CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

DOCKET	
08-AFC-9	
DATE	MAR 05 2010
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NOTICE OF AVAILABILITY

PRELIMINARY STAFF ASSESSMENT
FOR PALMDALE HYBRID POWER PROJECT
PLUME TRAFFIC IMPACT MODELING ANALYSIS
APPLICATION FOR CERTIFICATION (08-AFC-9)

This notice is to inform you of the availability of the Plume Traffic Impact Modeling Analysis that was inadvertently omitted from the Traffic and Transportation section of the Preliminary Staff Assessment (PSA) for the Palmdale Hybrid Power Project (PHPP) Application for Certification (08-AFC-9). The PSA was published in two parts: part one was published on December 23, 2009 and part two published on February 8, 2010. The PSA, part 1 included the California Energy Commission staff's initial engineering and environmental evaluation of the PHPP project and contained the following sections: Alternatives, Efficiency, Facility Design, General Conditions, Geology/Paleontology, Hazardous Materials, Introduction, Noise and Vibration, Public Health, Reliability, Socioeconomics, Transmission Line Safety and Nuisance, Transmission System Engineering, Waste Management and Worker Safety and Fire Protection. Part 2 contained Air Quality, Biological Resources, Cultural Resources, Executive Summary, Land Use, Soil and Water, Traffic and Transportation, Transmission System Engineering and Visual Resources.

PUBLIC PARTICIPATION

Technical or project schedule questions may be directed to Felicia Miller, Energy Commission Project Manager at (916) 654-4640, or by e-mail at fmiller@energy.state.ca.us. If you desire information on participating in the Energy Commission's review of the project, please contact Jennifer Jennings, the Energy Commission's Public Adviser's Office at (916) 654-4489 or toll free in California at (800) 822-6228. The Public Adviser's Office can also be contacted via email at pao@energy.state.ca.us. News media inquiries should be directed to the media office at (916) 654-4989 or via email at mediaoffice@energy.state.ca.us. The status of the proposed project, copies of notices, an electronic version of the AFC, and other relevant documents are also available on the Energy Commission's web site: http://www.energy.ca.gov/sitingcases//palmdale.

You can also subscribe to receive e-mail notification of all notices and announcements at http://www.energy.ca.gov/listservers. By being on this email list, you will receive all project-related notices and documents pertaining to the project's evaluation and review. If you have any questions related to the automatic email notification list, please contact Hilarie Anderson, Project Assistant at (916) 651-0479, or by email at handerson@energy.state.ca.us.

Date: ______________

TERRENCE O'BRIEN, Deputy Director
Siting, Transmission & Environmental
Protection Division

Proof of Service List
Mail Lists (08-AFC-9)

PROOF OF SERVICE (REVISED 3/2/10) FILED WITH
ORIGINAL MAILED FROM SACRAMENTO ON 03/09/10
TKG

APPENDIX TT-1
PLUME TRAFFIC IMPACT MODELING ANALYSIS

William Walters, P.E.

INTRODUCTION

The following provides the assessment of the Palmdale Hybrid Power Project (PHPP) gas turbine/HRSG and cooling tower exhaust stack plumes potential to impact aircraft and ground-based traffic. Impacts to light aircraft could result due to high vertical velocities that would create turbulence, and impacts to ground-based traffic could occur during cooling tower ground fogging events. Staff completed calculations and modeling to determine the worst-case vertical plume velocities at different heights above the stacks and the potential for ground fogging events at nearby roadway and other ground traffic locations based on the applicant's proposed facility design.

PROJECT DESCRIPTION

The proposed project includes two F-class gas turbines operating in combined cycle mode and a ten cell cooling tower that rejects heat from the steam condenser. Thermal load to the cooling tower comes from both the gas turbine/HRSG, which has duct burners to augment steam production, and from the project's thermal solar collectors.

PLUME TRAFFIC IMPACT MODELING METHODS

VERTICAL PLUME VELOCITY MODELING

Staff has selected a calculation approach from a technical paper (Best 2003) to estimate the worst-case plume vertical velocities for the PHPP exhausts. The calculation approach used by staff, which is also known as the "Spillane approach", is limited to calm wind conditions, which are the worst-case wind conditions. The Spillane approach uses the following equations to determine vertical velocity for single stacks during dead calm wind (i.e. wind speed = 0) conditions:

(1) $(V*a)^3 = (V*a)_o^3 + 0.12*F_o*[(z-z_v)^2-(6.25D-z_v)^2]$

(2) $(V*a)_o = V_{exit}*D/2*(T_a/T_s)^{0.5}$

(3) $F_o = g*V_{exit}*D^2*(1-T_a/T_s)/4$

(4) $Z_v = 6.25D*[1-(T_a/T_s)^{0.5}]$

Where: V = vertical velocity (m/s), plume-average velocity
a = plume top-hat radius (m, increases at a linear rate of $a = 0.16*(z- z_v)$
F_o= initial stack buoyancy flux m^4/s^3
z = height above ground (m)
z_v= virtual source height (m)
V_{exit}= initial stack velocity (m/s)

D = stack diameter (m)
T_a= ambient temperature (K)
T_s= stack temperature (K)
g = acceleration of gravity (9.8 m/s^2)

Equation (1) is solved for V at any given height above ground that is above the momentum rise stage for single stacks (where z > 6.25D) and at the end of the plume merged stage for multiple plumes. This solution provides the plume-average velocity for the area of the plume at a given height above ground; the peak plume velocity would be higher than the plume-average velocity predicted by this equation. As can be seen the stack buoyancy flux is a prominent part of Equation (1). The calm condition calculation basis clearly represents the worst-case conditions, and the vertical velocity will decrease substantially as wind speed increases.

For multiple stack plumes, where the stacks are equivalent, the multiple stack plume velocity during calm winds was calculated by staff in a simplified fashion, presented in the Best Paper as follows:

(5) $V_m = V_{sp}*N^{0.25}$

Where: V_m = multiple stack combined plume vertical velocity (m/s)
V_{sp} = single plume vertical velocity (m/s), calculated using Equation (1)
N = number of stacks

Staff notes that this simplified multiple stack plume velocity calculation method predicts somewhat lower velocity values than the full Spillane approach methodology as given in data results presented in the Best paper (Best 2003).

The applicant noted in the AFC (p. 5.13-21, 22) that they completed a modeling analysis for plume turbulence; however, the applicant's analysis only used an average wind speed of 6 miles per hour and does not evaluate the potential worst-case calm wind thermal plume conditions for both the gas turbine/HRSG and cooling tower (COP2008a).

GROUND FOGGING MODELING

The ground fogging plume modeling for the cooling tower was completed using the Seasonal/Annual Cooling Tower Impact (SACTI) model. The cooling tower operating parameters used in the model are provided in Appendix VR-2 to the Visual Resources Section and used meteorological data supplied by the applicant. This model determines the number of hours that an opaque plume will be at ground level at given distances along the 16 cardinal directions from the cooling tower.

PLUME TRAFFIC IMPACT MODELING ANALYSIS

VERTICAL PLUME VELOCITY MODELING RESULTS

The calm wind condition vertical plume velocities were calculated for the PHPP gas turbine/HRSGs and the cooling tower. The ambient and exhaust conditions for the gas turbine/HRSGs and the cooling tower, operating at full load, are provided below in **Plume Traffic Impact Table 1**.

Plume Traffic Impact Table 1
Gas Turbine/HRSG and Cooling Tower Parameters

Case	Gas Turbine/HRSG		Cooling Tower	
	23°F	64°F	30°F 10% RH	64°F 40%RH
Stack Height ft (m)	145 (44.2)		62.3 (19.0)	
Stack Diameter ft (m)	18 (5.49)		28.0 (8.53) per cell	
Operating Case	Base Nonfired	Base Nonfired	Base Nonfired	Solar Fired
Stack Velocity ft/s (m/s)	68.4 (20.8)	64.7 (19.7)	37.1 (11.3)	36.8 (11.2)
Exhaust Temperature F (K)	191.3 (362)	190.6 (361)	67.9 (293)	86.2 (303)

Source: AECOM2009h[1]

The ten cell cooling tower is a two cell by five cell design. Under cold conditions fewer than 10 cells will operate (AECOM2008h). The conditions modeled are worst case conditions where the plumes are not predicted to be visible, as visible condensed plumes can be seen and avoided by pilots, and also the velocity calculation procedure that is used by staff is not meant for condensed water vapor plumes that would create drag reducing the vertical plume velocity.

Using the Spillane calculation approach staff determined the calm wind plume velocity at different heights above ground level. Staff's calculated plume velocity values are provided in **Plume Traffic Impact Table 2.** The gas turbine/HRSG plume velocities are calculated for the two gas turbine/HRSG exhausts, which are approximately 135 feet apart, while the cooling tower plume velocities are calculated for an eight-stack and a ten-stack combined exhaust for the 30F and 64F cases, respectively. The values provided below assume that the multiple stack plumes have merged; however, the plumes may not have fully merged at the lowest heights in this table.

Plume Traffic Impact Table 2
Gas Turbine/HRSG and Cooling Tower Predicted Plume Velocities

Height (ft)	Gas Turbine/HRSGs Plume Velocity (m/s)		Cooling Tower Plume Velocity (m/s)	
	23°F	64°F	30°F 10%RH	64°F 40%RH
300	9.58	8.98	7.76	7.81
400	7.05	6.47	6.39	6.13
500	6.02	5.46	5.66	5.27
600	5.43	4.89	5.19	4.74
700	5.02	4.51	4.85	4.38
800	4.72	4.23	4.58	4.11
900	4.48	4.01	4.37	3.90
1,000	4.28	3.83	4.20	3.72
1,100	4.12	3.68	4.05	3.58
1,200	3.98	3.56	3.92	3.46
1,300	3.85	3.44	3.80	3.35
1,400	3.74	3.35	3.70	3.26
1,500	3.65	3.26	3.61	3.17

Source: Staff calculations.

[1] It should be noted that the cooling tower data, specifically the air flow and exhaust temperature provided in the data responses are considered to be conservative and likely over predict the cooling tower exhaust temperature, so the plume velocity results provided for the cooling tower incorporating that additional overly conservative assumption may overestimate the worst-case vertical velocities.

As explained in the Transportation and Traffic section a vertical velocity of 4.3 m/s has been determined as the critical velocity of concern to light aircraft. For the gas turbine/HRSG cases the heights at which the plume velocity drops below 4.3 m/s are calculated to be approximately 990 feet and 770 feet, respectively for the 23°F and 64°F operating cases. This indicates that the plume velocity of the gas turbine/HRSG exhausts decreases as a function of ambient temperature. Additionally, the plume velocities for the gas turbine/HRSGs would be lower for the duct fired and duct fired/solar operating cases due to the lower exhaust temperatures and velocities that occur under those operating cases. For the cooling tower the heights at which the plume velocity drops below 4.3 m/s are calculated to be approximately 940 feet and 725 feet, respectively for the 30°F and 64°F operating cases. However, the cooling tower vertical plume velocities at low temperatures are likely to be lower than predicted using this worst case velocity calculation as very low relative humidity conditions do not normally happen with very low temperatures in the project area, and higher relative humidity would cause the plumes to be visible and the velocities would drop due to increased density and drag, and visible plumes are generally less of a concern in terms of turbulence impacts as they can be seen and avoided.

COOLING TOWER GROUND FOGGING MODELING RESULTS

Plume Traffic Impact Table 3 provides the predicted number of hours of plume ground fogging with direction from the tower over the three year meteorological data period.

Plume Traffic Impact Table 3
Hours of Worst Case Annual Plume Fogging
Year Round Full Load Operation
Palmdale 2002-2004 Meteorological Data

	Wind From					
	SSW	SW	WSW	W	WNW	All
	Plume Headed					
Distance from tower (m)	NNE	NE	ENE	E	ESE	Sum
	Solar On with Duct Firing at Ambient Temperature, 98 °F					
100	1.3	6.1	1.7	1.2	2.0	12.3
200	6.7	35.7	1.2	0.6	8.0	52.3
300	3.9	16.9	0.0	0.0	3.5	24.3
400	2.0	4.0	0.0	0.0	0.6	6.6
500	2.0	4.0	0.0	0.0	0.5	6.5
600	1.2	2.5	0.0	0.0	0.0	3.7
700	1.0	2.0	0.0	0.0	0.0	3.0
800	1.0	2.0	0.0	0.0	0.0	3.0
900	1.0	2.0	0.0	0.0	0.0	3.0
1000	1.0	2.0	0.0	0.0	0.0	3.0
1100	1.0	2.0	0.0	0.0	0.0	3.0
1200	1.0	2.0	0.0	0.0	0.0	3.0
1300	1.0	2.0	0.0	0.0	0.0	3.0
1400	1.0	2.0	0.0	0.0	0.0	3.0

Source: Staff modeling.

The most prevalent ground fogging plume events would be to the northeast and north northeast. Plumes headed to northeast and north northeast directions would be observed as far as 1400 meters away from the center of the cooling tower. The northeast plumes would cross two roads 15th Street East and the East Avenue M at approximately 89 meters and 962 meters northeast from the cooling tower. The north northeast plumes would also cross these two roads at approximately 165 meters and 736 meters north northeast from the cooling tower for 15th Street East and the East Avenue M, respectively. Since 15th Street East is located less 100 meters east of the cooling tower, 15th Street would experience more plume fogging events than East Avenue M. The predicted ground fogging plumes headed toward east northeast, east, east southeast, and southeast would cross 15th Street East. 15th Street East is predicted to experience plume fogging in these directions for slightly less than 5 hours annually. East Avenue M is predicted to experience plume fogging for approximately 1 hour annually.

In addition to roadways, the Plant 42/Palmdale Regional Airport is located directly adjacent to the proposed project site. A portion of the airport property is located on the east side of the project site, and the far west boundary of the airport is only 320 meters east of the cooling tower. Since plume fogging is expected as far as 500 to 600 meters in east southeast direction, a portion of this airport area would potentially be affected by occasional plume fogging. However, the runways/taxiways of the airport are located far south and far southeast, therefore, the modeling analysis does not predict that the runways/taxiways would experience plume fogging.

CONCLUSIONS

The calculated worst-case calm wind condition vertical plume velocities from the PHPP gas turbine/HRSGs and cooling tower are predicted to exceed 4.3 m/s at heights as much as approximately 990 and 940 feet above ground level, respectively. The worst-case dead calm wind and cool to cold ambient conditions used in the velocity calculations will occur occasionally during the plant's life.

The vertical velocity from the equipment exhaust at a given height above the stack decreases as wind speed increases. However, the vertical velocities will remain relatively high, and may exceed 4.3 m/s above 500 feet about ground level, during very low wind speed conditions (less than 1 m/s hourly average). These low wind speed conditions occur relatively frequently at the site location, over 2.4 hours per day on average or approximately 10 percent of the time.

Plume ground fogging events are not predicted to occur across any of the Plant42/Palmdale Regional Airport runways or taxiways; however, two nearby roadways are predicted to experience infrequent ground fogging events. The majority of these ground fogging events are predicted to occur on 15th Street; while a very low frequency of ground fogging is predicted to occur across the more heavily traveled Avenue M.

REFERENCES

AECOM2009h – AECOM/ S. Head (tn: 51417). Applicant Responses to CEC Data Request Set 2 & Supplemental Responses # 4. Dated on 05/01/09. Submitted to CEC 05/04/09.

Best, P. et al. 2003. Aviation Safety and Buoyant Plumes. Presented at the Clean Air Conference, Newcastle, New South Wales, Australia. By Peter Best, Lena Jackson, Mark Kanowski of Katestone Environmental, Toowong, Queensland, Australia and Kevin Spillane of Bendigo, Victoria, Australia.

COP2008a – City of Palmdale/ S. Williams (tn: 47383). Application for Certification for the Palmdale Hybrid Power Project. Dated on 07/30/08. Submitted to CEC/ Docket Unit on 08/04/08.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION For the *PALMDALE HYBRID POWER PROJECT*

Docket No. 08-AFC-9

PROOF OF SERVICE

(Revised 3/2/2010)

APPLICANT
Thomas M. Barnett
Executive Vice President
Inland Energy, Inc.
3501 Jamboree Road
South Tower, Suite 606
Newport Beach, CA 92660
tbarnett@inlandenergy.com

Antonio D. Penna Jr.
Vice President
Inland Energy
18570 Kamana Road
Apple Valley, CA 92307
tonypenna@inlandenergy.com

Laurie Lile
Assistant City Manager
City of Palmdale
38300 North Sierra Highway, Suite A
Palmdale, CA 93550
llile@cityofpalmdale.org

APPLICANT'S CONSULTANTS
Sara J. Head, QEP
Vice President
AECOM Environment
1220 Avenida Acaso
Camarillo, CA 93012
sara.head@aecom.com

COUNSEL FOR APPLICANT
Michael J. Carroll
Marc Campopiano
Latham & Watkins, LLP
650 Town Center Drive, Ste. 2000
Costa Mesa, CA 92626
michael.carroll@lw.com
marc.campopiano@lw.com

INTERESTED AGENCIES
Erinn Wilson
Staff Environmental Scientist
Department of Fish & Game
18627 Brookhurst Street, #559
Fountain Valley, CA 92708
E-mail preferred
ewilson@dfg.ca.gov

Michael R. Plaziak, Manager
Lahontan Regional
Water Quality Control Board
14440 Civic Drive, Suite 200
Victorville, CA 92392-2306
mplaziak@waterboards.ca.gov

Rick Buckingham
3310 El Camino Avenue, LL-90
State Water Project
Power & Risk Office
Sacramento, CA 95821
E-mail preferred
rbucking@water.ca.gov

*Manuel Alvarez
Southern California Edison
1201 K Street
Sacramento, CA 95814
Manuel.Alvarez@sce,com

*Robert J. Tucker
Southern California Edison
1 Innovation Drive
Pomona, CA 91768
Robert.Tucker@sce.com

Christian Anderson
Air Quality Engineer
Antelope Valley AQMD
43301 Division St, Suite 206
Lancaster, CA 93535
E-mail preferred
canderson@avaqmd.ca.gov

California ISO
e-recipient@caiso.com

Jeffrey Doll
Air Resources Engineer
Energy Section/Stationary Sources
CaliforniaAir Resources Board
P.O. Box2815
Sacramento, California 95812
E-mail preferred
jdoll@arb.ca.gov

ENERGY COMMISSION
JEFFREY D. BYRON
Commissioner and Presiding Member
jbyron@energy.state.ca.us

ANTHONY EGGERT
Commissioner and Associate Member
aeggert@energy.state.ca.us

Kristy Chew
Advisor to Commissioner Byron
kchew@energy.state.ca.us

Paul Kramer
Hearing Officer
pkramer@energy.state.ca.us

Felicia Miller
Project Manager
fmiller@energy.state.ca.us

Caryn Holmes
Staff Counsel
cholmes@energy.state.ca.us

*Jennifer Jennings
Public Adviser
publicadviser@energy.state.ca.us

*indicates change

DECLARATION OF SERVICE

I, Teraja` Golston, declare that on, March 9, 2010, I served and filed copies of the attached Palmdale (08-AFC9) - Notice of Availability - Preliminary Staff Assessment. 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/palmdale/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;

_x__by personal delivery or by depositing in the United States mail at Sacramento, CA 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. 08-AFC-9
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 Signature in Dockets
Teraja` Golston

*indicates change