave Warner

RE: **APPROVE AND AUTHORIZE CHAIR TO SIGN AIR QUALITY MITIGATION AGREEMENT WITH MARIPOSA ENERGY, LLC**

RECOMMENDATION:

1. Authorize the Chair to sign the attached air quality mitigation agreement with Mariposa Energy, LLC to accept funds in the amount of six hundred forty-four thousand five hundred and three dollars ($644,503) to mitigate localized air quality impacts within the District from the operation of a proposed simple cycle power plant just west of the San Joaquin County line.

BACKGROUND:

Mariposa Energy, LLC is seeking approval from the California Energy Commission (CEC) to construct and operate the Mariposa Power Plant (MPP), a simple cycle peaker power plant. Peaker power plants are typically operated only during periods of peak power consumption, essentially remaining on call until the California Independent Systems Operators (ISO) calls on them to operate to fill an anticipated power need. The CEC has found that peaker plants in California operate 600 hours per year on average, with most of that in the summer months. The proposed project will be fueled with natural gas and will have a nominal electrical output of 200 megawatts. On-site construction of the project is expected to take place from April 2011 to June 2012, a total of about 14 months. Commercial operation is planned by the third quarter of 2012.

The proposed power plant will be located on a 10-acre portion of a 158-acre parcel in Alameda County, southeast of the intersection of Bruns Road and Kelso Road.

Located 7 miles northeast of the city of Tracy and 2.5 miles west of the community of Mountain House, the facility's boundaries will be approximately 2.4 miles from the District. Located in Alameda County, the project will be under the jurisdiction of Bay Area Air Quality Management District (BAAQMD). However, due the project's proximity to the District, the prevailing wind direction and the resulting transport of air pollution from the Bay Area to the Valley, the District is concerned with the project's localized impact within the Valley.

Mariposa Energy, LLC has been very receptive to the District's concerns and has exhibited great willingness to address the District's concerns as well those of Valley residents potentially impacted by the project. Towards that end, Mariposa Energy, LLC and District staff have negotiated the attached Air Quality Mitigation Agreement that will provide adequate funding for mitigating the air quality impact from the project.

DISCUSSION:

General transport of air pollution from the Bay Area into the Valley has been a longstanding source of concern for the District. With respect to this project, the District has an added concern due to the close proximity of the project to the District boundaries. It is expected that the project will employ state of the art pollution control technology, provide emissions reduction credits to offsets emissions within BAAQMD, and comply with all applicable BAAQMD prohibitory rules. Nonetheless, the District believes that due to the proximity of the proposed facility to the District, emissions from the project will mostly impact the District without corresponding benefits from offsets provided from sources within the BAAQMD. Therefore, an agreement was negotiated with Mariposa Energy, LLC to provide the necessary funding for mitigating the project's potential air quality impact within the District.

The quantity of emissions that needed to be mitigated was established based on the following methodology:

- For NOx and VOCs, the facility's potential emissions during the entire year, based on 4,000 hours of operation (for all periods during which the District might experience high Ozone concentrations or high PM10 concentrations), are to be mitigated.
- For PM10 and SOx, the facility's maximum expected emissions during the period from October through March (period during which the District might experience high PM10 concentrations) are to be mitigated. This is conservatively based on 600 hours of operation, based on the CEC finding that peaker plants in California only operate 600 hours per year on average, and most of that time will be during the summer months when PM10 concentrations typically do not occur.

- Allow credit for emission reduction credits provided in the Bay Area that are within 50 miles of the air basin boundary at the offset ratios specified in District rules.

Based on the above methodology, 22.55 tons per year of NOx and VOC emissions and 4.786 tons per year of PM10 and SOx emissions required mitigation within the Valley. The mitigation fee for NOx and VOC emissions is $16,800 per ton, and is based on the Carl Moyer program cost effectiveness threshold with 5% for administrative costs. The mitigation fee for PM10 and SOx is $55,508 per ton, based on the District's wood stove retrofit program, and also includes 5% for administrative costs. At these rates, a sum of $644,503 is required.

Similar to the past emission reduction incentive programs sponsored by the District, the funds received under this Air Quality Mitigation Agreement will be used to provide contemporaneous emission reductions in the Valley and to the extent possible near Tracy, within the District's Northern Region. Emission reduction programs that will be funded will be the most cost-effective projects available and are likely to include replacement or retrofitting of heavy duty diesel internal combustion engines and electrification of agricultural pump engines.

<u>FISCAL IMPACT</u>:

Under the terms of the Air Quality Mitigation Agreement, Mariposa Energy, LLC will pay $644,503 to the District within thirty (30) days after physical delivery of the first combustion turbine generator to the Project site. In general, this means that the funds will be available approximately nine months in advance of the project completion date. To ensure contemporaneous reduction in emissions, the District intends to award these funds in accordance with a schedule that would allow emission reductions to take place prior to the initial start-up of the proposed power plant. Accordingly, it is estimated that necessary budget resolutions authorizing the related appropriations will be presented to the Governing Board sometime in 2011.

Attachment:
Air Quality Mitigation Agreement (8 pages)

Attachment DR8-3
BAAQMD ERC Certificates 1182 and 1184

BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT
SINCE 1955

December 7, 2009

Diamond Generating Corporation
333 So Grand Avenue
Los Angeles, CA 90071

Attention: **Bohdan Buchynsky**

Dear Applicant:

SUBJECT: APPLICATION 21354 BANKING CERTIFICATE 1182

In accordance with Section 2-4-412.3 of the District's regulations, the following emission reduction credits:

Nitrogen Oxides	55.900	tons/year

have been transferred to you from:

Element Markets, LLC

Please include your application number with any correspondence with the District. If you have any questions on this matter, please call David M Brunelle, Supervising Air Quality Engineer at (415) 749-4684.

Very truly yours,

Jack P. Broadbent
Executive Officer/APCO

By D. M. B.
Engineering Division

DMB
Enclosure: Banking Certificate 1182

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

EMISSION REDUCTION BANK

Certificate of Deposit 1182

Diamond Generating Corporation

is hereby certified as the holder of the following emission reduction credits, approved pursuant to application number 21354:

Nitrogen Oxides	**55.900**	**tons/year**

These credits are for emission reductions occurring at:

Owens Corning Insulating Systems, LLC
Santa Clara, CA

Jack P. Broadbent
Executive Officer/APCO

December 7, 2009

By D W. R[illegible]

Engineering Division

Bay Area Air Quality Management District
Since 1955

December 7, 2009

Diamond Generating Corporation
333 So Grand Avenue
Los Angeles, CA 90071

Attention: **Bohdan Buchynsky**

Dear Applicant:

SUBJECT: APPLICATION 21354 BANKING CERTIFICATE 1184

In accordance with Section 2-4-412.3 of the District's regulations, the following emission reduction credits:

Precursor Organic Compounds 11.100 tons/year

have been transferred to you from:

Element Markets, LLC

Please include your application number with any correspondence with the District. If you have any questions on this matter, please call David M Brunelle, Supervising Air Quality Engineer at (415) 749-4684.

Very truly yours,

Jack P. Broadbent
Executive Officer/APCO

By [signature]
Engineering Division

DMB
Enclosure: Banking Certificate 1184

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

EMISSION REDUCTION BANK

Certificate of Deposit 1184

Diamond Generating Corporation

is hereby certified as the holder of the following emission reduction credits, approved pursuant to application number 21354:

Precursor Organic Compounds	11.100	**tons/year**

These credits are for emission reductions occurring at:

Quebecor World San Jose Inc
San Jose, CA

Jack P. Broadbent
Executive Officer/APCO

December 7, 2009

By M. Ble

Engineering Division

Cultural Resources (48)

Background

The construction of the MEP would entail ground disturbance at the 10310-acre project site and project linear facilities. The AFC Geology section identifies Quaternary alluvial fan deposits on the project site (p. 5.4-2). Figure 5.4-1 shows the proposed natural gas pipeline traversing siltstone exposed on the surface. The undifferentiated Quaternary alluvial deposits at the project site and at the location of the new fresh water pumphouse could obscure archaeological sites. Staff assumes that agriculture may have disturbed the project site to a depth of 3 feet, and the wind farm construction may have resulted in deeper disturbance, but it is likely that the construction of a number of project components would entail deeper project ground disturbance than either of these previous uses. In these Data Requests, staff is asking for the maximum depths for project components, but the AFC states that the natural gas pipeline would be installed in a trench at least 4.5 feet below grade (p. 4-1). Staff estimates that the ground disturbance resulting from the construction of major equipment installations at the plant site would be likely to extend as deep as 12 feet below the surface.

The Cultural Resources section of the AFC acknowledges that buried archaeological deposits could be encountered during construction activities (p. 5.3-12). Such deposits may be too deep to present surface manifestations, but may be within reach of construction impacts. Staff needs information of a finer resolution on the age, the structure, and the character of the geologic units beneath the surface of the project area to evaluate the project's potential to substantially and adversely change the California Register of Historic Resource eligibility of archaeological deposits that may lie buried in the areas where MEP construction could impact them.

Data Request

48. In the absence of sufficient extant Quaternary science and/or geoarchaeological literature pertinent to the reconstruction of the historical geomorphology of the project area, please have the approved geoarchaeologist design a primary geoarchaeological field study of the project areas, submit a research plan for staff approval, and conduct the approved research. The purpose of the study is to facilitate staff's assessment of the likelihood of the presence of archaeological deposits buried deeper than 3 feet in the project areas. The primary study should, at a minimum, include the following elements:

    a. A map of the present landforms in the project area at a scale of not less than 1:24,000; the data sources for the map may be any combination of published maps, satellite or aerial imagery that has been subject to field verification, and the result of field mapping efforts;

b. A sampling strategy to document the stratigraphy of the portions of the landforms in the project areas where the construction of the proposed project will involve disturbance at depths greater than 3 feet;

c. Data collection necessary for determinations of the physical character, the ages, and the depositional rates of the various sedimentary deposits and paleosols that may be beneath the surface of the project areas to the proposed maximum depth of ground disturbance. Data collection at each sampling locale should include a measured profile drawing and a profile photograph with a metric scale, and the screening of a small sample (3 5- gallon buckets) of sediment from the major sedimentary deposits in each profile through 1/4- inch hardware cloth. Data collection should also include the collection and assaying of enough soil humate samples to reliably radiocarbon date a master stratigraphic column for each sampled landform; and

d. An analysis of the collected field data and an assessment, based on those data, of the likelihood of the presence of buried archaeological deposits in the project areas, and, to the extent possible, the likely age and character of such deposits.

Response:

A geoarchaeological field study test plan was prepared and submitted for Staff review (see Attachment DR 48-1). Staff reviewed the preliminary geoarchaeological assessment previously submitted in response to Data Request 47, documenting the historical geomorphology of the project areas, and have indicated that it is not necessary to perform a field geoarchaeological study based on the results of the preliminary assessment and prior cultural resources surveys in the project area. Therefore, no further geoarchaeological investigation is planned at this time.

Attachment DR 48-1
Geoarchaeological Field Study Test Plan

GEOARCHAEOLOGICAL ASSESSMENT, RESEARCH DESIGN AND TREATMENT PLAN FOR THE MARIPOSA ENERGY PROJECT, ALAMEDA COUNTY, CALIFORNIA

By:
Jack Meyer, MA

with contributions by:
Brian Byrd, PhD
and
Jeffrey S. Rosenthal

January 2010

Submitted to:
Doug Urry
CH2MHILL
2485 Natomas Park Drive
Sacramento, CA 95833-2975

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FW

INTRODUCTION AND BACKGROUND

As requested by CH2M Hill and Mariposa Energy (ME), Far Western Anthropological Research Group, Inc developed this geoarchaeological assessment for the proposed Mariposa Energy Project (MEP) near Tracy, California. The assessment was prompted in part by concerns that some project-related construction activities (i.e., earth disturbances) may have the potential to encounter and impact previously unidentified buried archaeological deposits that are "too deep to present surface manifestations," based on a formal data request from the California Energy Commission (CEC). Given this, the CEC requested additional information regarding "the age, the structure, and the character of the geologic units beneath the surface of the Project Area to evaluate the project's potential to substantially and adversely change the California Register of Historic Resource eligibility of archaeological deposits that may lie buried in the areas where MEP construction could impact them."

Recognizing these issues, this study, (1) provides information about landscape evolution and known buried sites in the region, (2) explicitly outlines a research approach designed to distinguish landforms that may contain buried sites from those that may not, (3) assesses the potential for buried sites in specific segments of the Project Area, (4) offers recommendations about the need for further work, and (5) delivers a research design and treatment plan to mitigate potential impacts to cultural resources if they are identified.

REGIONAL LANDSCAPE EVOLUTION

As described by Meyer (1996) and Meyer and Rosenthal (1997, 2007), the landscape in eastern Contra Costa and Alameda Counties has been altered and shaped by a complex sequence of region-wide environmental changes. Over the past 15,000 years, central California has experienced the widespread effects of sea level rise, substantial climatic fluctuations, repeated flooding, and erosion of the uplands and deposition in the lowlands. Relatively short episodes of landform instability (i.e., erosion/deposition) and longer periods of landform stability (i.e., soil formation), were accompanied by localized changes in the size and position of streams and other water sources, and presumably in the types and distributions of associated plant and animal habitats and human settlements. Specifically, several geoarchaeological studies along the nearby Kellogg Creek in the Los Vaqueros Reservoir area and Marsh Creek suggest that major episodes of alluvial deposition occurred in the eastern Diablo Range sometime between about 15,000 and 9500 cal BP, 9500 and 4000 cal BP, and again after 1500 cal BP, separated by prolonged periods of landform stability (Rosenthal and Meyer 2009). Consequently, if sites more than 1,500 years old are located in the project area they may be buried by one or more episodes of deposition within the floodplains that comprise the lowland areas.

Since the last major pulse of deposition occurred in the latest Holocene, the current landscape reflects a significant "geologic bias" where younger sites tend to occur at or near the present surface, and older (>1500 cal BP) sites tend to be buried, especially within the valleys of the region. The timing and widespread extent of these recent landscape changes has severely limited the ability of archaeologists to identify and sample a substantial and conceivably important part of the archaeological record (e.g., Meyer and Rosenthal 2007, 2008; Rosenthal and Meyer 2004a, 2004b); a problem further exacerbated by artificial landscape modifications in some areas. These processes either promoted or discouraged the burial of once habitable land surfaces, and the preservation or destruction of any associated archaeological materials.

Because of this, buried archaeological deposits are not distributed randomly, but are confined to those portions of the landscape where sediments were deposited during the span of human occupation (i.e., during the latest Pleistocene and Holocene). With this basic understanding, the search for buried sites can generally be narrowed to Holocene-age depositional landforms, allowing the older portions of the landscape to be confidently excluded from consideration.

BURIED SITES IN THE REGION

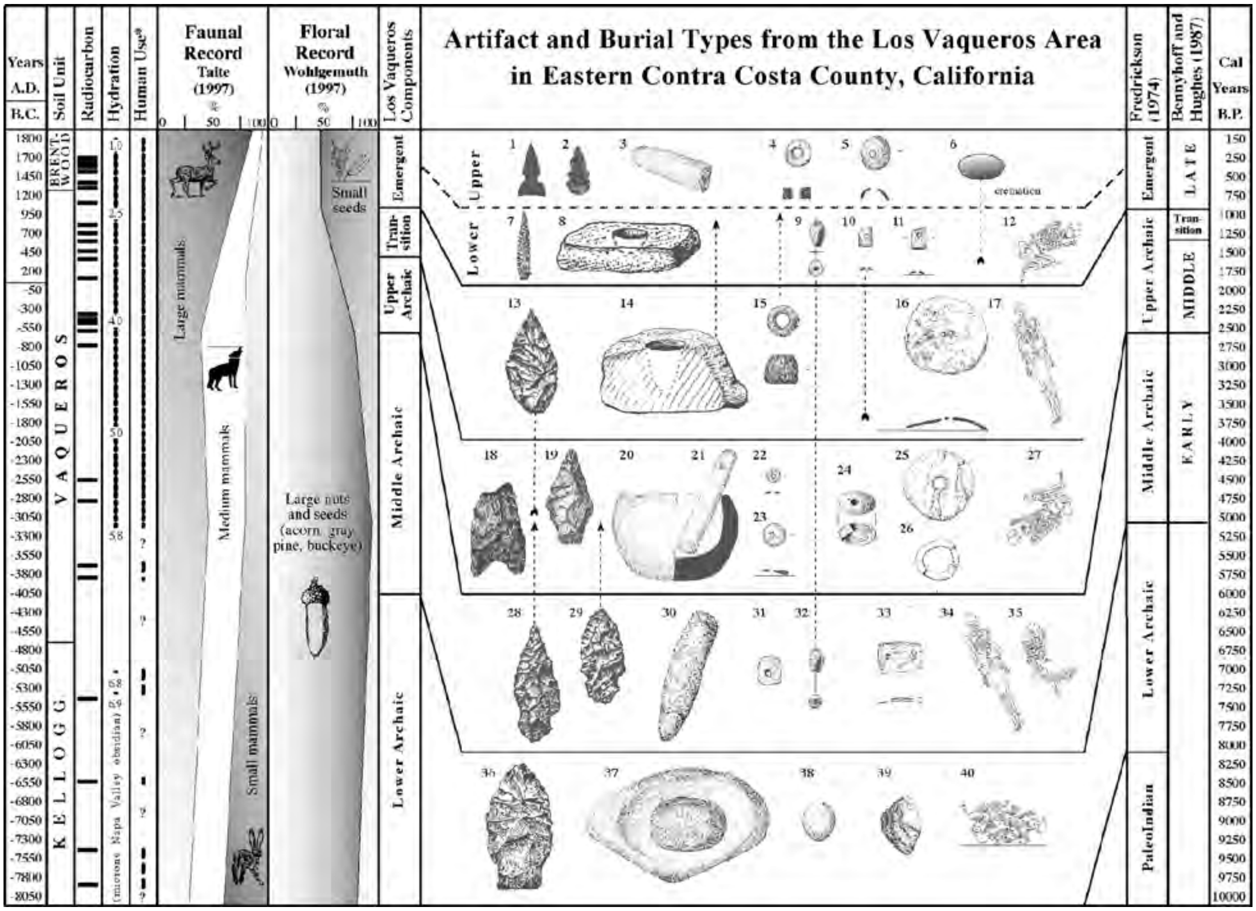
Beginning with the 1922 discovery of the "Stanford Man" skull (SCL-33/609) in the San Francisquito Creek floodplain, buried archaeological deposits have been discovered in virtually every major valley in the San Francisco Bay Area, the northern Diablo Ranges, and at various places in the Central Valley (Meyer 1996, 2000; Meyer and Rosenthal 1997, 2008a, 2009; Rosenthal and Meyer 2004a, 2004b; White 2002, 2003). In portions of the northern Santa Clara Valley, for example, more than 60% of the recorded archaeological sites are buried (Meyer 1999, 2000), including most of the older sites along Coyote Creek and the Guadalupe River (Allen et al. 1999; Anastasio 1988:401; Cartier 1988:277; Hylkema 1998:20-26; Wiberg 1997:3). Some of the oldest sites include a buried hearth and human burial exposed in a storm drain east of Sunnyvale (known as "Sunnyvale Man") that dates to 5063 cal BP (LaJoie et al. 1980; Moratto 1984), the "Sunnyvale Red Burial" (SCL-832) dated to 5545 cal BP and found during construction (Cartier 2002), and (3) the deeply buried early Holocene-age Blood Alley Site (SCL-178) in the Coyote Creek Narrows, which is one of the oldest in the Bay Area (Fitzgerald and Porcasi 2003; Hildebrandt 1983).

Buried sites and site components (CCO-30 and -308) have been identified in valleys throughout the Diablo Ranges including San Ramon Valley (Fredrickson 1966, 1968), at CCO-431 on Walnut Creek (Banks et al. 1984), at CCO-137 ("Concord Man") in the Walnut Creek-San Ramon drainage (c.f. Bennyhoff 1994; Heizer 1950a; Jones 1992), and recently within the Rossmoor Valley at CCO-309 (Price et al. 2006). At least eleven buried sites have been recorded within the Amador-Livermore Valley (Rosenthal and Byrd 2006), and others have been found along Kellogg Creek in the Los Vaqueros Reservoir locality (Meyer 1996; Meyer and Rosenthal 1997, 1998); most recently at several locations along Marsh Creek (Meyer and Rosenthal 2008b, 2009; Rosenthal et al. 2006; Wiberg and Clark 2004). Floodplains and alluvial fan deposits that rim San Francisco Bay have revealed several buried sites or site components, including recent finds at Fremont, Hayward, and San Leandro. More recently deeply buried and stratigraphically separate middle and late Holocene components were discovered at CCO-309, where a very late site deposit was known to occur at the surface (Price et al. 2006).

Along the western margin of the Central Valley, buried early and middle Holocene-age soils and cultural deposits have been identified in the Marsh Creek floodplain (Rosenthal and Meyer 2009; with those at the John Marsh House site (CCO-18/548) being the most substantial (Meyer and Rosenthal 2008b; Rosenthal et al. 2006). Farther east, buried site components are recorded at CCO-146, -147 and -368. All of these sites appear to be late Holocene in age and are associated with buried soils that formed on or adjacent to sand mounds around the margins of the Sacramento-San Joaquin Delta (Cook and Elsasser 1956; Holson et al. 1993; Waechter et al. 1995).

Not far west of the project area, in the Amador-Livermore Valley, buried sites have been recorded at 11 locations on the western end of the floodplain near Arroyo de la Laguna and Arroyo las Positas Creek. Buried components at these sites range in age between 6,100 and 600 years (Rosenthal and Byrd 2006). Just northeast of the Amador-Livermore Valley, the Los Vaqueros Reservoir locality contains the longest documented sequence of human occupation in the San Francisco Bay Area. In this drainage basin, buried archaeological deposits ranging between 9,900 and 700 years old are contained in both early and middle Holocene-age paleosols that formed in alluvial fan and floodplain deposits along Kellogg Creek (Meyer and Rosenthal 1997). The stratigraphic and cultural chronology of the Los Vaqueros area is summarized in Figure 1.

As the majority of these sites are more than 2,000 years old, they offer compelling proof that the apparent dearth of earlier sites is, in part, a reflection of the extensive landscape changes that occurred during the late Holocene. This is particularly true in areas such as the Santa Clara Valley where people were attracted to the well-watered and low-lying settings that were also subject to sediment deposition. Thus, it is very likely that many early portions of the archaeological record are buried and have yet to be discovered in the Santa Clara valley.



Key for Figure 1

No. Description

1. Panoche Side Notched and Desert Side Notched projectile points (mainly cryptocrystalline rock)
2. Stockton Side Notched and Corner Notched projectile points made only of obsidian
3. Small cylindrical pestles
4. Clam shell disk beads
5. Lipped Olivella beads, Type E
6. Cremation of human remains
7. Stockton Stemmed projectile points made only of obsidian
8. Small block mortars
9. Spire-lopped Olivella beads, Type A1b
10. Thin rectangular Olivella beads, Type M1
11. Thin rectangular Olivella beads, Type M2
12. Tightly flexed burials with variable orientations
13. Shouldered lanceolate projectile point made of obsidian
14. Bedrock mortars (Upper Archaic Period cups larger than Emergent Period cups)
15. Steatite beads
16. Haliotis ornaments, Type CA4fm
17. Ventrally extended burials primarily with northern orientations
18. Concave-base projectile points made of chert and obsidian
19. Contracting-stem projectile point made of chert
20. Shaped and cobble bowl mortars
21. Shaped and cobble pestles
22. Saucer Olivella beads, Type G1 and G2
23. Macoma clam disk beads
24. Split Olivella beads, Type C
25. Haliotis ornaments, Type C1C
26. Haliotis ornaments, Type C2C
27. Tightly flexed burials, primarily with southwest orientation
28. Side-notched projectile point made of chert (CCO-637, Burial 7, 5795 cal B.P.)
29. Side-notched projectile point made of chert (CCO-637, Burial 5, 5665 cal B.P.)
30. Cobble pestles with convex parabolic end-wear
31. Thick rectangular Olivella beads
32. Spire-lopped Olivella beads, Type A1a
33. Haliotis ornament, Type uBA7
34. Fully extended and semi-extended burials, primarily with northwest orientations
35. Loose-flexed burials, primarily with northwest orientations
36. Wide-stem projectile point made of obsidian (CCO-696, 6.9 microns Napa Valley)
37. Millingslabs and oval bifacial handstones
38. Small round handstones
39. Cobble-core tools
40. Cairn burial (CCO-696, Burial 160, 7400 cal B.P.)
*** Approximate timing and duration of human use based on combined radiocarbon and obsidian hydration evidence**

Figure 1. Los Vaqueros Natural Strata, Archaeological Datasets, and Culural Components

This brief review of known buried sites demonstrates the potential for such deposits in virtually all of the lowland valleys of this region. As many of these constitute the oldest known archaeological deposits in central California, their research potential is quite high, and therefore these sites tend to have elevated levels of significance with respect to National Register of Historic Places eligibility criteria. The presence of human remains at most of these sites also has implications for Native American heritage and further emphasizes the need to identify such resources early in the planning process.

GEOARCHAEOLOGICAL APPROACH AND ASSESSMENT

Among the many issues that challenge archaeologists and cultural resources managers is the problem of locating buried archaeological sites, such as those covered by naturally deposited sediments or deposits of artificial fill. While some parts of the landscape have remained relatively stable over the span of human occupation (~13,000 years), many other portions were either removed by erosion (mainly uplands), or buried by the deposition of sediments (mainly lowlands). Many former land surfaces once used and occupied by prehistoric people have been buried, disturbed, or destroyed by these processes, along with any associated archaeological deposits. Consequently, the present landscape is at best an indirect and imperfect reflection of the environment used by people during the prehistoric and even historical eras. Since it is the responsibility of archaeologists to account for the entire archaeological record, it is important to assess both the large- and small-scale effects of landscape evolution to help insure that buried sites are identified and appropriately sampled.

Simply stated, there is an inverse relationship between landform-age and the potential for buried archaeological deposits. This is based on the principal that archaeological deposits cannot be buried within landforms that developed prior to human colonization of North America (Rosenthal and Meyer 2004a, 2004b), nor can they be buried in landforms that were non-depositional or subject to net erosion over the past 13,500 years. Thus, as a first step, landforms with the potential to contain buried sites must be distinguished from those that are either too old or too young to contain them. While this basic distinction addresses the <u>possibility</u> for buried sites, the relative <u>potential</u> or <u>probability</u> for buried sites depends largely on the age different landforms.

For example, early Holocene surface landforms probably have a low potential for buried sites, not because such sites are absent, but simply because they can only contain sites that were buried during the latest Pleistocene or earliest Holocene over a relatively short 2,000- or 3,000-year interval of time (i.e., the Paleo-Indian and Paleo-Archaic periods). In addition, the likelihood that people occupied any one spot on the landscape was limited by the density of human populations, which are thought to have been comparatively low at that time. Thus, only a small number of sites were created by the region's first inhabitants over a relatively brief time. Consequently, the probability of finding one of these sites within or below an early Holocene surface landform is drastically reduced by these factors.

The same logic applies to the sensitivity of all subsequent Holocene-age depositional landforms. The buried potential of younger surface landforms is elevated by three main factors: (1) archaeological deposits from later time periods are more common because the density of human populations increased over time; (2) Holocene-age depositional landforms commonly overlie older land surfaces (i.e., buried soils) that were exposed for a greater amount of archaeological time than those buried by older landforms; and (3) young depositional landforms can contain multiple Holocene-age buried soils that represent periods when they were available for human use. From this perspective, the longer that a landform remained at the surface, the greater the chance that it was occupied by people. It follows then that the chance for buried archaeological materials is elevated when landforms are buried later in time.

Because buried sites typically lack visible or obtrusive features that would indicate their presence to an observer in the field, most are not found by conventional pedestrian surface surveys (Bettis 1992:120). If it is accepted that buried sites "are probably always underrepresented in survey samples" (Nance 1983:349), then the difficulty of locating these sites can be treated as a fundamental sampling problem to be addressed at the inventory and research design phases (McManamon 1984).

Since it is necessary to know something about the age and nature of the landforms exposed at the proposed project area, this section provides information about the geology, geomorphology, and soils in the project area that are relevant for estimating buried site potential.

Project Area Geology, Geomorphology, and Hydrology

The project area is located in the northeast corner of Alameda County and the southeast corner of Contra Costa County about 7 miles northwest of Tracy, California (Figure 2). This area is situated at the interface between the rolling hills of Northern Diablo Range to the west, composed of Cretaceous-age sedimentary rocks of the Great Valley sequence, and the lowlands of the San Joaquin Valley and Delta region to the east composed of alluvial deposits that are Quaternary in age (Graymer et al. 1996). The hills are drained by several small unnamed streams that intermittently flow eastward to the valley. Due to the rain shadow (orographic) effect created by Mount Diablo, the project area receives only 10 to 20 inches of average annual precipitation. Since the summers tend to be hot and dry, annual evaporation rates normally exceed annual rainfall amounts. Consequently, there are no permanent or semi-permanent watercourses in or near project area because very little surface run-off reaches the local drainages. As discussed below, the lack of substantial Holocene-age alluvial deposits within the area's drainages is a further reflection of this semi-arid climatic pattern.

As shown in Figure 3 the proposed project area crosses a large area mapped as latest Pleistocene alluvial fan deposits (Qpf), and one much smaller area mapped as early to late Pleistocene pediment deposits (Qop?) for which the identification is uncertain (Knudsen et al. 2000). It should be noted that the ages of these units is based mainly on their relative geomorphic position and soil development, and not on absolute dating techniques such as radiocarbon. The lack of temporal resolution is problematic for studies that need to understand how the nature and timing of landscape changes may have affected the structure and visibility of the archaeological record. Thus, the following section addresses this need by providing empirical data about the actual age of particular soils and landforms.

Project Area Soils

A depositional landform map was created using the Soil Survey Geographic (SSURGO) digital soil database from the Natural Resource Conservation Service (2008). The SSURGO-data are an exact duplication of the original soil surveys mapped at a 1:24,000 Though designed primarily for natural resource planning and management, SSURGO-level data have previously been used to develop reasonably detailed maps of depositional landforms, including those created for geoarchaeological sensitivity studies elsewhere in central California (Meyer and Rosenthal 2008a; Rosenthal and Meyer 2004a, 2004b) and other states (Monaghan and Lovis 2005).

Based on the SSURGO-data, five different soil series have been mapped at the surface of the proposed project area, with the Altamont and Linne series found in upland areas underlain by pre-Quaternary bedrock, and the San Ysidro, Solano, and Rincon series found in the lowland areas (Figure 4). The Altamont series, which underlies portions of the Project Site, are well-developed upland soils formed on bedrock. The central and southern portions of the project area are mapped as the Linne soil series, which are formed on bedrock in upland and foothill settings. Since both are associated with pre-Quaternary-age bedrock, these soil bodies have virtually no potential for buried sites because they formed on erosional landforms that pre-date the arrival of people to the continent.

Soils of the San Ysidro series occur at the surface in the southern and northern portions of the project area and a large portion of lowlands along the northern portions (Figure 4). This well-developed soil formed on older fans and low terraces that are at least latest Pleistocene in age. The Solano-series soil occurs on nearly level low terraces and hummocky surfaces in the lowland portions of the project area. The landscape position and well developed nature of this soil suggest that it is at least latest Pleistocene in age. While these soils are associated with depositional landforms, their potential to contain buried sites is very low because they were deposited before people arrived in the region.

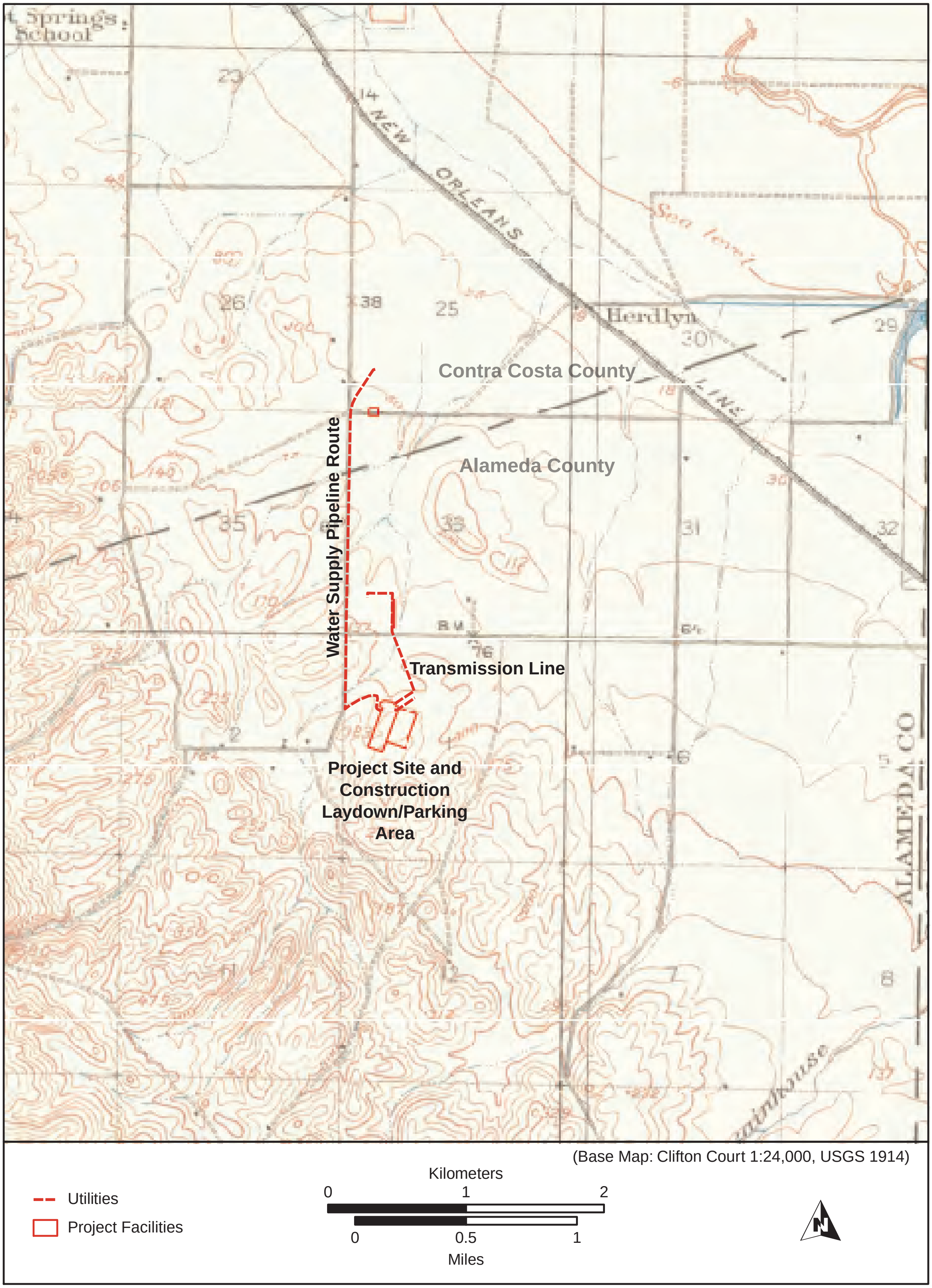


Figure 2. Location of Mariposa Energy Project Area and 1914 Topography.

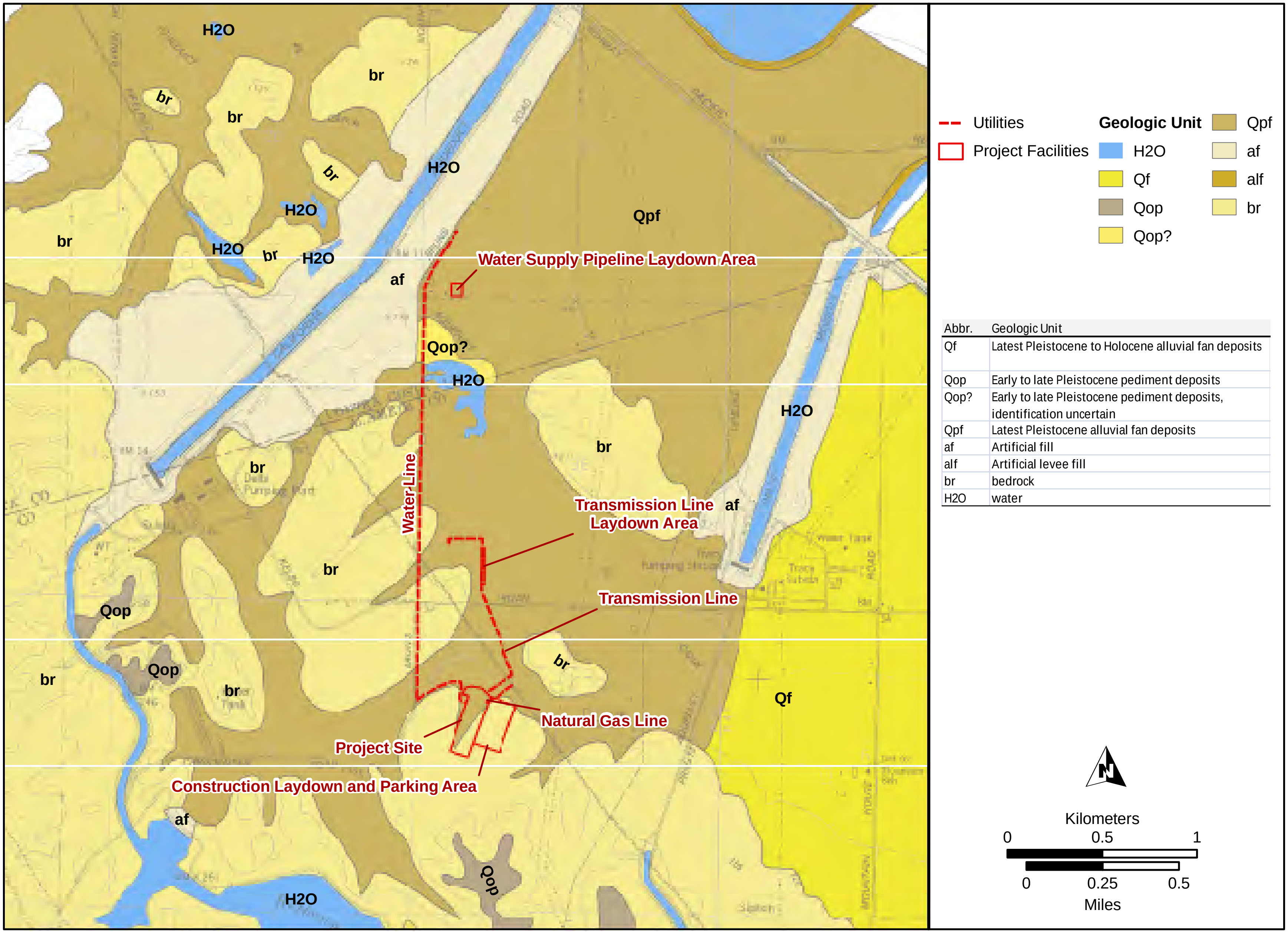
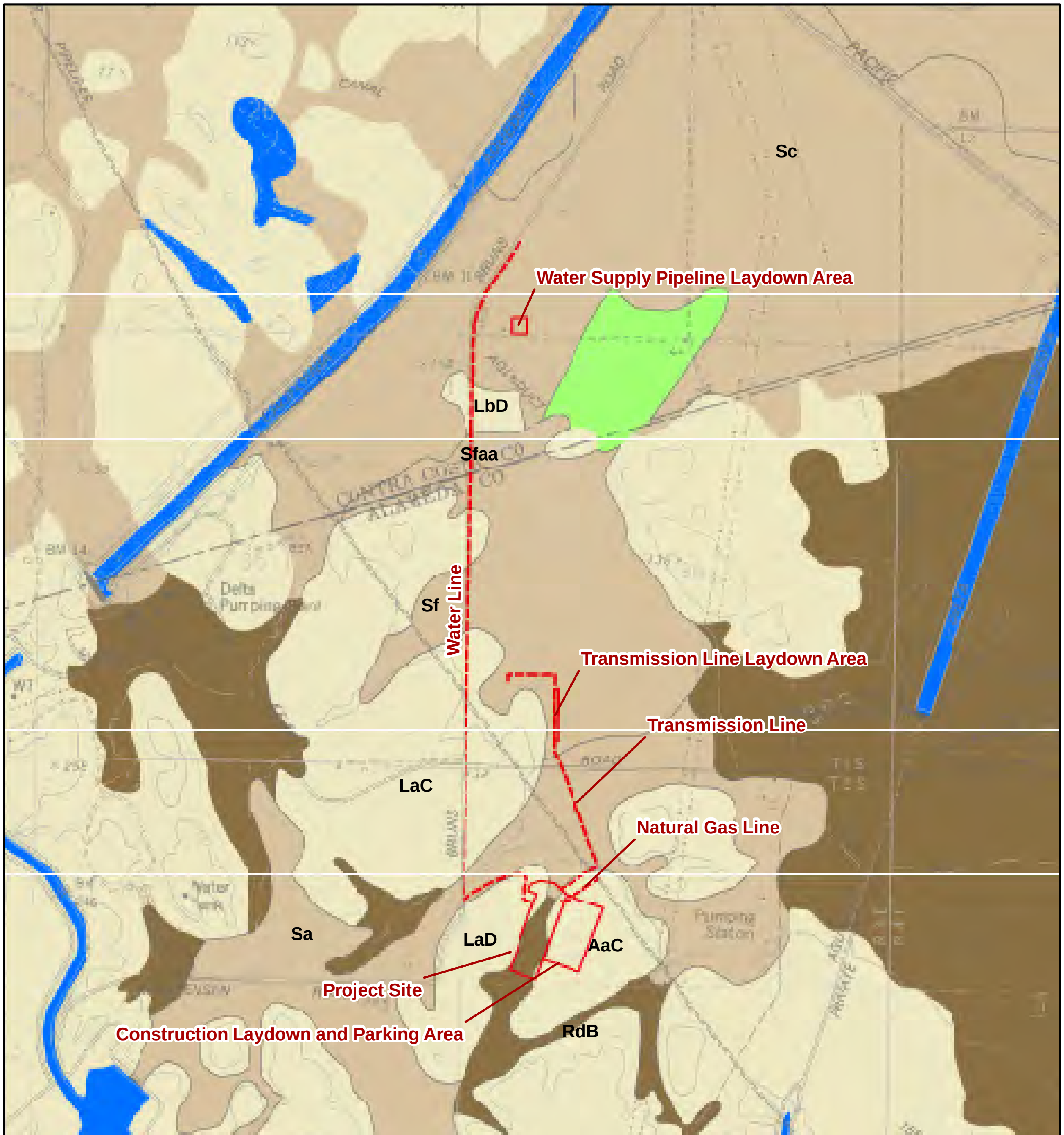


Figure 3. Distribution and Age of Quaternary Surface Deposits in the Mariposa Energy Project Area (adapted from Knudsen et al. 2000)



(Base Map: Clifton Court Forebay 1:24,000, USGS 1978)

- Utilities
- Project Facilities

Soil Age

- Water
- Latest Holocene
- Late Holocene
- Early Holocene
- Latest Pleistocene
- Pre-Quaternary

Symbol	Map Unit Name	Soil Age
AaC	Altamont clay, 3 to 15 percent slopes	Pre-Quaternary
LaC	Linne clay loam, 3 to 15 percent slopes	Pre-Quaternary
LbD	Linne Clay Loam, 5 To 15 Percent Slopes	Pre-Quaternary
RdB	Rincon clay loam, 3 to 7 percent slopes	Early Holocene
Sa	San Ysidro loam	Latest Pleistocene
Sc	San Ysidro Loam	Latest Pleistocene
Sf	Solano fine sandy loam	Latest Pleistocene
Sfaa	Solano Fine Sandy Loam	Latest Pleistocene

Kilometers: 0, 0.5, 1

Miles: 0, 0.25, 0.5

Figure 4. Estimated Landform-Ages Based on Surface Soil Types in the Mariposa Energy Project Area

Soils of the Rincon series occur in a bedrock swale or small valley in part of the Project Site (Figure 4). These moderately well-developed soils are formed mainly on alluvial fans. The maximum age of this series is constrained by a radiocarbon date of 10,490 ±60 BP, or 12,480 cal BP (Beta-261296) from a buried soil along Bird Creek in Yolo County (Kaijankoski and Meyer 2009), and by a date of 10,010 ±70 BP, or 11,180 cal BP (Beta-85996) from a buried soil along nearby Kellogg Creek in southeast Contra Costa County (Meyer and Rosenthal 1997). Thus, Rincon-series soils are not latest Pleistocene-age as suggested by the mapping of Knudsen et al. (2000), but are early Holocene-age instead. Since landforms with these soils were deposited soon after people entered the region, their potential to contain buried sites is estimated to be low.

A small area of Brentwood-series soils occur at the surface series approximately 1000 feet east/south of the northern portion of the Water Supply Pipeline Route (Figure 4). This soil has been shown to be latest Holocene in age based on radiocarbon dates from the Kellogg Creek floodplain in southeast Contra Costa County (Meyer and Rosenthal 1997). Thus, the only known Holocene-age depositional landform in the project area is the small area of Rincon soils found at the Project Site. The significance of the soil-landform relationships for specific project components is discussed below.

Buried Site Potential of Project Components

Water Supply Pipeline Route

A proposed water supply pipeline extends north along Bruns Road for approximately 1.6 miles from the Project Site. Since the pipeline crosses landforms that are either pre-Quaternary or latest Pleistocene in age (Table 1), there is a very low potential that any buried sites will be impacted by the excavation of the pipeline trench. While it is possible that some small areas of unidentified Holocene-age alluvium may occur within one or more of the several unnamed, ephemeral watercourses crossed by the pipeline, such deposits will likely occur as inset terraces that are restricted to channels down cut (eroded) into the older landforms. Thus, it is probable that erosive activity within the channel either removed and/or redeposited any prehistoric archaeological deposits that may have been located in these settings.

Transmission Line and Lay down Area

This transmission line extends from the Project Site for approximately 0.6 miles to the north following an irregular route. This line crosses only pre-Quaternary and latest Pleistocene-age deposits, indicating there is a very low potential to impact buried archaeological sites in these areas (Table 1). The transmission line also crosses an unnamed, ephemeral drainage where isolated pockets of Holocene-age alluvium, but as discussed above, the potential for intact buried archaeological materials is very low in these deposits.

The majority of the Project Site is to be situated on part of a small swale/valley that contains the early Holocene deposits associated with the Rincon-soil series (Figure 4). A small area of latest Pleistocene-age deposits associated with the Solano-soils series is located at the northeast end of the swale and Project Site. The alluvial deposits within the swale/valley are flanked by pre-Quaternary upland soils associated with soils of the Altamont and Linne series. The construction lay down/parking area and portion of the natural gas pipeline are located entirely within the pre-Quaternary deposits in the uplands southeast of the Project Site.

Project Site and Construction Lay down/Parking Area

The evidence at hand suggests there is a possibility that archaeological deposits could be buried within the area of early Holocene-age Rincon soils, but not elsewhere at the Project Site or within the construction laydown/parking areas. However, the likelihood that a site is actually buried in the swale/valley is considered to be low because, (1) the early Holocene sediments were deposited only a few thousand years after the region was first occupied by people, and (2) there is no viable water source (e.g., spring or stream channel) located within the swale/valley, nor does there appear to have been one in the past. Furthermore, preliminary grading and drainage plans indicate that construction activities will not fully remove the deposits from the swale/valley, but that only small segments will be cut, grubbed, or graded before the swale/valley is filled to an elevation of approximately 125 feet with materials removed from the pre-Quaternary hillside east of the site. The grading and drainage plans also show that there is not potential for buried sites to be impacted by construction of a proposed detention basin at the northwest end of the Project Site because, (1) it will be located within the latest Pleistocene (Solano series) portion of the swale/valley, and (2) the base of the basin will not extend below the surface of the original grade.

Table 1. Landform Age, Extent, and Buried Site Potential of Project Components.

Project Component	Pre-Quaternary	Latest Pleistocene	Early Holocene	Total Acres	% of Total Acres
Buried Site Potential	*Very Low*	*Very Low*	*Low*		
Project Site	3.34	0.57	5.78	9.69	31.3%
Construction Laydown/Parking	9.19	-	0.06	9.25	29.9%
Natural Gas Pipeline Route	0.45	-	-	0.45	1.5%
Transmission Line Laydown Area	-	0.60	-	0.60	1.9%
Transmission Line Route	0.26	2.51	-	2.77	9.0%
Water Supply Laydown Area	-	1.00	-	1.00	3.2%
Water Supply Pipeline Route	3.70	3.48	-	7.18	23.2%
Grand Total	16.94	8.15	5.84	30.93	100.0%
% of Total Acres	54.8%	26.4%	18.9%	100.0%	

Note: Areas based on the extent of project component polygons, with a 5-meter (15 feet) buffer added to linear components.

RECOMMENDATIONS FOR FURTHER WORK

This assessment indicates the majority of the proposed project area has a very low potential to contain buried archaeological sites. There is, however, a small portion of the Project Site (early Holocene Rincon soils) the potential for buried sites is slightly elevated, yet remains low (Figure 4). Thus, if the natural deposits in this area are disturbed by project-related earth moving there is small chance that a buried archaeological site could be impacted as a result. Given that the project should comply with the requirement that "a reasonable and good faith effort to carry out appropriate identification efforts" is made to identify archaeological resources [Section 106 800.4(b)(1)], the following recommendations are provided to help insure that potentially buried sites are identified, avoided, and/or properly sampled as needed:

- It is recommended that project designs be reviewed to determine if impacts will be occurring below the existing grade in low lying portions of the small swale/valley where the Project Site will be located. If the natural deposits in this area will not be impacted no further archaeological studies or identification efforts, including construction monitoring, are recommended. If subsurface impacts in this area cannot be avoided the following recommendations apply.
- At minimum, it is recommended that the possibility for late archaeological discoveries is specified as part of the construction bid package, and that the construction contract requires the contractor(s): (1) to inform all field personnel of this possibility; (2) to halt excavations immediately within ten meters (~33 feet) of a potential archaeological find; and (3) to allow a qualified professional archaeologist to examine and evaluate the find to determine if it warrants further treatment or not.

- If it is imperative to insure that the project schedule (critical path) and budget are not inadvertently affected by a late archaeological discovery, then a limited (1-2 day) subsurface exploration should be conducted in the area where the early Holocene-age Rincon soil occur at Project Site.
- If exploratory studies are not conducted prior to construction, then a qualified professional archaeologist should be retained to actively monitor project-related ground disturbing activities in the sensitive portion of the Project Site. The archaeological monitor should be required to be present before and during any substantial earth disturbances (i.e., trenching or grading) can be performed in the sensitive area to (1) help maximize the opportunity for archaeological discovery, (2) insure that potentially important cultural resources are not impacted, (3) conduct "real-time" preliminary assessments of any finds, and (4) facilitate and re-direct on-going construction activities by providing initial recommendations for the appropriate treatment of any finds. The archaeological monitor should be required to keep detailed records that document their daily activities, observations, decisions, and the presence or absence of any archaeological materials. If archaeological materials are discovered in a particular area, then it may be prudent to explore and/or monitor some adjoining areas, whether or not they were predicted to have the potential for buried sites.
- Finally, it may be possible to stop archaeological monitoring, at least temporarily, if and when it is determined that the Holocene-age deposits have been removed and that only pre-latest Pleistocene deposits will be impacted by further excavations. At the same time, no archaeological monitoring is needed or warranted in the remaining portions of the project area because the potential for buried sites in pre-latest Pleistocene deposits is very low.

RESEARCH DESIGN

(With contributions from Brian Byrd and Jeffrey S. Rosenthal)

The following presents a research design for evaluation of cultural resources in the project area, including a framework and an overview of salient research domains useful for assessing the significance and eligibility for nomination of cultural resources to the National Register. It begins with a discussion of cultural resources regulations and eligibility criteria, followed by issues relevant to prehistoric resources.

REGULATORY CONTEXT AND EVALUATION CRITERIA

Eligibility Criteria

Undertakings that involve federal funding, lands, or permits require that the significance of cultural resources within the project area be measured against the National Register criteria for eligibility (36 CFR 60.4) which state, in part, that:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, materials, workmanship, feeling, and association, and

(A) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(B) That are associated with the lives of persons significant in our past; or

(C) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) That has yielded, or may be likely to yield, information important in prehistory or history.

Guidelines for applying National Register eligibility criteria are provided in National Register Bulletin 15 (Andrus and Shrimpton 2002). While historic-era properties may be found National Register eligible under virtually any of these criteria, prehistoric archaeological sites are almost always evaluated with respect to Criterion D. The eligibility criterion most usually appropriate to evaluate archaeological properties is 36 Code of Federal Regulation (CFR) Part 60.4(d), which pertains to an historic-era property's demonstrated likelihood or potential to yield information important to an understanding of history or prehistory. National Register Bulletin 15 (US Department of the Interior 1991:22) emphasizes that, "The information that a property yields, or will yield, must be evaluated within an appropriate context." This context consists of archaeological data potentials, research domains, and topics identified as pertinent to local, regional, and theory-driven archaeology.

Under Criterion D, archaeological properties deemed significant and eligible for nomination to the National Register should provide evidence that they retain information applicable to identified research domains. The first step in this process is thus the identification of pertinent research domains that might be addressed by data generated from project area archaeological sites. Archaeological sites for which it can be demonstrated that there is the potential to recover important information to address these research domains may be determined eligible for National Register listing.

Regulatory Setting

Under federal and state law, effects to significant cultural resources—archaeological remains, historic-era structures, and traditional cultural properties—must be considered as part of the environmental analysis of a proposed project. Criteria for defining significant cultural resources are stipulated in 36 CFR Part 63 (Determinations of Eligibility for Inclusion in the National Register of Historic Places); the National Historic Preservation Act (NHPA) of 1966, as amended (NHPA; 16 USC 470 et seq.); and the California Environmental Quality Act (CEQA, revised 2005). In addition, 36 CFR 800 outlines the compliance process for Section 106 of the NHPA.

Under the NHPA, the lead federal agency must consider effects to eligible or unevaluated resources ("historic properties") from the proposed undertaking, in consultation with the State Historic Preservation Officer. This includes identification (usually through archival research, field inventories, public interpretation, and/or test evaluations) of cultural properties eligible for the National Register, assessment of adverse effects to eligible properties, and development of mitigation measures to offset those effects. The revised regulations emphasize consultation with appropriate Native American communities, in the case of prehistoric or ethnographic properties or traditional cultural properties, and the preparation of Memoranda of Agreement among all involved agencies and parties.

Under CEQA, the lead non-federal agency (state, county, city, or other) must consider potential effects to important or unique cultural resources. While the language is somewhat different between the NHPA and CEQA, the definitions of eligible properties and of adverse impacts are essentially the same. Evaluations under CEQA consider a resource's potential eligibility to the California Register of Historical Resources.

Criteria for Determining Significance of Effects

An environmental document prepared to comply with the National Environmental Protection Act must consider the context and intensity of the environmental effects that would be caused by, or result from, the proposed action. Under the National Environmental Protection Act, the significance of an effect is used solely to determine whether an Environmental Impact Statement must be prepared. An environmental document prepared to comply with CEQA must identify the potentially significant environmental effects of a proposed project. A "[s]ignificant effect on the environment" means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project (State CEQA Guidelines, Section 15382). CEQA also requires that the environmental document propose feasible measures to avoid or substantially reduce significant environmental effects (State CEQA Guidelines, Section 15126.4(a)).

The criteria used to determine the significance of an impact to historic properties are based on Section 800.5(a)(1) and (a)(2) of the NHPA; Appendix G of the State CEQA Guidelines (Environmental Checklist); and the US Bureau of Reclamation's Directives and Standards (LND 02-01).

Section 106

The NHPA defines an adverse effect to an eligible resource as any of the following:

- Physical destruction, damage, or alteration, including moving the property from its historic location
- Isolation from, or alteration of, the setting
- Introduction of intrusive elements
- Neglect leading to deterioration or destruction
- Transfer, sale, or lease from federal ownership

In addition to archaeological and architectural resources, federal regulations define Traditional Cultural Properties those that are eligible for the National Register because of their "association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King 1998: National Register Bulletin 38: Guidelines for Evaluation and Documenting Traditional Cultural Properties). Examples of traditional cultural properties are as follows:

- A location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world

- A rural community whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents
- An urban neighborhood that is the traditional home of a particular cultural group, and that reflects its beliefs and practices
- A location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice
- A location where a community has traditionally carried out economic, artistic, or other cultural practices important in maintaining its historic identity

Native American burials are also protected by federal law. The Native American Graves Protection and Repatriation Act (Public Law 101-601; 25 USC 3001-3013) protects Native American burial sites and controls the removal of human remains, funerary objects, sacred objects, and items of cultural patrimony on federal and tribal lands.

CEQA

California regulations require that effects to cultural resources must be considered only for resources meeting the criteria for eligibility to the California Register of Historical Resources, outlined in Section 5024.1 of the California Public Resources Code. Under this section, an important historical property is one that meets any of the following criteria:

- Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage,
- Is associated with the lives of persons important in California's past,
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic value,
- Has yielded, or may be likely to yield, information important in prehistory or history, or
- Under Section 21083.2 of CEQA, a "unique" archaeological resource is an object, artifact, or site that can be clearly shown to meet any of the following criteria:
  - Contains information needed to answer important scientific research questions, and a demonstrable public interest in that information exists,
  - Has a special and particular quality such as being the oldest of its type, or the best available example of its type, or
  - Is directly associated with a scientifically recognized important prehistoric or historic event or person.

Actions that could change the significance of the resource include the demolition, replacement, substantial alteration, or relocation of an eligible resource. Under the State CEQA Guidelines, impacts on cultural resources may be considered significant if a project alternative would result in any of the following:

- Cause a substantial adverse change in the significance of a historical resource, as defined in Guidelines Section 15064.5,
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to Guidelines Section 15064.5, or
- Disturb any human remains, including those interred outside formal cemeteries.

California law also protects Native American burials, skeletal remains, and associated grave goods regardless of their antiquity, and provides for the sensitive treatment and disposition of those remains (California Health and Safety Code Section 7050.5, California Public Resources Code Sections 5097.94 et seq.).

Summary

According to the above criteria, the project would be considered to have a significant impact on cultural resources if it would result in any of the following:

- Substantial adverse change in the significance of an historical resource,
- Substantial adverse change in the significance of a unique archaeological resource,
- Disturbance or destruction of unique paleontological resource or site or unique geologic feature,
- Disturbance of any human remains, including those interred outside of formal cemeteries, or
- Elimination of important examples of the major periods of California history or prehistory.

Significance statements are relative to both existing conditions and future conditions, unless stated otherwise. Only those elements of a resource which contribute to its eligibility need to be considered; effects to noncontributing elements are less than significant.

Prehistoric Property Types

One of the first steps in the evaluation process is to identify the types of properties that might be encountered in a project area. While no prehistoric archaeological sites have been recorded so far within the Project APE, archaeological investigations conducted in other portions of the region provide a basis for discerning the range of prehistoric property types that may be encountered in buried contexts within the project area. Potential property types, based on the material remains associated with individual sites, include middens, artifact and/or ecofact scatters, burial complexes/cemeteries, isolated artifacts or features, and re-deposited prehistoric material. Table 2 summarizes these site types and gives examples of the characteristics associated with each property type.

Table 2. Prehistoric Property Types and Characteristics.

PROPERTY TYPE	CHARACTERISTICS
Midden	Dark, friable or sometimes greasy sediment; midden constituents may include all or some of the following: shell, bone, macrobotanical remains, ash, charcoal, fire-cracked rock, artifacts (worked bone, worked shell, flaked stone and ground stone), features, house floors, and human burials
Artifact/Ecofact Scatter	Scatters of material culture, typically dominated by artifacts (such as flaked stone and ground stone) or ecofacts (such as shellfish or faunal material) and lacking midden
Burial Complex/Cemetery	Deliberately interred burials, cremations, or human bone; mortuary offerings and items of personal adornments (such as beads and other ornaments) interred with burials
Isolates	One or a few artifacts or a single feature (such as a hearth or burial)
Re-deposited Material	Prehistoric remains (such as a midden) that have been removed from their original context and deposited elsewhere, typically by modern construction activities

RESEARCH ISSUES

The discovery and analysis of previously unidentified (e.g., buried)) archaeological sites is crucial for archaeological inquiry because, without new or comparative data, many important questions regarding chronology, settlement, and subsistence cannot be properly addressed or answered, and current research questions cannot be confirmed, denied, or refined beyond our present understanding. Although it has long been suspected that natural processes obscured many archaeological sites in California (Heizer 1949:39-40, 1950b, 1952:9; Lillard et al. 1939; Moratto 1984:214), the nature and completeness of the archaeological record has not been treated as an explicit research problem as it has in other parts of North America. It has since become apparent that a significant portion of the archaeological record in the San Francisco Bay Area has been buried by processes related to the evolution of the landscape over the last 14,000 years (e.g., Rosenthal and Meyer 2004a, b). Yet the extent to which environmental changes actually affected human populations and the structure of the archaeological record are on-going problems for archaeologists.

The lack of geoarchaeological studies is an ongoing problem for researchers seeking to understand the relationships between demographic and socio-economic change and site distribution patterns (Meyer and Rosenthal 1997). Over the last 30 years, archaeological research in central California has shifted toward techno-economic concerns related to resource optimization and intensification, and away from culture-historical issues and the search for antecedent archaeological assemblages. Current theoretical models usually assert that economic and socio-political development in prehistoric central California was ultimately driven by changes in human population density and resource availability (Basgall 1987; Bouey 1987; Broughton 1994; Jones 1992).

In the context of these models, the abundance of late Holocene archaeological sites has frequently been considered *prima facie* evidence for human population growth (Basgall 1987:43; Beaton 1991; Broughton 1994; Glassow 1999; Hildebrandt 1983; Jones 1992; Schulz 1981:181-188). If, however, the archaeological record has been structured by large-scale landscape changes in a manner consistent with prevailing assumptions about prehistoric land use and population densities, then demographic-driven theoretical models are inherently flawed. This problem of archaeological representativeness will not, therefore, be further clarified or resolved if the larger issue of landscape evolution is not explicitly addressed by future geoarchaeological studies in the region.

Important archaeological research issues in central California include: (1) chronology and dating; (2) human occupation and landscape evolution; (3) changes in diet and health; (4) socio-spatial structure of settlements; (5) causes and trajectory of sedentism; (6) emergence of socio-political complexity; (7) reconstructing regional interaction spheres; and (8) population movement and its implications. While these issues focus on the broad-scale evolution of adaptive strategies and associated socio-political developments, the first two issues are considered the most relevant for this study, because well-dated cultural component can provide a basis for addressing most or all of the other research issues.

Chronology and Dating

A major objective of archaeological excavations is to identify single-component assemblages. Ideally, the temporal extent of site components will be of sufficient resolution (i.e., 200-year-intervals or less) to allow for detailed study of temporal developments; particularly with respect to subdivisions of the Late Archaic and Emergent periods. Information from well-dated site components can then be used to address higher-order issues of hunter-gatherer adaptations in the region.

Accomplishing this fundamental baseline objective requires an analysis of site structure to determine whether cultural deposits are present and whether they retain physical integrity. Using a geoarchaeological perspective, this entails an assessment of site-formation processes and the extent of post-depositional disturbances. This is particularly important for sites that may lie buried directly below, or have been impacted by, historic-era construction events. Such site disturbance events can have a significant impact on the integrity of a prehistoric site. Radiocarbon dating is also essential for assessing the research utility of re-deposited midden sediment, since it provides substantive insight into whether the material was derived from a single or multi-component site.

Very different approaches are needed to discern discrete occupation events depending on the type of site under consideration. For midden sites, the objective is to accurately assess the length of time it took for the cultural deposits to accumulate. This objective is relatively straight-forward for small sites or loci, although thicker middens naturally require more dates than thin middens to accurately assess their temporal duration. Very large sites with thick deposits, such as shell mounds, are much more challenging, since they were generally occupied for long periods of time and portions of the sites often built up at different rates. As such, similar depths in different areas of a site may have been occupied at very different time periods, and occupation hiatuses can occur as well. Dating at such sites requires multiple vertical dating sequences at key localities. In other words, horizontal variability needs to be held constant in each dating sequence. This then provides a basis for understanding the full time range of occupation and the spatial extent of occupation for a particular period.

Determining the time span of site occupation is arguably the single most important facet of archaeological investigation, since the utility of all subsequent research issues rests on this foundation. The amount of project funds and the analytical effort and rigor used to address this topic, however, are often relatively minor. Successful dating efforts invariably entail assessing initial dating results and then submitting additional samples to resolve outstanding issues. The following discussion outlines investigative protocol for ensuring that this research issue is address using state-of-the-art standards.

Whenever possible, single items will be submitted for radiocarbon dating (such as one piece of carbonized plant remains, bone, or shell). This invariably requires the use of the Accelerator Mass Spectrometry (AMS) technique, and sometimes micro-sample AMS counting, rather than conventional dating (which requires larger samples). Although AMS dating is more expensive than conventional dating, it provides both greater precision (i.e., a date with a smaller standard deviation) and more accuracy. Greater accuracy is obtained because submittals of multiple pieces or fragments (such as scattered charcoal fragments or several shell fragments) will often yield averaged dates from a series of disparate events. Such dating can potentially mask the presence of two discrete occupation events that have been mixed by post-depositional processes (e.g., Breschini and Haversat 2005).

Reliance on carbonized annuals (such as seeds or nuts) is also preferred, since it avoids the problem of dating wood charcoal derived from old trees—the "Old Wood" problem (Schiffer 1986). It should also be noted that shellfish dating needs to take into account differences in radiocarbon content between terrestrial and marine systems (generally referred to as the reservoir effect). Typically, marine shellfish provide measured radiocarbon ages considerably different than terrestrial carbon samples from the same setting, and it is necessary to apply an appropriate reservoir correction (the correction factor will vary by geographic location). As demonstrated by Ingram (1998) in a study of paired charcoal and oyster shellfish samples throughout the long West Berkley shell mound (ALA-307) sequence, one must take into account changes in the radiocarbon reservoir driven by location and age. Finally, it is strongly recommended that multiple dates be obtained from each component. Typically, one in five radiocarbon dates are inaccurate, due most often to post-depositional disturbance. As such, multiple dates are often needed from each component to assess occupation duration and to exclude dates that may be inaccurate.

Determining the duration of occupation, whether spatially discrete occupation events are also temporary discrete, and which dates do not accurately reflect the actual occupation event is an analytical exercise. Measured or conventional radiocarbon dates cannot be used; instead the dates must be calibrated to determine their probable age in calendar years (Stuiver et al. 1998). Furthermore, as Telford and other (2004) cogently demonstrate, calibrated intercepts should not be compared, since these are not accurate assessments of the probable age range of a sample. Instead, weighted averages, probability distributions, or statistical tests will be used to assess chronological issues. The use of calibrated probability distribution calculations can provide strong insight into dating issues, and highlights the importance of assessing initial dating results and then submitting additional samples to identify whether the upper and lower dates represent outliers or not.

When sites have three or fewer dates it is often difficult to accurately assess the age range of occupation. If sample selection is dominated by wood charcoal, then this increases the likelihood of the dates being older than the occupation events. Previous discussions of chronological issues by other scholars working in the general region have typically been based on measured or conventional radiocarbon ages, rather than calibrated dates. Moreover, dating was generally considered only with reference to intercepts (which have a very low likelihood of actually representing the age of the item in question) rather than age ranges based on standard deviations or probability distributions. As such, prior dating discussions must be viewed with caution concerning the duration of occupation, temporal comparisons between sites, and how occupation events are placed within the existing well-dated sequence for the region.

Obsidian hydration results also can provide insight into chronological issues. For example, using Origer's (1982) hydration formula conversion for Napa Valley obsidian (the predominant obsidian source in the Bay area), one can compare calibrated radiocarbon dates and hydration-derived age ranges (at one standard deviation). Recent studies have indicated that for the most part, sites with radiocarbon dates indicating Middle Late Transition or Late Period occupation have the best correspondence with obsidian hydration age estimates (Byrd et al. 2009; Byrd and Berg 2009). Sites with earlier radiocarbon dates almost invariably have correspondingly later obsidian hydration-derived age estimates. This trend indicates that Origer's (1982) curve needs to be refined for all sites in the regions falling in the Middle and Early periods, or only for occupation episodes that are either rapidly buried by other occupation debris (such as with thick shell middens) or by natural processes such as dune sand. The developing of revised curves must be based on matched pairs of hydration readings and radiocarbon dates from the same context. With such a refinement, obsidian hydration can play a more valuable role in defining site components and chronological units for the region.

Data Requirements

For a site to contribute meaningfully to our understanding of the regional cultural chronology (and for all other research topics, since they also require chronological control), several data requirements need to be fulfilled. First, the site must contain one or more demonstrably single-component depositional contexts and one or more classes of temporal information: e.g., organic remains suitable for radiometric assay; time-sensitive artifacts (such as ceramics, projectile points, and beads); obsidian artifacts for hydration and source studies; or association with a datable geomorphic context. If a site lacks chronologically sensitive data, it cannot contribute significant information to a wide range of research issues. By the same token, the simple presence of one or more of these data sets does not necessarily make a site chronologically significant, as evidenced by the common occurrence of temporally mixed deposits in California which produce rich assemblages with no chronological resolution. This situation also highlights the utility of aggressively dating small, short-term occupation episodes. Such sites have reduced likelihood of component mixing and hence greater potential to provide insight into a discrete set of correlated activities.

Human Occupation and Landscape Evolution

A robust understanding of ancient landscapes is a necessary condition for determining how and why groups positioned and organized themselves on an annual basis. Geomorphic processes have profoundly altered both the local and regional landscapes, and these processes were driven by environmental conditions that differed greatly from today (such as rapid global warming and sea-level rise in the terminal Pleistocene/early Holocene). Nowhere is this more obvious than in littoral settings where changes were rapid and profound, altering both where land and sea met and what food resources were available within each context.

In order for archaeologists to rigorously investigate prehistoric site distributions, to reconstruct how prehistoric populations adapted to a changing landscape, and to model the decision-making processes that underlay settlement and subsistence choices, it is necessary to reconstruct paleogeography and paleoecology. Such a reconstruction then provides a solid basis for refining predictive models of where sites are most likely to be located (a key factor in buried-site sensitivity modeling), and it also provides robust insights into the diachronic changes in settlement patterns and subsistence strategies. Specifically, one can gain insight into key questions such as what resources were locally available at any point in time. This can then be compared with what was actually exploited; site seasonality and the annual round; and how labor was organized (for example, whether settlement locations were chosen to target seasonally available resources or were placed near types of resources that could easily be collected in daily foraging events by elderly and very young individuals).

As noted in the Background section above, relatively few sites pre-dating the late Holocene have been found so far in the region. As a result, very little is known regarding the nature of local and regional settlement and subsistence practices and the pace of culture change in this region during the first 10,000 years that Native Americans occupied California. It seems very unlikely that Native populations largely ignored this region, while occupying other, much more arid and marginal environments such as the Mojave Desert, where there is a considerable archaeological record dating prior to the late Holocene. Two factors undoubtedly have played a role in the dearth of evidence for pre-late-Holocene occupation in the region: (1) occupation, at least initially, was low in density and as a result the material record is sparse and rarely preserved; and (2) much of the earlier archaeological record is buried by later alluvial deposition, dune sand accumulation, and urban development. We suspect that although there may be some validity to both explanations, the latter two have more significantly impacted current perspectives on the first 10,000 years of settlement in the region.

Refined insight into prehistoric adaptation to highly divergent landscapes during the last 14,000 years requires knowledge of: sea level changes; location of the shoreline; location and character of drainages (e.g., entrenched or meandering); extent of associated riparian corridors, freshwater marshes, saltwater marshes, and intertidal mud flats; and extent of alluvial fans and dune fields. More refined insight regarding the paleo-landscape can then form a basis for subsequent modeling of settlement configuration.

Data Requirements

Site location and correlation of archaeological sites with geomorphic events can provide insight into such issues as site location patterns and how site formation processes have affected site visibility and integrity. Addressing these issues requires well-preserved sites in contexts that can be evaluated by geomorphic and paleo-ecologically oriented investigations.

Only by explicitly designing field studies to discover and investigate buried and low-density sites will this topic be resolved (e.g., Meyer and Rosenthal 1997; Rosenthal and Meyer 2004a, 2004b). Such studies will include geoarchaeological assessment of the sensitivity of certain settings to contain buried prehistoric sites of particular ages, and then designing and conducting detailed geoarchaeological research to discover these buried sites. These baseline data will then provide a firmer foundation for reconstructing settlement patterns and other aspect of prehistoric human behavior.

If these research issues are to be addressed, it is important to ask if the project area contains, or has the potential to yield: (1) buried land surfaces (i.e., buried soils or paleosols) that were available for prehistoric human occupation, and are these surfaces of sufficient vertical and horizontal extent that they can be used as stratigraphic markers and searched for buried archaeological remains?; (2) organic materials (e.g., bone, charcoal, shell, wood, and soil carbon) suitable for determining and constraining the age of deposits from natural and cultural contexts, and for establishing the local depositional history and cultural sequence?; (3) one or more depositional sequences (i.e., landform-sediment assemblages) that can be compared and correlated with others in the region, and used to reconstruct the prehistoric landscape?; and (4) natural or cultural stratigraphy that contributes to an understanding of the timing and extent of local or regional landscape evolution and the effects of these processes on the location, duration, and mode of prehistoric human land use?

The types of data required to answer these questions would include, but not be limited to: (1) natural and cultural deposits and buried soils of sufficient integrity and variability that they can be identified, traced, and contribute to landscape reconstruction; (2) datable organic materials to determine the age of the natural and cultural deposits; (3) intact assemblages of artifacts and other cultural remains (i.e., floral and faunal) of sufficient quantity and variety for determining the nature and duration of human settlement; and nature and configuration of the paleo-landscape.

TREATMENT PLAN

(With contributions from Brian Byrd and Jeffrey S. Rosenthal)

In this section, the procedures (in the field, laboratory, and office) are outlined for operationalizing the research design and conducting studies in a professionally acceptable and cost-effective manner. The section lays out a general phased approach to prehistoric archaeological investigations and field methods that are appropriate to the project area as a whole. Also discussed here are the procedures for laboratory processing and data analysis, and a consideration of technical reporting and artifact curation.

METHODOLOGICAL APPROACH

The research issues outlined above are underpinned by important methodological considerations that revolve around an awareness of the dynamic nature of hunter-gatherer land use and the implications of these patterns for site formation processes. As is often noted, any given location could have served as a residential base during part of the year, a resource collecting camp during another, and a processing locale during still a third. When hundreds of years are added to the equation, it becomes even more difficult to unravel the remains of potentially disparate land-use patterns. The easiest way to learn about hunter-gatherers from their archaeological remains is by isolating spatially discrete and chronologically restricted deposits, or "components." This approach minimizes the effort of trying to sort out badly mixed or jumbled accumulations and also avoids building assemblages and interpreting prehistoric behavior based on intermixed cultural remains throughout a site area.

Components are made up of temporally related aggregates of artifacts, features, and other residues representing the material remains produced during a specific time span of residence or other use at a specific location, ideally found associated with a definable horizontal/vertical fraction of a site or landform. Component chronological assignments are most reliable when based on several independent lines of evidence, including bead or ornament seriation, point types, regional comparison ("cross-dating"), obsidian hydration, and ^{14}C dating. However, integrity is relative and more often defined by analytical utility. Operationally, one can expect considerable variability in temporal resolution. Components are more or less chronologically resolved, with some heavily mixed and strictly inferential, and others stratigraphically well segregated. Some components represent very brief spans of occupation while others were accumulated over hundreds of years of similar activity.

This methodological approach is characterized by recognition that the component is first a geomorphic phenomenon, and second, an inferential archaeological unit. The methodology involves the deployment of both field and lab resources in a feedback system aimed at isolating and defining individual temporal phenomena, which includes detailed examination of site stratigraphy from a geological perspective (Waters 1992). From the standpoint of the development of sampling strategy, initial site investigations should seek to document general chrono-stratigraphic structure and spatial patterning, define the range of components available, and establish the horizontal and vertical distribution of the archaeological deposits.

FIELD INVESTIGATIONS FOR PREHISTORIC RESOURCES

Subsurface Identification Efforts

The potential for buried archaeological sites is a practical problem for resource managers who must make a reasonable effort to identify archaeological deposits in a three-dimensional project area; ensuring that potentially important resources are not affected by project activities. Early detection of buried archaeological deposits also avoids the potential for costly delays that may occur when unknown resources are discovered after project-related earth moving activities have begun and late discovery protocols are necessary. This is particularly important for projects that can suffer significant delays and incur unexpected costs if a buried site is discovered "late" in the design or construction phases.

Before buried sites can be avoided, sampled, or otherwise "managed," they must first be identified. Most buried sites are not found by conventional pedestrian surface surveys because they typically lack visible or obtrusive features that would indicate their presence to an observer in the field (Bettis 1992:120). Thus, locating sites that may be buried by natural deposition can be one of the most difficult issues faced by archaeologists and cultural resource managers.

Thus to help insure that project schedules (critical path) and budgets are not inadvertently affected by late archaeological discoveries, a sensitivity study was conducted to determine where buried sites are most likely to be located. When designed and conducted in an informed fashion, this type of geoarchaeological approach can help satisfy the requirements of Section 106 that "a reasonable and good faith effort to carry out appropriate identification efforts" [800.4(b)(1)] is made for undertakings that receive federal funds. Such efforts are, therefore, a proactive approach for determining whether prehistoric sites are present within the project APE, preferably in advance of construction.

Exploratory Approach and Methods

Exploratory testing for buried archaeological sites has become an important part of the initial identification process in California and across the country (Monaghan et al. 2006). The ability to locate buried sites in the Project Area depends on whether or not appropriate methods are properly used to explore sensitive landforms. Based on independent tests of backhoe trenching, coring and auguring; and geophysical survey (resistivity, magnetometry, and ground-penetrating radar) methods, backhoe trenching was found to be the most effective way of identifying buried archaeological sites (Monaghan et al. 2006; Monaghan and Lovis 2005); a finding reinforced by the author's experience in working throughout California.

Ideally, the amount and extent of the subsurface explorations should be roughly proportional to: (1) the physical size of each sensitive area; (2) the nature and extent of any earth disturbances proposed in each area; and (3) the presence or absence of cultural resources, if present. Since the thickness of the Holocene deposits are usually less than 4.5 meters (~14.7 feet), a backhoe is the most appropriate method for identifying potentially buried sites in the Project Area.

The average dimensions of each excavated trench will be about one meter (~3 feet) in width, 4 meters (~13 feet) in length, and 4.5 meters (~14.7 feet) in depth. Each trench will be given a unique field designation, and their locations recorded by using a GPS-device and/or by plotting them on high-resolution air photographs. Project personnel will not be allowed to enter a trench that is more than 1.5 meters (~5.0 feet) in depth unless an appropriate shoring system is installed in accordance with the California Occupational Safety and Health Administration standards. All of the trenching will be supervised by a qualified geoarchaeologist.

The presence or absence of archaeological materials will be determined by: (1) examining and raking the deposits as they are removed from the trenches; (2) examining the trench walls whenever it is safe and practical; and (3) selectively spot-screening a sample of the deposits through 1/4-inch mesh screen with volumetric controls. If cultural remains are identified, all formed tools or diagnostic artifacts (e.g., awls, beads, ground stone, projectile points) will be collected and transported to a laboratory to be cleaned, cataloged, and analyzed as needed. Unless otherwise specified, more rudimentary cultural materials, such as flaked stone, manuports and fire-cracked rock, can be documented in the field and discarded (see *Curation and Discard Policy* section below). The main disadvantage of this technique is the lack of contextual control required for standard archaeological analysis; unique features may also be badly damaged or destroyed.

If any intact cultural features are identified, they will be documented in profile, and an appropriate sized sample of the soil matrix collected for flotation processing and micro-constituent analyses. If any intact human burials or isolated human remains are discovered, the Alameda County

Coroner will be contacted and the Native American Heritage Commission consulted to determine the appropriate treatment in coordination with the designated Most-Likely Descendant and Caltrans.

If organic materials suitable for radiocarbon dating are found (e.g., bone, shell, charcoal, buried soils), appropriate samples will be collected so they can be submitted for dating analysis. As discussed in the *Chronology* section above, priority will be given to datable materials such as single pieces of charcoal or shell that are clearly associated with cultural contexts. Buried soils may also be dated to help determine the timing of local landform changes. Similarly, obsidian artifacts will be collected so they can be submitted for hydration analysis. The use of hydration and radiocarbon for dating and correlating subsurface deposits is highly recommended. Further archaeological work will likely be needed to assess the nature, extent, and information potential of any archaeological sites identified as a result of the explorations.

Stratigraphic Identification and Soil Description

The depth and general nature of the deposits exposed in each trench will be recorded in the field, with additional attention given to trenches that contain buried soils and/or archaeological remains. Natural and/or cultural stratigraphy will be identified whenever possible by carefully examining deposits exposed in the sidewalls of the subsurface exploration trenches. Stratigraphic units (strata) are identified on the basis of physical composition, superposition, relative soil development, and/or textural transitions (i.e., upward-fining sequences) characteristic of discrete depositional cycles. In the field, each stratum exposed in exploration trenches will be assigned a Roman numeral beginning with the oldest or lowermost stratum (e.g., bedrock) and ending with the youngest or uppermost stratum. Buried soils (also called paleosols), representing formerly stable ground surfaces, will be identified in the field based on color, structure, horizon development, bioturbation, lateral continuity, and the nature of the upper boundary (contact) with the overlying deposit, as described by Birkeland et al. (1991), Holliday (1990), Retallack (1988), and Waters (1992), among others.

Master horizons describe in-place weathering characteristics and are designated by upper-case letters (A, B, C); an R designates solid bedrock. These are preceded by Arabic numerals when the horizon is associated with a different stratum (i.e., 2Cu); number 1 is understood but not shown. The upper part of a complete soil profile is usually called the A-horizon, with a B-horizon being the zone of accumulation in the middle of a profile, and the C-horizon representing the relatively unweathered parent material in the lower part of a profile. Lower-case letters are used to designate subordinate soil horizons. Combinations of these numbers and letters indicate the important characteristics of each major stratum and soil horizon; they are consistent with those outlined by Birkeland et al. (1991), Schoeneberger et al. (1998), and the USDA Soil Survey Staff (1998).

Threshold for Additional Identification Efforts

If the results of backhoe explorations indicate that there is potential for archaeological sites to be buried more than 4.5 meters (14.7 feet) below the surface within the vertical APE, it may be necessary to continue the exploratory work using a coring device (i.e., Geoprobe). If the potential for deeply buried sites is confirmed within the APE, the project geoarchaeologist may use future geotechnical investigations to collect samples from specific depths below surface to examine them for archaeological materials. Rather than "skip" or "interval" samples typically obtained for geotechnical investigations, archaeological testing would require continuous samples be obtained from specific sections within cores.

Analysis of stratigraphic profiles and evidence of cultural remains within the trenches should assist in determining the need for additional investigations within the APE. Beyond the preparation and submission of a technical report documenting the subsurface identification investigation, it is possible that no further archaeological study will be required if, (1) Holocene-age deposits are consistently penetrated, and (2) no intact archaeological deposits are identified. If an intact cultural feature or more extensive deposit is identified within the APE (horizontal and vertical) then test excavations will likely be needed to determine its eligibility for the National Register.

TESTING AND EVALUATION

Prehistoric material identified within the project area must be evaluated for its National Register eligibility as an important or unique resource determined by the ability to address research issues presented in the previous section. This entails test excavations to determine site size within the APE and thickness, integrity, the range of artifact and ecofact classes present, whether or not features are present (and if so which types), and whether significant intra-site variability exits. Mechanical and manual methods may be employed during testing, including backhoe trenching, shovel test units (STUs), hand auguring, detailed hand-excavation control units (CUs), and column sampling. The results of these field investigations form the basis for assessing the site's significance.

A flexible phased approach is recommended, since many sites will have considerable spatial variation in the horizontal and vertical distribution of intact deposits. As such, diverse techniques may be employed to assess the range and density of cultural material preserved. Ideally, a detailed discussion (in the form of a work plan) will be developed after the resource has been identified that guides the approach to field and lab investigation.

Data Recovery

If a site is determined eligible for the National Register and impacts to the site cannot be avoided, then mitigation of those impacts must be undertaken. In the case of prehistoric sites, this most often takes the form of data recovery excavations. The objective of any archaeological data recovery investigation is to salvage the artifacts and information that made an individual resource eligible for inclusion in the Register. This is done largely through archaeological research, including fieldwork and laboratory analyses. Archaeological data recovery by its very nature is a comprehensive research effort designed to gain new insights into topics of demonstrated scientific value.

Data recovery will not be viewed as simply an extension or continuation of archaeological testing, since these two phases of the compliance process have very different objectives. Data recovery investigations are initiated by identifying one or more regionally relevant research questions that can be advanced by new research at the site in question. As such, the research questions must be tailored to data sets that the test investigations have identified as being contained within the site deposits.

Data recovery operations will be concentrated in those areas of a site where data potential is considered greatest. This often includes, but is not limited to, the best preserved and most substantial portions of each archaeological deposit, and areas where features have been identified or predicted. Data recovery methods are largely similar to those employed for test excavations; the differences lie in the amount of data collected and how those data are used to address research questions.

Testing and data recovery may occur during the same field session in some situations. This is most common when access is limited, time is the most valuable commodity, or uncovered resources may be at risk from exposure. There is a major drawback, however, to conducting these two phases of investigation together. Since test-phase investigations would not have been completed (notably the laboratory analysis and comparative research phases), it is very difficult to know what key regional research questions the site can address and what sort of sampling strategy is needed to realize this data potential.

If the compressed approach cannot be avoided, then it is recommended that certain aspects of laboratory analysis move forward in a concurrent manner during the initial (testing) portion of this combined field investigation. At a minimum, this will include comprehensive radiocarbon dating (using Beta Analytic's Priority AMS data with results within six working days or Time-Guide AMS dating with results within two to three working days), initial lab processing, and assessment of the range of recovered materials and their density (this is especially relevant with respect to flotation sampling for carbonized plan remains and fine-grade wet-screening for fish remains). With this information, the scale and focus of the data recovery fieldwork can be better assessed. It may also be necessary to excavate a larger data recovery sample of the site (potentially collecting more data than may be ideally needed) using this approach.

Field Methods and Recovery Techniques

The following briefly describes various techniques that may be used during field investigations. A flexible approach will always be used to facilitate the precise objectives of a particular testing or data recovery project. In addition, field recovery techniques will vary in rigor depending on the nature of specific depositional units (such as clearly disturbed, probably disturbed, or intact cultural sediments). All trenches and excavation units will be backfilled upon the competition of fieldwork.

Mechanical Trenching

Mechanical trenching may be employed to quickly define site limits (both vertically and horizontally), identify site loci (especially in cases where a series of very small loci are present), locate subsurface features, and assess intra-site variability. The exact size, number, and location of each trench will be determined in the field based on existing conditions (e.g., physical access, safety, weather) and constraints (e.g., presence of sensitive species or underground utilities), and the results of previous trenching.

Trenching will always be monitored by an archaeologist. Trenches that measure greater than 1.5 meters in depth must be reinforced by shoring or graded to 1:1.5 slopes in accordance with Cal/OSHA guidelines before any personnel are allowed to enter them. Trenches will be backfilled as soon as possible upon completion of inspection and any detailed recording and sampling that is deemed necessary. If any trenches must remain open, they will be covered and barricaded with flagging at the end of each workday.

Mechanical Areal Exposure

This technique involves a bucket backhoe or a front-end loader to remove overlying non-cultural sediments from a buried prehistoric deposit. Once the overburden has been removed to just above the cultural deposit, controlled hand excavations can be initiated. An archaeologist will always be present to direct the mechanical removal and initiate the hand excavations.

On occasion, this technique can be used to expose sparsely distributed features/deposits, or when data recovery investigations are nearly complete and the archaeologist needs to target data-rich features and unique contexts. In such situations, mechanical excavation will cease and manual excavation will commence when intact areas or archaeological features are encountered.

Hand Excavation

Several hand-excavation techniques may be employed during an archaeological investigation, including shovel testing or surface transect units, larger control units, and/or hand auguring. It is generally recommended that excavated sediments be screened through 1/8-inch (3-millimeter) mesh in order to recover small artifacts during data recovery; in some cases, samples will be collected for finer screening in the lab. All units will be excavated using vertical and horizontal control, usually in the form of arbitrary 10- or 20-centimeter levels. In the absence of a unit wall from which to measure depth and horizontal location (for example, with larger exposures), spatial control will be maintained using appropriate mapping equipment such as a theodolite or total station. This equipment will also be used to plot the excavation units onto the site map.

Shovel Test Units (STUs)

STUs are typically used to define site boundaries and to quickly gain insight into spatial variation in material culture and the character of cultural deposits within a site. Units are typically 1 x 0.5 meter in size but may be larger or smaller, and often are set at regular intervals along a linear transect or grid pattern. Units are typically excavated in arbitrary 10-centimeter levels (and occasionally in 20-centimeter levels in deposits with little cultural material or stratigraphy).

Augers

Hand augers (typically 7.5 centimeters in diameter) can also be used as a supplement to STUs and mechanical trenching to quickly and cost-effectively gain insight into spatial variation within a site and to define site boundaries. Augers will be excavated in 10- or 20-centimeter levels and the sediment screened to recover cultural material. Augers are most useful in contexts where site deposits are easily recognized (e.g., in dark middens or dense shellfish features).

Control Units (CUs)

Control Units are designed to gain insight into site structure, and gather representative and statistically meaningful samples of artifacts and ecofacts. CUs are typically 1 x 1 meter, 1 x 2 meters, or 2 x 2 meters in size, and their locations are based on the results of exploratory methods such as STUs and mechanical trenching. CUs will be excavated in natural contour or stratigraphic levels, but in their absence, arbitrary 10-centimeter levels will be employed.

Areal Exposure

On occasion, larger areal exposures may be necessary. They are most appropriate during data recovery when larger excavation units are needed either to reach deeply buried contexts or to excavate large features (such as house floors) or feature complexes (such as a cemetery area). Large areal exposures will maintain sufficient horizontal control so that intra-site spatial analysis can be carried out. This usually entails establishing a 1-x-1-meter or 2-x-2-meter grid over the site, to which all excavation units can be referenced.

Areal exposure is useful in contexts where archaeological deposits lie deeper than the maximum depth allowed for a single excavation unit as set by Cal/OSHA guidelines (generally 1.5 meters; less in loose or sandy soils). Initially, a large unit area is excavated (sometimes using mechanical equipment, especially if the upper portion is artificial fill), and it is reduced in size on all four unit walls following a slope format of 1:1.5 from surface to base, allowing no sidewall to exceed 1 meter in height. The resulting excavated area has the shape of an inverted pyramid. On occasion excavation walls will need to be shored using hydraulic jacks or other means of earth stabilization when the slope gradation cannot be maintained. This strategy provides large areal exposures of stratified deposits and wall profiles, and ensures safe working conditions.

Feature Excavation

Once encountered, archaeological features (such as hearths, house floors, and burials) will be excavated with greater spatial control, more rigorous collection and sampling techniques, and more detailed observations than are typically used during unit excavations. Upon discovery, each feature will be assigned a unique number (consecutive with the site). Feature contexts will be excavated following natural stratigraphy and documented with photographs and drawings. Samples for flotation, wet-screening, radiocarbon dating, and other specialized constituent analyses (such as pollen, fish otoliths, lipids, and other residues) will be collected and their contexts clearly documented. Features will also be carefully sketched and/or photographed both before and after excavation, and their depths and horizontal locations plotted on maps.

Screening Methods and Sampling Strategies

A number of screening techniques can be employed depending on the nature of the archeological material, the condition of the sediments, and the analytical objectives. Dry-screening (processing excavated sediments through shaker screens) is typically employed and works well for dry, loose sediments, such as sand. Wet-screening (washing extracted matrix in screens using a high-pressure water nozzle) is better suited for clays and is the only technique that will be used in hyper-saturated contexts. Wet-screening always results in higher recovery rates than dry screening, but it also requires special techniques (for example, to impound the draining water) and takes more time than dry-screening.

Modern archaeological investigation generally involves the use of 3-millimeter (1/8-inch) screen size. The larger 6-millimeter (1/4-inch) screen size is rarely employed in coastal contexts, because shell middens have low artifact densities, and smaller faunal remains (such as birds) that might fall through the larger screens were often an important part of the diet of the site inhabitants. The use of 6-millimeter screening results in much lower recovery rates for these data sets (including virtually all late-stage pressure flaking debris, small fish or bird bone, and beads) and will be avoided.

Varied recovery techniques will be used during on-site dry-screening, depending on depositional units and sample size parameters. For example, if shellfish remains are ubiquitous, then it may not be necessary to collect them systematically from hand-excavation units. Instead, quantitatively representative samples can be obtained from column samples collected from each (or selected) units.

Column and Flotation Sampling

This involves systematic collection of all sediments from selected contexts. The material is then subjected to flotation and wet-screening in the lab. When features are encountered within units, flotation samples will be collected. The size and number of samples is context-dependent, but prior research has demonstrated the necessity of larger samples. Without prior knowledge of carbonized plant remains densities at a site, each sample will have a volume of at least 15 liters, if possible. Samples will be taken from within and adjacent to features, especially hearths, and off-site comparison samples are encouraged.

Column samples are a very efficient way to obtain analytical samples of micro-debitage, beads, shellfish, small vertebrate remains, fish remains, carbonized plant material, and radiocarbon samples from *intact* deposits. Column samples can vary in size but usually are 25 x 25 centimeters or 30 x 30 centimeters in horizontal extent and are collected in 10-centimeter levels.

Field Documentation

Site Recording and Mapping

All sites will be recorded (or re-recorded) on DPR 523 forms issued by the California Department of Parks and Recreation and the State Office of Historic Preservation. This includes, at a minimum, a Primary Record and an Archaeological Site Record, as well as a site map and location map.

As a standard procedure, field investigations will include preparation of a site map that meets professional standards. Site maps will depict the locations of all excavation units, features, isolated artifacts, and prominent aspects of the natural landscape and setting. A primary datum must be established and indicated on the site map. Moreover, the UTMs of the site datum and its elevation in relationship to mean sea level must be recorded. Each excavation unit will be plotted with reference to the site grid, and the top elevation of each unit measured in reference to the elevation of the site datum. If a separate mapping or locus datum is used, this also must be plotted on the map in reference to the primary datum.

Field Records and Other Documentation

Information resulting from each of the recovery techniques outlined above will be carefully recorded on standard forms provided to the field crew. Records compiled in the course of fieldwork will include, as appropriate, mechanical excavation forms, auger forms, STU forms, CU forms, level record forms for each excavation unit level, plan drawings when appropriate for a level, and plan and section drawings for each feature encountered. Site-wide inventory forms will also be maintained for various sample categories including radiocarbon, flotation, and column samples.

Project photographs will be taken with a digital camera and logged on appropriate forms (detailing date, time, number, subject description, and view direction). Photo documentation will include overview photographs of the site and fieldwork. Unit sidewall profiles and features will be photographed for archival purposes, as will other aspect of site stratigraphy and contexts encountered during fieldwork. Additional documentation may include video recording where appropriate.

Stratigraphic profiles will be drawn: typically this will entail one wall of each CU, as well as selected sections of trenches. Profile documentation will include descriptions of each stratum using Munsell color description, texture, structure, natural and cultural inclusions, and contacts between strata. Micro-morphology samples may be taken to facilitate the study of undisturbed soils and sediments at a microscope scale.

Treatment of Human Remains

If any human remains are found during any field investigations, they will be treated with the utmost respect. The remains will be uncovered sufficiently to identify them as human. If they are so identified, all provisions of California Health and Safety Code Sections 7054 and 7050.5 and Public Resources Code Sections 5097.9 through 5097.99, as amended per Assembly Bill 2641, will be followed. The ME representative as well as the project's Principal Investigator and Project Manager will be contacted immediately. The Project Manager will contact the appropriate coroner (either for Alameda County or Santa Clara County) immediately.

If the remains are determined not to be Native American, ME may choose to treat them as an historical resource. If the remains are believed to be Native American, the Coroner must contact the Native American Heritage Commission within 24 hours. The Commission must then designate a Most Likely Descendant. The designated descendant will meet with the agency representative within 24 hours of being notified, to inspect the remains and make a recommendation on the treatment of the remains and associated artifacts. In the event human remains need to be left uncovered overnight, a guard will be put on duty until the next working day, unless the designated Most Likely Descendant requests otherwise (e.g., that they be left unmarked or collected).

It is ideal to leave identified human remains in place and avoid disturbing them and their grave offerings through project redesign. If this is not possible, treatment scenarios could include storage of human remains in a secure place, as close as possible to the site. Initially, no photographs will be taken of any human remains. They will be recorded, along with any grave-associated artifacts, and left in place until the designated Most Likely Descendant can make a decision on their reburial. Upon reburial, a GPS point will be recorded at that location, and a Sacred Lands Form will be submitted to the Native American Heritage Commission, so the remains can be better protected.

Construction Monitoring

In general, construction monitoring is not considered a suitable alternative to the actual archaeological field identification efforts discussed above. On rare occasions, however, construction monitoring may be appropriate. The most likely circumstance would be in contexts where identification efforts employed coring (because trenching was not feasible) and were unable to obtain a sufficient number of samples from a buried surface to clearly ascertain that no prehistoric deposits were present. In this circumstance it may be appropriate to recommend either targeted monitoring once construction has exposed this context or, more suitably, additional identification efforts (such as backhoe trenching) once the building and some overburden have been removed. Construction monitoring may also be appropriate after an inadvertent discovery has been made and assessed.

During any monitoring, a qualified archaeologist must be present to observe sediment-disturbing construction activities at depths that may encounter archaeological resources. If prehistoric remains are encountered, the archaeological monitor must have the authority to temporarily halt or re-direct construction activities. It may be necessary to remove overlying non-cultural strata (using mechanical excavation techniques) in order to identify the nature and extent of the deposit, and to allow further controlled, manual excavation. Subsequent fieldwork would follow the protocol outlined in the testing and data recovery sections.

Laboratory Processing and Data Analysis Procedures

Prehistoric Materials

The analysis of prehistoric materials generally entails classification, sorting, counting, measuring, weighing, and tabulating according to context (typically unit and level). Modern/historic-era materials recovered from prehistoric contexts generally are considered intrusive and hence of limited interpretive value, and typically are only counted and catalogued by major category (e.g., glass or metal). Such material will be collected and recorded, however, since it provides insight into depositional integrity.

Once prehistoric materials are washed and cataloged, selected materials (such as obsidian and fish bone) from intact components are submitted to specialists for appropriate study. Analysis of artifact tool classes includes documentation of basic morphological and functional attributes, while faunal and plant materials are identified to taxonomic classification. Specialized technical studies, such as DNA or lipid residue analyses, may also be used to provide new insight into key research questions. Data are tabulated according to artifact type, raw material, provenience, temporal component, and any other relevant organizational structure. The combined analytical data can then be used to address pertinent regional research issues. All materials will be processed and analyzed according to current professional standards as outlined below.

Radiocarbon Investigations

The first step in any analysis entails identifying intact depositional units, determining the temporal extent of site occupation, and assessing whether or not temporally discrete occupation components can be distinguished. Radiocarbon dating, in conjunction with stratigraphic and contextual observations, provides the foundation for this initial and crucial step in the analytical process. This chronological exercise will follow the approach and sampling criteria laid out above.

Appropriate material (typically individual carbonized plant remains or if need be, individual shells) will be submitted for radiocarbon dating early in the analytical process. Direct dating of temporally significant shell beads may also be warranted. All dates must be calibrated, and shell dates must be corrected and calibrated with the appropriate correction for the local reservoir effect.

Once components are identified, then sampling strategies for detailed analytical studies can be finalized. Specialists will be provided samples from discrete site components, and instructed that their analysis will be organized studies to examine variation between components as well as characterizing the site as a whole. Disturbed contexts generally will be excluded from specialized analyses. If included, data tables will clearly distinguish material by intact or disturbed provenience, and by component.

Analysis of Site Structure and Integrity

In addition to infield observations and stratigraphic analysis of deposits, analysis of site structure and integrity can be aided by laboratory analysis of sediment samples. Potentially appropriate analytical studies, depending on the questions, may include micro-morphology, grain size, and phosphate analysis.

Obsidian Sourcing and Hydration Studies

A sample of obsidian, including formal tools and debitage, will be subjected to hydration and X-Ray Fluorescence Spectrometry sourcing analyses. When the assemblage is small (fewer than 50 pieces) the entire assemblage will be studied. The obsidian data will provide information on the integrity of the deposit and its relative age, and aid in the identification of single-component areas, if present. In addition, geochemical sourcing studies can contribute to questions regarding prehistoric mobility and exchange.

Time-Sensitive Artifacts

Time-sensitive artifacts (e.g., beads, projectile points) will be classified following appropriate typological schemes and summarized by unit and depth. This information (in conjunction with other data, notably radiocarbon results) then can be used to assess deposit integrity, define assemblages, and interpret site chronology.

Flaked Stone Assemblage

The flaked stone analysis will define the pattern(s) of stone tool acquisition, use, and discard at the sites. Functional and morphological attributes also will be identified. Each item will be separated by material and artifact type (e.g., projectile point, casual flake tool, debitage). Each artifact will be measured and weighed, and the condition of the artifact (e.g., whole, end, margin) noted. Bifaces will be further subdivided on the basis of reduction stage. The unit and depth distribution of each tool type will be summarized.

All debitage will be counted, weighed, and sorted by raw material. Technological analysis will be conducted on representative samples of debitage and will include separation into various categories (e.g., primary reduction, early biface thinning). Analysis samples will be selected from excavation units; however, debitage from column samples may also be included, if appropriate.

Battered or Ground Stone Artifacts

Battered or ground stone artifacts will be separated into appropriate functional categories (e.g., handstone, pestle, mortar, hammerstone). Tool morphology will be recorded, including measurements, modifications, and fragment types. Unit, depth, and component will be summarized for all items. Distribution data will be used (in conjunction with other data) to assess the deposit, define assemblages, identify discrete activity areas, and infer site function.

Shell and Bone Artifacts

Shell and bone artifacts will be separated into appropriate functional categories (e.g., awl, bead). Tool morphology will be described, including measurements, modifications, and fragment type. All items will be summarized according to unit, depth, and site component. Distribution data will be used to assess the deposit, define assemblages, and infer site function.

Vertebrate Assemblage

All faunal specimens of sufficient size will be identified to genus, species, element, age, weight, condition (e.g., burned), unidentifiable elements, and intrusive rodent categories. Unidentifiable specimens will be segregated into grosser categories (e.g., large mammal, small mammal, bird, fish, reptile). All bone will be tabulated (number/weight) according to unit, depth, and site component. Fish remains obtained from column samples will be subjected to detailed analysis including microscopic sorting and subsequent evaluation of remains from screens up to 24 mesh/inch, and identification to species (if possible). Distribution of faunal remains will be used to define assemblage constituents, diet, natural environment, and site function. Appropriate indices will be developed to determine meat yield and relative contribution of various taxa to the native diet.

Invertebrate Assemblage

Shellfish remains will be analyzed, typically from selected column samples collected from the excavation units. Column samples will be water-screened through graduated screens and sorted. All marine and/or freshwater shellfish remains will be identified by species or genus (where possible), weighed, counted, and tabulated according to species, unit, depth, and site component. Additional analyses may include calculation of minimum number of individuals (MNI), size analysis, identification of age using growth ring studies, and isotopic analysis to determine seasonality.

Macrobotanical Assemblage

Large-volume flotation samples will be recovered from column samples and from feature-related contexts. Flotation will be done under the direct supervision of a paleoethnobotanist to ensure that appropriate techniques are used (including recording sediment volume, screen sizes for light and heavy fraction, and sampling techniques). Analysis will concentrate on charred plant remains, and reporting will include size-sorting results and follow established archaeobotanical protocols to ensure that regional comparative analyses can be carried out.

TECHNICAL REPORTING

Once all analyses and special studies have been completed, draft and final technical reports will be prepared. Individual reports will vary greatly depending on the phase of investigations being reported and the substantive results of that phase. Negative or limited results may require only a short report, while extensive data recovery investigations invariably result in large, detailed technical reports. Evaluation results will be used to determine whether sites are eligible for listing in the National Register; for eligible sites, it will be necessary to determine what impacts a planned project will have on contributing elements, and whether data recovery will be required to mitigate those impacts.

Technical reports will fully document the results of field and laboratory investigations, and will, at a minimum, meet the Secretary of the Interior's *Standards for Archaeological Documentation*. Substantive reports on project results typically include the following elements: executive or management summary; statement of scope, including project location and setting; background contexts or summaries; summary of previous research, historical and archaeological; research goals and themes; field and laboratory methodologies; descriptions of recovered materials; findings and interpretations, referencing research goals; conclusions; references cited; and appendices. Tables will be provided that clearly: 1) list all recovery units organized by type (including trenches and column samples) showing sampling techniques, depth, and size and volume of sediment recovered; and 2) list artifacts and ecofacts divided into major categories and organized by component, and within that by recovery unit. Selected diagnostic artifacts, representative or unique tool types, and intact features will be illustrated.

Most appendices will be digital and include all catalogs (artifacts, vertebrates, invertebrates, macrobotanical), radiocarbon dating documentation provided by the laboratory, special studies, digital imagery, GIS and all geospatial data, and other information relevant to the project and findings. California Department of Parks and Recreation (DPR 523 1998) site records will be used to document work at the sites, following *Instructions for Recording Historical Resources* (Office of Historic Preservation 1995). Upon submitting the final report, documentation will be provided that a copy of the report and any applicable site forms was submitted to the Northwest Information Center at Sonoma State University.

The *Secretary of the Interior's Standards for Archaeological Documentation* encourages public interpretation of archaeological data where merited by the findings. Archaeological materials are frequently used to physically demonstrate information and ideas about the past. Typical ways to disseminate this information are lectures, exhibits, websites, video documentaries, and preservation and display of archaeological features. Archaeology has great potential for interesting a community in their local history. Carefully planned information programs can educate the public and elicit information important to interpreting the past through artifacts, photographs, and documents.

Artifacts are also useful components of hands-on teaching packages that are sent to public classrooms. Many artifacts that may not have significant enough data potential due to an archaeological feature's lack of integrity or historic context are especially suited for hands-on activities. In this case, the artifacts in and of themselves are not important, but still retain enough information to illustrate the past. In keeping with this spirit of interpretation, it is recommended that ME keep in mind potential avenues of public interpretation. Many public interpretive opportunities can be coordinated with local historical societies, and/or the designated curation facility.

CURATION AND DISCARD POLICY

Once the final report is finished, archaeological materials will be transferred to a long-term curation facility. This facility will be identified prior to testing and data recovery fieldwork, and curation costs will be included in all budgets. The curation facility will meet standards outlined in the National Park Services' *Curation of Federally Owned and Administered Archeological Collections* (36 CFR 79; available at <http://www.nps.gov/history/archeology/TOOLS/36cfr79.htm>).

Upon completion of laboratory analyses, materials for long-term curation will be placed in archival quality, long-term storage packing materials, including acid-free boxes, inert polyethylene plastic bags, and acid-free paper labels. Documentary materials, such as progress reports, photographs, computer disk files, field notes, other pertinent records, and the final report will also be permanently stored at the curation facility. Copies of final reports and relevant field notes will be printed on acid-free paper for storage.

Prehistoric archaeological material for curation will include all formal tools and at least a sample of debitage; all vertebrate remains; and all macrobotanical remains. If large quantities of invertebrate remains are recovered, it is appropriate to select a sample for curation. This sample, however, will be quantifiably representative (such as material from one or a few column samples) and include material from all components and key contexts. Any discarded materials will be noted as such in the artifact catalogue. Such guidelines acknowledge the current problem of finding acceptable curation facilities, and offer the premise that not all materials have equal curation value.

Discard procedures may occur in-field. Construction materials, for example, may be identified, counted, and weighed but not return to the laboratory for further processing. Recovered artifacts from features or sheet refuse that are determined to be non-significant will also be discarded in the field. Where possible, discarded materials will be returned to the feature or area from which they were recovered. Materials with high interpretive value, such as whole objects, may be retained from non-significant features. All in-field and laboratory discard policies for the current project will be discussed with the long-term curation facility prior to their enactment.

Curation of Materials

Recovered artifacts are considered to be the property of ME. Upon completion of laboratory analysis, materials for curation will be placed in archival quality, long-term storage packing materials, including acid-free boxes, inert polyethylene plastic bags, and acid-free paper labels. Documentary materials, such as progress reports, photographs, computer disk files, field notes, and other pertinent records will also be permanently stored, following directions in the Lab Manual. Copies of final reports and relevant field notes should be printed on acid-free paper for storage.

Collections should be available for long-term study by researchers in an appropriate curation facility. As an example, the Anthropological Studies Center Collections Facility at Sonoma State University in Rohnert Park, California has been identified as a facility that exceeds Secretary of the Interior Standards for curation.

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Transmission System Engineering (56)

Introduction

Staff needs to determine the system reliability impacts of the project interconnection and to identify the interconnection facilities including downstream facilities needed to support the reliable interconnection of the proposed Mariposa Energy Project (MEP). The interconnection must comply with the Utility Reliability and Planning Criteria, North American Electric Reliability Council (NERC) Planning Standards, NERC/Western Electricity Coordinating Council (WECC) Planning Standards, and California Independent System Operator (California ISO) Planning Standards. In addition the California Environmental Quality Act (CEQA) requires the identification and description of the "Direct and indirect significant effects of the project on the environment." For the compliance with planning and reliability standards and the identification of indirect or downstream transmission impacts, according to the previous guidelines staff so far relied on the System Impact Study (SIS) and Facilities Study (FS) as well as review of these studies by the agencies responsible for insuring the adjacent interconnecting grid meets reliability standards, in this case, the Pacific Gas & Electric (PG&E) and/or California ISO. However, the California ISO's generator Interconnection study process under the new Large Generator Interconnection Procedures (LGIP) Tariff is in transition from a queue or serial SIS to a cluster window process for the Phase 1 and Phase 2 Interconnection studies. The Phase 1 Interconnection study is almost same as the SIS except it is now performed with several queue projects in a group in the same area of a utility. The Phase 2 Interconnection study (same as the FS and Operational study, but with all the queue projects in a group as included in the Phase 1 Interconnection study) would be performed at a later date. The Interconnection studies would analyze the effect of the proposed project on the ability of the transmission network to meet reliability standards. When the studies determine that the project will cause the transmission to violate reliability requirements the potential mitigation or upgrades required to bring the system into compliance are identified. The mitigation measures often include modification (such as reconductoring of an existing transmission line or extension or remodeling of an existing substation) and construction of downstream transmission facilities. The CEQA requires environmental analysis of any downstream facilities for potential indirect impacts of the proposed project.

Background

Staff has received a copy of the Transition Cluster Group1 Phase 1 Interconnection study report dated July 28, 2009 for interconnection of the proposed MEP (DGC Kelso CT project) and the study was performed by the California ISO and PG&E. However, the Appendices A to J of the study report have not been received for staff's analysis. The study is considered incomplete without the Appendices.

The report shows that the power flow study was conducted under 2013 summer peak and 2013 summer off-peak system conditions with and without the Group 1 twelve generation interconnection queue projects with about a total of 4,700 MW new generating power output in the greater bay area of PG&E, which also includes the proposed MEP with 193.6 MW net generation output. The cluster study identified a large number of reliability criteria violations for new overloads on the downstream transmission facilities under normal (N-0) system conditions and California ISO category B contingency conditions (N-1, L-1 & G-1). In order to eliminate the identified overloads, preferred mitigation options include reconductoring of the overloaded lines with higher size conductors and constructing a new 230 kV switching station with three switch bays. The applicant, therefore, needs to comply with the CEQA requirements for environmental analysis for modification of these downstream facilities for potential indirect impacts of the proposed interconnection projects (Transition Cluster Group 1 Phase 1 Interconnection study report, sections 1-3 and 11).

Data Requests

56. Provide a general environmental analysis sufficient to meet the CEQA requirements for indirect project impacts for the following preferred mitigation measures:

- Reconductor 22.8 miles of the Castro Valley- Newark 230 kV line with 795 Kcmil steel supported aluminum conductor (ACSS) or equivalent conductor.
- Reconductor 10 miles of the Contra Costa-Brentwood 230 kV line with 954 Kcmil ACSS or equivalent.
- Reconductor 17 miles of the Contra Costa-Windmaster section of the Contra Costa-Delta Pumps 230 kV line with 1113 Kcmil ACSS or equivalent.
- Reconductor 1.4 miles of the Windmaster-Delta Pumps section of the Contra Costa-Delta Pumps 230 kV line with 1113 Kcmil ACSS or equivalent.
- Reconductor 4.7 miles of the Altamont-Delta Pumps section of the Delta Pumps-Tesla 230 kV line with 1113 Kcmil ACSS or equivalent.
- Reconductor 3 miles of the Altamont-Tesla section of the Delta Pumps-Tesla 230 kV line with 1113 ACSS or equivalent.
- Reconductor 3 miles of the Kelso-USWP RLF section of the Kelso-Tesla 230 kV line with 1113 Kcmil ACSS or equivalent.

- Reconductor 5 miles of the USWP RLF-Tesla section of the Kelso-Tesla 230 kV line with 1113 Kcmil ACSS or equivalent.
- Reconductor 21 miles of the Las Positas-Newark 230 kV line with 954 Kcmil ACSS or equivalent.
- Reconductor 12 miles of the Lonetree-USWP JRW section of the LonetreeCayetano 230 kV line with 954 Kcmil ACSS or equivalent.
- Reconductor 12 miles of the Morago-Castro Valley 230 kV line with 795 Kcmil ACSS or equivalent.
- Reconductor 1.1 miles of the Trimble-San Jose B 115 kV overhead line section with 477 Kcmil ACSS or equivalent.
- Reconductor 3 miles of the USWP JRW-Cayetano 230 kV line section with 954 Kcmil ACSS or equivalent.
- Reconductor 10 miles of the North-Dublin- Vineyard 230 kV line with 954 Kcmil ACSS or equivalent.
- Reconductor 14 miles of the Vineyard-Newark 230 kV line with 954 Kcmil ACSS or equivalent.
- Reconductor 5 miles of the Vaca Dixon-T275 No.1 230 kV line with bundled 795 Kcmil ACSS or equivalent.
- Reconductor 5 miles of the Vaca Dixon-T275 No.2 230 kV line with bundled 795 Kcmil ACSS or equivalent.
- Installing a new 230 kV switching station for three switch bays with a breaker and a half configuration and looping the Lonetree-Cayetano, Contra Costa-Las Positas, and North-Dublin-Vineyard 230 kV lines.

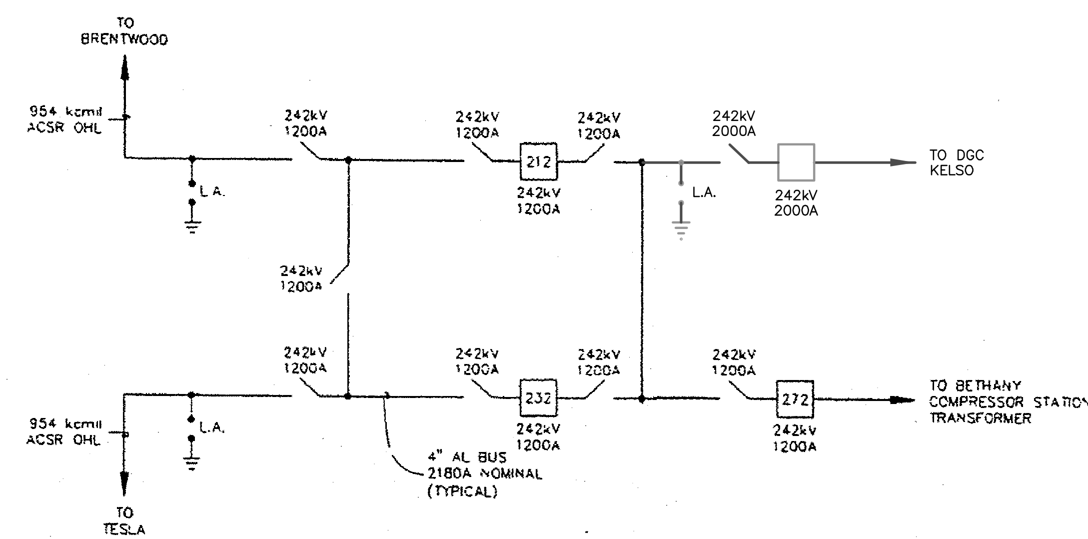
In addition provide a physical layout drawing of the proposed 230 kV switching station as stated above with major equipments (buses, breakers and disconnect switches) and transmission outlets.

Response:

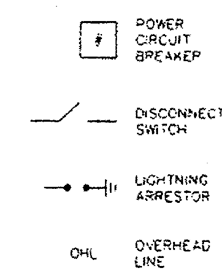
On December 2, 2009, PG&E indicated that interconnection of the MEP generator tie line into Kelso Substation could be accomplished using an existing 230 kV breaker position, rather than breaker and a half or ring bus configurations. Updated single line drawings, physical layout drawings, and e-mail correspondence are provided in Attachment DR56-2.

Mariposa Energy was provided access and performed environmental surveys of the Kelso-USWP RLF and USWP RLF-Tesla sections of the Kelso-Tesla 230 kV line in January 2010. The completed environmental analysis will be submitted for Staff review in early March 2010.

Attachment DR56-2
Updated Interconnection Configuration



LEGEND



NOTES:

1. THIS DESIGN IS CONSISTENT WITH PG&E GENERATION INTERCONNECTION HANDBOOK SECTION S2.
2. ADDED ONE BREAKER TO FORM RADIAL BUS DESIGN.
3. ACHIEVABLE WITHIN EXISTING FOOTPRINT.
4. BUS AMPACITY IS 2436 AMPERES AND 969284.4 kVA.

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS	
B	ADDED NOTE 4 – BUS AMPACITY	12/15/09	JVH	JVH	CM	CM		
A	PRELIMINARY	12/11/09	JVH	JVH	RVE	RVE	*	*

DSGN	*	*
DRN	*	*
CKD	*	*
SCALE:	*	

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POWER ENGINEERS www.powereng.com

KELSO SUBSTATION

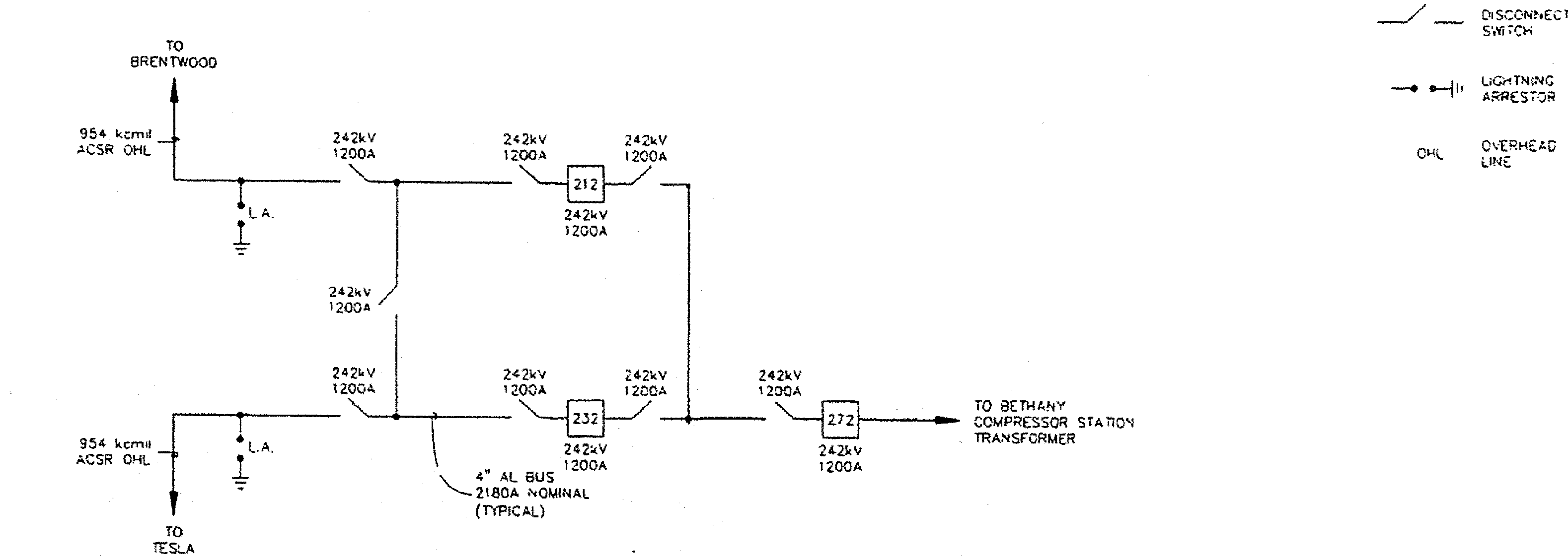
PROPOSED INTERCONNECTION

RADIAL BUS CONFIGURATION

JOB NUMBER	REV
**	B

DRAWING NUMBER

SK5



NOTES:
1. BUS AMPACITY IS 2436 AMPERES AND 969284.4 KVA.

FILE

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS	
B	ADDED NOTE 1 – BUS AMPACITY	12/17/09	JVH	JVH	CM	CM		
A	PRELIMINARY	12/11/09	JVH	JVH	RVE	RVE	*	*

DSGN	*	*
DRN	*	*
CKD	*	*
SCALE:	NONE	

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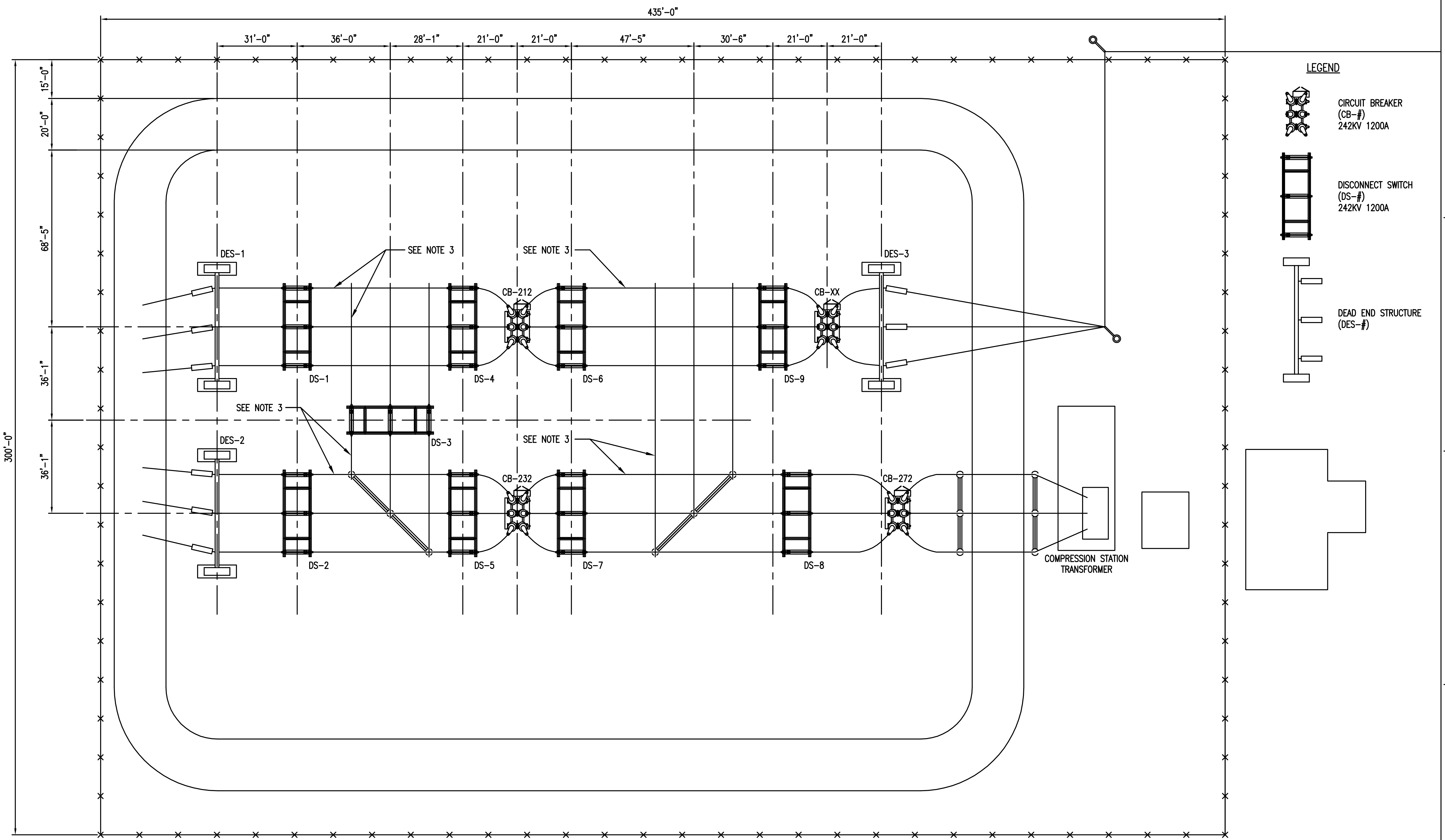
MARIPOSA ENERGY PROJECT
KELSO SUBSTATION
1–LINE DIAGRAM

JOB NUMBER 114677
REV B
DRAWING NUMBER SK1



NOTES:

1. DETAIL DESIGN IS SUBJECT TO FUTURE FIELD AND FINAL ENGINEERING REQUIREMENTS BASED ON EXACT CONDITIONS OF THE SITE.
2. SCALE IS APPROXIMATE.
3. BUS AMPACITY IS 2436 AMPERES AND 969284.4 KVA.

0 10 20 40 80
GRAPHIC SCALE
1"=20'-0"

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ADDED NOTE 3 - BUS AMPACITY	12/15/09	JVH	JVH	CM	CM
A	PRELIMINARY	12/11/09	JVH	JVH	RVE	RVE

REFERENCE DRAWINGS

DSGN
DRN
CKD
SCALE: 1" = 20'-0"
NOTE 2
FOR 22x34 DWG ONLY

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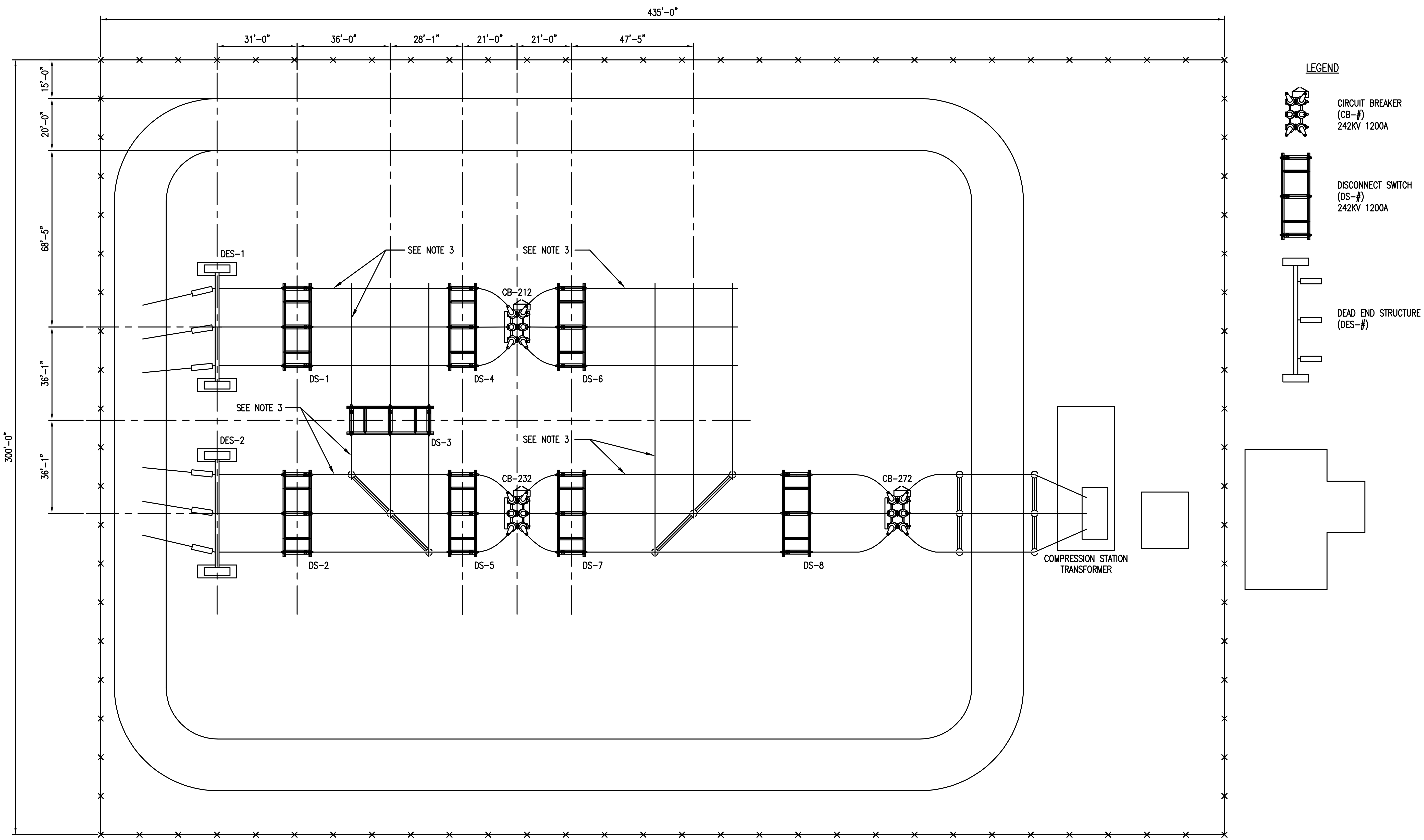
MARIPOSA ENERGY PROJECT
KELSO SUBSTATION
PRELIMINARY
GENERAL ARRANGEMENT

JOB NUMBER 114677
REV B
DRAWING NUMBER SK-E3



NOTES:

1. SCALE IS APPROXIMATE.
2. BUS AMPACITY IS 2436 AMPERES AND 969284.4 kVA.

GRAPHIC SCALE 0 10 20 40 80
1"=20'-0"

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ADDED NOTE 2 - BUS AMPACITY	12/17/09	JVH	JVH	RVE	RVE
A	PRELIMINARY	12/11/09	JVH	JVH	RVE	RVE

REFERENCE DRAWINGS

DSGN
DRN
CKD
SCALE: 1" = 20'-0"
NOTE 2
FOR 22x34 DWG ONLY

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MARIPOSA ENERGY PROJECT
KELSO SUBSTATION
GENERAL ARRANGEMENT

JOB NUMBER 114677
REV B
DRAWING NUMBER SK-E4

Urry, Doug/SAC

From: Vardanian, John (ET) [JAV7@PGE.COM]
Sent: Wednesday, December 02, 2009 12:39 PM
To: Fishback, Edward
Cc: Urry, Doug/SAC; Gary Normoyle; randal.vaness@powereng.com; Bo Buchynsky; Shah, Nisar; Palomares, Arsenio
Subject: RE: Substation Design

Hello Ed,

PG&E has reviewed various alternatives for terminating Mariposa's generator tie line in Kelso Substation and will proceed with the assumption that the vacant 230 kV position will be used for a 230 kV breaker for the gen tie. This breaker will therefore be considered an Interconnection Facility to DGC.

john

From: Fishback, Edward [mailto:EFishback@caiso.com]
Sent: Tuesday, December 01, 2009 7:03 PM
To: Vardanian, John (ET); Palomares, Arsenio
Cc: Doug.Urry@CH2M.com; Gary Normoyle; randal.vaness@powereng.com; Bo Buchynsky; Shah, Nisar
Subject: RE: Substation Design

John and Arcy,
Please respond to the e-mail below, it looks the same as the previous e-mail. The following statement was noted in the phase 1 results meeting minutes attached.

A PG&E Substation engineering walk down is required to identify the required Kelso Substation configuration to be incorporated into the phase 2 study. Possible configurations are a radial interconnection into the existing substation, or conversion to a ring bus or BAAH. A determination of footprint needs to be identified and if the build out can be done within the existing fence line. – John Vardanian to work with Chung Lam. PG&E to provide reasoning for interconnection configuration requirements in excess of requirements outlined in PG&E Generation Interconnection Manual published on the PG&E website during project development.

Ed Fishback
Project Manager
California ISO
151 Blue Ravine Road
Folsom, CA 95630
Phone (916) 608-5836
Cell (916) 802-6401
Fax (916) 351-2264

From: Bo Buchynsky [mailto:b.buchynsky@dgc-us.com]
Sent: Tuesday, December 01, 2009 6:54 PM
To: Fishback, Edward; Vardanian, John; Palomares, Arcy; Shah, Nisar
Cc: 'Doug.Urry@CH2M.com'; Gary Normoyle; 'randal.vaness@powereng.com'
Subject: Substation Design

Ed & John,

The CEC is evaluating the Phase I Study Report and would like to obtain a clarification that the BAAH design referenced in the Phase I Study Report has been replaced by a ring bus design. This is mentioned in our meeting minutes, but was not picked up in the CAISO meeting minutes; therefore could you please forward to me an email indicating that the currently contemplated design for the Kelso Substation is a ringbus.

Bo

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Soils and Water Resources (59, 61, and 65)

Background

During construction of the MEP site, water would be required for dust suppression, concrete washout, soil compaction, and hydrostatic testing. Approximately 2,500 gallons of water per day will be required during construction. No source for water used during construction was provided.

Data Request

59. Please provide information regarding the source of the water to be used during construction of the MEP site.

Response:

During the CEC Data Response and Issue Resolution Workshop on December 15, 2009, Staff requested additional clarification on whether a permit is required to use BBID hydrants for a construction water source. Based on further discussion with BBID it was determined that obtaining construction water from the fire suppression system would be problematic due to system pressurization alarms. Therefore, Canal 45 water will be pumped directly into tanker trucks for construction water requirements prior to completion of the water supply pipeline.

Background: Wastewater

Process wastewater and contact stormwater at the proposed MEP site would be collected through a series of drains, sumps, and pipes and delivered to an onsite oil/water separator prior to treatment by an activated carbon filtration zero liquid discharge (ZLD) system. Treated ZLD reclaim water would be recycled to the raw water storage tank for process water usage. Oily waste collected from the separator, as well as wastewater from combustion turbine water washes, would be contained in an on-site drum and hauled offsite for disposal.

Data Request

61. A. Identify the offsite disposal location and identify the licensed hauler that will be used to transport the oily and combustion turbine wastewater.

    B. Estimate the anticipated frequency of offsite disposal of oily and combustion turbine wastewater.

Response:

During the CEC Data Response and Issue Resolution Workshop on December 15, 2009, Staff requested additional clarification on the frequency and location of turbine wash water disposal (based on expected water quality). Updated generation rate and water quality information is provided below and is based on actual wastewater generation data from other LM6000 peaking facilities operated by Diamond Generating Corporation.

Mariposa Energy will perform turbine washes at a frequency of approximately every 100 to 150 hours of turbine operation. Approximately 200 to 250 gallons of wastewater is generated per turbine wash. Conservatively assuming the shorter wash intervals (every 100 hours) and higher quantity (250 gallons per turbine), MEP would generate approximately 667 gallons per month based on the expected operating scenario (600 hours per year plus 200 start and stop cycles) or 3,583 gallons per month based on the maximum permitted operating scenario (4,000 hours per year plus 300 start and stop cycles). Based on a truck capacity of 4,500 gallons, approximately 2 tank trucks per year would be required based on the expected operating scenario, and approximately 10 tank trucks per year would be required based on the maximum permitted operating scenario. Smaller quantities may be removed from the site at more frequent intervals if appropriate based on operating or regulatory compliance requirements.

Based on limited bioassay toxicity testing of similar waste streams at other facilities, the wash water may be characteristically hazardous for toxicity. Metals concentrations have not exceeded Title 22 toxicity levels at these facilities. Based on this information, MEP turbine wash water may require disposal at a Class I landfill (Kettleman Hills). Final disposal location determinations will be made for MEP based on waste profile analyses performed following wastewater generation during MEP operations.

Background

Onsite stormwater at the proposed MEP site would be collected in a series of inlets and storm drain pipes and drained to a proposed onsite extended detention basin. The proposed extended detention basin would be sized to contain the facility site 100-year storm event and would release the volume over a minimum 48-hour period into the northeasterly-aligned constructed swale. The extended detention basin discharge would join with stormwater from offsite areas and pass through a 36” diameter culvert to discharge offsite.

Data Requests

65. According to the Alameda County Clean Water Program, Stormwater Technical Guidance, Appendix G – Infiltration Guidelines, the infiltration rates of the site’s soil and bedrock are not high enough to support infiltration. Additionally, increased water infiltration could potentially cause increased uplift due to soil swelling to any adjacent structures or utilities. Please identify the receiving water (i.e. a stream, land, sewer, etc.) for the 36” diameter stormwater culvert outfall and verify that this discharge will not impact adjacent properties or affect the quality of US Waters or Waters of the State.

Response:

During the CEC Data Response and Issue Resolution Workshop on December 15, 2009, Staff requested additional clarification on the detention basin size determination methodology and calculations for the volume.

The project includes an extended detention basin, which is designed to handle stormwater runoff quality and quantity. An extended detention basin is a preferred type of stormwater quality treatment BMP by the Alameda County Stormwater Technical Guidance

Handbook.[1] One component of the County's design criteria for an extended detention basin is that it must be sized to capture the required Water Quality Capture Volume (WQCV). The outlet of the extended detention basin is sized with a drawdown time of 48 hours for the design WQCV. Other design parameters are listed in the Stormwater Technical Guidance Handbook. As presented in the AFC (Appendix 5.15A), the project is consistent with these standards. The extended detention basin has a WCQV of 4,962 cubic feet (0.114 acre-feet).

The extended detention basin also functions as a buffer for peak flows such that post-construction stormwater flows do not exceed pre-construction levels. This requirement for flow-duration control is also required by the Alameda Countywide Clean Water Program. The volume of the pond was sized to store the difference between the inflow and outflow hydrographs for the 100-year, 24-hour storm event with some freeboard. The total volume of the extended detention basin is approximately 1.4 acre-feet, this volume accounts for a 100-year storm peak storage volume of 0.79 acre-feet (much larger than the WCQV), plus approximately 2 feet of freeboard. The outlet structures are designed to release the site's post-developed storm runoff at predevelopment runoff rates.

The extended detention basin was designed using Bentley CivilStorm software (Version 8), using standard inputs and methods consistent with the Stormwater Technical Guidance Handbook. Specific values are presented in the AFC (Appendix 5.15A). These methods are consistent with the Alameda County Stormwater Technical Guidance Handbook.

[1] Alameda Countywide Clean Water Program. 2006. C.3 Stormwater Technical Guidance: A Handbook for Developers, Builders, and Project Applicants. Version 1.0. August 31.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
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APPLICATION FOR CERTIFICATION FOR THE *MARIPOSA ENERGY PROJECT* (MEP)

Docket No. 09-AFC-3

PROOF OF SERVICE
(Revised 2/8/2010)

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DECLARATION OF SERVICE

I, Stephanie Moore, declare that on February 12, 2010, I served and filed copies of the attached Mariposa Energy Project Data Responses, Set 1C. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at:
[http://www.energy.ca.gov/sitingcases/mariposa/index.html].
The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(C*heck all that Apply*)

For service to all other parties:

_x_ sent electronically to all email addresses on the Proof of Service list;

___ by personal delivery or by depositing in the United States mail at Sacramento, California, with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list above to those addresses **NOT** marked "email preferred."

AND

For filing with the Energy Commission:

_x_**sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

_____depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-3
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct.

_Original signed by:_________
Stephanie Moore