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April 1, 2004

Ms. Theresa Epps Dockets Unit California Energy Commission 1516 9<sup>th</sup> Street Sacramento, CA 95814

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## **RE:** The Tesla Power Project (01-AFC-21)

Dear Ms. Epps:

Enclosed for filing with the California Energy Commission are one original and 12 (Twelve) copies of the Applicant's Testimony (with Exhibits) for the Tesla Power Project (01-AFC-21).

Sincerely,

Chilps for Scott A. Galati

ол behalf of Midway Power, LLC

SAG/cp Enclosures

...Admin\Tesla\Dockets\Cover 04-01/04

## **EXHIBIT 169**

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## STATE OF CALIFORNIA

## Energy Resources Conservation and Development Commission

In the Matter of:	DOCKET NO. 01-AFC-21
Application for Certification for the Tesla Power Project	SUPPLEMENTAL AIR QUALITY AND SOCIOECONOMICS TESTIMONY OF DAVID A. STEIN, P.E.

I, David Stein, declare as follows:

- 1. I am presently employed by URS Corporation, as Vice President, Environmental and Energy Services.
- 2. A copy of my professional qualifications and experience been previously submitted and docketed.
- 3. I prepared the attached supplemental testimony relating to Air Quality for the Tesla Power Project (California Energy Commission Docket Number 01-AFC-21).
- 4. I directed the preparation of the attached supplemental testimony regarding Socioeconomics for the Tesla Power Project.
- 5. It is my professional opinion that the attached prepared supplemental testimony is valid and accurate with respect to issues that it addresses.
- 6. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed at Oakland, CA on March 31, 2004.

Stern

## SUPPTE-3

### SUPPLEMENTAL TESTIMONY OF DAVID STEIN

### AIR QUALITY

### 1. Comment.

The record states that U.S. EPA withdrew PSD authority from local air districts in December 2002. The parties shall indicate whether this affects their air quality analyses or would change any findings of the FDOC.

### Response.

The ehange in PSD delegation status does not change any of the findings with respect to PSD compliance summarized in the FDOC. Accordingly, the CEC does not need to modify any of the air quality conditions contained in the PMPD to address the change in PSD authority. Additional information is provided below.

The PSD Notice of Withdrawal of Delegation of Authority for the BAAQMD ("Notice") was published in the Federal Register on April 21, 2003 (68 FR 76, 19371-19372). The Notice (a full copy is included as Attachment AQ-1) indicates that the rescission of PSD delegation status was effective on March 3, 2003. The FDOC was issued by the District by letter dated February 27, 2003. At the time of FDOC issuance the BAAQMD had full PSD authority and the final FDOC had incorporated all comments received by EPA or other commenting parties.

Although PSD delegation authority has been rescinded, both EPA and BAAQMD have identified several power projects that have undergone a timely and complete PSD review, including the Tesla Power Project (TPP). EPA has no intention of undertaking any modifications to these completed PSD analyses. EPA and BAAQMD are in the process of entering into a limited PSD authority delegation agreement that will grant BAAQMD authority to issue the final PSD permit to TPP and the other affected power projects. Several drafts of the agreement have been exchanged between the two agencies and the limited delegation agreement is expected to finalized by April 30, 2004 (Gerardo Rios, Chief, New Source Review, Region IX, EPA, March 2004. Personal conversation with David Stein, URS).

### 2. <u>Comment.</u>

Staff's Air Quality Table 9 reflects the NAAQS and CAAQS in effect in 2002. If these standards have been modified since that time, the parties shall update Table 9 and correct the calculations of potential violations consistent with the updated standards, specifically regarding particulate matter  $(PM_{10} \text{ and } PM_{2.5})$  as indicated in Staff's Air Quality Table 1.

### Response.

Table 9 of the PMPD has been updated (Table 9-Rev) to reflect revised  $PM_{10}$  and  $PM_{2.5}$  ambient air quality standards. Table 9-Rev includes the most stringent Ambient Air Quality Standard, as well as background monitored concentrations for both  $PM_{2.5}$  and  $PM_{10}$ . The  $PM_{10}$  concentrations were staff recommended and were included as part of the PMPD. Background concentrations of  $PM_{2.5}$  were

obtained from the California Air Resources Board Web Site (<u>www.arb.gov</u>). Concentrations were obtained from both Modesto and Stockton, CA (2002 and 2003). Maximum background concentrations have been included in Table 9-Rev.

We have provided a recommended update to Table 16 of the PMPD (Table 16-Rev) that presents total post-project impacts plus background, including the impacts of  $PM_{2.5}$ . We have also noted and recommended a correction for an apparent Staff calculation error in the percentage of the applicable annual  $PM_{10}$  standard. While not all of the project's particulate emissions will be  $PM_{2.5}$ , we have provided a very conservative estimate assuming that 100 percent of the  $PM_{10}$  is  $PM_{2.5}$ . This is a particularly conservative for the  $PM_{2.5}$  cooling tower emissions. If all of the  $PM_{10}$  is assumed to be  $PM_{2.5}$  the impact levels are ass shown in Table 16-Rev. As shown, the project would not result in a new exceedance of any applicable ambient air quality standard. Because full mitigation of  $PM_{2.5}$  / $PM_{10}$  has been required in the form of seasonal emission targets, a supplemental mitigation agreement with SJVAPCD and a separate mitigation program with the City of Tracy, and emission offsets, the impacts of the project's individual and cumulative impacts on  $PM_{10}$  and  $PM_{2.5}$  are insignificant.

Table 9-Rev Staff's Recommended Background Concentratious of Tesla – Applicant Suggested Revision (bold shading)

Pollutant Averaging Time		Maximum Mouitored Background (ppm)	Staff Recommended Background (µg/m <sup>3</sup> )	Limiting Standard (ppm)	Type of Standard
Ozone	l Hour	0.13		0.09	CAAQS
$(O_3)$	8 Hour	0.113		0.08	NAAQS
	24 Hour	150	150	50 μg/m <sup>3</sup>	CAAQS
PM <sub>10</sub>	Annual Arithmetic Mean	36.4 µg/m <sup>3</sup>	36.4	20 μg/m³	CAAQS
	24 Hour	87.1 μg/m <sup>3</sup> *	87.1*	65 μg/m <sup>3</sup>	NAAQS
PM <sub>2.5</sub>	Annual Arithmetic Mean	18.7 μg/m <sup>3</sup> *	18.7*	12 μg/m <sup>3</sup>	CAAQS
NO <sub>2</sub>	1 Hour	0.079	149	0.25	CAAQS
	Annual	0.0149	28	0.053	NAAQS
CO	l Hour	8.9	13,054	20	CAAQS
	8 Hour	7.2	8,405	9	NAAQS
	1 Hour	0.029	76	0.25	CAAQS
SO2	3 Hour			0.5	NAAQS
	24 Hour	0.0094	24.6	0.04	CAAQS
	Annual	0.002	5.2	0.03	NAAQS

\* Background concentrations not available during previous submittals. Concentrations represent the maximum collected during 2002 and 2003.

# Table 16-RevTesla Power Project, Ambient Air Quality Impacts from Routine Operation (μg/m³) –<br/>Applicant Suggested Revision (bold shading)

Pollutant	Averaging	Project	Back-	Total	Limiting	Type of	Percent of
	Period	Impact	ground	Impact	Standard	Standard	Standard
PM10	24 Hour	5.1	150	155	50	CAAQS	310
	Annual	0.5	36.4	37	20	CAAQS	185
PM2.5	24 Hour <sup>t</sup>	5.1*	87.1	92	65	NAAQS	142
	Annual	0.5*	18.7	19	12	CAAQS	158
NO <sub>2</sub>	l llour <sup>2</sup>	120.1	149	269	470	CAAQS	57
	Annual	0.23	28	28	100	NAAQS	28
CO	1 Hour <sup>2,3</sup>	1,346	13,054	14,400	23,000	CAAQS	63
	8 Hour	241.3	8,405	8,646	10,000	NAAQS	86
SO <sub>2</sub>	1 Hour <sup>2</sup>	4.6	76	81	655	CAAQS	12
	3 Hour <sup>2</sup>	2.4	76	78	1,300	NAAQS	6
	24 hour	0.72	24.6	25	105	CAAQS	24
	Annual	0.04	5.2	5	80	NAAQS	7

\* The modeling analysis did not include the estimation of PM<sub>2.5</sub> concentrations. Maximum modeled PM<sub>10</sub> have been added to background concentration to estimate potential air quality impacts from PM<sub>2.5</sub> emissions. Please note that this overestimates potential impacts due to emission of PM<sub>2.5</sub>. PM<sub>2.5</sub> emissions will be a portion of the PM<sub>10</sub> emissions.

<sup>1</sup> 24-hour PM10 impacts based on Staff review including a full day of wintertime operation at 50% load.

<sup>2</sup> Hourly and 3-hour impacts do not include fire water pump engine testing. With fire water pump testing, hourly Project impacts would be NO<sub>2</sub>: 1,348 μg/m<sup>3</sup>. All results include has turbine startups as part of routine operation. NO<sub>2</sub> impacts based on ISC3-OLM analysis with CTGs achieving 2.0 ppm on a 1-hour basis.

3 I-hour CO impacts based on Staff review of Applicant's CD-R(Updated Mndeling 12/5/01).

## 3. <u>Comment.</u>

Staff refers to Applicant's "Updated Modeling Analysis, docketed 12/05/01," however, this document has not been identified as an Exhibit. The Applicant shall file this document as an Exhibit

## Response.

We have included a copy of the Updated Modeling Analysis for the Committee's convenience as Attachment AQ-2

## 4. Comment.

The evidence indicates that maximum daily  $PM_{10}$  impacts in San Joaquin County would be approximately 50% of the overall maximum concentrations due to the TPP. According to the analysis, TPP would cause 24-hour  $PM_{10}$  concentrations to increase by approximately 2.6 µg/m<sup>3</sup> at elevated terrain in San Joaquin County approximately 3.5 miles southeast of the site. Maximum annual  $PM_{10}$  TPP impacts in San Joaquin County would be less than 0.2 µg/m<sup>3</sup>. However, the evidence does not reconcile the finding of maximum impacts west of the site in Alameda County with the finding of impacts at 50% of overall maximum impact east of the site in San Joaquin County. The parties shall explain how the pollutants are dispersed in opposite directions and whether this is based on a seasonal analysis.

## Response.

The ISCST3 dispersion model used for this analysis uses hourly meteorological data along with other site-specific information. One of these inputs includes the input of offsite points, or receptors, where pollutant eoneentrations are calculated. The ISCST3 model ealculates maximum pollutant concentration, for each specified averaging time (in this case a 24-hour or daily average), at each of the receptor locations independently of all other receptor locations. The maximum pollutant concentration therefore refers to the highest concentration calculated by the model for any 24-hour period within the meteorological data set for that specific location only. Since wind speed and direction vary throughout the year and throughout any given day, the 24-hour period that produces the overall maximum concentration at each receptor will vary. Hence, a maximum concentration calculated at a receptor located to the west does not necessarily correspond to the same 24-hour hour period as a maximum concentration located at receptor to the southeast. Maximum concentrations that are being referred to in the San Joaquin Valley (southeast of the site) would not and do not occur on the same day as maximum concentrations in Alameda County (west of the site) and there is no clear relative relationship that can be drawn from the maxima at these two locations. It is physically impossible for and the ISCST model does not allow for emissions to simultaneously disperse in opposite directions. The analysis is based on a "seasonal" analysis in sense that the model calculates impacts for all seasons of the year and then selects and reports the maximum impact unique to each receptor location for each averaging period.

## 5. <u>Comment.</u>

The parties shall clarify their positions on the use of Landfill road paving ERCs to offset combustion-related emissions. The parties shall also provide information on the timeline for implementing CARB's new PM<sub>2.5</sub> standard and whether it will ultimately affect use of the Landfill ERCs to mitigate TPP emissions. In addition, the parties shall clarify the regulatory procedure by which TPP can substitute the Crown Zellerback ERC option for the proposed Landfill ERCs.

## Response.

The applicant has provided evidence indicating that  $PM_{2.5}$  emissions associated with landfill roads are substantially greater than was estimated by CEC staff (see Supplemental Air Quality Testimony of David A. Stein, P.E. of October 27, 2003). CEC staff have indicated in their testimony that some  $PM_{2.5}$  emission reductions will result from the road paving program. We continue to believe that Staff has very conservatively underestimated the amount of the  $PM_{2.5}$  reduction. The Committee has incorporated these reductions into the proposed air quality conditions of certification. We continue to believe that the landfill road paving offsets proposed for the Tesla project will provide substantial and localized air quality benefits. Furthermore, the  $PM_{2.5}$  air quality mitigation requirements set forth in Staff's testimony and adopted by the Committee in the PMPD incorporate a substantial reduction in the overall PM10 road paving reduction credits approved by BAAQMD to more than adequately address Staff's concerns regarding any potential difference in  $PM_{2.5}$  and  $PM_{10}$  emissions from the landfill. The new PM<sub>2.5</sub> standard is effective. There is nothing in the timing of the implementation of the standard that would affect the use of the landfill ERCs, which have already been approved by BAAQMD, after opportunity to comment by both CARB and EPA. As previously testified to at the evidentiary hearing, in recent conversations with Mike Tollstrup, Chief of ARB's Project Assessment Branch within the Stationary Source Division, Mr. Tollstrup indicated that ARB does not oppose the use of the Altamont landfill PM10 ERCs to offset emissions from the Tesla project. Although the Applicant has no authority to produce Mr. Tollstrup as a witness, we can offer his telephone number, (916)322.6026, for the Committee's use in corroborating this representation of ARB's position.

Air Quality Table 17 lists 91.0 tons of PM10 from Crown Zellerbach on certificate number 831. We have proposed to use these ERCs in addition to the ERCs from the Altamont landfill. The BAAQMD PM10 liability is 190 tons and the landfill certificate will offset 98.01 tons of the total liability. With regard to the possible substitution of ERCs, the FDOC provides an adequate regulatory framework for a substitution, if necessary, of proposed ERCs. The BAAQMD FDOC conditions 46 and 47 and PMPD proposed conditions AQ-46 and AQ-47 identify specific offset amounts that must be under the Applicant's control prior to commencement of construction and operation, respectively. A substitution would need to be reviewed and approved by the BAAQMD prior to issuance of the Authority to Construct and submitted to the CPM. Any substitution of ERCs would involve modification to the amount of residual emission reduction targets identified in **AQ-C7**.

With respect to CEQA residual impacts to San Joaquin County, the Committee should note that the Condition of Certification AQ-C7 discounts the Altamont landfill ERCs by 85 percent to account for that fraction of the ERC that represents  $PM_{2.5}$ . Therefore, AQ-C7 effective requires full mitigation for  $PM_{2.5}$ .

## 6. Comment.

The record does not directly address Mr. Sarvey's concerns regarding the contribution of ammonia slip to formation of secondary particulate matter. The parties shall provide evidence to establish that the contribution of ammonia slip to secondary particulate matter was included in the analysis and that appropriate mitigation will be provided, if necessary.

## Response.

Secondary particulate ammonium sulfate and ammonium nitrate can form by chemical reactions involving nitric acid, sulfuric acid, sulfurous acid and ammonia. The extent of formation of each secondary particulate species in the atmosphere is complex and is a function of the availability of the reactants. In the San Joaquin Valley, the predominant component of fine particulate matter is ammonium nitrate (approximately 60% of the PM2.5<sup>1</sup>). Ammonium sulfate is not a key component of PM2.5 in the San Joaquin Valley.

The San Joaquin Valley airshed is rich with ammonia, largely from agricultural sources. According to estimates by the SJVAPCD and ARB, industrial sources account for less than 4% of the total SJV

<sup>&</sup>lt;sup>1</sup> Pun and Seigneur, 2001, "Sensitivity of Particulate Nitrate Formation to Precursor Emissions In the California San Joaquin Valley", Atmospheric and Environmental Research.

ammonia inventory<sup>2</sup> and power plants account for approximately 0.2% of the total ammonia<sup>3</sup>. For this reason, ARB has not identified ammonia injection for NOx control as an important source of ammonia and has assigned the source category a low priority source of atmospheric ammonia emissions in the Valley. Furthermore, it has been demonstrated by a number of researchers<sup>1,4</sup> that the formation of secondary ammonium nitrate and sulfate is not limited by atmospheric ammonia. Since there is already an overabundance of ammonia in the SJV atmosphere to form ammonium secondary particulate, the incremental addition of small quantities of ammonia from the Tesla project or other power plants will have no perceptible impact on fnture secondary ammonium particulate levels in the SJV.

It is also noteworthy that the concern regarding ammonia slip-induced secondary particulate was raised by Mr. Sarvey during the recently licensed East Altamont Energy Center proceedings. In that case, similar evidence regarding the ammonia-rich nature of the SJV airshed was presented and accepted by the CEC. The East Altamont Energy Center was ultimately permitted by both the SJVAPCD and the CEC with an ammonia slip limit of 10 ppm (compared to the applicant-proposed Tesla ammonia slip limit of 5 ppm). The East Altamont Energy Center, as permitted, will therefore result in approximately twice the ammonia emissions as the proposed Tesla project. The CEC required no specific mitigation for East Altamont Energy Center's proposed ammonia emissions at twice the level proposed by the Tesla Project.

Based on the above information, the Tesla project ammonia slip will not cause a significant impact on ammonium particulate formation and no additional mitigation of ammonia slip is necessary.

## 7. Comment.

The evidence shows that  $PM_{10}$  cumulative impacts in San Joaquin Valley (4.3 µg/m<sup>3</sup> in the elevated terrain approximately 3.5 miles southeast of the site) exceed those identified in the analysis of TPP's direct impacts (i.e. 2.6 µg/m<sup>3</sup> at the same location). Staff, however, did not provide a recommendation on cumulative impacts. The parties shall submit additional evidence on cumulative impacts and specifically address the effects of cooling tower  $PM_{10}$  emissions. If cumulative impacts are significant, the parties shall identify mitigation measures that would reduce those impacts to insignificant levels.

## Response.

The Applicant submitted a cumulative air quality inpact analysis with the AFC. The analysis demonstrated that the Tesla Project would not cause a new exceedance of the applicable PM10 standards. The analysis included the impacts of potential cooling tower PM10 emissions. Similar analyses reaching similar conclusions were previously submitted in the Tracy Peaker Project and East Altamont Energy Center siting cases. Furthermore, the CEC Staff has recommended and the Committee has proposed a variety of PM2.5/PM10 mitigation measures, including seasonal

<sup>&</sup>lt;sup>2</sup> Gaffney and Shimp, 1999, "Ammonia Emission Inventory Development: Needs, Limitations, and What is Available Now", California Air Resources Board, Planning and Technical Support Division.

<sup>&</sup>lt;sup>3</sup> ARB, 2001, "Year 2000 Anunonia Emission Inventory for the San Joaquin Valley Air Pollution Control District", Planning and Technical Support Division

<sup>&</sup>lt;sup>4</sup> Blanchard, et. al., 2000, "The Use of Ambient Measurements to Identify which Precursor Species Limit Aerosol Nitrate Formation", Journal of the Air and Waste Management Association.

emission caps, BAAQMD emission offsets, local landfill PM reductions, a SJVAPCD Mitigation Agreement, and a mitigation agreement with the City of Tracy that, taken together, will reduce Tesla Project emissions potential contribution to San Joaquin Valley air quality to insignificant levels.

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## **EXHIBIT 170**

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Attachment AQ-1

Federal Notice Withdrawing BAAQMD PSD Authority

work either concurrently or within a specified reasonable period of time. The fual terms agreed upon will be set forth in writing and made a part of the CA before commencement of work.

(a) Contributed funds. Contributed funds may be accepted, or refunded, without further reference or approval by the Chief of Bugineers. The required certificate of the district commander will cite 33 U.S.C. 701h as the pertinent authority.

(b) Obligation of contributed funds. Per OMB Circular A-34, all contributed funds must be received in cash and deposited with the Treasury before any obligations can be made against such funds. Public Law 84-09 assistance for well construction is exempted from this requirement because financing is specifically authorized, Howaver, the CA for such well construction assistanco (see subpart G of this part) must be signod in advance of any obligations. To reduce administrative problems, CA terms for well construction should be for no longer a period than that which will allow for paymonds within the means of the applicant. Public Law 84-99 limits the form to a maximum of 30 years.

(c) Provision of work or services in kind. To the extent practicable, local interests should be allowed to minimize the around of contributed hinds by providing equivalent work or services in kind. Such services do not include LERRD's.

#### § 203.85 Rehabilitation of Federal Flood Control Projects.

Some sponsors of Federal flood control projects are not required to fumish written assurances of local exoperation, when such assurances alroady exist from the PCA of the original construction of the preject. In lieu of a new PCA, the Corps will notify the sponsor, in writing, of the spunsor's standing requirements. These roquiroments include such items as LERRD's, costs attributable to deficient or deforred maintenance, removal of temporary works, cost-sharing requirements, and any other requirements contained in § 203.82. The project sponsor must acknowledge its responsibilities prior to the provision of Rehabilitation Assistance, If the existing PCA does not adequately address responsibilities, then a CA will be required.

#### § 203.86 Transfer of completed work to local interests.

Responsibility for operation and maintenance of a project for which emergency work under Public Law 84– 09 is undertakon will always remain with the non-Federal sponsor throughout the process, and thereafter. The Corps will notify the non-Federal sponsor by lotter when repair/ rehabilitation/work offorts are completed. Detailed instructions, and suggestions relative to proper maintenance and operation, may be furnished as an enclosure to this latter. The letter will remind the local interests that they are responsible for satisfactory maintenance of the flood control works in accordance with the terms of the PCA or CA. In appropriate cases for Federal projects, refer to the "Flood Coutrol Regulation for Maintenance and **Operation of Flood Control Works: (03** CFR 20B)" or the project's Operation and Maintonanco Manual, Reporting requirements placed on the non-Fedoral sponsor will vary according to organization and other circumstances.

[FR Bor. 03-0008 Filed 4-18-03, 8:45 am] shows code \$719-12-9

#### DEPARTMENT OF COMMERCE

#### Patent and Trademark Office

37 CFR Part 2

[Docket No.: 2003-P-011]

Correspondence With the United States Patent and Trademark Office

AGENCY: United States Patent and Trademark Office, Commerce, ACTION: Final rule; correction.

**SUMMARY:** The United States Patent and Trademark Office (Office) published in the Federal Register of March 25, 2009 (68 FR 14332) a final rule rovising the rules of practice to change the mailing address for certain correspondence with the Office, and to change the titles of cortain Office officials. This document corrects an error in the zip code sat forth in the address for chailing trademarkrelated correspondence.

EFFECTIVE DATE: Effective on May 1, 2003.

FOR FURTHER INFORMATION CONTACT: Mary Hannon, Office of the Commissionor for Trademarks, hy telaphone at (703) 308-8910, axt. 137: by o-mail to mory.hannon@uspto.gov; by facsimile transmission addressed to her at (703) 872-9280; or by mail marked to her attention and addressed to Commissioner for Trademarks, 2000 Crystal Drive, Arlington, Virginia 22202-3514.

SUPPLEMENTARY INFORMATION: The Office published in the Federal Register of March 25, 2000 (68 FR 14392) a final rule that changed the mailing address for certain correspondence with the Office. This document amonds § 1.1(a)(2) to correct the zip code in the address for mailing trademark-mlated documents (other than documents sent to the Assignment Services Division for recordation and requests for copies of trademark documents). Specifically, 37 CFR 1.1(a)(2) is amended to refer to "22202-3514" rather than "22202-3513."

In FR Dec. 03-6971, published on March 25, 2003 (66 FR 14392), make the following correction.

#### PART 37—[Corrected]

§1.1 [Corrected].

 1. On page 14335, in the third column, in § 1.11ai(2), line 10, convet "22202-3513" to read "22202-3514,"

Dated: April 15, 2003.

Lynne G. Bereslord. Deputy Cozirclesioner for Trudemork Examination Policy.

(FR Doc. 03-0696 Filed 4-18-03; 8:45 am) withing code 1516-16-P

#### ENVIRONMENTAL PROTECTION AGENCY

#### 40 CFR Part 52

[FRL-7485-3]

Prevention of Significant Detenoration; Notice of Withdrawal of Delegation of Authority; Bay Area Air Quality Management District; Kern County Air Pollution Control District; Nevada Division of Environmental Protection; San Olego County Air Pollution Control District; Santa Barbara County Air Pollution Control District; Shasta County Air Quality Management District; South Coast Air Quality Management District; and Washoe County District Health Oepariment

AGENCY: Environmental Protoction Agency (EPA).

ACTION: Notice of withdrawal of dolegation of PSD permitting authority.

SUMMARY: This document is to inform interested parties that, by latters dated March 3, 2003, the Regional Administrator of EPA, Region 9, has rescinded the Region's delegations of authority to issue federal Prevention of Significant Deterioration (PSD) permits to the following agencies in California and Novada: Bay Area Air Quality Management District: Kern County Air Pollution Control District; Nevada Division of Environmental Protection; San Diego County Air Pollution Control

District: Santa Barbara County Air Pollution Control District; Shasta County Air Quality Management District: Sonth Coast Air Quality Managornont District; and Washoo County District Health Department. **DATES:** The letters withdrawing delegation to these jurisdictions specify that the rescission of the PSD delegations is effective on March 3. 2003.

ADDRESSES: Yon can inspect copies of the delegation agreements and Region 9's lottors rescinding each delegation agreement at our Region IX office during normal business hours. Due to security procedures, ploase call Curt Taipale at 415-072-3066 at least one day in advance of inspecting these documents at our office: Pennits Office (AIR-3), Air Division, U.S. Environmental Protection Agoncy, Region IX, 75 Hawthorus Street, San Francisco, CA 04105,

You may also see copies of the pertinent delegation agreement and rescission latter at the following locations:

Bay Area Air Quality Management District. 939 Ellis Street, San Francisco. CA 94109

Californía Air Resources Board, Stationary Source Division, Rule Evaluation Section, 1001 "I" Street, Sacramento, CA 95814.

Kern County Air Pollution Control District, 2700 "M" Street, Suito 302, Bakersfield, CA 93301-2370.

Nevada Division of Environmental Protection, Bureau of Air Pollution Control, 333 West Nya Lana, Carson City, NV 89706.

San Diego Air Pollution Control District, 9150 Chosapeake Drivo, San Diego, CA 92123-1096.

Santa Barbara County Air Pollution Control District, 26 Castilian Drive B-23. Goleta, CA 93117.

Shasta County Air Quality

Management District, 1855 Placer Street, Suite 101, Redding, CA 95001-1750. South Coast Air Quality Management

District. 21865 E. Copley Drive. Diamond Bar, CA 91765-4182.

Washoe County District Health Department, Air Quality Management Division. 401 Ryland Street, Suite 331, Reno, Nevada 89502.

FOR FURTHER INFORMATION CONTACT: Gerardo Rios, EPA Region IX, (415) 972-3074. or sond e-mail to rios.getardoBepa.gov.

SUPPLEMENTARY INFORMATION:

Throughout this document. "we," "us" and "Our" refer to EPA.

#### 1. Background

In 1976, EPA published final regulations at 40 CFR 52.21.

under Part C of the Clean Air Act. 42 U.S.C. 7475-7479. See 43 FR 26403 (June 19, 1978). The PSD regulations provide authority to EPA to delegate the responsibility for conducting PSD source review to a State or local air pollution control agency, 40 CFR 52.21(u). In general, delegations are implemented through agreements between EPA Regions and state or local air pollution control agoncies. Those acreermonts are in essence contracts between the Agency and permitting agancies, setting out the responsibilities of each in carrying out the federal PSD program for that jurisdiction. The specific elements of delegation agreements vary to take into consideration particular circumstances. such as legal restrictions that may apply in a specific jurisdiction.

Pursuant to its authority under § 52.21(u). Region 9 entand into delegation agreements with the following permitting agoncies on the date specified; Bay Area Air Quality Management District-April 23, 1086; Karn County Air Pollution Control District-August 12, 1999; Novada Division of Environmental Protection-May 27, 1983; San Diego County Air Pollution Control District-November 21, 1985; Santa Barbara County Air Pollution Control District-August 21, 1985; Shasta County Air Qualify Management District-July 8, 1985; South Coast Air Quality Management District-lanuary 15, 1997; and Washoo County District Health Department-April 9, 1985. Region 9 published notices of the delegation agreements in the Federal Register at various datas, On December 31, 2002, EPA

published its Final Rule significantly ravising 40 CFR 52.21. 67 FR 80186 (Dec. 31, 2002). The ravised rules were effective on Match 3, 2003.

Since publication of the ravised PSD rules, Region 9 has consulted with each of the California permitting agencies that implemented 40 CFR 52.21 pursuant to a dolegation agreement and with the California Air Resources Board (CARB). The permitting agancies and CARB have informed Region 9 that they are unable to implement 40 CFR 52.21 as revised without making changes to California law and/or local regulations, Region 9 has also discussed the issue with the Nevada Division of Environmental Protection, who indicated that changes to Nevada low would be necessary for either NDEP or the Washoe County District Health Department to implement the revisions to 40 CFR 52.21.

As the California and Nevada permitting agoncies identified above did

implementing the PSD program required - not helieve that their current law would allow them to implement revised 40 CFR 52.21, Region 9 will tosume issuing federal PSD permits as of the date the revisions to 40 CFR 52.21 take effect. Region 9 has issued a letter to each permitting agancy in the Region that is implemonting 40 CFR 52.21 phrsuant to a delegation agreement, advising the permitting agencies that the delegation of lederal PSD parnitting authority woold be rescinded effective March 3, 2003. A copy of each letter reacinding the PSD delegation of authority is available for inspection and copying at the addresces provided above.

> EPA's withdrawal of authority to implement the federal PSD pennitting program does not affect permitting requirements under state or local law, Companies should continue to work with their state or local permitting agencies to ensure that state or local permitting requirements are not.

#### 11. EPA Action

We have written latters reacteding the dolegation agroements to implement the regulations at 40 CFR 52.21 for the following California permitting agencies: Bay Area Air Quality Management District; Kern County Air Pollution Control District; San Diego County Air Pollution Contro) District; Santa Barbara County Air Pollution Control District: Shasta County Air Quality Management District; and South Coast Air Quality Managament District. We have written a letter rescinding the delegation agreements to unplement the regulations at 40 CFR 52.21 for the following Novada permitting againcies: Nuvada Division of Environmental Protection: Washee County District Health Dopartment.

#### List of Subjects in 40 GFR Part 52

Environmental protection, Air pollution control, Intergovernmental regulations, Reporting and moordkeeping requirements.

Dated: April 2, 2003.

Alexis Strauss.

Acting, Regional Administrator, Region IX. [FR Doc. 03-0621 Filed 4-18-03; 8:45 am] BILLING CODE 6566-50-P

## **EXHIBIT 171**

Attachment AQ-2

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Supplemental Air Quality Modeling Analysis

## UPDATED MODELING ANALYSIS FOR THE TESLA POWER PLANT PROJECT

## ALAMEDA COUNTY, CALIFORNIA

Prepared for Midway Power, LLC

November 29, 2001



500 12th Street, Suite 200 Oakland, California 94607

51-80167033.00

## UPDATED MODELING ANALYSIS FOR THE TESLA POWER PLANT PROJECT

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## INTRODUCTION

This updated modeling analysis is designed to supplement the analysis presented in the Tesla Power Plant (TPP) AFC. The modeling analysis was conducted using the methodology described in the AFC. The following updates are included in this analysis:

- Turbine shutdown emissions included in annual emission estimates;
- Emergency generator removed;
- Firewater pump engine emissions based on 26 hours of operation per year; and
- Three years (1997-1999) of Tracy meteorological data used in the analysis.

Electronic copies of all modeling analysis input and output files and meteorological data are included in CD format. Excerpts of the modeling output files are contained in the Appendix.

## UPDATED EMISSION ESTIMATES

Facility emissions were updated to include the changes described above. Updated annual turbine operating conditions, including shutdown events are shown in Table 1. Turbine emissions during shutdown are shown in Table 2. Startup emissions were not updated and are the same as those reported in the AFC. Revised annual turbine emissions are shown in Table 3.

	0/11(003)	
Number of Startups	45	
Hot Starts	27	
Warm Starts	6	
Cold Starts	12	
Number of Shutdowns	45	
Startup/Shutdown Time (hrs)	141.0	
Turbine Operation (hrs)	8,060	
Duct Burner Operation (hrs)	5,260	
Total CTG Operating Hours	8,201	_

Table I. Annual Operating Conditions per Generating Set
(consisting of 2 CTG/HRSGs)

Generating Set (consisting of 2 CTG/HRSGs)	Table 2. Shutdown Emission Rates per
	Generating Set (consisting of 2 CTG/HRSGs)

Pollutant	LbJ30 minute shutdown
NO <sub>x</sub>	100
CO	350
VOC	34

Pollutant	Duct Pollutant Burner Off H (lbs)		Startup/ Shutdown (Ibs)	Annual Emissions (lhs/yr)	Annual Emissìons (tpy) <sup>a,b</sup>
NOx	143,461	309,133	46,913	499,507	249.75
CO	262,036	564,640	141,533	968,209	484.10
VOC	23,421	84,695	12,750	120,866	60.43
$PM_{10}$	109,643	264,731	5,521	379,896	189.95
SO <sub>2</sub>	18,410	39,739	927	59,076	29.54

Table 3. Annual Turbine/HRSG Emissions (all four turbines/HRSG)

a Includes emissions from all four turbines/HRSGs.

b Emissions include 12 cold startups, 6 warm starts, 27 hot startups and 45 shutdowns, and 5,260 hours at 100% duct burner capacity with the balance of the time operating at 100% load at 62°F.

The emergency generator that was included in the TPP AFC has been removed. In addition, the firewater pump engine hours of operation have been revised to 26 hours per year, based on one-half hour of operation per week. Table 4 shows the updated firewater pump engine emissions. Total project annual emissions (including four turbines with duct firing, cooling tower and firewater pump engine) are shown in Table 5.

Estimated BHP	368		
Estimated kW	274		
Hourly Er	nissions (lb/hr)		
NO <sub>x</sub>	7.41		
CO	1.75		
POC	0.18		
PM <sub>10</sub>	0.13		
SOx	0.75		
Annual E	missions (tpy)		
NO <sub>x</sub>	0.0963		
CO	0.0228		
POC	0.0023		
$PM_{10}$	0.0017		
SO <sub>x</sub>	0.0098		

### Table 4. Emissions for Firewater Pump Engine

Poliutaut	Generator Set #1° (tpy)	Generator Set #2 <sup>c</sup> (tpy)	Cooling Tower (tpy)	Fire Water Pump Engine (tpy)	Annual Emissions (tpy) <sup>a,b</sup>
NO <sub>x</sub>	124.88	124.88		0.096	249.85
CO	242.05	242.05		0.023	484.13
POC	30.22	30.22		0.002	60.44
$PM_{10}$	94.97	94.97	6.10	0.002	196.05
SO <sub>2</sub>	14.77	14.77		0.010	29.55

<b>Table 5. Total Annual Emission</b>	s for TPP During Operation	Л
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a Includes emissions from four turbines, cooling tower, and tirewater pump engine.

b Emissions include 12 cold startups, 6 warm starts, 27 hot startups, and 45 shutdowns and 5,260 hours at 100% duct burner capacity with the balance of the time operating at 100% load at 62°F.

e Each generator set includes two CTG/HRSGs and associated duct burners

## METEROLOGICAL DATA

In addition to the two years of meteorological data from Station 442 used in the AFC, three years of data from Tracy are being used in this additional analysis. An analysis of the Tracy and Station 442 meteorological data is included in the original AFC. The analysis shows similar wind patterns for Station 442, Tracy and other nearby meteorological stations. The Tracy and Station 442 data are considered representative of the conditions at the TPP site.

The Tracy meteorological data set used in the modeling analysis was generated using three years (1997-1999) of data from the Tracy monitoring station and concurrent sky cover and ceiling height data from the Stockton Airport NWS site. The Tracy meteorological data files are the same files used for the nearby East Altamont Energy Facility AFC. Windroses for the Tracy data are included in the AFC.

## AIR QUALITY ANALYSIS RESULTS

Results of the additional air quality impacts analysis using Station 442 and Tracy meteorological data are included in the tables below. Table 6 contains a comparison of maximum predicted impacts from the Station 442 and Tracy data sets. The results indicate that no new violations of any AAQS are predicted. Construction parameters were unchanged from the AFC.

Pollutant	Averaging Tracy Data		Station 442 Data B	Background <sup>b</sup>	Total Predicted	AAQS	Location of Maximum Impact UTM Coordinates	
	renua	Impact (µg/m³)	(µg/m <sup>3</sup> )	(µg/m )	Concentration (µg/m <sup>3</sup> )	(µg/m.)	East (m)	North (m)
			Co	nstruction Im	pacts			
60	l-hour	571	571	13,054	13,625	23,000	625,675	4,176,050
	8-hour	307.8	292.8	8,405	8.713	10,000	625,675	4,176,150
NO	I-hour"	124.1	124.1	199	323.1	470	626,675	4,176,050
NO <sub>2</sub>	Annual <sup>d</sup>	15.9	23.4	45.2	68.6	100	626,250	4,176,150
DM	24-hour	68.9	42.46	150	218.9	50	625,927	4,176,120
PM <sub>10</sub>	Annual	11.33	8.56	40.9	52.2	30	626,281	4,176,107
	l-hour	117.9	117.9	29.3	147	655	626,675	4,176,050
SO <sub>2</sub>	3-hour	81.0	73.9	29.3	110	1,300	626,300	4,176,300
	24-hour	33.0	47.2	16	63.2	105	625,725	4,175,901
	Annual	2.09	3.07	8	11.1	80	626,250	4,176,150
Routine Plant Operation Impacts								
00	l-hour	1,220	1,714	13,054	14.768	23,000	624,300	4,173,800
	8-hour	241.3	249.0	8.405	8,654	10,000	624,375	4,173,450
NO	l-hour <sup>c</sup>	178.9	170.4	199	378	470	626,469	4,175,945
NO <sub>2</sub>	Annual <sup>d</sup>	0.23	0.19	45.2	45,4	100	619,475	4,175,500
DM	24-hour	4.95	4.86	150	155.0	50	621,950	4,176,050
$PM_{10}$	Annual	0.48	0.84	40.9	41.7	30	626,375	4,176,225
	I-hour	68.3	68.4	29.3	97.7	655	626,300	4,176,175
	3-hour	13.1	11.5	29.3	42.4	1,300	626,325	4,176,125
302	24-hour	0.72	0.72	16	16.7	105	623,675	4,172,900
	Annual	0.04	0.04	8	8.0	80	619,475	4,179,250

Table 6. TPP Project ISCST3 Modeling Results<sup>a</sup>

a Bold results indicates maximum impacts.

b Background represents the maximum value measured at Tracy Patterson Pass Road, Stockton Hazelton Street, and Modesto 14th Street, 1997-1999. SO<sub>2</sub> Data from Bakersfield, Chester Street and 5558 California Ave Stations, 1997 and 1999.

Results used OLM to estimate NO<sub>2</sub> impacts

d Results used ARM with default ratio of 0.75.

e Results used first order decay to estimate NO<sub>2</sub> impacts.

Hourly CO and NO<sub>2</sub> impacts from commissioning were modeled using the methodology described in the AFC with Tracy meteorological data. Hourly CO and NO<sub>2</sub> impacts using the Tracy data were less than the facility impacts shown in Table 6. The values in Table 6

Cumulative impacts were estimated using the methodology in the AFC and the Tracy meteorological data. Results of the cumulative impacts assessment are shown in Table 7.

Pollutant	Averaging	Maximum Modeled	PSD Significant	Background <sup>b</sup>	Total Predicted	AAQS	UTM C	coordinates
	Period	Impact (µg/m³)	Impact Level <sup>*</sup> (µg/m <sup>3</sup> )	(µg/m³)	Concentration (µg/m³)	(µg/m²)	East (m)	North (m)
	l-hour	1,220.4	2,000	13,054	14,274	23,000	624,500	4,173,500
ιu	8-hour	214.9	500	8.405	8,620	10,000	625,000	4,172,500
NO	l-hour	178.9°	NA	199	377.9	470	626,469	4,175,945
NO2	Annual	0.28 <sup>d</sup>	1	45.2	45.5	100	619,000	4,180,000
DM	24-hour	4.91	5	150	154.9	50	622,000	4,176,000
r M IQ	Annual	0.58	I	40.9	41.5	30	626,625	4,176,225
	(-hour	68.3	NA	29.3	97.6	655	626,300	4,176,175
50	3-hour	13.1	25	29.3	42.4	1,300	626,325	4,175,125
302	24-hour	0.64	5	16	16.6	105	625,000	4,172,500
	Annual	0.043	I I	8	8.0	80	619.000	4.180.000

Table 7. Cumulative Impacts Analysis Results (Tracy Met Data)

a Source: 40 CFR 52.21

b Background represents the maximum value measured at Tracy Patterson Pass Road, Stockton Hazelton Street, and Modesto 14th Street, 1997-1999. SO<sub>2</sub> Data from Bakersfield, Chester Street and 5558 California Ave Stations, 1997 and 1999.

e Results used OLM to estimate NO2 impacts

d Results used ARM with default ratio of 0.75.

## PUBLIC HEALTH IMPACTS

Public health impacts, including incremental cancer risk, chronic hazard index and acute hazard index were estimated using the methodology described in the AFC. The emergency generator was removed from the analysis and the Tracy meteorological data was used along with the Station 442 data. Copies of the ISCST3 and ACE2588 input and output files are included on the CD. Table 8 summarizes the results of the HRA using Station 442 and Tracy meteorological data.

Metcorological Data	Maximum Cancer Risk	Maximum Chronic THI	Maximum Acute THI
Station 442	3.75 x 10 <sup>-6</sup>	0.0191	0.0739
Тгасу	2.26 x 10 <sup>-6</sup>	0.0135	0.0636
Significance Criteria	10 x 10 <sup>-6</sup>	1.0	1.0
Significance Determination	Insignificant	Insignificant	Insignificant

## Table 8. Estimated Cancer Risk and Acute and Chronic Total Hazard Indices (THIs)

## APPENDIX Modeling File Excerpts

## Project Operation Modeling Files

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 Stack-tip Downwash. 3. Buoyancy-induced Dispersion. 4. Calms Processing Routine. 5. Not Use Missing Data Processing Routine. 6. Default Wind Profile Exponents. 7. Default Vertical Potential Temperature Gradients. Model Accepts Receptors on ELEV Terrain. Model Assumes No FLAGPOLE Receptor Heights. \*\*Model applies the Ozone Limiting Method by source group. \*\*Input ozone concentration file is in units of PPB. Model Calculates | Short Term Average(s) of: and Calculates PERIOD Averages 1-HR \*\*This Run Includes: 5 Source(s): J Source Group(s); and 1200 Receptor(s) The Model Assumes A Pollutant Type of: NO2-OLM \*Model Set To Continue RUNning After the Setup Testing. \*O<sup>1</sup> "It Options Selected: Model Outputs Tables of PERIOD Averages by Receptor Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword) Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword) \*NOTE: The Following Flags May Appear Following CONC Values: c for Cslm Hours m for Missing Hours b for Both Calm and Missing Hours \*\*Misc. Inputs: Anem. Hgt. (m) = 10.00; Decay Coef. = 0.0000 Rot. Angle = 0.0 1 Emission Units = GRAMS/SEC Emission Rate Unit Factor = 0.10000E+07 ÷ Output Units = MTCROGRAMS/M\*\*3 Input Runstream File: T1h99NOa.dta ; \*\*Output Print File: T1h99NOa.io3

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GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 4IH HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 8TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 1ST HIGHEST VALU 2ND HIGHEST VALU	E       IS       0.3°	0828       AT       (       6         0642       AT       (       6         0605       AT       (       6         0505       AT       (       6         0556       AT       (       6         0556       AT       (       6         0556       AT       (       6         0514       AT       (       6         0466       AT       (       6         04454       AT       (       6         0439       AT       (       6         0349       AT       (       6         0803       AT       (       6         0803       AT       (       6	519475.00, 519525.00, 519505.00, 519475.00, 519475.00, 519500.00, 519500.00, 519450.00, 519450.00, 519425.00, 519425.00, 519425.00,	4179250.( 4179250.( 4179250.( 4179275.) 4179275.) 4179275.( 4179275.( 4179275.( 4179275.( 4179275.( 4179250.)] 4179250.]	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 290.90, 286.00, 286.80, 284.80, 289.40, 287.30, 297.40, 289.60, 277.90,	C.CO) C.CO)	TYPE GRID- DC NA DC NA	
GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 5TH HIGHEST VALU 7TH HIGHEST VALU 8TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 1ST HIGHEST VALU 3RD HIGHEST VALU 4TH HIGHEST VALU	E       IS       0.3	0828       AT       (       6         0642       AT       (       6         0655       AT       (       6         0556       AT       (       6         0556       AT       (       6         0556       AT       (       6         0554       AT       (       6         0466       AT       (       6         0453       AT       (       6         0439       AT       (       6         0349       AT       (       6         0803       AT       (       6         05560       AT       (       6         05580       AT       (       6         05572       AT       (       6	519475.00, 519525.00, 519475.00, 519475.00, 519750.00, 519750.00, 51950.00, 519450.00, 519450.00, 519425.00, 519425.00, 519525.00, 519500.00, 519500.00,	4179250.( 4179250.( 4179250.) 4179225.) 4179225.) 4179225.) 4179225.) 4179225.) 4179275.] 4179275.] 4179275.] 4179225.] 4179250.] 4179225.]	00, 20, 20, 20, 20, 20, 20, 20, 20, 20,	289.60, 277.90, 283.00, 286.00, 286.00, 286.80, 284.80, 292.40, 287.30, 297.40, 289.60, 277.90, 283.00, 290.90,	0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00)	TYPE GRID- DC NA DC NA	
GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 4IH HIGHEST VALU 6TH HIGHEST VALU 6TH HIGHEST VALU 8TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 1ST HIGHEST VALU 3RD HIGHEST VALU 3RD HIGHEST VALU 6TH HIGHEST VALU	E       IS       0.3'	0828       AT       (         0642       AT       (         0662       AT       (         0558       AT       (         0466       AT       (         0466       AT       (         04454       AT       (         0349       AT       (         0803       AT       (         05615       AT       (         05500       AT       (         0572       AT       (         0541       AT       (         0486       AT       (	519475.00, 519525.00, 519505.00, 519475.00, 519475.00, 51950.00, 51950.00, 519450.00, 519450.00, 519425.00, 519425.00, 51950.00, 51950.00, 519475.00, 519475.00, 519475.00,	4179250.( 4179250.( 4179250.( 4179250.) 4179255.( 4179275.) 4179225.( 4179225.) 4179225.( 4179275.) 4179275.( 4179250.) 4179250.( 4179250.) 417925.( 4179255.)	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 290.90, 286.00, 284.80, 292.40, 287.30, 297.40, 289.60, 277.90, 283.00, 290.90, 286.80,	(), (0), (0), (0), (0), (0), (0), (0), (	TYPE GRID- DC NA DC NA	
GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 3RD HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 8TH HIGHEST VALU	E       IS       0.3°         E	0828       AT       (         0642       AT       (         0662       AT       (         0556       AT       (         0543       AT       (         0349       AT       (         05580       AT       (         05500       AT       (         05572       AT       (         05572       AT       (         05486       AT       (         04460       AT       (         0440       AT       (	519475.00, 519525.00, 519500.00, 519475.00, 519475.00, 519500.00, 519500.00, 519450.00, 519450.00, 519450.00, 519525.00, 51950.00, 519475.00, 519475.00, 51950.00, 51950.00, 51950.00, 51950.00,	4179250.1 4179225.4 4179225.4 4179225.4 4179275.1 4179275.1 4179275.4 4179275.4 4179205.4 4179275.6 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 290.90, 286.00, 286.80, 284.80, 292.40, 287.30, 297.40, 289.60, 277.90, 283.00, 283.00, 290.90, 284.80, 292.40,	(), (0), (0), (0), (0), (0), (0), (0), (	TYPE GRID- DC NA DC NA	
GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 8TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 3RD HIGHEST VALU 4TH HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU	E       IS       0.3°	0828       AT       (         0642       AT       (         0655       AT       (         0556       AT       (         0544       AT       (         0454       AT       (         0454       AT       (         0549       AT       (         0549       AT       (         0557       AT       (         05500       AT       (         05500       AT       (         05572       AT       (         05541       AT       (         05486       AT       (         0440       AT       (         0440       AT       (         0414       AT       (         0325       AT       (	519475.00, 519525.00, 519475.00, 519475.00, 519750.00, 519750.00, 519450.00, 519450.00, 519450.00, 519450.00, 519475.00, 519475.00, 519475.00, 619500.00, 619500.00, 619400.00, 619425.00,	4179250.1 4179225.4 4179225.4 4179225.4 4179225.4 4179275.1 4179275.4 4179275.4 4179275.4 4179205.4 4179275.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4 4179225.4	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 284.00, 286.00, 286.80, 284.80, 287.30, 287.40, 289.60, 277.90, 283.00, 283.00, 284.80, 284.80, 284.80, 284.80, 287.30,	(), (0), (0), (0), (0), (0), (0), (0), (	TYPE GRID- DC NA DC NA	
GT	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 3RD HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU	E       IS       0.3°         E	0828       AT       (         0642       AT       (         0655       AT       (         0556       AT       (         0543       AT       (         0349       AT       (         0349       AT       (         0550       AT       (         0550       AT       (         05572       AT       (         0550       AT       (         0550       AT       (         0541       AT       (         05429       AT       (         05430       AT       (         05440       AT       (         05429       AT       (         0325       AT       (         00355       AT       (	519475.00, 519525.00, 51950.00, 519475.00, 519750.00, 519750.00, 519750.00, 519450.00, 519450.00, 519450.00, 519475.00, 519500.00, 519475.00, 619500.00, 619500.00, 619450.	4179250.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179225.1         4179275.1         4179275.1         4179275.1         4179275.1         4179275.1         4180650.1         4180650.1	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 290.90, 286.00, 266.80, 284.80, 292.40, 287.30, 297.40, 289.60, 277.90, 283.00, 284.80, 290.90, 286.00, 286.00, 284.80, 292.40, 287.30, 297.40, 144.20,	(), (0), (0), (0), (0), (0), (0), (0), (	TYPE GRID- DC NA DC NA	
GT FW	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 4IH HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 6TH HIGHEST VALU 6TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 1ST HIGHEST VALU 1ST HIGHEST VALU 1ST HIGHEST VALU 1ST HIGHEST VALU 1ST HIGHEST VALU 1ST HIGHEST VALU	E       IS       0.3°         E       IS       0.0°         E       IS       0.0°         E       IS       0.0°         E	0828       AT       6         0642       AT       6         0665       AT       6         0558       AT       6         0558       AT       6         0558       AT       6         0556       AT       6         05514       AT       6         0454       AT       6         0454       AT       6         0454       AT       6         0349       AT       6         05615       AT       6         0560       AT       6         05615       AT       6         05616       AT       6         05500       AT       6         0541       AT       6         05429       AT       6         0440       AT       6         0440       AT       6         00325       AT       6         0055       AT       6         0055       AT       6         0054       AT       6         0054       AT       6         0054       AT       6         0054	519475.00, 519525.00, 519505.00, 519475.00, 519475.00, 51950.00, 51950.00, 519425.00, 519425.00, 519425.00, 519425.00, 519475.00, 519475.00, 519475.00, 519425.00, 519450.00, 51950.00, 51950.00, 51950.00, 51950.00, 51950.00, 51950.00, 519450.00, 5195000.00, 5195000.00, 5195000.00, 5195000.00, 5195000.00	4)79250.1         4)79250.1         4)79250.1         4)79250.1         4)79250.1         4)79255.1         4)79275.1         4)79275.1         4)79275.1         4)79275.1         4)79275.1         4)79275.1         4)79275.1         4)79250.2         4)79275.1         4)79250.1         4)79250.1         4)79255.1         4)79255.1         4)79275.1         4)79275.1         4)79275.1         4)79275.3         4)79275.4         4)79275.4         4)80650.1         4)80650.2         4)80650.2         4)80675.1         4)80675.1	00, 00, 00, 00, 00, 00, 00, 00,	289.60, 277.90, 283.00, 290.90, 286.00, 286.80, 284.80, 297.40, 289.60, 277.90, 289.60, 277.90, 283.00, 296.60, 277.90, 286.80, 284.80, 292.40, 286.80, 284.80, 297.40, 144.20, 144.20, 144.00, 143.40	(c)	TYPE GRID- DC NA DC NA	
JLL GT FW	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 5TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 1ST HIGHEST VALU	E       IS       0.3°         E       IS       0.0°         E       IS       0.0°         E       IS       0.0°         E	0828       AT       (         0642       AT       (         0642       AT       (         0656       AT       (         0556       AT       (         0543       AT       (         0454       AT       (         0454       AT       (         0549       AT       (         0549       AT       (         0550       AT       (         0550       AT       (         0550       AT       (         05541       AT       (         0549       AT       (         0540       AT       (         0440       AT       (         0440       AT       (         0440       AT       (         05325       AT       (         0055       AT       (         0054       AT       (         0053       AT       (         0053	519475.00, 519525.00, 519525.00, 51950.00, 519475.00, 51975.00, 51975.00, 519450.00, 519450.00, 519450.00, 519452.00, 519525.00, 51950.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519450.00,	#179250.1         #179250.1         #179225.1         #179225.1         #179225.1         #179225.1         #179225.1         #179275.1         #179275.1         #179225.2         #179275.1         #179275.1         #179225.2         #179225.3         #179225.4         #179275.4         #180650.4         #180650.4         #180675.1         #180780.1         #180780.1	00, 200, 200, 200, 200, 200, 200, 200,	289.60, 277.90, 283.00, 290.90, 286.00, 266.80, 284.80, 292.40, 287.30, 297.40, 289.60, 277.90, 283.00, 290.90, 285.00, 284.80, 294.90, 284.80, 292.40, 287.30, 297.40, 144.20, 144.20, 144.20, 144.00, 139.40, 141.70	(c)	TYPE GRID- DC NA DC NA	
GT FW	1ST HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 7TH HIGHEST VALU 9TH HIGHEST VALU 10TH HIGHEST VALU 10TH HIGHEST VALU 2ND HIGHEST VALU 3RD HIGHEST VALU 5TH HIGHEST VALU 6TH HIGHEST VALU 6TH HIGHEST VALU 10TH HIGHEST VALU	E       IS       0.3°         E	0828       AT       (         0642       AT       (         0655       AT       (         0556       AT       (         0558       AT       (         0556       AT       (         0556       AT       (         0556       AT       (         0544       AT       (         04539       AT       (         0439       AT       (         05439       AT       (         05439       AT       (         05439       AT       (         05439       AT       (         05580       AT       (         05590       AT       (         05541       AT       (         0446       AT       (         0429       AT       (         0414       AT       (         0055       AT       (         0055       AT       (         0055       AT       (         0053       AT       (         0053       AT       (         0053       AT       (         0053	519475.00, 519525.00, 519525.00, 519500.00, 519475.00, 519475.00, 51950.00, 519450.00, 519425.00, 519425.00, 519425.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519475.00, 519700.00, 519725.00, 519750.00, 51975.00, 519755.00, 519755.00,	+179250.1         +179250.1         +179250.1         +179250.1         +179250.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179250.1         +179275.1         +179250.1         +179250.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +179275.1         +180650.1         +180650.1         +180750.1         +180750.1         +180750.1         +180750.1         +180750.1         +180750.1	00, 00, 00, 00, 00, 00, 00, 00,	289.60, 277.90, 283.00, 290.90, 286.00, 286.80, 284.80, 287.30, 287.30, 287.30, 287.40, 289.60, 277.90, 283.00, 290.90, 286.00, 286.00, 286.00, 286.00, 296.00, 297.40, 287.30, 297.40, 287.30, 297.40, 144.20, 144.20, 144.20, 144.70, 143.40, 139.40, 141.70, 142.40, 139.00.	(c)	TYPE GRID- DC NA DC NA	

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•	י	UTCUEST	VALUE	т¢	0 78710	ат (	626300 00	4176300 00	14ስ እስ	0.003	nc	NA
	ATU	HIGHEST	UNITE	10	0.76954	AΤ (	676350 00	4136300.00,	176 10	0.00)	nc	NA
	415	NICHECT	VALUE	15	0.76954	от (	£26330.00,	4176200.00,	120.10,	0.007	DC	ND.
	516	MIGHEOR	VALUE	13	0.70201	A 4 1	C2C3C3C0 AD	4176200.00,	120.90,	0.00)	DC DC	1176
	010	NIGNEST	VALUE	13	0.74306	A1 (	626300.00,	4176275.00,	133.30,	0.00)	DC	IN H
	7TH	HIGHEST	VALUE	12	0.73946		626325.00,	4176225.00,	120.20,	0.00)		NA
	STH	HIGHEST	VALUE	15	0.72175	AT (	626325.00,	4176200.00,	124.20,	0.00)	DC	NA
	9TH	HIGHEST	VALUE	15	0.71547	AT (	626375.00,	4176250.00,	128.30,	0.00)	DC Da	NA
	10TH	HIGHEST	VALUE	15	0.71330	AT (	626275.00,	4176300.00,	139.60,	0.00)	DC	NA
	1ST	HIGHEST	VALUE	15	0.17681	AT (	621500.00,	4175500.00,	273.60,	0.00)	DC	NA
	2ND	HTGHEST	VALUE	15	0.17459	AT (	621500.00.	4175000.00,	289.60,	0.00)	DC	NA
	3RD	HIGHEST	VALUE	15	0.17156	AT (	621000.00	4175500.00.	337.10.	0.00)	DC	NA
	4TH	HIGHEST	VALUE	IS	0.17085	AT (	621000.00.	4176000.00.	312,40,	0.00)	DC	NA
	STH	HIGHEST	VALUE	15	0.15261	AT (	621500.00.	4174500.00.	294.00.	0.00)	DC	NA
	6ТН	HIGHEST	VALUE	IS	0.14633	AT (	621000.00.	4175000.0D.	373.00.	0.00)	DC	NA
	778	HIGHEST	VALUE	IS	0.14486	AT (	620500.00.	4175000.00.	314.90.	0.00}	DC	NA
	втн	HIGHEST	VALUE	ts	0.14268	AT (	623501.00.	4173000.00.	291.90.	0.00)	DC	NA
	отн	HIGHEST	VALUE	TS .	0.14126	AT (	622500.00.	4174000.00.	287.10.	0.00)	DC	NA
	10TH	HIGHEST	VALUE	IS	0.13894	AT (	624500.00,	4173500.00,	261.00,	0.00)	DC	NA
	1.07	WE GUE CO		70			CO.C.1.7.5	417/005 00	100 70	0.001	D.C.	
•	151	HIGHEST	VALUE	15	0.03210	AT (	626375.00,	41/6225.00,	129.20,	0.00)	DC DC	NA MB
	2ND	HIGHEST	VALUE	15	0.75906	AL L	626350.00,	4176225.00,	147.50,	0.00)	DC	NA ND
	380	HIGHEST	VALUE	18	0.77172	AT (	626300.00,	4176300.00,	140.30,	0.00)	DC	NA
	4TH	HIGHEST	VALUE	15	0.76710	AT (	626350.00,	4175200.00,	126.10,	0,00)	DC	AN
	STH	HIGHEST	VALUE	15	0.75860	AT (	626375.00,	4176200.00,	128,40,	0.001	nc	NA
	6TH	HIGHEST	VALUE	IS	0.73927	AT (	626300.00,	4176275.00,	133.50,	0.00}	DC	AN
	7TH	HIGHEST	VALUE	IS	0.73696	AT (	626325.00,	4176225.00,	126.20,	0.00}	DC	NA
	STH	HIGHEST	VALUE	IS	0.71992	AT (	626325.00,	4176200.00,	124.20,	0.00)	DC	NA
	9 <b>T</b> H	HIGHEST	VALUE	IS	0.71051	AT (	626375.00;	4176250,00,	128.30,	0.00)	DC	NA
	10TH	HIGHEST	VALUE	15	0.70968	AT (	626300.00,	4176250.00,	128.70,	0.00}	DC	NA

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\*\*\* THE SUMMARY OF MAXIMUM PERIOD ( 8760 HRS) RESULTS \*\*\*

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		** CONC OF	PMANN IN M1CROGRAMS/M**3	**
ROUP		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZFLF	NETWORK (G) OF TYPE GRID-ID
w	1ST NIGHEST VALUE I	S 0.00159 AT (	626375.00. 4176025.00. 114.80.	0.00) DC NA
. /-	2ND HIGHEST VALUE 1	S 0.00159 AT (	626362.89. 4176034.50. 114.80.	D.00) DC NA
	3RD HIGHEST VALUE I	S 0.00156 AT (	626380.50, <b>4176019.50</b> , <b>115.10</b> ,	D.00) DC NA
	4TH HIGHEST VALUE 1	S 0.00138 AT (	626375.00, 4176050.00, 114.60,	0.00) DC NA
	5TH HIGHEST VALUE I	S 0.00132 AT (	626400.00, 4176050.00, 114.20,	0.00) DC NA
	6TH HIGHEST VALUE I	S 0.00129 AT (	626400.00, 4176025.00, 113.10,	0.00) DC NA
	7TH HIGHEST VALUE I	S 0.00125 AT (	526475.00, 4176100.00, 122.70,	0.00) DC NA
	8TH HIGHEST VALUE I	5 0.00124 AT (	626398.13, 4176004.75, 114.80,	0.00) DC NA
	9TH HIGHEST VALUE 1	5 0.00124 AT (	626350.00, 4176050.00, 115.20,	0.00) DC NA
	10TH HIGHEST VALUE I	S 0.00122 AT (	626345.31, 4176049.25, 115.40,	0.00) DC NA

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** ISCST3 ** FPL Te *** Model	- VERSION sla Executed (	V 00101 *** on 11/15/01 a	t 12:34:4C	***			***				
BEE-Line	ISCSTJ "BI	EEST" Version	8.10								
J Fil OL Fil Met Fil	e - D:\Bro e - D:\Bro e - D:\Bro	ent\Tesla\Tra ent\Tesla\Tra ent\Tesla\Tra	cyMet_99_S cyMet_99_S cy99.asc	03.DTA 03.LST							
. Numb Number of Number	er of sou: source gre of recept	rces - oups - tors -	5 1 2673								
		L.			POINT SC	URCE DAT	A ***				
SDURCE	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
GT1 , GT2 GT3 GT4 ' FWPUMP	0 D 0 0	0.25330E+00 0.25330E+00 0.25330E+00 D.25330E+00 D.25330E+00 D.15750E-01	625968.8 626011.3 626095.8 626138.3 626217.2	4176031.0 4176031.0 4176031.0 4176031.0 4176031.0 4175917.0	118.9 118.9 118.9 118.9 118.9	60.96 60.96 60.96 60.96 3.00	358.71 358.71 358.71 358.71 622.00	18.86 18.86 18.86 18.86 75.00	5.79 5,79 5.79 5.79 0.13	YES YES YES YES YES	
-				*** SOURC	E IDa OEF:	INING SOU	RCE GROUI	*** 29			
TD TD TD					sour	RCE IDS					
	GT1	. GT2 , G	T3 , G	***	FWPUMP , The summal	RY OF HIG	HEST 3-1	R RESULTS	•••		
			•*	CONC OF S	03 11	MICROGR	AMS/M**3			**	
GROUP ID	IGH 1ST	HIGH VALUE IS	AVERAGE C	ONC () 7943 ON	DATE YYMMDDHH) 99091106:	AT ( 62	RECE:	PTOR (XR, 4176125.	YR, 2ELEV 00, 118	7, ZFLAG) .40,	OF TYPE 0.00) DC
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*** ISCST: *** FPL Te	, esla Executed o	∛ 00101 *** on 11/26/01 a	ac 13:51:50 ***			•••				
BEE-Line	ISCST3 "B	EEST" Version	9,10							
Fi Ol Fi Met Fi	le - D:\Bro le - D:\Bro le - D:\Bro	ent\Tesla\Fir ent\Tesla\Fir ent\Tesla\tra	neGridSnpp\Trac neGridSupp\Trac acy98.asc	:yMetFG_98 :yMetFG_98_	SOANN . DTA SOANN . LST					
Number of Number:	ber of sour source gro r of recept	rces - ' oups - tors -	5 3 6561			,				
				*** PO]	INT SOURCE DA	TA ***				
SOURCE	NUMBER PART. CATS.	EMISSION RAT	TE ) X (METERS) (ME	BAS Y ELI TERS) (MET	SE STACK EV. HEIGHT FERS) (METERS	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
GT1 GT2 GT3 GT4 FWPUMP	0 0 0 0 0	0.25330E+00 0.25330E+00 0.25330E+00 0.25330E+00 0.25330E+00 0.28200E-03	625968.0 4170 626011.3 4170 626095.0 4170 626130.3 4170 626217.2 4170	5031.0       13         5031.0       13         5031.0       13         5031.0       13         5031.0       13         5031.0       13         5031.0       13	18.9 60.96 18.9 60.96 18.9 60.96 18.9 60.96 18.9 60.96 18.9 3.00	358.71 358.71 358.71 358.71 358.72 622.00	18.86 18.86 19.86 19.86 75.00	5.79 5.79 5.79 5.79 0.13	YES YES YES YES YES	
			***	SOURCE 1D	S DEFINING SC	URCE GROU	PS ***			
ROUP ID					SOURCE IDs					
ALL	GT1	, GT2 , (	GT3 ,- GT4	, FWPUI	ЧР,					
GT	GT1	, GT2 , I	GT3 , GT4	,						
- FW	FWPUMP									
										. •
-			**	* THE SUMM	ARY OF MAXIMU	M PERIOD	( 8760 HF	(S) RESULTS	5 ***	
			CON	COF SOANN	IN MICROC	RAMS/M**3	Ļ		* * សធាជាសា	7. PK
GROUP ID		A	VERAGE CONC		RECEPTOR	(XR, YR,	ZELEV, 2FL	LAG) OF 1	TYPE GRID	- ID
	1ST HIGHES 2ND HIGHES 3RD HIGHES 4TH HIGHES 5TH NIGHES 6TH HIGHES 7TH HIGHES 9TH HIGHES 9TH HIGHES	T VALUE IS T VALUE IS	0.04275 A 0.04247 A 0.04229 A 0.04225 A 0.04224 A 0.04224 A 0.04224 A 0.04215 A 0.04209 A 0.04208 A 0.04208 A	F ( 61947) F ( 61947) F ( 61945) F ( 61945) F ( 61947) F ( 61942) F ( 61952) F ( 61945) F ( 61945) F ( 61942)	5.00, 417925 5.00, 417925 0.00, 41792 5.00, 41792 5.00, 417925 5.00, 417927 5.00, 417927 5.00, 417927 5.00, 417930	60.00, 25.00, 75.00, 75.00, 75.00, 75.00, 75.00, 75.00, 85.00, 90.00, 25.00, 90.00,	289.60, 290.90, 292.40, 283.00, 285.00, 297.40, 277.90, 287.30, 284.80, 293.40,	0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00)	DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni	A A A A A A A A A
GT I FW	1ST HIGHES 2ND HIGHES 3RD HIGHES 4TR HIGHES 5TH HIGHES 6TH HIGHES 7TH HIGHES 8TH HIGHES 9TH HIGHES 0TH HIGHES 1ST HIGHES	T VALUE IS T VALUE IS	0.04272 A 0.04245 A 0.04227 A 0.04222 A 0.04221 A 0.04221 A 0.04221 A 0.04212 A 0.04206 A 0.04205 A 0.04203 A	F (       61947)         F (       61945)         F (       61945)         F (       61947)         F (       61947)         F (       61942)         F (       61952)         F (       61952)         F (       61945)         F (       61945)         F (       61942)         F (       61945)         F (       61945)	5.00, 41792; 5.00, 41792; 0.00, 41792; 5.00, 41792; 5.00, 41792; 5.00, 41792; 0.00, 41792; 0.00, 417930; 0.00, 417930; 5.00, 417930; 5.00, 41806;	50.00, 50.00, 75.00,	269.60, 290.90, 292.40, 283.00, 286.00, 297.40, 277.90, 287.30, 284.60, 293.40, 144.20,	0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00] 0.00) 0.00) 0.00)	DC N/ DC N/	A A A A A A A A A A A
	2ND HIGHES 3RD HIGHES 4TH HIGHES STH HIGHES 6TH HIGHES 8TH HIGHES 8TH HIGHES 9TH HIGHES	T VALUE IS T VALUE IS	0.00006 A 0.00006 A 0.00005 A 0.00005 A 0.00005 A 0.00005 A 0.00005 A 0.00005 A	F ( 61972) F ( 61970) F ( 61972) F ( 61972) F ( 61977) F ( 61977) F ( 61977) F ( 61977) F ( 61977)	5.00, 41806 5.00, 41806 5.00, 41806 5.00, 41807 5.00, 41807 5.00, 41807 5.00, 41807 5.00, 41807 5.00, 41807	50.00, 25.00, 25.00, 50.00, 00.00, 50.00, 25.00, 25.00, 25.00, 25.00,	144.20, 144.00, 143.40, 139.40, 141.70, 142.40, 139.00, 143.40, 140.30,	0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00) 0.00] 0.00)	DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni DC Ni	A A A A A A A A A

## Construction Impacts Modeling Files

*** ISCST3 *** FPL Te *** Model	s - VERSIO sla Executed (	N 00101 *** on 11/27/01 a	t 16:25:23	***			***				
BEE-Line	ISCST3 "B	EEST" Version	8.10								
J Fil _Oi Fil / met Fil	e - D:\Br .e - D:\Br .e - D:\Br	ent\Tesla\Con ent\Tesla\Con ent\Tesla\tra	struction\ struction\ cy99.asc	TracyMet\" TracyMet\"	TracyConst TracyConst	x_99_CO.1 x_99_CO.1	DTA LST				
Numb Number of Number	er of sou source gr of recep	rces - oups - tors -	3 1 2673								
).  -				••	* POINT SC	DURCE DAT.	A •**				
SOURCE ID	NUMBER PART . CATS .	EMISSION RAT (GRAMS/SEC)	E (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACX HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
EQ1 EQ2 EQ3	0 0	0.93518E+00 0.93518E+00 0.93618E+00	626093.3 625900.0 6 <b>262</b> 75.0	4176026.0 4175870.0 4175870.0	118.9 118.9 118.9	3.00 3.00 3.00	622.00 622.00 622.00	70.00 70.00 70.00	0.15 0.15 0.15	no No No	
· .		,		••• SOURC	E 1Ds DEF:	INING SOU	RCE GROUI	PS ***			
GROUP ID					SOU	CE IDs					
ALL	EQ1	, EQ2 , E	Q3 ,								
				•••	THE SUMMAI	RY OF HIG	HEST 1-1	HR RESULTS	***		
			**	CONC OF C	:0 II	MICROGR	AMS/M**3			**	
	(IGH 1ST	NIGH VALUE IS	AVERAGE C	CONC ( 2108 ON	DATE YYMMDDHH) 99122708:	AT ( 62	RECE 6675.00,	PTOR (XR, 4176050.	YR, ZELEV 00, 144	7, ZFLAG) 1.60,	OF TYPE
				***	THE SUMMA	RY OF HIG	HEST 8-1	HR RESULTS	***		
<b>E</b>			**	CONC OF C	:o 11	N MICROGR	AMS/M**3			••	
GROUP ID	HIGH 1ST	HIGH VALUE IS	AVERAGE C	CONC ( 30432 ON	DATE YYMMDDHH) 97121708:	AT ( 62	RECE:	PTOR (XR, 4176150.	YR, ZELEV 00, 142	7, 2FLAG) 2.40,	OF TYPE 0.00) DC
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** ISCST3 - *** FPL Tesl *** Model Ex	VERSION	00101 *** on 11/27/01 at	t 16:39:39 ·	* * *			***							
BEE-Line IS	SCST3 "BE	EST" Version	8.10											
J File Qu File Met File	- D:\Bre - D:\Bre - D:\Bre	ent\Tesla\Cons ent\Tesla\Cons ent\Tesla\tra	struction\Tr struction\Tr cy98.asc	racyMet\T racyMet\T	racyConst: racyConst:	r_98_PM24 r_98_PM24	A.LST							
Number Number of so Number o	r of aour purce gro of recept	cces - oups - tors -	4 1 2673											
				***	FOINT SO	URCE DAT	Ą ***							
SOURCE ID	NUMBER PART CATS	EMISSION RAT (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HBIGHT (METERS)	STACK TEMP, (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY			
EQ1 EQ2 EQ3	<b>D</b> O O	0.31500E-01 0.31500E-01 0.31500E-01 0.31500E-01	626093.3 4 625900.0 4 626275.0 4	176026.0 175870.0 175870.0	118.9 118.9 118.9	3.00 3.00 3.00	622.00 622.00 622.00	70.00 70.00 70.00	0.15 0.15 0.15	00 NO NO				
				*** A	REAPOLY S	OURCE DA	TA ***							
SOURCE ID	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC /METER**2)	E LOCATIO X (METERS)	N OF AREA Y (METERS)	BASE ELEV. (METERS)	RELEASI HEIGHT (METERS)	E NUMBER OF VER:	R INI IS. SZ (METE	T. EMISS SCAL RS)	SION RATE LAR VARY BY				
DUST	o	0.19917E-05	625825.0 4	175820.0	118.9	1.50	В	Ο.	00					
1				** SOURCE	IDs DEFI	NING SOU	RCE GROUI	PS ***						
SROUP ID					SOUR	CE IDS								
P I	DUST	, EQ1 , E	QZ , EQ	з.						·				
				*** T	HE SUMMAR	Y OF HIG	HEST 24-1	R RESULTS	***					
Ì			•• C	ONC OF PM	124 IN	MICROGE	AM\$/M**3			* *				
ROUP ID	<b>.</b>		AVERAGE CO	йС (Y	DATE (YMMDDHH)		RECE	PTOR (XR,	YR, ZELEY	V, ZFLAG)	OF TYPE			
ATT HIC	GH 1ST	HIGH VALUE IS	68.88	816 ON 9	8011424 :	AT ( 62	5927.19,	4176119.	50, 12	D.90,	0.00) DC			
t ·														
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	•*• ISC •*• FPL *** Mod	ST3 - Tesla lel Exe	VERSION a scuted of	N 00101 *** on 11/27/01 a	t 16:27:39				***					
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			וסוי נידסי	PPETH Vernion	B 10									
- /	BEE-DI	File ·	- D:\Br	ent\Tesla\Con	struction\	TracyMet\]	TracyConst	r 98 SO2	DTA					
ł	p : met	File File	D:\Br D:\Br	ent\Tesla\Con ent\Tesla\tra	struction\ cy90.asc	TracyMet \1	TracyConst	r_98_502	LST					
	Number Number Num	of sounder of sounder of	or sou. Arce gro f recep	rces - pups - tors -	3 1 2673									
						* * 1	POINT SC	OURCE DAT	A ***			·		
ļ	sour II	RCE	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP, (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION SCALAR BY	RAT VARY
	, EQ1 EQ2 EQ3		0 0 0	0.19316E+00 0.19316E+00 0.19316E+00	626093.3 625900.0 626275.0	4176026.0 4175870.0 4175870.0	118.9 118.9 118.9	3.00 3.00 3.00	622.00 622:00 622.00	70.00 70.00 70.00	0.1S 0.15 0.15	NO NO NO	·	
Í	,					*** SOURCE	E IDs DEFI	INING SOU	RCE GROUI	PS ***				
	GROUP 1	ID					SOUP	RCE IDS						
	ALL	Ē	01	, е <b>0</b> 2 , е	, íog ,									
ĺ						***	THE SUMMAR	ч ч ог ніс	HEST 1-1	HR RESULTS	; ***			
•	<b>.</b>				**	CONC OF S	02 11	N MICROGR	ams'/m++3			**		
	, 31 ]	ID			AVERAGE (	CONC (	DATE YYMMDDHH)		RECE	PTOR (XR,	YR, ZELET	V, ZFLAG)	OF TY	PE
	ALL	HIG	H 15T	HIGH VALUE IS	117.0	87433 ON 1	98103107:	AT ( 62	6675.00,	4176050,	00, 14	4.60,	0.00) D	
	l,					*** '	THE SUMMAN	RY OF HIG	HEST 3-1	HR RESULTS	; ***			
Í	1				**	CONC OF S	02 11	N MICROGE	LAMS/M**3			**		
1	GROUP 1	ID			AVERAGE (	CONC (	DATE YYMMODHH)		RECE	PTOR (XR,	YR, ZELE	V, ZFLAG)	OF TY	PE
ſ	LL	HIG	н <b>1</b> ST	HIGH VALUE 15	81.0	01842 ON	99010403;	AT ( 62	6300.00,	4176300.	00, 14	0.30,	0.00) 0	 c
						*** '	THE SUMMAN	RY OF HIC	HEST 24-	HR RESULTS	5 ***			
	l I				**	CONC OF S	02 11	N MICROGE	UAM5/M**3			* *		·
	SROUP	ID			AVERAGE	CONC (1	DATE YYMMDDHH)	_	RECE	PTOR (XR,	YR, ZELE	V, ZFLAG)	OF TY	PE
	ιLL	HIG	H 1ST	HIGH VALUE IS	32.9	98062c ON	98111024:	AT ( 62	5675.00,	4176025.	00, 13	8.50,	0.00) D	)C
1	Ì													

# Construction 1-Hour NO<sub>2</sub> 1<sup>st</sup> Order Decay

#### FIRST ORDER DECAY METHODOLOGY

Ambient NO<sub>2</sub> impacts from construction activities were remodeled using a methodology that accounts for the reaction time required for NO to be converted to NO<sub>2</sub> in the atmosphere. Results of the updated modeling indicate a maximum hourly NO<sub>2</sub> impact of 124  $\mu$ g/m<sup>3</sup>. When added to the background of 199  $\mu$ g/m<sup>3</sup>, the total impact is 323  $\mu$ g/m<sup>3</sup>, which is below the AAQS of 470  $\mu$ g/m<sup>3</sup>. No violation is predicted. The methodology used to estimate the NO<sub>2</sub> concentrations is described below. Excerpts of the construction ISCST3 modeling files are attached.

 $NO_2$  impacts were estimated based on the assumption that the actual  $NO_2$  emission rates are 10% of the total  $NO_x$  emitted. The  $NO_2/NO_x$  ratio of 10% is a conservative assumption for the actual ratio of  $NO_2$  to total  $NO_x$  emissious for internal combustion engines (Flagan, 1988). In addition, it was assumed that the NO emitted from the construction activities would not have sufficient time to be converted to  $NO_2$  near the facility boundarics where the maximum impacts occur. Transport times to the areas of maximum construction impacts are on the order of 5 to 6 minutes, while the half-life of NO in the atmosphere is estimated to be 5 days (Williamson, 1973). Assuming a firstorder exponential decay, the portion of the directly emitted NO that converts from NO to  $NO_2$  in 5 minutes can be estimated as follows:

Conversion equation:  $NO/NO_o = exp(-kt)$   $NO/NO_o = ratio of NO remaining to original NO concentration, <math>NO_o$ k, rate constant =  $9.63 \times 10^{-5} \text{ min}^{-1}$ t, reaction time = 5 minutes  $NO/NO_o = exp(-9.63 \times 10^{-5} \text{ min}^{-1} * 5 \text{ minutes}) = 0.9995$ Amount of NO converted to  $NO_2 = 1 - NO/NO_o = 1 - 0.9995 = 0.0005$ 

Impacts from the initial modeling results were multiplied by 0.1 to account for the  $NO_2$  fraction (10%) that is directly emitted. The fraction of the directly emitted NO (90%) that is estimated to convert to  $NO_2$  in the short travel time (5 min) to the point of maximum impact was then multiplied by the conversion fraction estimated above and added to the directly emitted  $NO_2$  contribution. The table below shows the NO2 concentration at different distances from the construction area.

Receptor UTM X	Location UTM Y	ISCST3 NO <sub>x</sub> Conc. (μg/m <sup>3</sup> )	Distance from Source (m)	Transit Time (min.)	NO2/NO Ratio	Adjusted NO <sub>2</sub> Conc. (μg/m <sup>3</sup> )
626,675	4,176,050	1230.5	585	9.76	9.39E-04	124.09
625,300	4,175,800	860.3	812	13.54	1.30E-03	87.04
625,100	4,175,800	660.6	1,010	16.83	1.62E-03	67.03
624,600	4,176,000	460.9	1,501	25.02	2.41E-03	47.09
627,600	4,175,400	206.9	1,594	26.57	2.56E-03	21.17

*** ISCST3 - VERSION 00101 *** *** FPL Tesla	***													
BEE-Line ISCST3 "BEEST" Version 7.10														
Input File - E:\FPLEnergy\TESLA\Construction\UpdatedNO2\TRAC99NO.DTA Outmut File - E:\FPLEnergy\TESLA\Construction\UpdatedNO2\TRAC99NO.LST - File - E:\FPLEnergy\TESLA\MetData\tracy99.asc														
Number of sources - 3 Jumber of source groups - 1 Number of receptors - 2673														
*** POINT SOURCE DATA ***														
NUMBER EMISSION RATE BASE STACK STACK STACK STACK BUI SOURCE PART, (GRAMS/SEC) X Y ELEV. HÉIGHT TEMP. EXIT VEL. DIAMETER EX ID CATS. (METERS) (METERS) (METERS) (DEG.K) (M/SEC) (METERS)	LDING EMISSION RAT ISTS SCALAR VARY BY													
EQ100.20160E+01626093.34176026.0118.93.00622.0070.000.15EQ200.20160E+01625900.04175870.0118.93.00622.0070.000.15EQ300.20160E+01626275.04175870.0118.93.00622.0070.000.15	NO NO NO													
*** SOURCE IDA DEFINING SOURCE GROUPS ***														
ROUP ID SOURCE IDS														
ALL EQ1 , EQ2 , EQ3 ,														
*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***														
** CONC OF NO21H IN MICROGRAMS/M**3	••													
DATE PROUP ID AVERAGE CONC (YYMMDDHH) RECEPTOR (XR, YR, ZELEV, 28	FLAG) OF TYPE													
HIGH 1ST HIGH VALUE IS 1230.51648 ON 99122708: AT ( 626675.00, 4176050.00, 144.60,	0.00) DC													

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Commissioning Modeling Files

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BEE-Line	ISCST3 "B	EEST" Version	8.10								
Fil C : Fil ret Fil	le - D:\Br le - D:\Br le - D:\Br	ent\Tesla\Com ent\Tesla\Com ent\Tesla\tra	missioning\7 missioning\7 cy98.asc	TracyMet\ TracyMet\	TracyComm TracyComm	n_98_CO1. n_98_CO1.	DTA LST				
Number of Number	per of sou source gr f of recep	rces - oups - tors -	4 2 2673			-					
				***	POINT SC	DURCE DAT	'A ***				
SOURCE ID	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC)	e X (Meters)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RA SCALAR VAR BY
GT1 GT2 GT3 GT4	0 0 0 0	0.12020E+02 0.12020E+02 0.12020E+02 0.12020E+02	625968.8 4 626011.3 4 626095.8 4 626138.3 4	176031.0 176031.0 176031.0 176031.0	118.9 118.9 118.9 118.9 118.9	60,96 60,96 60,96 60,96	350.37 350.37 350.37 350.37 350.37	10.56 10.56 10.56 10.56	5.79 S.79 5.79 5.79	YES YES YES YES	
				** SOURCI	E IDS DEF:	INING SOU	IRCE GROU	PS ***			·
GROUP ID					SOU	RCE IDs					
ALL	GT1	, G <b>T</b> 2 , G	<b>T3 ,</b> GT	4,							
GT	GT1	, GT2 , G	<b>TJ , GT</b>	4,							
■'				***	THE SUMMA	RY OF HIG	HEST 1-	HR RESULTS	; ***		
			•• c	ONC OF C	<b>D</b> 1 II	N MICROGE	VAM5/M++3			**	
ROUP ID			AVERAGE CO	NC (	DATE YYMMDDHH)		RECE	PTOR (XR,	YR, ZELEV	/, ZFLAG)	OF TYPE
LL GT	HIGH 1ST HIGH 1ST	NIGH VALUE IS HIGH VALUE IS	336.83 136.83	850 ON 850 DN	98081306: 98081306:	AT ( 62 AT ( 62	24500.00, 24500.00,	4173500 4173500	00, 26 00, 26	1.00, 1.00,	0.00) DC 0.00) DC

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ISC3 OLM - VERSION 96113 \*\*\* \*\*\* FPL Tesla \*\*\* Commissioning 1 P RURAL ELEV MODELOPTS: CONC GRDRTS \*\*\* MODEL SETUP OPTIONS SUMMARY \_ \_ \_ \_ \_ . . . . . rmediate Terrain Processing is Selected Model Is Setup For Calculation of Average CONCentration Values. SCAVENGING/DEPOSITION LOGIC --\*Model Uses NO DRY DEPLETION. DDPLETE = Model Uses NO WET DEPLETION. WDPLETE = F NO WET SCAVENGING Data Provided. Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations \*\*Model Uses RURAL Dispersion. Model Uses User-Specified Options: 1. Gradual Plume Rise. 2. Stack-tip Downwash. 3. Buoyancy-induced Dispersion. 4. Calms Processing Routine. 5. Not Use Missing Data Processing Routine. 6. Default Wind Profile Exponents. 7. Default Vertical Potential Temperature Gradients. 'Model Accepts Receptors on ELEV Terrain. Model Assumes No FLAGPOLE Receptor Heights. \*Model applies the Ozone Limiting Method by source group. \*\*Input ozone concentration file is in units of PPB. Model Calculates 1 Short Term Average(s) of: and Calculates PERIOD Averages 1-HR 1 Source Group(s); and 1200 Receptor(s) \*\*This Run Includes: 4 Source(s); The Model Assumes A Pollutant Type of: NO2-OLM Model Set To Continue RUNning After the Setup Testing. \*Output Options Selected: Model Outputs Tables of PERIOD Averages by Receptor Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword) Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword) \*\*NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours m for Missing Hours b for Both Calm and Missing Hours Anem. Hgt. (m) = 10.00 ; Smission Units = GRAMS/SEC \*\*Misc. Inputs: 10.00 ; Decay Coef, = 0,0000 ł Rot. Angle = 0.0 Emission Rate Unit Factor = 0.10000E+07 2 Output Units = MICROGRAMS/M\*\*3 Input Runstream File: T97NOb.dta ; \*\*Output Print File: T97NOb.io3

** 1SC3_0L	4 - VERSION 96113 ***	*** FPL Tes *** Commissio	ala Ding			*** ***	1
MODELOPTS :	CONC	RURAL	ELEV	GRDRIS F HIGHEST 1-HR RESULTS ***			Þ
NOUN ID		** CONC C	DF NO2-OLM IN MI DATE (YYMMDDHH)	CROGRAMS/M**3 RECEPTOR (XR, YR,	ZELEV, ZFLAG)	OF TYPE	N G
L HIGH	H 1ST HIGH VALUE IS	159.62077	ON 97092318: AT	( 627500.00, 4171500.00,	265.70, 0	1.00) DC	
*** RECEPTOR	R TYPES: GC = GRIDCA GP = GRIDPO DC = DISCCA DP = DISCPO BD = BOUNDA	RT LR RT LR RY					

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Cumulative Impacts Modeling Files

*** ISCSTJ *** FPL Tes *** Model E BEE-Line I File L File Met File Number of s Number	- VERSION bla Executed of SCST3 "BE - D:\Bre - D:\Bre - D:\Bre - D:\Bre of source gro of recept	D 00101 *** on 11/27/01 a DEST" Version Ent\Tesla\Cum ent\Tesla\Cum ent\Tesla\tra- coups - oups - ors -	t 18:08:17 8.10 ulative\Supp ulative\Supp cy98.asc 8 4 2673	<pre>&gt;&gt;+++ plement\C plement\C</pre>	Tumulative Tumulative	T_98_CO1 T_98_CO1	DTA LST								
	*** POINT SOURCE DATA ***														
*** POINT SOURCE DATA ***															
NUMBER EMISSION RATE     BASE     STACK     STACK     STACK     STACK     STACK     BUILDING EMISSION RAT       SOURCE     PART. (GRAMS/SEC)     X     Y     ELEV.     HEIGHT     TEMP.     EXIT VEL.     DIAMETER     EXISTS     SCALAR VARY       ID     CATS.     (METERS)     (METERS)     (METERS)     (DEG.K)     (M/SEC)     (METERS)     By															
GT1 GT2 GT3 GT4 FWPUMP UNKGT EALTGT EALTBLR	GT1       0       0.83540E+02       625968.8       4176031.0       118.9       60.96       350.37       10.56       5.79       YES         GT2       0       0.83540E+02       626011.3       4176031.0       118.9       60.96       350.37       10.56       5.79       YES         GT3       0       0.36060E+01       626095.8       4176031.0       118.9       60.96       358.71       18.86       5.79       YES         GT4       0       0.36060E+01       626138.3       4176031.0       118.9       60.96       358.71       18.86       5.79       YES         FWUMP       0       0.1040E+00       626217.2       4176031.0       118.9       3.00       622.00       75.00       0.13       YES         UNKGT       0       0.12708E+02       633100.0       4174603.0       54.0       30.48       727.59       36.58       5.18       NO         EALTGT       0       0.63D00E+00       625550.0       4184800.0       15.0       53.34       334.26       16.86       5.64       NO         EALTBLR       0       0.63D00E+00       625550.0       4184800.0       15.0       30.48       435.93       5.22       2.16       NO														
GROUP ID			•	** SOURCE	E IDS DEFI SOUR	NING SOUI	RCE GROUI	PS ***							
ALL	gtı,	, GT2 , G	T3 , GT	4,1	FWPUMP ,	UNKGT	, EALTGT	, EALTBL	R,						
TESLA	GTI .	, GT2 . G	τι , GT	4 , 1	FWPUMP ,										
U. JWN	UNKGT ,	,				1									
EASTALTM	EALTGT ,	, EALTBLR ,													
-				*** '	THE SUMMAR	RY OF HIG	HEST 1-1	HR RESULTS	•••						
			** C	ONC OF C	01 IN	I MICROGR	AMS/M++3								
					DATE										
LL H TESLA H UNKNOWN H ASTALTM H	IGH 1ST H IGH 1ST H IGH 1ST H IGH 1ST H	HIGH VALUE IS HIGH VALUE IS HIGH VALUE IS HIGH VALUE IS	AVERAGE CO 1220.40 1220.40 49.47 85.57	NC ( 149 ON ( 149 ON ( 533 ON ( 453 ON (	YYMMDDHH) 98081306: 98081306: 98040104: 98090502:	AT ( 62 AT ( 62 AT ( 63 AT ( 63	RECE 4500.00, 4500.00, 1500.00, 1000.00,	PTOR (XR, 4173500. 4173500. 4171500. 4191000.	YR, 2ELEV 00, 261 00, 261 00, 270 00, 168	7, 2FLAG) 00, 00, 0.70, 0.20,	OF TYPE 0.00) DC 0.00) DC 0.00) DC 0.00) DC 0.00) DC				
-															

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           .
*BEE-Line Software: BEEST for Windows data input file
Date: 0/15/01 Time: 11:35:01 AM
* *
NO ECHO
 *** Message Summary For ISC3 Model Setup ***
      ---- Summary of Total Messages ------
  Total of
Total of
                      0 Fatal Error Message(s)
                     1 Warning Message(s)
0 Informational Message(s)
A Total of
   ******** FATAL ERROR MESSAGES ********
*** NONE ***
   ******** WARNING MESSAGES
 0 W320 75 PPARM :Source Parameter May Be Out-of-Range for Parameter VS
   *****
*** SETUP Finishes Successfully ***
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RURAL ELEV

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#### \*\*\* POINT SOURCE DATA \*\*\*

GRDRIS

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SOURCE	NUMBER PART CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
<b>.</b>	•										
GT1	0	0.18900E+02	625968.8	4176031.0	118.9	60.96	358.71	16.81	5.79	YES	
GT2	0	0,1890DE+02	626011,4	4176031.0	118.9	60.96	358.71	16.81	5.79	YEŞ	
GT3	0	0.19744E+01	626095.8	4176031.0	118.9	60.96	358.71	16.B1	5.79	YES	
GT4	0	0.19744E+01	626138.3	4176031.0	116.9	60.96	358.71	16.81	5.79	YES	
FWPUMP	0	0,46683E+00	626217.2	4175917.0	118.9	3.00	622.00	. 75.00	0.13	YES	
UNKGT	C	Q.43445E+01	633100.0	4174603.0	54.0	30.48	727.59	36.58	5.18	NO	
EALTGT	0	0.75058E+01	625550.0	4184800.0	15.0	53.34	334.26	16,86	5.64	NO	
EALTBLR	D	0.18900E+00	625550.0	4184800.0	15.0	30.48	435.93	5.22	2.16	NO	

*** ISCST3 *** FPL Te *** Model	- VERSION sla Executed o	00101 *** n 11/27/01	at 19:08:46	***			•••				
' BEE-Line	ISCSTJ "BE	EST" Versic	m 8.10								
I Fil	e - D:\Bre	nt\Tesla\Cu	mulative\5up	plement\	Cumulative	T_98_NOAL	NN.DTA				
Outs i Filo Met Filo	e - D:\Bre e - D:\Bre	nt\Tesla\Cu nt\Tesla\tr	mulative\Sup acy98.asc	plement\(	Cumulative	T_98_NOA1	NN.LST				
Number of Number	er of sour source gro of recept	ces - oups - ors -	8 4 2673								
<b>I</b>											
<b>—</b> ,				• •	• POINT SC	URCE DAT	A ***				
SOURCE	NUMBER PART. CATS.	EMISSION RA (GRAMS/SEC	ATE 2) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. I (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
GT1 GT2	0	0.17970E+01	625968.8 (	176031.0	118.9	60.96 60.96	358.71 358.71	17.57	5.79	YES	
GT3 GT4	ů o	0.17970E+01 0.17970E+01	626095.8 4	176031.0 176031.0	118.9 118.9	60.96 60.96	358.71	17.57	5,79	YES	
FWPUMP UNKGT	Ŭ Q	0.27700E-02 0.43445E+02	626217.2 ( 633100.0 4	175917.0 174603.0	110.9	3.00	622.00 727.59	75.00 36.58	0.13	YES	
EALTOT EALTBLR	0 0	0,75058E+01 0,18900E+00	625550.0 ( 625550.0 (	1184800.0 1184800.0	15.0 15.0	53,34 30,48	334.26 435.93	16.86 5.22	5.64 2.16	NO NO	
			,	*** SOURC	E IDs DEFI	IN1NG SOU	RCE GROU	PS ***			
GROUP ID					SOUR	CE 1Ds					
	0.773	<b>CT2</b>				1. NIVOT					
	G11 ,	012 ,	G13 , G		EWPORP ,	UNKGI	, ERLIGI	, <i>CA</i> LIBUR	,		
ТЕСТА	GT1 ,	GT2 ,	GT3 , G'	Γ4 ,	FWPUMP ,						
UN1240WN	UNKGT ,										
EASTALTM	BALTGT ,	EALTBLR ,									
■.											
				THE	SUMMARY OF	<pre>MAXIMUM</pre>	PERIOD	( 8760 HRS	) RESULT	5 ***	
			** (	CONC OF N	DANN II	N MICROGR	AMS/M**3			**	
TROUP 1D			AVERAGE CONC	<b></b>	RE	CEPTOR (	XR, YR,	ZELEV, ZFLA	G) OF	NETWO TYPE GRID-	
ALL 1	ST HIGHEST	VALUE IS	0.3763	8 AT ( 6	19000.00,	4180000	.00,	292.60,	0.00)	DC NA	
<b>2</b> <b>3</b>	ND HIGHEST	VALUE TS	0.3523. 0.3397	5 AT ( 6 3 AT ( 6	20500.00, 20500.00.	4180500 4178500	.00, .00.	241.70, 243.70,	0.00) 0,00)	DC NA	L L
4	TH HIGHEST	VALUE 1S	0.3292	9 AT ( 6	18000.00,	4181000	.00,	294.20,	0.00)	DC NA	k.
6	TH HIGHEST	VALUE IS	0,3181	0 AT ( 6	18000.00,	4180000	.00,	276.10,	0.00)	DC NA	L L
- 8	TH HIGHEST	T VALUE IS	0,3163: 0.2923:	9 AT ( 6 9 AT ( 6	29000.00, 20000.00.	4186000	.00,	0.00, 232.80.	0.00) 0.00)	DC NA DC NA	L L
9 10	TH HIGHEST	r VALUE IS r VALUE 1S	0.2912	8 AT ( 6 1 AT ( 6	20000.00, 30000.00,	4177000 4172500	.00, .00,	300.60, 246.50,	0.00) D.00)	DC NA DC NA	- 1 1
TESLA 1	ST HIGHEST	VALUE 15	0.2791	6 AT ( 6	19000.00,	4180000	.00,	292.60, 243.70	0.00)	DC NA	L.
	RD HIGHEST	VALUE IS	0.2423	4 AT ( 6	20500.00,	4180500	.00,	241.70,	0.00)	DC NA	• L
4 5	TH HIGHEST	VALUE IS	0.2397 0.2349	7 AT ( 6 0 AT ( 6	18000.00, 18000.00	4181000	.00,	294.20, 276.10.	0.00) 0.00)	DC NA DC NA	L.
6	TH HIGHEST	VALUE IS	0.2178	5 AT ( 6	20000.00,	4177000	.00,	300.60,	0.00)	DC NA	-
B 8	TH HIGHEST	VALUE IS	0.2075	9 AT ( 6 1 AT ( 6	20000.00, 30000.00,	4179000 4172000	.00, .00,	232.80, 264.80,	0.00) 0.00)	DC NA DC NA	L L
9	TH HTGHEST	VALUE IS	0,1985	4 AT ( 6	30000.00,	4172500	. 00,	246.50,	0.00)	DC NZ	L
		WALUE IS		- AI ( 6	ADDUU.00,	4180000	.00,	220.60,	0.00)	DC NA	L
	ND HIGHEST	VALUE IS	D,0651	0 AT ( 6 B AT ( 6	∠0500.00, 19000.00,	4180500 4180000	.00, .00,	241.70, 292.60,	0.00) 0.00)	DC NA DC NA	L L
3	RD HIGHEST	VALUE IS	0.0598	ВАТ ( 6 3 ат ( 4	18000.00,	4181000	.00,	294.20,	0.00)	DC NA	L .
5	TH HIGHEST	VALUE IS	0.0582	IAT ( 6	20000.00,	4182000	.00,	224.40,	0.00)	DC NA	4

\*\* ISCST3 - VERSION 00101 \*\*\* \*\*\* FPL Tesla \*\*\* Model Executed on 11/27/01 at 19:14:27 \*\*\*

BEE-Line ISCST3 "BEEST" Version 8.10

File - D:\Brent\Tesla\Cumulative\Supplement\CumulativeT\_97\_PM24.DTA
Qut\_\_\_ File - D:\Brent\Tesla\Cumulative\Supplement\CumulativeT\_97\_PM24.LST
Met File - D:\Brent\Tesla\tracy97.asc

- Number of sources - 31 Number of source groups - 4 Number of receptors - 2673

\*\*\* POINT SOURCE DATA \*\*\*

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	SOURCE ID	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
•		-										
	GT1	0	0.15930E+01	625968.0	4176031.D	118.9	60.96	358.71	16.81	5.79	YES	
	GT2	0	0.15930E+01	626011.3	4176031.D	118.9	60.96	358.71	16.81	5.79	YES	
	GT 3	0	0.15930E+01	626095.8	4176031.0	118.9	60.96	358.71	16.61	5.79	YES	
	GT4	1	0.15930E+01	626138.3	4176031.0	118.9	60,96	358.71	16.61	5.79	YES	•
•	CT1	0	0.79758E-02	625945.0	4176094.0	119.9	16,92	307.04	6.51	9.14	YES	
	CT2	٥	0.79758E-02	625959.0	4176094.0	118.9	16,92	307.04	6.51	9.14	YES	
	CT3	0	0.79758E-02	625973.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT4	0	0.79758E-02	625987.0	4176094.0	118,9	16.92	307.04	6.51	9.14	YES	
	CT5	0	0.79758E-02	626001.D	4176094.0	118. <b>9</b>	16.92	307,04	6.51	9.14	YES	
•	CT6	0	0.79758E-02	626015.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT7	0	0.79758E-02	626029.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CTS	0	0.79758E-02	626043.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
<u> </u>	CT9	0	0.79758E-02	626057.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT10	a	0.79758 <b>E-0</b> 2	626071.0	4176094.0	118.9	16.92	307.04	5.51	9.14	YES	
<b>.</b>	CT11	0	0.79758E-02	626085.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT12	0	0.79758E-02	626103.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT13	0	0.79758E-02	626117.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
-	CT14	0	0.79758E-02	626131.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT15	0	0.79758E- <b>0</b> 2	626145.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
<b>.</b>	CTIS	0	0.79758E-02	626159.0	4175094.0	118.9	16.92	307.04	6.51	9.14	YES	
		0	0.7975BE-02	626173.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
		0	0.7975BE-02	626187.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
;	CL19	0	0.79758E-02	626201.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT20	0	0.79758E-02	626215.0	4176094.0	319.9	16.92	307.04	6.51	9.14	YES	
-	CT21	Q	0.79758E-02	626229.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
	CT22	0	0.7975BE-02	626243.0	4176054.0	118.9	16.92	307.04	6.51	9.14	YES	
	FWPUMP	٥	0.34120E-03	626217.2	4175917.0	118.9	3.00	622.00	75.00	0.13	YES	
	UNKGT	D	0.24066E+01	633100.0	4174603.0	54.0	30.49	727.59	36.59	S.18	ND	
	EALTGI	0	0.57708E+01	625550.0	4184900.0	15.0	53.34	334.26	16.86	5.64	Ю	
_	EALTBLR	O	0.33390E+00	625550.0	4184800.0	15.0	30.48	435.93	5.22	2.16	NO	
	EALTCT	Q	0.30240E+00	625550.0	4184800.0	1S.O	13.72	294.26	10.00	10.27	ои	

#### \*\*\* SOURCE IDs DEFINING SOURCE GROUPS \*\*\*

ROUP ID									S	cu	RCE IDs										
ALL	GT1	1	GT2		GT3	,	GT4	,	CT1	,	CT2		CT3	,	CT4	,	C <b>T</b> 5	. •	CT6	, (	CT 7
	СТЭ		CT10	,	СТ11	,	CT12		C <b>T</b> 13	,	CT14	,	CT15	,	CT16	,	CT17	. (	СТ18	, (	CT19
<b>•••</b>	CT 21	ï	CT22		FWPUMP	ŕ	UNKGT	,	EALTGT	,	EALTBLR	,	EALTCT								
TESLA	GT1		GT2	,	GT3	,	GT4	•	CT1	,	CT2	,	CT3	,	CT4	,	CT5	, •	стб ,	, ( ,	CT7
1	CT21	,	CT22	,	FWPUMP	,		,	C113	,	C114	,	0113	,	0116	,	(11)	, ,		ſ	_119
UNKNOWN	UNKGT	,																			
EASTALTM	EALTGT	,	EALTBLR	,	EALTCT																

\*\*\* ISCST3 - VERSION 00101 \*\*\* \*\*\* FPL Tesla \*\*\* Model Executed on 11/27/01 at 18:23:29 \*\*\*

BEE-Line ISCST3 "BEEST" Version 8.10

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J File - D:\Brent\Tesla\Cumulative\Supplement\CumulativeT\_97\_PMANN.DTA Output File - D:\Brent\Tesla\Cumulative\Supplement\CumulativeT\_97\_PMANN.LST Met File - D:\Brent\Tesla\tracy97.asc

Number of sources - 31
 Number of source groups - 4
 Number of receptors - 2673

\*\*\* POINT SOURCE DATA \*\*\*

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SOURCE ID	NUMBER PART. CATS.	EMISSION RAT (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK Exit Vel. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
						·					
CT1	•	D 176508+01	675968 8	4176031 0	118 9	60.96	158 71	17 57	5 79	VEC	
GTI	n	0.13660E+01	626011 3	4176031 0	118.9	60.96	358 71	17.57	5 7 9	YES	
GTI	ő	0 13660E+01	626095 B	4176031.0	118 9	60.96	358.71	17 57	5.79	YES	
GT4	Ô	0.13660E+01	626138 3	4176031.0	118 9	60 96	358.71	17 57	5.79	YES	
CT)	0	0.79758E-02	625945.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT2	õ	0.79758E-02	675959 0	4176094.0	118 9	16.92	307.04	6.51	9.14	YES	
CT3	ă	0.79758E-02	625973.0	4176094.0	118 9	16.92	307 04	6.51	9 14	YES	
CT4	ă	0.79758E-02	625987.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	1
CT5	ā	0.79758E-02	626001.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT6	0	0.79758E-02	626015.0	4176094.0	118.9	16.92	307.04	6.51	9,14	YES	
CT7	ō	0.79758E-02	626029.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
СТЯ	Ō	0.79758E-02	626043.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT9	0	0.79758E-02	626057.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT10	0	0.79758E-02	626071.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT11	0	0.79758E-02	626085.0	4176094.0	118.9	16.92	307.04	6.51	9,14	YES	
CT12	Ō	0.79758E-02	626103.0	4176094.D	118.9	16.92	307.04	6.51	9.14	YES	
CT13	0	0.79758E-D2	626117.0	4176094.0	118.9	16.92	307.04	6.51	- 9.14	YES	
CT14	0	0.79758E-02	626131.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT15	0	0.797588-02	626145.0	4176094.0	118.9	16.92	307.04	6.51	5.14	YES	
6 17	0	0.79758E-02	626159.0	4176094.0	118.9	16.92	307,04	· 6.51	9.14	YES	
	0	0.79758E-02	626173.0	4176094.0	118.9	15.92	307.04	6.51	9.14	YES	
	0	Q.79758E-02	626187.0	4176094.0	118.9	16.92	307.04	6,51	9.14	YES	
C119	D	0.79758E-02	626201.Q	4176094.0	118.9	16.92	307.04	6,51	9.14	YES	
CT20	Ð	0.79758E-02	626215.0	4176094.0	118,9	16.92	307.04	6.51	9.14	YES	
CT21	D	0.79758E-02	626229,0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
CT22	ō	0.79758E-02	626243.0	4176094.0	118.9	16.92	307.04	6.51	9.14	YES	
FWPUMP	0	0.48599E-04	626217.2	4175917.0	118.9	3.00	622.00	75.00	0.13	YES	
UNKGT	0	0.24066E+01	633100.0	4174603.0	54,0	30.48	727.59	36.58	5.18	NO	
EALTGT	Q	0.57708E+01	625550.0	4184800.0	15.0	53.34	334.26	16.86	5.64	NO	
EALTBLR	0	0.33390E+00	625550.0	4184800.0	15.0	30.48	435.93	5.22	2.15	NO	
EALTCT	Q	0.30240E+00	625550.0	4184800.0	15.0	13.72	294.26	10.00	10.27	NO	
				*** \$0000	f IDe DEE	INTRO POT		89 ***			

ROUP ID									S	០ហ	RCE IDS										
ALL	GT1	,	GT2	,	GT3	,	GT4	۰,	CT1	,	ст2	,	СТЗ	,	CT4	,	СТ5	,	CT 6	, (	CT7
	СТ9	,	CT10	,	CT11	,	CT12	,	CT13	,	CT14	,	CT15	,	CT16	,	CT17		CT18	, (	CT19
•	CT21	,	CT22		FWPUMP	,	UNKGT	,	EALTGT	,	EALTBLR	,	EALTCT								
TESLA	GT 1		G <b>T</b> 2	,	GT3		GT4	,	CT1	,	CT2	,	стз		CT4	,	CT5		CT6	, (	<b>CT</b> 7
	СТ9	,	CT10	,	CT11	,	CT12		CT13	,	CT14	,	CT15	,	CT16	,	CT17	,	CT18	, (	CT 1 9
	CT21	,	CT22	,	FWPUMP	,															
UNKNOWN	UNKGT	,																			
EASTALTM	EALTGT	,	EALTBLR		EALTCT	,															
							***	тне	SUMMARY	0	F MAXIMUN	4	PERIOD (		8760 HRS)	F	ESULTS	***	·		
						**	CONC	OF	PMANN	I	N MICROGH	AS	MS/M**3						**		

· .											
** ISCST3 *** FPL Te. *** Model	- VERSION sla Executed of	N 00101 *** on 11/27/01 a	t 17:40:45	***			***				
JFT Line	ISCST3 "BI	EEST" Version	8.10								
l Fil Output Fil Met Fil	$e - D: \Briele - D: Briele -$	ent\Tesla\Cum ent\Tesla\Cum ent\Tesla\tra	ulative\Su ulative\Su cy98.asc	pplement\C pplement\C	Cumulative Cumulative	T_98_SO1 T_98_SO1	DTA LST				
. Numb	er of sou	rces -	- 8								
Number of Number	source gro of recept	oups - tors -	4 2673								
				* * *	POINT SC	URCE DAT	4 ***				
SOURCE	NUMBER PART. CATS.	EMISSION RAI (GRAMS/SEC)	E X (METERS)	Y (Meters)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK Exit Vel. (m/sec)	STACK DIAMETER (METERS)	BUILDING Exists	EMISSION RAT SCALAR VARY BY
· · · · · ·	• • • • • •	• • • • · • •									
GT1 GT2 GT3 GT4	0 0 0	0.25330E+00 0.25330E+00 0.25330E+00 0.25330E+00	625968.8 626011.3 626095.8 626138 3	4176031.0 4176031.0 4176031.0	118.9 118.9 118.9	60,96 60,96 60,96 60,96	350.71 358.71 358.71 358.71	18.86 18.86 18.86 18.86	5.79 5.79 5.79 5.79	Yes Yes Yes Yes	
FWPUMP	ŏ	0.472S0E-01	626217.2	4175917.0	118.9	3.00	622.00	75.00	0.13	YES	
EALTGT	0	0.61236E+00 0.11340E-01	625550.0	4184800.0	15.0 15.0	53.34 30.48	334.26 435.93	16.06	5.64 2.16	NO NO	
				*** \$017277	The new	INING SOU	RCE CROIN	05 ***			
BOUP 1D				BOOKEL	SOUT	RCE IDS	CE GROUI				
■.											
ALL	GT1	,GT2 ,C	<b>51</b> 3, G	5 <b>T</b> 4 , H	г₩РИМР ,	UNXGT	, EALTGT	, EALTEL	R,		•
TF	GT1	, GT2 , C	5T3 , G	GT <b>4</b> , P	FWPUMP ,			•			
JINKNOWN	UNKGT										
CASTALTM	EALTGT	, EALTBLR ,									
]				•** ]	THE SUMMAN	RY OF HIG	HEST 1-1	HR RESULTS	* * *		
<b>L</b>			**	CONC OF SC	51 II	N MICROGR	AMS/M•*3			**	
					DATE						
			AVERAGE C		YYMMDDHH)		RBCEI	PTOR (XR,	YR, ZELEV	(, ZFLAG)	OF TYPE
TÈSLA H	IGH 15T	HIGH VALUE IS HIGH VALUE IS	5 68.2 5 68.2	26703 ON 9 26703 ON 9	98112604: 98112604:	AT ( 62 AT ( 62	6300.00, 6300.00,	4176175. 4176175.	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	60,	0.00) DC 0.00) DC
UNKNOWN H	HIGH 1ST HIGH 1ST	HIGH VALUE IS HIGH VALUE IS	5 0.4 5 1.9	9053 ON 9 7531 ON 9	98040104: 98090502:	AT ( 63 AT ( 62	1500.00, 1000.00,	4171500.4 4191000.4	00, 270 00, 168	1.70, 1.20,	0.00) DC 0.00) DC
, _											
1											
•											
•											

** ISCST3 *** FPL Tes *** Model 1	- VERSION sla Executed o	9 00101 ••• on 11/27/01 at	18:02:08	• • •			* * *				
BEE-Line	ISCST3 "BI	EEST" Version	8.10								
i Filo Quirac Filo Met Filo Numbo	e - D:\Bro e - D:\Bro e - D:\Bro e - D:\Bro er of sou:	ent\Tesla\Cumu ent\Tesla\Cumu ent\Tesla\trac rces -	ilative\Sup ilative\Sup cy99.asc 8	plement\( plement\(	Cumulative Cumulative	T_99_SO2 T_99_SO2	4.DTA 4.LST				
Number of : Number	source gra of recept	bups - tors - 2	4 2673								
μ. i				***	POINT SC	URCE DAT.	A ***				
	NUMBER PART. CATS.	EMISSION RATI (GRAMS/SEC)	E X (METERS)	Y (METERS)	BASE ELEV (METERS)	STACK HEIGHT (METERS)	STACK TEMP . (DEG . K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RAT SCALAR VARY BY
GT1 GT2 GT3 GT4 'FWPUMP UNKGT EALTGT EALTGLR	0 0 0 0 0 0 0	0.25330E+00 0.25330E+00 0.25330E+00 0.19660E-02 0.12600E+00 0.61236E+00 0.11340E-01	625968.8 4 626011.3 4 626095.8 4 626138.3 4 626217.2 4 633100.0 4 625550.0 4 625550.0 4	176031.0 176031.0 176031.0 176031.0 176031.0 17603.0 1174603.0 1184800.0	118.9 110.9 110.9 110.9 110.9 54.0 15.0 15.0	60.96 60.96 60.96 3.00 30.48 53.34 30.48	358.71 358.71 358.71 358.71 622.00 727.59 334.26 435.93	18.06 18.86 18.86 18.86 75.00 36.58 16.86 5.22	5.79 5.79 5.79 0.13 5.18 5.64 2.16	YES YES YES YES NO NO NO	
	-										
GROUP ID			•	*** 50URCI	E IDS DEFI	INING SOU RCE IDs	RCE GROUI	?\$ ***			
ALL TFOUR	GT1 GT1	, GT2 , G <sup>.</sup> , GT2 , G <sup>.</sup>	T3 , G1 T3 , G1	r4 , 1 r4 , 1	FWPUMP , FWPUMP ,	UNKGT	, EALTGT	, EALTBL	R,		
UNKNOWN	UNKGT	,									
EASTALTM	EALTGT	, EALTBLR ,									
<b>.</b>				*** '	THE SUMMAN	RY OF HIG	HEST 24-1	HR RESULTS	* * *		
			** (	CONC OF 5	D24 II	I MICROGR	AMS/M**3			**	
ROUP ID			AVERAGE CO	DNC ()	DATE YYMMDDHH)		RECEI	PTOR (XR,	YR, ZELEV	, ZFLAG)	OF TYPE
LL H TESLA H UNKNOWN H VASTALIM H	IGH 1ST IGH 1ST IGH 1ST IGH 1ST IGH 1ST	HIGH VALUE IS HIGH VALUE IS HIGH VALUE IS HIGH VALUE IS	0.6 0.5 0.0 0.2	36830 ON 88560 ON 87980 ON 69960 ON	99112724; 99112724; 99112724; 99112724;	AT ( 62 AT ( 62 AT ( 63 AT ( 63 AT ( 62	5000,00, 5000.00, 2000.00, 4000.00,	4172500, 4172000, 4171000, 4179000,	00, 254 00, 334 00, 268 00, 139	.50, .80, .40, .90,	0.00) DC 0.00) DC 0.00) DC 0.00) DC 0.00) DC
										·	

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6TH	HIGHEST	VALUE	IS		0.00166	AT	(	620500.00,	4181000.00,	216.60,	0.00)	DC	NA
7TH	HIGHEST	VALUE	IS		0.00165	AT	(	620500.00,	4178500.00,	243.70,	0.00)	DC	NA
8TH	HIGHEST	VALUE	IS	•	0.00157	AT	(	618000.00,	4180000.00,	276.10,	0.00)	DC	NA
9ТН	HIGHEST	VALUE	IS		0.00154	AΤ	(	618000.00.	4184000.00,	226.10,	0.00)	DC	NA
10TH	HIGHEST	VALUE	IS		0.00148	AT	(	620000.00	4180000.00.	228.60,	D.CO)	DC	NA

\*\*\* THE SUMMARY OF MAXIMUM PERIOD ( 8760 HRS) RESULTS \*\*\*

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-							** 0	ONC (	0F	SOANN	IN	MICROG	GRAMS/	/M**:	3				**	
	ROUP	1D	<b></b>			AVERAGE			-		REQ	EPTOR	(XR, 	YR,	ZELEV,	ZFLAG)	08	TYPE	NETWORK GRID-ID	<b></b>
	EASTALT	M IST	HIGHEST	VALUE	15	c	0.02576	AT	(	630000	.00,	418600	00.00	,	0.00	,	0.00)	DC	NA	
_	_	2ND	HIGHEST	VALUE	IS	τ	0.02495	AT	(	629000	.00,	418600	00.00		0.00	,	0.00)	DC	NA	
	Ţ	3 R D	HIGHEST	VALUE	IS	0	02250	AT	(	631000	.00,	418600	00.00	,	0.00		0.00)	DC	NA	
		4 T H	HIGHEST	VALUE	IS	C	0,01912	AT	(	632000	.DD,	418600	00.00		0.00	,	0.00)	DC	NA	
		STH	HIGHEST	VALUE	IS	C	),01633	AT	(	633000	.00,	418500	00.00,		0.00	,	a.oo)	DC	NA	
		6ТН	HIGHEST	VALUE	IS	C	0.01609	AΤ	(	627000	.00,	418500	00.00,		7.00	,	0.00)	DC	NA	
		7TH	HIGHEST	VALUE	IS	C	).01557	AT	{	626000	.00,	418300	00.00,		24.30	,	0.00)	DC	NA	
	•	8TH	HIGHEST	VALUE	IS	C	0.01534	AT	(	628000	.00,	418500	00.00		2.10	,	0.00)	DC	NA	
		9TH	HIGHEST	VALUE	15	C	0.01426	AT	(	626000	.00,	418200	00.00		34.10	,	0.00)	DC	NA	
	I.	10 <b>T</b> H	HIGHEST	VALUE	15	C	0.01408	Ат	ţ	634660	.00,	418500	00.00	,	0.00	,	0.00)	DC	NA	

### Health Risk Assessment Modeling Files

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FPL Tesla Power Plant Health Risk Assessment

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Output File: 4HRA99.aco

\*\*\*\*\* A C E 2 5 B 8 --- ASSESSMENT OF CHEMICAL EXPOSURE FOR AB 2588 --- VERSION 93288 \*\*\*\*\*

\*\*\* A MULTI-SOURCE, MULTI-POLLUTANT, MULTI-PATHWAY RISK ASSESSMENT MODEL DEVELOPED BY APPLIED MODELING INC. AND SANTA BARBARA COUNTY APCD \*\*\*

Distributed and Maintained by CAPCOA

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#### \*\*\* POLLUTANT-SPECIFIC DATA \*\*\*

NAME	SYMBO	L NUM	UNIT RISK	POTENCY	ACUTE AEL	CHRONIC AE	L ORAL DOSE		CHR	ONI	СΤ	ΟX	END	ÞÖI	NTS		ACU	TE '	то
			(ug/m3)-1	(mg/kg-d)	-1 (ug/m3)	) (ug/m3)	(mg/kg-d)	CV	CN	IM	κı	LI	RP	RE	SK	CV	CN	IM	¢κ
.Naphthalene	NAP	TH 110	0.00E+00	0.00E+00	0.00E+00	9.00E+00	4.00E-03	0	0	0	0	Û	0	1	0	0	0	0	0
Polycyclic arom. H	C PAH	130	1.10E-03	1,20E+01	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	Q	0	0	Q	0
Ethylbenzene	ETH	ԼՅ 158	0.00E+00	C.00E+00	0.00E+00	2.00E+03	0.00E+00	0	0	0	l	1	1	0	Þ	0	0	Q	Q
Butadiene-1.3	EUT	AD 20	1.70E-04	0.00E+00	0.00E+00	2.00E+01	0.00E+00	0	D	0	0	0	1	0	Þ	0	0	Q	Q
Acetaldehyde	AÇE	ТА 1	2.70E-06	0.00E+00	0.00E+00	9.00E+00	0.00E+00	0	0	0	٥	Q	0	1	۵	0	0	Q	0
,Acrolein	ACR	OL 3	0.00E+00	0.00E+00	1,90E-01	6.00E-02	0.00E+00	0	p	0	0	0	0	1	Q	Q	0	Q	Q
Benzene	BEN	ZE 13	2.90E-05	0.00E+0D	1,30E+03	6.00E+D1	0.00E+00	1	1	0	0	0	1	۵	Q	1	0	1	0
-Formaldehyde	нсн	0 70	6.00E-06	0.00E+00	9.40E+01	3.00E+D0	0.00E+00	0	0	0	0	0	0	L	Q	0	0	D	0
N-hexane	NHE	X 159	D.D0E+00	0.00E+00	0.00 <b>E+0</b> 0	7.00E+03	0.00E+00	0	1	0	0	0	Q	٥	0	0	0	D	Ď
Propylene	PRC	PL 134	0,00E+00	0.00E+00	0.00E+00	3.00E+03	0.00E+00	٥	0	0	0	0	0	1	0	0	0	0	0
Propylene oxide	PRC	X 135	3.70E-06	2.40E-01	3.10E+03	3.00E+01	0.00E+00	Ó	0	0	0	D	Û	l	0	0	0	0	0
Toluene	TOL	145	\$ 0.00E+00	Q.00E+00	3.70E+04	3.00E+02	0.00E+00	Ô	1	0	0	0	1	1	D	0	1	Q	0
Xylene	XYL	EN 151	0.00E+00	0.00E+00	2.20E+04	7.00E+02	0.00E+D0	0	1	0	0	0	0	1	0	0	۵	0	Q
Ammonia	NH3	5	0.00E+00	D,00E+00	3.20E+03	2.00E+02	0.00E+00	0	0	0	0	0	0	1	0	D	0	0	0
DieselExhaust	DIE	SL 160	3.00E-04	0.00E+00	0.00E+00	5.00E+00	0.00E+00	0	0	0	0	0	0	1	0	٥	0	0	0
Arsenic	As	10	3.30E-03	1.50E+00	1.90E-01	3.00E-02	3.00E-04	1	1	O,	۵	0	1	0	Q	0	0	0	0
Bromine	Br	19	0.00E+00	0.00E+00	0.00E+00	1.70E+00	0.00E+00	0	0	٥	Û	0	0	1	٥	0	Q	0	0
Cadmium	Cđ	22	4.20E-03	0.00E+00	0.COE+00	2.00E-02	5.00E-04	0	0	0	l	0	0	1	0	0	0	0	0
Chromium (hex.)	Cr	36	5 1.50E-01	4.20E-01	0.00E+00	2.00E-01	2.00E-02	0	0	0	0	0	0	1	٥	0	0	0	D
Copper	Cu	36	8 0.00E+00	0.00E+00	1.00E+02	2.40E+00	0.00E+00	0	0	0	0	0	D	1	۵	0	Q	0	Ď
Fluoride and Cmpnd	IS FLR	1D 161	L 0.00E+00	0.00E+00	2.40E+02	5.90E+00	0.00E+00	0	0	0	0	0	D	1	1	0	0	0	0
'Manganese	Mn	85	6 0.00E+00	0.00E+00	0.00E+00	2.00E-01	0.00E+00	٥	1	0	0	0	D	0	o	0	0	0	0
_Mercury	Нg	87	0.00E+00	0.00E+00	1.80E+00	9.00E-02	3.00E-04	l	1	0	1	1	1	1	0	0	1	0	1
Nickel	Ni	111	2.60E-04	0.00E+00	6.00E+00	5.00E-02	0.00E+00	0	0	1	1	σ	0	1	Q	D	a	1	0
Sulfates	SO4	141	0.00E+00	0.00E+00	1.20E+02	2.50E+01	0.00E+00	Q	0	D	0	٥	0	1	0	D	۵	٥	0
Zinc	Zn	153	0.00E+00	0.00E+00	0.00E+00	3.50E+01	0.00E+00	1	0	0	D	0	0	1	0	D	٥	0	0

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TOTAL 1	NUMBE	ROPI	IOOEL	ED PC	LLUTAN	NTS ¥	26			
NUMBER	OP C	ARCIN	<b>MEN1</b>	C POL	LUTANI	rs =	11			
$\begin{array}{c} 130\\111\end{array}$	20	1	13	70	135	160	10	22	36	
NUMBER	OF M	ULTIP	ATHWA	Y POL	LUTANI	<b>S</b> =	7			
110	130	135	10	22	36	87				
NUMBER	OF P	OLLUTA	INTS	WITH	ACUTE	NON-	CANCER	RISE	< =	13
3 87	13 111	70 141	135	145	151	9	10	38	161	

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Output File: 4HRA99.aco

\*\*\* INPUT SOURCE EMISSION RATES \*\*\*\*

FOR SOURCE # 1 Gas Turbines OPERATING HOURS = 8760.00 SURFACE AREA (m2) ≈ 1.000E+00 DEPOSITION ADJUST. FACTOR = 1.00000

POLLUTANT NAME	POLLUTANT NUMBER	R 1-HOUR	RATE	ANNUAL RATE			
		(g/s)	(lb/hr)	(g/s)	(lb/yr)		
NAPTH	110	1.860E-03	1.476E-02	1.560E-03	1.085E+02		
PAH	130	1.840E-04	1.460E-03	1.540E-04	1.071E+01		
ETHLB	158	1.350E-02	1,071E-01	1.130E-02	7.8S6E+02		
BUTAD	20	3.150E-05	2.500E-04	2.630E-05	1.828E+00		
ACETA	1	1.210E-01	9.603E-01	1.010E-01	7.022E+03		
ACROL	3	0.000E+00	0.000E+00	0.000E+00	0.0005+00		
BENZE	13	1.120E-02	8.889E-02	9.340E-03	6.494E+02		
нсно	70	2.170E-01	1.722E+00	1.810E-01	1.258E+04		
NHEX	159	9.030E-02	7.167E-01	7.560E-02	5.256E+03		
PROPL	134	4.730E-01	3.754E+00	3.960E-01	2.753E+04		
PROX	135	1.390E-02	1.103E-01	1.160E-02	B.Q65E+Q2		
TOL	145	3.970E-02	3.151E-01	3.320E-02	2.309E+03		
XYLEN	151	1.480E-02	1.175E-01	1.240E-02	8.621E+02		
NH3	9	1.830E+00	1.452E+01	1.500E+00	1,043E+05		
DIESL	160	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
As	10	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Br	19	0.000 <b>E+00</b>	0.000E+00	0.000E+00	0,000E+00		
Cd	22	0.000E+00	0.000E+00	0.000E+00	0,000E+00		
Cr	36	0.000E+00	0.000E+00	0.000E+00	0.000E+D0		
Cu	38	0.000E+00	0.000E+00	0.000E+00	0.000E+DD		
FLRID	161	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Mn	85	0.000E+00	0.000E+00	0.000E+00	0.000E+0D		
Нġ	87	0.000E+00	0.000E+00	0.000E+00	0.000E+D0		
Ni	111	0.000E+00	0.000E+00	0.000E+00	0.000E+DD		
S04	141	0.000E+00	0.000E+00	0.000E+00	0,000E+00		
2n	152	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
FOR SOURCE #	2 Cooling To	overs					
OPERATING HOURS	= 8760.00	SURFACE AREA (m2) =	1.000E+00	DEPOSITION ADJUS	T. FACTOR = 1.00000		
DOLLITENT VINC							
FORDINIT NAME	POPEOLANI NOMBER	< 1-HOUR	RATE	ANNUA	L RATE		

		T-1100	A ARIE	ANNUAL RATE				
		(g/s)	(lb/hr)	(g/s)	(1b/yr)			
NAPTH	110	0.000E+00	0.000E+00	0.000E+00	0.0005+00			
PAH	130	0.000E+00	0.000E+00	0.000E+00	D DDDE+00			
ETHLB	158	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
BUTAD	20	0.000E+00	0.000E+00	0.000E+00	0,000E+00			

FPL Te Input	sla Power Plant H File: FPLTPP.aci	ealth Risk Assessment	Output File:	4HRA99.aco	* OUTPUT OF AM	I/SBCAPCD ACE2588 MODEL V 11/20/01 12:16:18
	Mn	85	0.000E+00	0.000E+00	0.000E+00	0.000E+00
	Hg	87	0.000E+00	0.000E+00	0.000E+00	0.000E+00
-	NI	111	0.000E+00	0.000E+00	0.000E+00	0.000E+00
	SO4	141	0.000E+00	0.000E+00	0.000E+00	0.000E+00
	Zn	152	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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\*\*\* 70-YEAR LIFETIME CANCER RISK BY SOURCE FOR PEAK RECEPTOR # 938 \*\*\*

SOURCE	INHALE	DERMAL	SOIL	WATER	PLANTS	ANIMAL	MOTHER MILK	SUM
1	5.872E-09	1.494E-09	1.270E-09	0.000E+00	1.4705-09	0.000E+00	0.000E+00	2.334E-08
2	3.530E-06	6.581E-09	9.J40E-08	0.000E+00	3.858E-08	0.000E+00	0.000E+00	3.668E-06
З	5.460E-0B	0.000E+00	0,000E+00	0.000E+00	0.000E+00	0.010E+00	0.000E+00	5.460E-08
SUM	3.590E-06	8.075E-09	9.467E-08	0.000E+00	5.320E-08	0.000E+00	0.000E+00	3.746E-06

RECEPTOR RISK OF 3.746E-06 IS BELOW SIGNIFICANT RISK LEVEL OF 1.000E-05

RECEPTOR R1SK OF 3.745E-05 EXCEEDS IMPACT ZONE RISK LEVEL OF 1.000E-06 RECEPTOR POPULATION = 0 RECEPTOR BURDEN = 0.000E+00

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\*\*\* 70-YEAR LIFETIME DOSE (mg/kg/d) BY POLLUTANT FOR PEAK RECEPTOR # 938 \*\*\*

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POLLUTANT	INHALE	DERMAL	SOIL	WATER	PLANTS	ANIMAL	MOTHER MILK	SUM
PAH	1.399 <b>E-1</b> 0	4.269E-11	6.723E-11	0.000E+00	4.888E-10	0.000E+00	0.000E+00	7.387E-10
BUTAD	2.390E-11	0.000E+00	0.000E+00	0.000E+00	0,000E+00	0.000E+00	0.000E+00	2.390E-11
ACETA	9.177E-08	0.000E+00	0.000E+00	Q.000E+00	0.000E+00	0.000E+00	0.000E+00	9.177E-08
BENZE	B.487E-09	0.000E+00	0,000E+00	0.000E+00	0.0005+00	0.000E+00	0.000E+00	8.487E-09
нсно	1.6452-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.645E-07
PROX	1.054E-08	4.089E-09	1,932E-09	0.000E+00	3.682E-08	0.000E+00	0.000E+00	5.338E-08
DIESL	5.200E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.200E-08
As	5.067E-09	9.768E-10	4.615E-08	0.000E+00	1.923E-08	0.000E+00	0.000E+00	7.143E-08
Cd	1.013E-08	D.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.013E-08
Cr	6.319E-09	1.218E-08	5.755E-08	0.000E+00	27316E-08	0.000E+00	0.000E+00	9.922E-08
Ni	5.067E-09	0.000E+00	0.000E+00	0.000E+00	0,000 <b>E+00</b>	0,000E+00	0.000E+00	5.067E-09

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Output File: 4HFA99.aco

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\*\*\* MAXIMUM CHRONIC EXPOSURE BY POLLUTANT FROM ALL SOURCES \*\*\*

	*******	*******		* * * * PATHWA	AY DOSE (r	ng/kg-d) *•	********	********	*********				
POL.	INHALE	DERMAL	501L	WATER	PLANTS	ANIMAL	MOT MILK	NON-INH DOSE SUM	ACCEPTABL ORAL DOSE	INH CONC (ug/mJ)	BACKGR (ug/m3)	AEL (ug/m3)	н
NAPTH	5.77E-08	1.75 <b>E</b> -06	2.77E-08	0.00E+00	2.02E-07	0.00E+00	0.00E+00	2.47E-07	4.00E-03	2.02E-04	0.00E+00	9.00E+00	8,4
ETHLB	4.19E-07	0,00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-03	0.00E+00	2.00E+03	7.3
BUTAD	9.73E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00£+00	0.00£+00	0.00E+00	3.40E-06	0.0DE+00	2.00E+01	1.7
ACETA	3.74E-06	0,00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-02	0.00E+00	9.00E+00	1.4
ACROL	0.00E+00	0.00E+00	0.00E+DD	0,00E+00	D.CO <b>E+</b> 00	0.0 <b>0E+</b> CO	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-02	ō.0
BENZE	3.45E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+0Q	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-03	0.002+00	6.00E+01	2.0
HCHO	6.695-06	0.00E+00	0.00E+00	0.00E+00	0.00E+D1	0.00E+0D	0.00E+00	0.00E+00	0.00E+00	2.34E-02	0.00E+00	3.00E+00	7.8
NHEX	2.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+DD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.79E-03	0.00E+00	7.00E+03	1.4
PROPL	1,46E-05	0.00E+00	0.00E+00	0.00E+DC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.13E-02	0.00E+00	3.00E+03	1,7
PROX	4.29E-07	0. <b>00E+</b> 00	0,00E+00	0.00E+00	D.00E+00	0.00£+00	0,00E+00	0.00E+00	0.00E+00	1.50E-03	0.00E+00	3.00E+01	5.0
TOL	1.23E-06	0.00E+00	0.00E+00	0.00E+00	0.002+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E-03	0.00E+00	3.00E+02	1.4
XYLEN	4.59E-07	0.00E+00	0.00E+00	D.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-03	0.00E+00	7.00E+02	2.2
NHB	5.55E-05	0.00E+00	0,00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+90	0.00E+00	1.94E-01	0.00E+00	2.00E+02	9.7
DIESL	4.55E-07	0.00E+00	0.00E+ <b>00</b>	0.00E+ <b>90</b>	0.00E+00	C.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-03	0.00E+00	5.00E+00	3.1
As	5.07E-09	9.77E-10	4.622-08	0.00E+00	1.92E-08	0.00E+00	0.00E+00	6.64E-08	3.00E-04	1.77E-05	0.00E+D0	3.00E-02	8.1
Br	5.31E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-03	0.00E+00	1.70E+00	1.0
Cđ	1,01E-08	3.91E-09	9.23E-08	0.006+00	9.92E-08	0.00E+00	0.00E+00	1.95E-07	5.00E-04	3.55E-05	0.00E+00	2.00E-02	2.1
Cr	6.32E-09	1.22E-08	5.76E-08	0.00E+00	2.32E-08	0.00E+00	0,00E+00	9.29E-08	2.00E-02	2.21E-05	0.00E+00	2.00E-01	1.1
Cu	1.26E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+CO	0.00E+00	4.42E-05	0.00E+00	2.40E+00	1.8
FLRID	2.26E-07	0.00E+00	D.COE+00	0.00E+00	0.00E+00	0.00E+00	0.DDE+00	0.00E+00	0.00E+00	7.97E-04	0.002+00	S.90E+00	1.3
Mn	1.77E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-05	0.00E+00	Z.00E-01	3.1
Hg	2.02E-09	3.90E-09	1.84E-09	0.00E+00	2.28E-08	0.00E+00	0.00E+00	4.52E-08	3.00E-04	7.08E-06	0.00E+00	9.00E-02	2.2
Ni	5.07E-09	0.00E+00	0.00E+D0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.COE+00	0.00E+00	1.77E-05	0.005+00	5.00E-02	3.5
- SO4	1.03E-04	0.00E+DC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.81E-01	0.00E+00	2.50E+01	1.5
2n	2.28E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-05	0.00E+00	3.50E+D1	2.2

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November 29, 2001

Mr. Dennis Jang Bay Area Air Quality Management District 939 Ellis Street San Francisco, CA 94109

#### Re: Updated Modeling Analysis for the Tesla Power Plant Project and Permit Forms

Mr. Jang:

Enclosed are two (2) copies of the *Updated Modeling Analysis for the Tesla Power Plant Project* and a copy of the required BAAQMD permit forms for the firewater pump engine. Also enclosed are two (2) CDs that include all of the updated modeling input and output files.

The purpose of the Updated Modeling Analysis for the Tesla Power Plant Project is to provide a more refined air quality and public health impact analysis using additional meteorological data from the Tracy station.

If you have any questions, please feel free to call me at (510) 874-3156.

Sincerely,

URS CORPORATION

Brent P. Eastep Air Quality Engineer

Enclosure

URS Corporation 500 12th Street, Suite 200 Oakland, CA 94607-4014 Tel: 510.893.3600 Fax: 510.874.3268

BAY AREA AIR QUALITY MANAGEMENT DISTRICT 939 Ellis Street San Francisco, CA 94109 (415) 749-4990 fax (415) 749-5030	Data Form C FUEL COMBUSTION SOURCE
(for Dis	strict use only)
New 🗆 Mo	dified 🛛 Retro 🗆
Form C is for all operations which burn fuel. If the operation also involves evaporation of any and attach to this form. If the operation involves a process which generates any other air pollutattach to this form.	organic solvent, complete Form S utants, complete Form G and
Check box if this source has a secondary function as an abatement device for some 2, and 7-13 on Form A (using the source number below for the Abatement Device N	e other source(s); complete lines 1, lo.) and attach to this form.
1. Company Name: Midway Power, LLC Plant No:	(ir unknown, leave blank) Source No. S-11
2. Equipment Name & Number, or Description: Fire Water Pump Engine	
3. Make, Model : To be determined Maximum firing	rate; 0.0142 m gal/hr
4. Date of modification or initial operation: (if unknown, leave blank)	
5. Primary use (check one): electrical generation space heat abatement device cogeneration results for the process heat; material heated	ste disposaltesting ource recovery other
6. SIC Number	-
7. Equipment type (check one)	
Internal 🛛 diesel engine combustion 🗍 Otto cycle engine Displacement gas turbine	cubic inches
Incinerator	Temperature°F Residence timeSec
Others       boiler       dryer         afterburner       oven         flare       furnace       Material dried, bak         open burning       kiln         other       other	ed, or heated:
8. Overfire air?       □ yes       ⋈ no       If yes, what percent%         9. Flue gas recirculation?       □ yes       ⋈ no       If yes, what percent%         10. Air preheat?       □ yes       ⋈ no       Temperature°F         11. Low NO <sub>X</sub> burners?       □ yes       ⋈ no       Make, Model	·
12. Maximum flame temperature°F	
13. Combustion products: Wet gas flowrateacfm at°F Typical Oxygen Content dry volume % or wet volume % or % exc	cess air
14. Typical Use <u>0.5</u> hours/day <u>1</u> days/week <u>52</u> weeks	/year
15. Typical % of annual total: Dec-Feb 25% Mar-May 25% Jun-Aug 25	5% Sep-Nov 25%
16. With regard to air pollutant flow, what source(s) or abatement device(s) are immediately         SSSSSA	/ UPSTREAM? AA
With regard to air pollutant flow, what source(s) or abatement device(s), and/or emission DOWNSTREAM?	n points are immediately
<b>S S A A P P</b> 5	
Person completing this form: Brent Eastep Date:	11/14/01

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#### FUELS

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INSTRUCTIONS: Complete one line in Section A for each fuel. Section B is OPTIONAL. Please use the units at the bottom of each table. N/A means "Not Applicable."

#### SECTION A: FUEL DATA

Fuel Name	Fuel Code**	Total Annual Usage***	Maximum Possible Fuel Use Rate	Typical Heat Content	Sulfur Content	Nitrogen Content (optional)	Ash Content (optional)
Diesel Oil	98	0.3692	0.0142	137x10 <sup>6</sup>	0.05	N/A	N/A
	_[		: 	<u> </u>			
		ļ				ļ	<u> </u>
				]			l
Use the appropriate	Natural Gas	therm*	Btu/hr	N/A	N/A	N/A	N/A
units for each fuel	Other Gas	MSCF*	MSCF/hr	Btu/MSCF	ppm	N/A	N/A
	Liguid	m gal*	m gal/hr	Btu/m gal	w1%	wt%	wt%
	Solid	ton	ton/hr	Btu/ton	w1%	wt%	wt%

#### SECTION B: EMISSION FACTORS (optional)

			Particulates		NOx		ço	
	Fuel Name	Fuel Code**	Ernission Factor	**Basis Code	Emission Factor	**Basis Code	Emission Factor	**Basis Code
<b>1</b> 1.								
2.								
З.								
4.			-					

Use the appropriate units for each fuel: Natural Gas = Ib/therm\* Other Gas = Ib/MSCF\* Liquid = Ib/m gal\*

Note: \* MSCF = thousand standard cubic feet

\* m gal = thousand gallons

\* therm = 100,000 BTU

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\*\* See tables below for Fuel and Basis Codes

Total annual usage is: - Projected usage over next 12 months if equipment is new or modified.

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Actual usage for last 12 months if equipment is existing and unchanged.

**Fuel Codes			25	**Basis Codes		
Code	Fuel	Code	Fuel	Code	Method	
25 33 43 47 242 80 89 98 493 315 - 392	Anthracite coal Bagasse Bark Bituminous coal Brown coal Bunker C fucl oil Coke Crude oil Diesel oil Digester gas Distillate oil Fuel oil #2	189 234 235 236 238 237 242 495 511 256 466 304	Process gas - blast furnace Process gas - CO Process gas - CO Process gas - coke oven gas Process gas - RMG Process gas - other Residual oit Refuse derived fuel Landfill gas Solid propellant Solid waste Wood - bogged	0 1 2 3 4 5 6 7 8	Not applicable for this pollutant Source testing or other measurement by plant (attach copy) Source testing or other measurement by BAAQMD (give date) Specifications from vendor (attach copy) Material balance by plant using engineering expertise and knowledge of process Material balance by BAAQMD Taken from AP-42 (compilation of Air Pollutant Emission Factors, EPA) Taken from literature, other than AP-42 (attach copy) Guess	
160 165 167 494	Gasoliue Jet fuel LPG Lignite Liquid waste Municipal solid waste	305 198 200 203	Wood - thogged Wood - other Other - gaseous fuels Other - liquid fuels Other - solid fuels			

BAY AREA AIR QUALITY MANAGEMENT DISTRICT 939 Ellis Street San Francisco, CA 94109 (415) 749-4990 Fax (415) 749-5030									
Form P is for well-defined emission points such as stacks or chimneys only; do not use for windows, room vents, etc.									
Business Name: Tesla Power Pr	Business Name: Tesla Power Project Plant No								
Emission Point No: P-5									
With regard to air pollutant flow into this emission point, what sources(s) and/or abatement device(s) are <b>immediately</b> upstream?									
S- 11 S-	S-	S-	S-						
S A	A-	A	A	A					
.ι cross-section area: <u>0.14 sq. ft</u> . Height above grade: <u>9.8 ft</u> .									
	Typical	Operating Condition	Maximum	Operating Condition					
Actual Wet Gas Flowrate	TBD	cfm	TBD	cfm					
Percent Water Vapor	TBD	Val %	TBD	Vol %					
· · · · · · · · · · · · · · · · · · ·									
Temperature	TBD	°F	TBD	· °F					
Temperature If this stack is equipped to mea Is monitoring continuous? What pollutants are monitore	TBD sure (monitor	°F ) the emission of any a ⊠ no	TBD air pollutants,	••F					

response by B/23 to Data Request

Technical Area: Air Quality Author: Brewster Birdsall

#### BACKGROUND

An Air Quality Mitigation Agreement between the applicant and the SJVAPCD was docketed at the CEC June 5, 2002, too late for previous rounds of Data Requests. The applicant's responses to the previous rounds of Data Requests (submitted to CEC, March 8 and May 17, 2002) were incomplete. In Response to Data Request #11, the applicant indicated that it was developing a mitigation scheme for impacts to PM<sub>10</sub>

concentrations caused by new emissions of SOx. At this time, a SOx mitigation plan has not yet been outlined. In Response to Data Request #207, the applicant identified that payment of an air quality mitigation fee to the SJVAPCD would be used for creating air quality benefits, but did not provide any specific mitigation program and did not discuss what benefits might occur.

### DATA REQUEST

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289.Please provide a specific mitigation plan for impacts to PM<sub>10</sub> concentrations caused by SOx emissions. This is a follow-up to Data Request #11. Impacts from TPP SOx emissions are not addressed by the SJVAPCD Mitigation Agreement or the offset package for compliance with BAAQMD Rule 2-2-303.

290 Please provide a specific air quality benefits analysis that could be achieved with 290 the SJVAPCD Mitigation Agreement. This is a follow-up to Data Request #207. The Mitigation Agreement states that use of the Air Quality Mitigation Fee by the SJVAPCD will create real time air quality benefits. The anticipated benefits need to be outlined, perhaps with assistance of the SJVAPCD, in order for staff to determine if this proposal can be characterized as a viable mitigation measure. For example, a projection of the approximate number of buses to be retrofit or lawnmowers to be replaced, the specific locations of these mitigation programs, the quantities and types of emission reductions that would be generated, and the schedules for these mitigation programs needs to be provided.

# EXHIBIT 172

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### Attachment AQ-3

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Technical References Regarding Ammonia Slip and Potential Secondary Particulate Formation in SJV

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Motor Vehicles

Native Animals

Soil - Natural & Ag

Powerplant (approximated)

POTW

	NH3	NH3	
Source Category	tons/year	tons/day	Percent
Burning - Ag & Timber	341	0.93	0.3%
Burning - Res	214	0.59	0.2%
Composting	5,409	14.82	4.0%
Domestic	1,844	5.05	1.4%
Fertilizer Application	5,570	15.26	4.1%
Landfill	917	2.51	0.7%
Beef	14,610	40.03	10.9%
Dairy	78,997	216.43	58.7%
Poultry	16,889	46.27	12.5%
Other Livestock	2,208	6.05	1.6%

1,871

5,001

134,590

509

7 203 5.13

1.40

0.02

0.56

13.70

368.74

1.4%

0.4%

0.0%

0.2%

3.7%

100.0%

## Year 2000 Ammonia Emission Inventory for the San Joaquin Valley Unified Air Pollution Control District

**Charts Provided Below** 

Primary data developed from: California Regional PM10/PM2.5 Air Quality Study Ammonia Emission Improvement Projects in Support of CRPAQS Aerosol Modeling and Data Analyses: Draft Ammonie Inventory Development ENVIRON International Corporation, September 6, 2002 Contract Manager: Vernon Hughes, PTSD Data analysis and display by: Patrick Gaffney, PTSD June 4, 2003

Powerplant emissions were not estimated in the ENVIRON report, and are approximated. Powerplants reporting ammonia in ARB's emissions database show that ammonia emissions are about 4% of NOx emissions. SJV ammonia emissions for powerplants were approximated as 4% of reported electric utility and cogeneration NOx emissions (about 14 tons/day). California Air Resources Board Planning Technical Support Division




# **EXHIBIT 173**

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# Ammonia Emission Inventory Development: Needs, Limitations, and What is Available Now

Patrick Gaffney, Dale Shimp California Air Resources Board Planning and Technical Support Division 2020 L Street, Sacramento, CA 95814 October 22, 1999

### ABSTRACT

Many regions in the country need to develop ammonia emission inventories to clearly evaluate  $PM_{2.5}$  levels and visibility degradation. For most agencies, we are beginning this process with little or no previous experience collecting ammonia emission data. This paper discusses what type of ammonia inventory may be appropriate based on the nature of the  $PM_{2.5}$  problem within an area. Also described are some of the issues, challenges, and solutions for developing ammonia inventories, as well as a brief case study for cattle ammonia estimates and a summary of some ongoing ammonia related research.

### INTRODUCTION

Ammonia gas can react in the atmosphere to produce particulate matter, such as ammonium nitrate or ammonium sulfate. Because inhaled particulate matter is known to produce negative health effects, it is important to estimate the emissions of particulate matter (PM) and its precursors in those regions with elevated PM levels. Most regions with air quality concerns have already estimated emissions for other PM precursor gases such as oxides of nitrogen, oxides of sulfur, and volatile organic compounds, but they do not have estimates of ammonia emissions.

In preparing an animonia inventory, it is helpful to evaluate what type of inventory is appropriate to deal with an area's  $PM_{2.5}$  problem. For example, regions that are in attainment for particulate matter may meet their needs by developing a general, top-down, inventory using generic emissions and activity data. For other regions, a comprehensive, bottom-up, highly specific, spatially and temporally resolved ammonia inventory may be appropriate for meeting an area's needs to reduce airborne particulates. In this paper, we provide some ideas for evaluating which type of inventory an area may need for developing initial regional ammonia estimates. We will also discuss some of the difficulties we are encountering, and the approaches we are using for prioritizing our efforts and developing ammonia inventory data.

The following topics are discussed in the remainder of this paper.

- Evaluating ammonia inventory needs
- Ammonia inventory preparation planning
- Developing emission estimates
- Current ammonia research

The information provided here is intended to help with the development of initial inventories for regional ammonia emissions. These inventories will allow identification of where additional resources and further refinement will be most beneficial. The initial data can also be used as preliminary inputs to atmospheric models to better evaluate the influence of ammonia on particulate levels in regions with air quality concerns.

# I. EVALUATING AMMONIA INVENTORY NEEDS

In many regions, ammonia emission inventories will be needed to understand the sources of, and the means to reduce, particulate matter levels. This section provides some concepts for evaluating what level of ammonia emission inventory detail may be most reasonable based on the nature of an area's  $PM_{2.5}$  problem. The approach is focused on PM inventory development, but it could also be used with some modification for visibility inventory development.

Ammonia is primarily an air quality concern due to its contribution to the formation of particulate matter (PM). Therefore, the PM attainment status of a region will help guide the level of refinement that is suitable for a regional ammonia inventory. For example, if PM levels are low, and there are not problems with PM exceedances or downwind effects, then initially, a general annual average inventory will probably meet regional needs. In addition, if  $PM_{10}$  or  $PM_{2.5}$  levels are not known, then again it may be reasonable to rely on generalized composite ammonia data, such as the national EPA ammonia inventory estimates<sup>1</sup>, until further ambient air quality data are available.

## **Evaluation of Direct and Secondary PM**

In regions where direct or secondary PM particulate levels tend to approach or exceed the particulate air quality standards, more refined ammonia inventory estimates may be needed. The estimates will help to identify the major annonia sources, evaluate their influences, and identify how to reduce particulate levels. In these cases, it is useful to evaluate the types of particulates observed in the ambient air during times of high PM. For example, are the particulates dominated by primary emission sources such as geologic dust or wood smoke? In this case, a highly detailed ammonia inventory would probably not give information that would help in meeting air quality goals. Or, are high PM levels dominated by secondary particulates such as nitrates or sulfates? In this case a detailed ammonia inventory could be instrumental in understanding the causes of high PM levels in the region.

In those areas with high levels of secondary PM, knowledge about the relative ambient levels of precursor gases such as  $NO_x$  or  $SO_x$ , to ammonia levels can also be helpful in evaluating inventory needs. The details are beyond the level of this paper, but as an example, in the situation when  $NO_x$  is the limiting substance in nitrate formation, reducing ammonia levels might have little or no effect (in a simplified homogeneous atmosphere) in reducing PM levels. Therefore, it may not be warranted, at least initially, to develop a fully gridded, temporally resolved modeling inventory for ammonia because it may not be needed to meet air quality objectives. In contrast, when it appears a region may be ammonia limited, a more detailed ammonia inventory will probably be needed to effectively evaluate control strategy development.

By developing a conceptual model of potential emission sources and the contributors to PM or visibility problems, it is possible to formulate ammonia inventory requirements based on the regional air quality improvement needs. It is then possible to tailor the inventory elements, listed below, so that they best meet air quality planning and modeling needs.

- Number of sources inventoried
- Completeness of the activity data collected
- Specificity of the emissions rate data used
- · Level of spatial and temporal refinement

# **II. AMMONIA INVENTORY PREPARATION PLANNING**

In preparing an ammonia inventory, it is worthwhile to prioritize which of the many potential ammonia sources should receive attention. Table 1 provides a list of ammonia sources that can be used to evaluate which sources are present within a region. These sources may then be ranked in terms of priority for estimating emissions. To assist with this, the table provides a simple, semi-quantitative method for prioritizing and documenting the initial source significance.

The ranking approach includes several subjective factors including the relative importance of the source based on policy, health, and other eoncerns; the expected magnitude of emissions from the source; the quality of the existing emission factors and activity data; and the availability of spatial and temporal allocation data for the source. The ranking takes into account what is known, but also what is unknown, and is designed to give the highest scores to the sources with the greatest uncertainty and the highest potential emissions.

For illustration, the table is populated with values used to evaluate California statewide ammonia inventory priorities. Values are summed across the rows to get scores. However, to reduce some of the influence of the spatial and temporal data, which are of secondary importance for the first draft inventory, they were divided by two prior to summing. Note that the sources with high scores are a combination of those that are likely to have high emissions, such as livestock, and those with high uncertainties, such as ammonia from soils or biomass burning.

In completing the prioritization table, it may be unclear what to input to the source magnitude column. To assist with this, Table 2 provides a comparison of the emissions levels from typical ammonia producing activities. These arc rough estimates based on generic emission factors and activity data. The example activity data were selected to show the emissions for representative facility sizes and emission sources, and are meant to provide order-of-magnitude comparisons only. If the type and number of ammonia sources are known within a region, these data may be of help in giving some indication of emissions levels.

In addition, Figure 1 also shows some pie charts from previous inventories, which may be helpful in evaluating the relative emission magnitudes of various ammonia sources. Note the tremendous variations in source contributions for these inventories. The national inventory shows that 80% of the ammonia emissions are from livestock. The San Joaquin Valley inventory shows that 42% of ammonia is from soil, but the national inventory purposely excludes soil emissions because of their high level of uncertainty and the capability of soils to emit and uptake ammonia. Unlike the San Joaquin Valley and national inventories, the Southern California estimates include significant emissions from domestic and point sources.

An important point here is that there is tremendous range of possibilities in preparing and presenting ammonia emission estimates. Some of the variations shown in the pie charts are due to differences in ammonia emissions, but many of the variations are due to differences in methodologies and which sources were inventoried.

For this planning process, the objective is to create a general strategy to begin development of an initial inventory. Then, as inventory development proceeds and more information is gathered, the inventory and priorities can be modified as needed to meet air quality goals. Therefore, detailed ammonia literature reviews, needs assessments, or planning studies are probably not necessary.

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		Primary Score Categories			Secondary Scores			
Source Type	Source Name	Source Importance	Source Magnitude	NH3 EF Quality	Activity Data	Spatial Data	Monthly Temporal	Totals
Livestock	Beef	5	4	3	2	2	4	17.0
	Dairy	5	4	3	2	2	4	17.0
	Poultry	4	3	3	3	3	4	16.5
	Swine	3	2	3	3	Э	4	14.5
	Horses	2	2	3	3	4	4	14.0
Fertilizer	Agricultural	4	3	4	2	2	4	16.0
	Commercial	3	2	4	3	3	4	15.5
	Residential	3	2	4	4	2	4	16.0
Soil	Disturbed soil	4	4	4	4	3	5	20 0
	Natural soil	4	4	4	4	3	5	20.0
Stationary	Waste water treatment	3	2	3	2	1	4	12.5
-	Ammonia injection	3	1	3	2	2	3	11.5
	Geothermal	1	3	2	2	1	2	9.5
Motor Vehicles	MV Catalysts	3	3	3	3	3	2	14.5
Other Industrial	Refrigeration	2	2	3	3	4	2	13.0
	Fertilizer production	2	1	3	2	2	2	10.0
	Ammonia production	2	1	3	2	2	2	10.0
	Others	1	1	3	3	3	3	11.0
Other Area	Compost & Landfills	2	2	4	5	3	4	16.5
Sources	Biomass burning	2	2	4	5	3	4	16.5
	Humen & domestic	2	1	5	4	4	Э	17.5
	Pets	2	1	5	4	4	3	15.5
	Wildlife	1	1	5	5	5	5	15.5
	Scoring Criteria	5 =	5 =	1 =	1 =	1 =	1 =	
		most	most	highest	highest	highest	highest	
		important	important	quality	quality	quality	quality	
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Table 1. Ammonia Sources and Priority Scoring for Inventory Development Needs.

#### Description of Scoring Categories

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a - Source Importance	Based on magnitude, perception, public awareness, existing resources, industry interest, potential for control, potential toxicity
b - Source Magnitude	Estimated based on previous ammonia inventories, number of sources, Chemical Mass Balance (CMB) data
c - EF Quality	Score based on estimated uncertainty and variability of existing emission factors (EFs) and complexity of source category
d - Activity Data Quality	Estimation of quality and availability of overall annual activity date; includes datail available and expected newness of available data
e - Spatial Data*	Availability of spatial data; general quality and resolution expected to be available
f - Monthly Temporal*	Availability of data which could be used to estimate monthly variations in emissions
g - Tolals	This is the total prioritization score. Score = $(a+b+c+d) + (e+f)/2$
* Note on e & f	*The spatial and temporal column scores are multiplied by ½ prior to summing because they are of less significance in preparing an initial inventory

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Source	NH <sub>3</sub> Emission Factor	Activity Data Examples	Emissions (tons/yr)	Comments
Dairy	70  bs/head/yr	585 head	20	EF from population weighted dairy cattle avg. Battye <sup>2</sup> Table 2-9. Average herd size of 585 from CDFA <sup>3</sup> , 1997.
Feedlot	47 lbs/head/yr	2000 head operation 15,000 he <b>a</b> d	47 352	EF from population weighted beel callle average/Baltye Table 2-9. Most CA cattle in 1000+ size operations.
Grazing	18.1 lbs/head/yr	2000 head	18	EF from Asman (via Baltye, Table 2-1). Herd size arbitrary.
Poultry	0.393 lbs/head/yr	200,000 head	39	EF from population weighted composite from Battye Table 2-9. Flock size arbitrary.
Water Treatment	16 lbs/10 <sup>6</sup> gallons	20 million gallons/day 75 mgpd facility	58 219	EF from Battye Table 6-2 based on CA POTW data. 20 mgpd moderate size treatment works. 75 mgpd large urban.
Fertilizer	167 lbs/lon urea 19.7 lbs/lon NH₃	10 square miles (=6400 acres)	15	EF Battye, Table 3-5, WI. % Table 3-1. Arbitrary essumption to apply 50 lbs urea & 50 lbs anhydrous ammonia/acre to get average mix (not realistic operational scenario). 100 lbs fertilizer/acre is realistic application rate.
Soil	1 lb/acre/yr	10 square mil <b>es</b>	3	EF from Schlesinger via Battye Table 6-3. Temperate grassland, range is 0.1 to 10. Arbitrarily selected 1 for analysis.
Autos	216 lbs/10 <sup>6</sup> VMT	100 million VMT	11	EF Fraser and Cass <sup>4</sup> . EF for fleet average adjusted for catalyst mix & high NH <sub>3</sub> emitters.

Table 2. Comparison of Example Ammonia Emission Sources.

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Figure 1. Ammonia Emission Inventory Examples.

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## **III. DEVELOPING AMMONIA EMISSION ESTIMATES**

Most of the potentially significant sources of ammonia are dispersed, area-wide sources such as livestock, fertilizer application, and motor vehicles. Because it is difficult to gather consistent and locally applicable emissions and activity data for these types of sources, emission estimates will have substantial uncertainty. To add further uncertainty, the inventory data must be input into atmospheric models, much like for ozone, to evaluate how much of the ammonia reacts to produce secondary particulates. Therefore, even with a perfect inventory, the results will still be subjected to the significant uncertainties of atmospheric modeling to evaluate the contribution of ammonia to PM levels or visibility degradation.

With these inherent uncertainties, it is sensible to identify and estimate emissions from the large, major sources first, evaluate their influence on PM or visibility, then refine emission estimates for the smaller contributors as needed. The remainder of this section discusses some of the problems we have encountered in preparing ammonia estimates and how we are dealing with them.

#### **Emission Factors**

Numerous studies have been funded to compile and tabulate emission factor data for the various animonia sources<sup>2,5,6</sup>. These compilations are helpful in providing a range of possible emission values for developing an inventory, but substantial judgement is necessary in selecting the specific values needed for emission estimates.

To develop a detailed, region specific inventory, it is important to know if the ammonia emission rates were developed using mass balance approaches, emissions testing, some type of engineering analysis, or another teehnique. It is also helpful to evaluate what assumptions went into the emission factors. For example, if testing was performed for dairy eattle, does it include just the direct animal waste emissions? Does it also include emissions from manure piles, storage ponds, and other site emission sources? Are the animals grazing for feed? What is the nitrogen content of their diet? How are they housed? How many are present at a single facility? What is the waste removal technique? Understandably, most summary reports do not provide the level of detail need to answer these questions, and most of us do not have the resources to evaluate the primary literature.

A cursory look at any of the published emission factors for ammonia sources shows a wide range of cmission possibilities. For example, emissions from soils<sup>2</sup> range from 0.1 to 10 lbs of ammonia per acre. Dairy cattle emission factors range from 20 to 130 lbs per animal per year<sup>7,6</sup>. Because of this large variability and lack of region specific data, it is useful to select the most sensible emission factor data available, and then develop methods that can be easily updated with new or more appropriate data as they become available.

With this perspective, the emission factors already provided in the existing published literature are probably adequate for initial ammonia inventory development. A helpful reference for emission factors is the report, "Development and Selection of Ammonia Emission Factors"<sup>2</sup> which was funded by the U.S. EPA. Tbis document is available on the EPA web site at:

http://www.epa.gov/ttn/chief/efdocs/ammonia.pdf. This report provides more detail than many of the other published documents and provides descriptions of the sources and issues involved. A partial summary of emission factors for the major source categories is also posted on the ARB website as part of a previous ammonia inventory presentation<sup>8</sup>. The address is http://arb.ca.gov/emisiov/pmnh3/pmnh3.htm.

## Activity Data

The emission factors for ammonia sources dictate what type of activity data are needed or appropriate. For example, beef cattle have emission factors for adults, calves, and other subcategories, so it makes sense to seek population data for these animal types. Similarly, fertilizer emission factors are provided for anhydrous ammonia, urea, and others, so again, the emission factors help to establish what fertilizer sales and application data are needed to prepare an inventory.

As with the emission rates, there is substantial uncertainty for the ammonia activity data, and in some cases, it is difficult to even obtain these data. For example, how many chickens are there in Arkansas? How much fertilizer is applied in North Dakota? What kind? When? How many ears are emitting ammonia in California? The principle is the same here as with the emission factors – it is worthwhile to make an initial estimate with whatever is available and refine as needed.

#### **Review of Estimates**

When an inventory method and estimates have been completed, an essential step follows. It is very beneficial to have the emission factor, activity data, and methodology reviewed by experts from the affected industries, academic researchers, and other air quality scientists. It is useful to explain what assumptions were made and why, what the method's shortcomings are, and how the data will be used (e.g., trying to determine which sources might possibly be significant). Working with industry and others also provides an opportunity to determine if there are better available sources of activity data, seasonal data, and spatial data.

### Summary of Issues for Major Source Categories

The following list provides a summary of issues and difficulties in estimating emission for the most obvious ammonia sources. The information is summarized from reports listed in the references, and it is provided to help identify some of the problems to keep in mind while collecting the data needed to prepare a source inventory.

- Livestock
  - difficult activity data collection due to various animal types and residency time issues
  - emission factors have wide variations and are not standardized; specific sources, handling practices, and housing practices difficult to estimate
  - emission factors do not take into account differences in temperature, humidity, soil, and other factors that can affect ammonia formation and volatilization
- Fertilizers
  - wide range of emission factors; effects of climate and soil difficult to incorporate
  - most emission factor data are based on theoretical ealeulations and laboratory study
  - need application methods, application calendars, and spatial allocation data
- Soils
  - soils emit and uptake ammonia so it is difficult to evaluate the net contribution; emissions potentially significant in some regions if uptake is not substantial
  - may need to model the emissions related to vegetation coverage, climate, and soil type as is done with biogenies
  - limited emission factor and test data are available, wide range of values
- Industrial sources
  - generally minor emissions, ammonia used as part of process or product, so efforts are made to limit losses for economic reasons

- Sewage treatment
  - there is concern about ammonia losses prior to effluent reaching the treatment plant
  - individual facility emissions can sometimes be significant, but often overwhelmed by other regional sources
  - limited emission factor data available, but activity data easy to obtain for facilities
- Domestic/urban sources
  - domestic sources such as cleaning products, pets, diapers may need to be evaluated
  - sources appear to be minor emission contributors, but may need to inventory for equity and to understand higher than expected ammonia levels in some urban regions
- Motor vehicles
  - emissions could be significant for urban areas
  - substantial variability in vehicle ammonia emissions within fleet
  - first order estimates may be possible with existing motor vehicle inventory data and literature emission factors

## IV. CASE STUDY: PREPARING A BEEF AND DAIRY CATTLE INVENTORY

The following discussion about preparing a cattle emission inventory illustrates some of the issues involved in estimating emissions from many of the non-point ammonia sources. As with many sources, the basic approach for estimating ammonia from cattle is simple enough: develop an emission factor by measuring ammonia emissions from a typical population of animals; count the number of animals that are present over the course of a year; then, multiply the emission factor by the number of animals to get the annual cattle ammonia emissions.

Unfortunately, the situation is far from being this simple. In estimating emissions from beef and dairy cattle there are a myriad of issues to consider. What kinds of animals are present? What is a typical population? How long are they present? Is there information available to estimate emissions for the various animal types? Is there data to evaluate how animal populations vary over the course of a year? How do practices change by season? Is manure stockpiled and disposed at distinct times of year? And, how do emissions change as a result of variations in climate, soil, and other factors?

For areas with PM exceedances driven by secondary particulates, all of these questions are relevant for understanding and modeling the seasonal and local variability of the emissions. This is important because in most regions, the effects of cattle ammonia emissions are not an annual problem, but a season specific, somewhat localized concern. Fortunately, although the estimates will be far from perfect, with existing data it will be possible to determine where the sources are, estimate their emissions, and evaluate what time of year they are likely to be most significant.

## Activity Data – Population

As stated previously, one of the ways to evaluate what activity data are needed for an emission source is to look at what emission factors are available. For cattle there are factors for beef cattle, dairy cattle, young eattle, grazing cattle, ealves, cows that have calved, heifers, animals 500 pounds and over, and of course, bulls<sup>2</sup>. From all of these choices, it is necessary to determine which population data are actually available on a regional basis. In California, beef and dairy cattle population data are available from the California Department of Food and Agriculture<sup>3</sup>, and the California Agricultural Statistics Service<sup>9</sup>. For beef and dairy cattle, data were available to estimate populations for the population classes shown in Table 3. These elasses were selected because there is information available to estimate the populations, as well as a relatively consistent set of emission factor data that can be used with the population data to perform emission estimates.

For livestock, it is important that the population estimates not be based strictly on sales or unexamined population figures, which can cause substantial miscounting. For example, feedlot animals typically are only kept about six months, so a feedlot might sell 100,000 head in a year, but that docsn't mean that 100,000 head of cattle were producing emissions over 12 full months. Instead, assuming a six-month residence time, 50,000 animals may be present from January through June, then they are sent to market, and another 50,000 arrive from July through December. Therefore, over the course of the year, there are emissions from only 50,000 animals that are actual residents for 12 months, not 100,000, which is the number marketed. There is a similar situation with inshipment cattle that are brought into California for only about seven months for grazing, so a straight count of the animals would not provide a correct estimate of the number of animals emitting per year.

Once it is determined what types of animals are present, it can be determined where they are located and when they are present. For the initial ARB methodology, information was available from the state agricultural agencies to apportion the cattle by county. As the method is refined by working with industry groups, efforts will be made to better spatially and temporally apportion emissions for those regions significantly affected by ammonia emissions.

### **Emission Factors**

The emission factors for cattle have a wide range of values ranging from 11 lbs NH<sub>3</sub>/head/year for range calves<sup>2</sup> to over 130 lbs of NH<sub>3</sub> head/year for dairy cattle<sup>6</sup>. As mentioned previously, selecting data from the existing literature is difficult because the researchers use different methods, applied to different types of operations, under different conditions. To add further difficulty, much of the ammonia research has been performed in Europe which raises questions about the applicability of these data to practices used in the United States.

In preparing first draft estimates we selected a set of emission factors that provided a level of consistency among the animal types, and appeared to take into account some of the differences in animal handling practices such as range feeding, stable housing,

	Table 3.	Reet	and	Dairy	Cattle	Classes	i & E	missio	on Fa	ctors.
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Beef Cattle	Emission Factor (!bs/head/yr)	Dairy Cattle	Emission Factor (ibs/head/yr)
Range adults	18.12	Dairy cow	37.58
Inshipments	18.12	Milk calves	11.53
Calves	11.52	Milk heifers	28.75
Feedlot animals	33.49	· Dairy bulls	61.53

manure spreading, and waste storage emissions. Our current emission factor selections, shown in Table 3, are on the low range of published factors and are provided in Battye<sup>2</sup>. Because of the variability in the emission factors, one approach we are considering is including a range of emissions estimates, possibly based on average emissions rates.

With the emission estimates completed and a well-documented methodology, our next step is to provide the information to the agricultural industry and others interested in ammonia estimates for review. We will then hold a meeting with the reviewers to discuss the methods, shortcomings, and ways to improve the estimates. For more detailed information on our approach, the complete draft methodology for this beef and dairy cattle ammonia estimates will soon be posted at http://arb.ca.gov/emisinv/pmnh3.htm.

## V. ONGOING AND PLANNED RESEARCH

It is important to be aware that there are numerous studies that have evaluated what ammonia emission data and methods are available, and what future research is needed<sup>2,5,6,10,11,12</sup>. Therefore, it is necessary to carefully target research efforts when funding further efforts in this area. At this time it is important to perform source specific research that will tangibly improve our emission inventories and provide a better understanding of ammonia emissions and variability. The following research studies are sponsored by the ARB and others to meet some of these goals.

To help better understand emissions from fertilizer application, the ARB is sponsoring a project with California State University, Fresno, and the NASA Ames research center. The project will measure ammonia emission rates from fertilizer application and then develop regional fertilizer emissions modeling based on the field test data. The project will test emissions for a variety of fertilizer types and application methods relevant to the major crop types in California's San Joaquin Valley. The modeling will include inputs for soil type, elimatic conditions, application ealendars, and other relevant factors. The project will also attempt to evaluate background agricultural soil ammonia levels by beginning ammonia sampling prior to the fertilizer application.

The ARB also has a project with the National Oceanographic and Atmospheric Administration to develop and evaluate a Lidar laser system to measure real-time, three-dimensional ammonia concentrations. For the longer term, the ARB is also evaluating the need to develop a GIS based model, which could estimate and display ammonia emissions in a way similar to biogenic emissions.

The California Regional Particulate Air Quality Study (CRPAQS) is planning to fund studies which will improve our emission estimates from commercial and residential fertilizer application, as well as collecting data which can be used to more clearly estimate ammonia emissions from urban sources such as household products, pet waste, diapers, and other unsavory sources. This work will help us better understand some of the sources that do not always receive much attention, but may possibly play a consequential role in nitrate or sulfate formation because their proximity to NO<sub>x</sub> sources.

Within the ARB, our Mobile Source Control Division is performing some limited testing of ammonia from motor vehicles to begin a more complete evaluation of these emissions. These emissions, which are not included in our emission estimates, may be important contributors to PM formation. In a simplified estimate performed by Mathew and Cass<sup>4</sup>, they showed that motor vehicle ammonia emissions may be as high as the dairy emissions in Southern California, which are in the range of 25 tons per day. These results are not comprehensive, but they do indicate that additional work is needed in this area.

The South Coast Air Quality Management District has also recently received the results of a contract they sponsored to develop a comprehensive, gridded ammonia emission inventory for Southern California. This report is one of the most recent, and probably among the most comprehensive regional ammonia inventories developed. These proceedings also include papers discussing swine ammonia emissions. Some of the work, protocols, and methods in these papers will be helpful for estimating ammonia from other ammonia sources, especially livestock.

There is additional ammonia work being sponsored by several agencies. At this time, it appears that what is needed most is specific emission rate information, better estimates of environmental variability, and resources to compile appropriate levels of activity data.

## VI. CONCLUSIONS

In some regions of the United States, it is important to develop detailed, well-defined ammonia emission inventorics appropriate for modeling. Other areas will be able to meet their needs for understanding the contributions of ammonia to air quality and visibility degradation with more general emission estimates. Because of all of the work we constantly have before us in improving air quality, it is important to elarify and prioritize which sources need the most attention, and what work will provide the greatest benefit.

Preparing ammonia inventories is a challenge because of the tremendous range in emission factors, the difficulty in collecting activity data, the climatic and other variations in the emission rates, and the often diffuse and poorly understood emission sources such as livestock and soils. These data must then be input to atmospheric models, with their own uncertainties and approximations, to fully understand the effect of the ammonia on air quality.

Fortunately, there is adequate information available to prepare initial inventories that can then be extended to the level of detail warranted by regional air quality and visibility improvement needs. There is also adequate time to prepare ammonia inventories that will meet regulatory requirements. In California, we plan to have a draft statewide ammonia emission inventory available in 2001. The inventory will include all of the major ammonia sources and will include some spatial and temporal allocation of the emissions. Additional inventory efforts will be focused on those areas with known secondary PM problems to better refine the information needed for modeling. With these data, we can begin to more clearly understand the effects of ammonia on air quality, and provide information that will be helpful in continuing to improve the air quality within California.

#### DISCLAIMER

The opinions, findings, and conclusions expressed in this paper are those of the staff and not necessarily those of the California Air Resources Board. In addition, the opinions provided regarding the needs and priorities for developing ammonia inventories are strictly those of the authors and have no regulatory authority.

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Key Words

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ammonia ammonia inventory cattle emissions inventory planning secondary PM

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# **EXHIBIT 174**



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## ABSTRACT

The formation of secondary ammonium nitrate during the 1995 Integrated Monitoring Study (IMS95) in San Joaquin Valley, CA was investigated using a box model that simulates the atmospheric chemistry and gas/particle partition of inorganic compounds. The concentration of particulate matter (PM) nitrate was found to be sensitive to reductions in VOC emissions. Nitric acid, rather than ammonia, was the limiting reagent in the formation of PM nitrate. The formation of nitric acid was more sensitive to the availability of oxidants than that of NO<sub>x</sub>. Oxidant chemistry in wintertime conditions in the San Joaquin Valley was shown to be VOC-sensitive. In fact, a decrease in NO<sub>x</sub> emissions may have the counter-intuitive effect of increasing PM nitrate.

#### INTRODUCTION

The 1995 Integrated Monitoring Study (IMS95) was a planning study for the California Regional  $PM_{10}/PM_{2.5}$  Air Quality Study (CRPAQS). Details of the IMS95, including maps of the study domain, can be found in a special issue of Atmospheric Environment (Volume 33, Issue 29, 1999). Ambient data from the IMS95 show that areas in the California San Joaquin Valley (SJV) exceed the short-term  $PM_{2.5}$  National Ambient Air Quality Standard (24-hour average concentration of 65 µg/m<sup>3</sup>)<sup>1</sup>. Much of the PM<sub>2.5</sub> observed during winter is secondary in origin. Of the key components of PM<sub>2.5</sub>, ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) typically accounts for close to 20 µg/m<sup>3</sup> of PM material, corresponding to 30% of urban  $PM_{2.5}$  and 60% of  $PM_{2.5}$  in rural areas<sup>2</sup>. In contrast, armonium sulfate, the kcy component in  $PM_{2.5}$  observed in may parts of the eastern United States, only accounted for less than 5% of the  $PM_{2.5}$  mass during IMS95<sup>2</sup>. Therefore, it is important to investigate the PM-precursor relationships of NH<sub>4</sub>NO<sub>3</sub> for the formulation of effective  $PM_{2.5}$  control strategies, especially in rural areas.

In their conceptual model of PM formation, Pun and Seigneur<sup>1</sup> postulated that the formation of  $NH_4NO_3$  is limited by the availability of nitric acid ( $HNO_3$ ), because ammonia ( $NH_3$ ) emissions seem abundant in the SJV. This conclusion is supported by other recent analyses<sup>3</sup>.  $HNO_3$  is itself a secondary component, formed in the atmosphere as a product of photochemical reactions involving nitrogen dioxide ( $NO_2$ ), hydroxyl radicals (OH), and ozone ( $O_3$ ) (the  $O_3$  reaction involves intermediate species nitrate radicals,  $NO_3$ , and dinitrogen pentoxide,  $N_2O_5$ ). While nitrogen oxides ( $NO_x$ ) are directly emitted, the radical species and  $O_3$  are produced from precursors  $NO_x$  and volatile organic compounds (VOC). Therefore, oxidant formation may be sensitive to  $NO_x$  or to

VOC. Clearly, the chemistry regime has important implications towards the choice of effective emission controls.

This modeling study was performed to investigate the sensitivity of PM nitrate formation under conditions prevalent in the SJV during the winter season. This work'was designed to complement field measurements that may help unravel the details of nitrate chemistry in the ambient environment. Our objectives were to: (1) study the sensitivities of oxidants and PM to precursors, and (2) corroborate the modeling results with indicator species approaches<sup>4,5,6</sup> for predicting the sensitivity of wintertime PM formation.

# SIMULATION METHODS

**Box Model.** A box model was selected to study the sensitivity of PM nitrate to NO<sub>x</sub> and oxidants. Although a three-dimensional (3-D) model should ultimately be used for this investigation, existing databases were insufficient for the reliable application of a 3-D model (e.g., a loft concentrations needed to define boundary and initial conditions were not available). A box model, with carefully chosen initial conditions and emissions, can provide valuable information on the major processes that govern the dynamics of nitrate formation during the winter PM episodes.

Winter PM accumulation is primarily associated with stagnant conditions with low wind speeds (less that 2 m s<sup>-1</sup>). Therefore, advection did not need to be treated. The box model treats the following processes using an operator splitting approach: (1) emissions of precursor gases and PM; (2) gas-phase chemistry using the Carbon Bond Mechanism  $IV^7$  (CMB-IV), augmented with isoprene chemistry and heterogeneous nitrate chemistry<sup>8,9</sup>; (3) dilution by and entrainment of aloft air as the mixing height rises; (4) dry deposition of gases and PM and wet deposition of PM associated fog; (5) gas/particle partitioning using SCAPE2<sup>10</sup>, a thermodynamic equilibrium aerosol module.

The key feature of CBM-IV is the lumping of organic compounds based on their molecular structures (model species represent paraffin earbons, olefin bonds, etc). Inorganic reactions represented in CBM-IV are similar to those used in the other gasphase mechanisms, such as SAPRC and RADM. Due to the abundance of biogenic emissions in the SJV, the most recent treatment for isoprene chemistry was implemented to ensure the proper representation of gas-phase chemistry. Isoprene reacts with oxygen atoms (O), OH, O<sub>3</sub>, NO<sub>3</sub>, and NO<sub>2</sub>. A surrogate isoprene reaction product, ISPD, may undergo photolysis or react with OH, O<sub>3</sub>, and NO<sub>3</sub>. Therefore, the version of CBM-IV used in this study simulates the chemistry of 34 species (25 molecular species and 9 radicals) with 88 reactions. Photolysis rates were calculated based on cloud-free conditions, although fog sometimes persisted after sunrise. Heterogeneous chemistry of N<sub>2</sub>O<sub>5</sub>, NO<sub>3</sub>, and HO<sub>2</sub> was treated using the reaction probability approach recommended by Jacob<sup>8</sup>. These reactions were simulated when fog was present using an average droplet diameter of 20 µm<sup>11</sup>. Aqueous-phase sulfate chemistry was not included. Sulfate is not a key component of  $PM_{2.5}$  in SJV and is not the focus of this study. The omission of aqueous-phase sulfur chemistry is not expected to have significant impacts on the simulation, since SO<sub>2</sub>/sulfate chemistry has little effect on nitrate formation in an ammonia-rieh and sulfate-poor environment.

The gas-phase chemical kinetic equations are solved using the Young and Boris<sup>12</sup> ordinary differential equation solver. Pseudo-steady-state assumptions are made for all radical species (with the exception of NO<sub>3</sub>, whose reaction time scale dictates whether or not steady state is assumed at any time). This approach provides a good balance between numerical robustness and computational efficiency.

SCAPE2 simulates the composition of atmospheric particles at equilibrium given the total (i.e., gas and particulate) amounts of sulfate, nitrate, ammonium, sodium, and chloride. At each time step, the concentrations of NH<sub>3</sub>, sodium, chloride, and sulfate change as a result of direct emissions. In addition, sulfuric acid and nitric acid are formed from chemical reactions in the gas phase. SCAPE2 calculates the thermodynamic equilibrium of the gas/particulate system based on time-varying inputs of temperature and relative humidity (RH). At each time step, SCAPE2 outputs the gaseous concentrations of NH<sub>3</sub>, HNO<sub>3</sub>, and HCl, and particulate concentrations of sodium, sulfate, ammonium, nitrate, and chloride.

Typical dry deposition velocities were derived for  $SO_2$ ,  $NO_2$ ,  $O_3$ ,  $HNO_3$ ,  $H_2O_2$ , formaldehyde, higher aldehydes, and sulfate from the SARMAP air quality model (SAQM) and from Models-3 for NH<sub>3</sub>. The dry deposition velocity of sulfate was used for all particulate species in the simulation. Wet deposition was modeled when fog was present using an average particle deposition rate of about 3% per hour<sup>13</sup>.

Base case simulation inputs. Conditions during the 4-6 January 1996 episode were generally cool, calm, and s tagnant<sup>14</sup>. S urface t cmperatures fluctuated b etween 7 and 16 °C. Surface wind velocities were below 0.5 m s<sup>-1</sup> 40% to 50% of the time, and day time maximum mixing heights ranged from 450 m to 1250 m at several stations. Fog was present for an average 12 hours per day during the episode<sup>14</sup>. PM<sub>2.5</sub> concentrations rose from 35  $\mu$ g m<sup>-3</sup> to 80  $\mu$ g m<sup>-3</sup> in Fresno during the three-day episode.

The box model requires emissions of ammonia, nitrogen oxides (NO<sub>x</sub>), and VOC, which are the precursors of PM nitrate and oxidants. The California Air Resources Board (CARB) prepared gridded emission inputs from the IMS95 inventories, which were evaluated by Magliano et al.<sup>2</sup> The emission files obtained from CARB for a typical

weekday in the IMS95 domain contained gaseous species  $NO_x$ , VOC (speciated),  $NH_3$ ,  $SO_2$ , and several particulate species including  $Na^+$ ,  $CI^-$ ,  $SO_4^=$ , organic carbon (OC), elemental carbon (EC), and a category representing all other particulate compounds. The diurnal emission profiles of  $NO_x$  and VOC (point plus area sources) show strong diurnal variations, but that of  $NH_3$  is fairly constant throughout the day. Eight classes of VOC (2 alkanes, 2 aromatics, 4 olefins) were converted to the lumped CBM-IV structure groups (PAR, TOL, XYL, OLE) and isoprene for use in the box model. For the box model simulations, the emissions in the modeling domain were extracted from these files.

Diurnal profiles of temperature, RH, and mixing layer height are needed to define the meteorological conditions used in the box model simulation. Temperature and RH are used in both the gas-phase chemistry and aerosol thermodynamics calculations. The mixing layer height is used to define the dilution and entrainment characteristics of the modeling domain. Meteorological data were downloaded from the CARB-maintained IMS95 data base (http://www.arb.ca.gov/themis). Very humid conditions were observed during IMS95; the average relative humidity was above 90% from 7 p.m. to 9 a.m. and minimum relative humidity during the day was about 65%. Mixing layer heights were determined from the vertical temperature profiles at four stations (Corcoran, El Nido, Bakersfield, and Fresno) within the SJV for the January 1996 episode (Ajith Kaduwela, CARB, personal communication, 1999). Spatially-averaged mixing height profiles were used in this study to represent typical episode conditions. Due to limited data, an averaged profile was used for all days. The mixing layer height ranged from less than 100 m during predawn hours to about 750 m in the late afternoon.

Observed concentrations were obtained from the IMS95 data base and were used to drive the box model as initial conditions (Table 1). Note that the model repartitioned gas-phase and particle-phase species that were not in equilibrium in the first time step.

Based on Magliano et al.<sup>2</sup>, the ambient  $NH_3/NO_x$  ratio compared well with the emissions inventory values over a 25 km radius of the monitoring station (i.e., an area of about 2000 km<sup>2</sup>). Therefore, a 44 km x 44 km area around Fresno was chosen for the box model simulations. Sensitivity simulations with domains of 4 km x 4 km (urban scale) and 216 km x 288 km (entire IMS95 domain) were also performed. These simulations showed chemical dynamics that were not characteristic of the ambient conditions in the SJV. Because of high emissions concentrated over a small area without advection flow, the urban scale simulation resulted in significant build-up of pollutants, such as  $NO_x$ , VOC, and PM, and a depletion of  $NH_3$  within a couple of simulated days, which was not observed during IMS95. The chemical dynamics of the regional scale simulation indicated that the oxidant chemistry was too slow (because of the dilution of emissions over a large area) in rural areas to account for the observed PM nitrate and oxidant concentrations.

A 3-day simulation was performed for the Fresno domain, based loosely on the conditions found during the 4-6 January 1996 episode. We assumed that pollutants are trapped and preserved aloft when the nocturnal inversion isolates the surface from the aloft layer. Therefore, the modeled aloft concentrations on each day are equal to the concentrations of pollutants in the previous afternoon at the time of maximum mixing height. Aloft concentrations are also required for the first of the modeled days. Since aloft concentrations were not measured during IMS95, characteristic aged emissions (the concentrations on the third day of a simulation without initial conditions) were assigned as the initial set of aloft concentrations.

Magliano et al.<sup>2</sup> found significant uncertainties in the emissions inventory (e.g.,

underestimation by a factor of 4 for NMOC/NO<sub>x</sub>) based on comparisons of inventory ratios of VOC/NO<sub>x</sub>, NH<sub>3</sub>/NO<sub>x</sub>, and PM/NO<sub>x</sub> to ambient values. Therefore, the emissions of organics were adjusted to obtain a base case that best matches the ambient concentrations. In the base case simulation, the organic emissions were doubled from 2.3 x  $10^6$  mole C/day to  $4.7 \times 10^6$  mole C/day within the modeling domain in order to produce O<sub>3</sub> concentrations similar to those observed in the during IMS95. Such an adjustment is commonplace in air quality studies<sup>15,16,17</sup>. Total emissions used in the simulations are listed in Table 1.

Sensitivity Simulations. Simulations were conducted to test the changes in  $PM_{2.5}$  nitrate concentrations resulting from changes in the emissions of NO<sub>x</sub> and VOC within the modeling domain. The results are summarized in an isopleth plot (Figure 1). Since the responses of 24-hour average PM nitrate concentrations to reductions in VOC and NO<sub>x</sub> emissions are very consistent over a range of reduction levels, we only discuss in detail a sensitivity simulation with a 50% reduction in VOC emissions and another one with a 50% NO<sub>x</sub> reduction.

## **RESULTS AND DISCUSSION**

**Base Case Simulation.** The first day is treated as a "spin-up" period, to minimize the effects of initial conditions on the results of the simulation. Therefore, only the results of the second and third days are compared against 24-hour average ambient concentrations in Table 2 to ensure that the box model captures the general dynamics of the formation of secondary pollutants. Figure 2 shows the average diurnal profiles of key secondary species, including O<sub>3</sub>, NO<sub>2</sub>, PM nitrate and ammonium. Available observatious are also displayed to ensure that the box model provides proper representations of the physical and chemical processes in SJV. The O<sub>3</sub> concentration peaks at 2 p.m. on both the second and third days, with values of 23 and 27 ppb, respectively (observed peaks of 20 to 35 ppb occurred between 2 and 3 p.m.). The simulated concentrations of  $O_3$  are within the range of values observed during the January 1996 episode of IMS95.

The NO<sub>x</sub> concentration profiles do not match the observed concentrations as well. The ambient data for NO typically display a peak value (60 - 100 ppb) between 8 and 9 a.m. and high concentrations (30 - 50 ppb) throughout the night. A morning maximum concentration of about 20 ppb is predicted at about 10 a.m., and NO concentrations are typically low during the night. The diurnal range of observed NO<sub>2</sub> concentrations is smaller than that of NO concentrations. NO<sub>2</sub> concentrations fluctuate between 10 and 30 ppb, with a midday minimum slightly before the time of maximum O<sub>3</sub>. The simulated NO<sub>2</sub> concentrations reproduced this profile well, although they are typically 10 ppb higher than the observed values. Model predictions of VOC compared reasonably well with the afternoon VOC samples. However, the box model was not able to predict the peak morning concentrations. The simulated concentrations of the p rimary p recursors (NO<sub>x</sub> and VOC) were lower than the observations. Since all emissions are well mixed in a box model, the size of the modeling domain is probably too large to represent the emission-driven variability in NO<sub>x</sub> and VOC observations at the Frespo core site.

The 24-hour average concentrations of  $PM_{2.5}$  and major  $PM_{2.5}$  components are summarized in Table 2<sup>18</sup>. The underprediction of  $PM_{2.5}$  was due to primary emissions. Schauer and Cass<sup>19</sup> analyzed the source contributions of  $PM_{2.5}$  in Fresno and found that 43% of the observed  $PM_{2.5}$  was primary in origin. In the box model, the contribution of primary compounds is smaller. Secondary compounds are more regionally distributed. Therefore, the model provides better estimates of secondary inorganic components and the base case concentrations of sulfate, nitrate, and ammonium are quite similar to those measured in Fresno<sup>18</sup>.

The diurnal profiles of predicted particulate ammonium and nitrate, as well as their precursors, NH<sub>1</sub> and HNO<sub>1</sub>, are shown in Figure 3. The concentration of HNO<sub>1</sub> predicted by the model is much lower than the IMS95 observations (Table 2). This result is consistent with the modeling results of Kumar et al.<sup>18</sup>, who alluded to measurement difficulties for HNO<sub>1</sub>. Some PM nitrate seems to be formed during the day; however, the accumulation of PM nitrate and ammonium also takes place in the evening, probably as a result of favorable partitioning of inorganic nitrate toward the particulate phase (due to colder temperatures and higher RH), as well as ehemical production. The relatively high concentrations of NH<sub>3</sub> and the build-up of NH<sub>3</sub> during the night (especially early morning) indicate that the formation of particulate nitrate is limited by the availability of HNO3, with a possible exception at the end of the simulation when NH3 is close to depletion. Since the increase in PM nitrate in the evening exceeds the available  $HNO_3$  in the gas phase for partitioning (the day time peak of HNO<sub>1</sub> is about 0.3 ppb), we conclude that the chemical production of nitric acid and PM nitrate is significant in the evening. Two chemical pathways exist for the production of HNO<sub>3</sub>. The OH pathway takes place primarily during the day, when OH is more abundant.

$$OH + NO_2 \rightarrow HNO_3$$
 (1)

The NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub> pathways consist of Reactions 2 to 5. Since NO<sub>3</sub> photolyzes rapidly during the day, these pathways take place primarily at night.

$$NO_2 + O_3 \rightarrow NO_3 \tag{2}$$

$$NO_3 \rightarrow \rightarrow HNO_3$$
 (3)

$$NO_2 + NO_3 \rightarrow N_2O_5 \tag{4}$$

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$$N_2O_5 + H_2O \rightarrow 2 HNO_3 \tag{5}$$

Reaction 3 is a heterogeneous reaction that takes place on fog droplets. Reaction 5 is favored when the RH is high and when lower temperatures increase the stability of the combination product  $N_2O_5$ . When fog is present, a heterogeneous mechanism of Reaction 5 is also viable. The conclusion that the NO<sub>3</sub> and  $N_2O_5$  pathways play a significant role in PM production is inferred from the predicted concentrations of the intermediates  $N_2O_5$  and NO<sub>3</sub> during the evening. The production of PM nitrate via the  $N_2O_5$  pathway ceased later at night when  $N_2O_5$  and NO<sub>3</sub> are depleted, because O<sub>3</sub>, a key ingredient of NO<sub>3</sub> (Reaction 2) is depleted. Figure 4a shows the relative contributions of the two chemical pathways and initial and boundary conditions to the observed PM nitrate. As seen in Figure 4a, excluding initial conditions and boundary conditions, 80% of the daytime concentration of PM nitrate is attributed to Reaction 1. While the PM nitrate formed from the OH+NO<sub>2</sub> reaction persists into the night, about 50% of the nighttime nitrate produced in situ is attributed to NO<sub>3</sub> reactions (Reaction 2 to 5).

The presence of fog at night enhances the production of HNO<sub>3</sub> (via the heterogeneous reactions of NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>). However, it also increases the removal rate of PM due to wet deposition. Compared to a sensitivity case where fog was not simulated, it was found that the net effect of fog was the removal of about 10% nitrate over a 24-hour period. PM nitrate removal as the net effect of fog is consistent with the fog modeling results of Lillis et al.<sup>14</sup> Because fog removes HO<sub>2</sub> radicals via heterogeneous reaction, daytime O<sub>3</sub> was also reduced when fog is present because of the reduced production of OH from HO<sub>2</sub> and NO<sub>3</sub> the next morning.

**VOC Emission Reduction.** Figures 5a and 5b show the  $O_3$ -NO<sub>x</sub> dynamics and the PM and precursor time series, respectively, for the sensitivity case with a 50%

reduction in VOC. The key result is that the 24-hour average PM nitrate concentration is reduced from 16.5 and 22.5  $\mu$ g/m<sup>3</sup> on days 2 and 3 in the base case (Table 2) to 13.5 and 14.5  $\mu$ g/m<sup>3</sup>, respectively. Given that the initial condition is 11.7  $\mu$ g/m<sup>3</sup>, the production of secondary PM is greatly reduced when the VOC emissions are halved. Particulate ammonium, which is associated with particulate nitrate, is also reduced (24-hour average concentrations are 5.0 and 5.5  $\mu$ g/m<sup>3</sup> on days 2 and 3, respectively; down from the base case values of 5.9 and 7.8  $\mu$ g/m<sup>3</sup>, respectively).

Figure 5b shows that, as in the base case, NH<sub>3</sub> is abundant in the system relative to HNO<sub>3</sub>. In fact, the gaseous concentrations of HNO<sub>3</sub> are lower in this sensitivity simulation than in the base case. The general features of Figure 5a are quite similar to those of the base case (Figure 3a).  $O_3$  concentrations are lower (maximum  $O_3$ ) concentrations reduced from 23 and 27 ppb on days 2 and 3 in the base case to less than 20 ppb in this sensitivity simulation), and  $NO_x$  concentrations are generally higher, consistent with slower chemical removal of  $NO_x$  by oxidation. The concentrations of NO<sub>2</sub>, the nitrogen-containing reagent in Reactions 1 and 2, are very similar in the 50% VOC simulation and in the base case. The reduction in PM is therefore caused by the limited a vailability of o xidants, OH and O<sub>3</sub>. Figure 6 c ompares the concentrations of OH, O<sub>3</sub>, and N<sub>2</sub>O<sub>5</sub> between the base case and the 50% VOC reduction case. A 50% reduction of VOC emissions reduces peak OH and  $O_3$  concentrations by as much as 20%. The resulting N2O5 concentrations are more than proportionately reduced, and consequently, the rate of HNO<sub>3</sub> production by this pathway is considerably reduced. Since the  $N_2O_5$  route contributes significantly to the production of HNO<sub>3</sub> in the base case, PM nitrate is similarly reduced. The change in the relative importance of Reaction 1 vs. Reactions 2 to 5 is reflected in the difference in the PM nitrate build-up pattern between

the base case and the 50% VOC casc. The base case shows a relatively small increase in the nitrate concentrations following the day-time minimum that resulted from the entrainment of cleaner air, followed by a substantial increase in PM nitrate after sunset. In the reduced VOC case, PM nitrate increased gradually from mid morning to the mid afternoon due to the NO<sub>2</sub> + OH reaction (see Figure 4b). On the other hand, little nitrate formation takes place at night because, by sunset, O<sub>3</sub> has been nearly depleted; therefore, the N<sub>2</sub>O<sub>5</sub> pathway for nitrate formation (which depends on O<sub>3</sub> to form NO<sub>3</sub>) is negligible in this ease. The smaller contribution of the NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub> reactions to the evening concentrations of PM nitrate can also be seen in Figure 4b. This is a major difference from the base case.

NO<sub>x</sub> Emission Reduction. The results of the 50% NO<sub>x</sub> emission reduction case are presented in Figure 7. Figure 7a shows the dynamics of O<sub>3</sub> and NO<sub>x</sub>. As is quite frequently the case with VOC-sensitive regimes, reducing NO<sub>x</sub> actually increases the formation of O<sub>3</sub> because less NO is available to titrate O<sub>3</sub>. The maximum O<sub>3</sub> concentrations are 28 and 38 ppb on days 2 and 3, higher than those observed in the SJV in the wintertime. The night-time NO<sub>2</sub> concentrations decreased from 35 to 37 ppb in the base ease to 27 and 22 ppb on the first two nights. NO concentrations are also low, even during the morning rush hour.

Despite the lower concentrations of  $NO_x$ , more PM nitrate is formed, as shown in Figure 7b. Twenty-four hour average PM nitrate concentrations rose from 21.3 to 28.6 from d ay 2 to d ay 3, a 30% i nerease over the base c as v alues. Although this r esult seems counter-intuitive, it is easily explained if one considers the dynamies of the VOCsensitive chemistry.

The NO<sub>2</sub> concentrations are always higher in the base case than in the sensitivity

case. As shown in Figure 6b, the concentration of OH radicals during the day is about 23% to 28% higher in the 50%  $NO_x$  reduction case than in the base case. The increase in the radical concentration occurs due to increased production from the photolysis of  $O_3$ . As shown in Figure 7b, daytime formation of HNO<sub>3</sub> increased slightly with respect to the base case because the decrease in NO<sub>2</sub> concentrations (Figure 7a) is compensated by the increase in OH concentrations (Figure 6b). The concentration of  $N_2O_5$  is about 50% higher in the evening compared to the base case. In the previous section, we have shown  $\cdot$  that a decrease in O<sub>3</sub> results in a more than proportional reduction in N<sub>2</sub>O<sub>5</sub>. The converse is also true; the increase in  $O_3$  in the reduced  $NO_x$  simulation relative to the base case triggers a more than proportional increase in N<sub>2</sub>O<sub>5</sub> in the evening (Figure 6c). Indeed, significant PM nitrate formation is observed at night in Figure 4c, indicating the importance of the NO<sub>3</sub> and  $N_2O_5$  pathways in this system. The midnight increase of gaseous HNO<sub>3</sub> on the last day follows a depletion of  $NH_3$ , which is converted to particulate ammonium to neutralize the particulate nitrate. Once NH<sub>3</sub> is depleted, the pH of the aqueous particles quickly drops (to 1.2 at the conclusion of the simulation), preventing further partitioning of HNO<sub>3</sub> from the gas phase into the particles.

**Photochemical Indicators.** Several photochemical indicators have been proposed to determine the sensitivity of O<sub>3</sub> to VOC vs. NO<sub>x</sub>. These indicators include H<sub>2</sub>O<sub>2</sub>/HNO<sub>3</sub>, NO<sub>y</sub>, HCHO/NO<sub>y</sub>, O<sub>3</sub>/(NO<sub>y</sub> – NO<sub>x</sub>) and (NO<sub>y</sub> – NO<sub>x</sub>)/NO<sub>y</sub><sup>4,5</sup>. They represent dominant products under VOC- or NO<sub>x</sub>-sensitive regimes or ratios of these products, or chain length in the radical reactions that produce O<sub>3</sub>. For example, the ratio H<sub>2</sub>O<sub>2</sub>/HNO<sub>3</sub> represents the competition of the HO<sub>2</sub> radical termination product (H<sub>2</sub>O<sub>2</sub> dominant in NO<sub>x</sub>-sensitive regime) and the OH + NO<sub>2</sub> termination product (HNO<sub>3</sub> dominant in VOC-sensitive regime). Since HNO<sub>3</sub> partitions between the gas and particle

phases, PM nitrate and HNO<sub>3</sub> are considered together in the denominator of the ratio. NO<sub>y</sub> is the total oxidized nitrogen.  $(NO_y - NO_x)$  is a measure of the amount of NO<sub>x</sub> oxidation products (HNO<sub>3</sub>, HNO<sub>2</sub>, PAN, etc.). The ratio of O<sub>3</sub> and  $(NO_y - NO_x)$  is an indication of the chain length of the radical reaction, i.e., the propagation reactions that produce O<sub>3</sub> vs. the termination reactions that remove radieals and NO<sub>x</sub> from the system.

Lu and Chang<sup>5</sup> proposed numerical thresholds for the above photochemical indicators to characterize between VOC-sensitive and NO<sub>x</sub>-sensitive regimes (see Table 3) based on a summertime modeling study using the three-dimensional model SAQM. There may be slight variations in the thresholds used to define VOC vs. NO<sub>x</sub> sensitivity for a winter vs. a summer simulation, but the underlying chemical trends should be the same. Our base case simulation shows that the wintertime O<sub>3</sub> concentrations should be sensitive to VOC. The simulated indicator values (Table 3) are different enough from the thresholds that this conclusion is insensitive to seasonal variations in the thresholds. In the sensitivity runs, O<sub>3</sub> also decreases with decreasing VOC (and increases with decreasing NO<sub>x</sub>). Since both O<sub>3</sub> and HNO<sub>3</sub> are formed from reactions involving radicals (HO<sub>2</sub> and OH) and NO<sub>x</sub>, this result was further extended in our simulations to the fact that inorganic nitrate production (i.e., HNO<sub>3</sub>) is also VOC-sensitive.

Blanchard et al.<sup>3</sup> determined that there was no ammonia limitation in the SJV during IMS95. We explore whether our results for the sensitivity of PM nitrate formation from its precursors, HNO<sub>3</sub> and NH<sub>3</sub>, are consistent with the generic analysis conducted by Ansari and Pandis<sup>6</sup>. Ansari and Pandis defined five variables that govern the inorganic PM formation system, as shown in Table 4. Using these variables, the wintertime condition in SJV is characterized by low temperature and high relative humidity with sufficient free ammonia relative to total nitrate. According to Ansari and

Pandis<sup>6</sup>, wintertime PM concentrations in the SJV should be very sensitive to a change in  $HNO_3$  concentrations but should not be sensitive to  $NH_3$  concentrations. This result is consistent with Blanchard et al.<sup>3</sup> and with our simulation results.

**Implications.** Our box model simulations point to the fact that PM formation in the SJV during winter is HNO<sub>3</sub>-sensitive, that HNO<sub>3</sub> formation is oxidant-sensitive, and that oxidant formation is sensitive to reductions in VOC emissions. In fact, a decrease in NO<sub>x</sub> emissions leads to an increase in PM due primarily to an increase in O<sub>3</sub> concentrations. The conclusion that PM formation is HNO<sub>3</sub>-sensitive is also obtained if one uses the generic analysis of Ansari and Pandis<sup>6</sup>. The indicator species of Lu and Chang<sup>5</sup> also indicate that oxidant formation is VOC-sensitive.

It should be noted that the box model represents some domain-averaged chemistry but cannot characterize the locally specific chemical regimes. Other assumptions include stagnant conditions and aloft carry-over of gaseous and PM pollutants. Further work should extend this box model analysis to a three-dimensional modeling study so that transport processes can be simulated and the spatial variability of the response of PM to precursors can be addressed. However, an extensive reliable database is needed for the application of a 3-D model. The forthcoming California Regional PM Air Quality Study (CRPAQS) database may provide such an opportunity.

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Table 1. Base case emissions and initial conditions for box model simulations.

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Chemical Species	Emissions
NO <sub>x</sub>	9.3 x 10 <sup>5</sup> mol/day
NH <sub>3</sub>	4.3 x 10 <sup>5</sup> mol/day
SO <sub>2</sub>	5.0 x 10 <sup>5</sup> mol/day
VOC	2 x 2.3 x 10 <sup>6</sup> molC/day
Isoprene	2.2 10 <sup>4</sup> mol/day
Chemical Species	Initial Concentration
NO	36 ppb
NO <sub>2</sub>	22 ррb
O <sub>3</sub>	8 ppb
NH <sub>3</sub>	4 ppb
SO <sub>2</sub>	1.6 ppb
СО	1.9 ppm
HNO <sub>3</sub>	1.2 ppb
VOC	218 ppbC
PM ehloride	$0.32 \text{ ppb} (0.49  \mu\text{g/m}^3)$
PM sulfate	0.54 ppb (2.2 μg/m <sup>3</sup> )
PM ammonium	5.5 ppb (4.3 μg/m <sup>3</sup> )
PM nitrate	4.4 ppb (11.7 μg/m <sup>3</sup> )

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Table 2.Daily average measured concentrations in the Fresno Area January 4-6,1996 (Source: Kumar et al.<sup>18</sup>) and results of base case simulation.

Chemical species	Average concentration	Predicted concentrations		
		Day 2	Day 3	
O <sub>3</sub>	7.5 ppb	7.9	10.3	
NO	56.4 ppb	7.6	6.5	
NO <sub>2</sub>	27.0 ppb	30.4	31.3	
HNO <sub>3</sub>	1.9 ppb	0.07	0.09	
NH <sub>3</sub>	6.6 ppb	8.0	6.0	
VOC <sup>(1)</sup>	0.46 ppmC	0.29	0.36	
PM nitrate	19.5 μg/m <sup>3</sup>	16.5	22.5	
PM ammonium	$6.3 \ \mu g/m^3$	5.9	7.8	
PM <sub>2.5</sub>	55 μg/m³	30	40	

(1) Average of morning (6-9 a.m.) and afternoon (3-6 p.m.) samples.

Table 3. Indicator thresholds and San Joaquin Valley simulation results.

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Indicator Speeles	Threshold <sup>5</sup>	SJV Winter Simulation
H <sub>2</sub> O <sub>2</sub> /(HNO <sub>3</sub> + PM nitrate)	0.9 (1)	$H_2O_2/(HNO_3 + PM nitratc)$
		always substantially less than 0.9
NOy	4.5 ppb <sup>(2)</sup>	$NO_y > 40$ ppb at all times
HCHO/NO <sub>y</sub>	0.6 (1)	HCHO/NO <sub>y</sub> is less than 0.1,
		because of the abundance of $NO_y$
$O_3/(NO_y - NO_x)$	27.5 <sup>(1)</sup>	$O_3/(NO_y - NO_x) < 3.5$ because
		O <sub>3</sub> is typically quite low
$(NO_y - NO_x)/NO_y$	0.55 <sup>(1)</sup>	(NO <sub>y</sub> - NO <sub>x</sub> )/NO <sub>y</sub> ratio less than
		0.3 throughout simulation

(1) high values = NO<sub>x</sub> sensitive; low values = VOC sensitive.

(2) high values = VOC sensitive; low values =  $NO_x$  sensitive.

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Table 4.
 Range of PM sensitivity variables for IMS95 (base case simulation results).

Sensitivity variables	Range of values
Free ammonia $(NH_3^F)^{(1)}$	9 to 20 ppb
Total nitrate $(HNO_3^T)^{(2)}$	3 to 14 ppb
Gas ratio (GR) = $NH_3^F / HNO_3^T$	1.1 to 4.5
Temperature	279 to 289 K (low)
Relative humidity (RH)	65 to 95% (high)

(1) total ammonia – 2 x sulfate

(2) sum of gas- and particulate-phase inorganic nitrate

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# **FIGURE CAPTIONS**

- Figure 1. Isopleths of 24-hour average PM nitrate (ppb).
- Figure 2. Predicted and observed average diurnal profiles of key secondary species(a) NO<sub>2</sub> and O<sub>3</sub> (b) PM amonium and nitrate.
- Figure 3. Base case simulation: (a) O<sub>3</sub>, NO, and NO<sub>2</sub> concentrations, (b) PM ammonium and nitrate, and gaseous NH<sub>3</sub> and HNO<sub>3</sub> concentrations.
- Figure 4. Contribution of the OH + NO<sub>2</sub> reaction, the NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub> reactions, and initial and top boundary conditions to PM nitrate for the (a) base case, (b) 50% VOC case, and (c) 50% NO<sub>x</sub> case.
- Figure 5. Sensitivity Simulation, 50% VOC Reduction: (a) O<sub>3</sub>, NO, and NO<sub>2</sub> concentrations. (b) P M ammonium and ultrare, gaseous N H<sub>3</sub> and HNO<sub>3</sub> concentrations.
- Figure 6. Comparison the base case simulation and the sensitivity cases: (a)  $O_3$ , (b) OH, and (c)  $N_2O_5$ .
- Figure 7. Sensitivity simulation, 50% NO<sub>x</sub> reduction: (a) O<sub>3</sub>, NO, and NO<sub>2</sub> concentrations, (b) PM ammonium and nitrate, and gaseous NH<sub>3</sub> and HNO<sub>3</sub> concentrations.

Figure 1.



Maximum 24-hour Average PM Nitrate

Figure 2.



Figure 3.

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Hour

Figure 4.



Hour





Sensitivity of PM Nitrate Formation to Precursor Emissions in the California San Joaquin Valley

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Figure 6.



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Figure 7.



# EXHIBIT 175



# SUPPLEMENTAL TESTIMONY OF DUANE MCCLOUD AND SCOTT BUSA

# WATER RESOURCES

# COMMENT 1

Applicant shall provide evidence on where TPP will obtain potable water for domestic uses.

# **RESPONSE 1**

If reclaim water was to be used for the project, restrictions on its use would prevent us from its utilization for domestic requirements. Accordingly potable water would need to be transported to the site by bulk truck from Tracy or Livermore and stored in a potable water storage tank for sanitary uses. An average potable water usage of 1.0 gpm translates into a 3000 gallon delivery once every other day, which represents a minimal impact on traffic.

Drinking water would be bottled in either scenario.

# **COMMENT 2**

The record does not indicate whether the City of Tracy will include denitrification in its tertiary treatment process or whether the TPP would install water treatment technology at the site or whether the TPP would install water treatment technology at the site or whether the biocide treatment required by Condition Public Health-I would result in sufficient denitrification to ensure effective removal of microorganisms in the cooling tower. The parties shall provide testimony that would resolve this issue.

## **RESPONSE 2**

The City of Tracy upgrades for Title 22 include activated sludge nitrification and selective anoxic denitrification, in addition to much higher levels of disinfection and filtration.

The presence of ammonia in water is a primary factor effecting disinfection effectiveness in an aerobic system. This is due to ammonia's tendency to combine with free oxidants, especially halogens, rendering them lcss effective. Nitrification is the process through which ammonia is converted to first nitrites and then nitrates. It is virtually impossible to meet Title 22 standards for disinfection with high levels of ammonia present, and accordingly nitrification is almost always employed as a part of advanced wastewater treatment processes.

Denitrification is conversion of nitrates to oxygen and nitrogen. As gases both of these products are then generally removed from the water. Denitrification is often employed based on the sensitivity of the receiving stream. While nitrates are generally not good

bacterial food in an aerobic system, they can function as algae food in an open body of water creating environmental impacts.

The expected impacts on these constituents from the Tracy upgrades are a significant reduction in ammonia, from an average of 15 mg/l to 0.5 mg/l, and a modest increase in nitrate from 5 mg/l to 10 mg/l. Denitrification will account for a significant nitrate reduction (83%) in this case, as the theoretical nitrate level, after ammonia conversion, would have been around 58 mg/l.

As indicated above, the primary driver for nitrification is disinfection effectiveness. Meeting the Title 22 requirements through the processes outlined above will result in no additional treatment required at TPP to address nitrogen balance in the water. A complete disinfection program, based on industry and CTI guidelines, will be utilized in the plant water systems to ensure that microorganism control is maintained once the water gets to the project.

The above references and numbers are from the Final EIR for the Tracy Wastewater Treatment Plant Expansion, dated September 2002.

# **COMMENT 5**

Applicant estimates the capital cost of its proposed cooling tower installation would be about \$18 million. This appears to be a low estimate compared with the cost of the cooling tower installation for a power plant project half the size of the TPP. Applicant shall provide evidence confirming that its cost estimate for the cooling tower is accurate or provide a corrected estimate, if appropriate.

# **RESPONSE 5**

The values provided in Table 3.10-5 of the AFC are not total system costs for either a wet or dry system. They are instead installed costs for just the major components that would differ between the three options. The total system costs of any of the three options would be higher, although likely by a fairly constant amount across the list. For example while the wet tower would have more feet of piping and pumps, the dry cooling would have much larger piping and structural support requirements. Civil and landscaping needs would also be greater for the larger dry cooling layouts. We believe that the cost difference in the options shown to be accurate, even though we acknowledge that the absolute values given are too low for a total system cost.

Table 3.10-5 however does not capture the difference in water treatment capital and infrastructure costs. For example the ZLD system costs would increase for a larger water usage, similar to the increase being debated for the higher TDS impact for reclaim water. In the case of a completely dry cooled plant, water demand would be much lower, on the order of 10% of a wet plant, for boiler makeup and inlet air cooling. However that 10% would still require both a supply pipeline and ZLD system, however much smaller.

Whether that supply comes from the Aqueduct or Tracy most of the pipeline costs being considered for a wet cooled plant would still be incurred. This was reflected in Staff's summaries. The ZLD system would also be much smaller and different in nature, primarily processing a straight RO reject instead of a cooling tower sidestream as currently envisioned. As a result it would consist only of an evaporator-crystallizer and dewatering equipment, of a size similar to the system currently envisioned for the aqueduct water supply. Instead of the total capital cost range of \$19MM to 22MM being carried for the wet system ZLD a number in the \$4-5 MM range is more likely. These capital numbers are consistent with analysis in the FSA Appendix Table 5. As indicated previously we believe that the lost revenue number associated with dry cooling is much higher.

# COMMENT 6

Applicant shall provide testimony on the status of negotiations with the City of Tracy for an agreement to supply tertiary treated recycled water to the TPP

# **RESPONSE 6**

Midway Power and the City of Tracy have been negotiating for the reclaimed water supply to be delivered by the City of Tracy. The City of Tracy did provide a draft agreement in December 2003 to Midway Power. The draft agreement included provisions such as interpretability, additional costs, no provision for backup supply and other provisions that pose substantial issues for the project. A meeting was held in January 2004 and Midway Power has been preparing modifications to the draft agreement. Midway Power is committed to negotiating an agreement with the City of Tracy.

Toward that end, Midway Power is willing to accept Condition of Certification SOIL & WATER 11 which requires the Project Owner to secure a User Agreement for Reclaimed Water from the City of Tracy at least 60 days prior to project operation. However, we request some additional clarifying language to ensure that the User Agreement can encompass interim and backup supply water in addition to the Reclaimed Water. Therefore we propose SOIL & WATER 11 be modified as follows:

**SOIL & WATER 11** The Project Owner shall secure a User Agreement for Reclaimed Water *and any interim and backup water* from the City of Tracy for the TPP's process and cooling water supply.

<u>Verification</u>: At east 60 days prior to the start of Project operation, the Project Owner shall submit to the CPM a eopy of its User Agreement for Reclaimed Water *and any interim and backup water* from the City of Tracy to supply reclaimed water *and any interim and backup water* to the TPP for power plant cooling and other industrial processes. Additionally, Midway Power accepts Condition of Certification SOIL & WATER 12 which would require the use of reclaimed water as the TPP's primary water supply source for cooling and landscape irrigation. Midway Power also accepts Condition of Certification SOIL & WATER 13 with the following modification:

**SOIL & WATER 13** In the event the TPP is constructed prior to the availability of recycled water and an interim water supply is to be used, the Project Owner shall submit a schedule of *projected* monthly water demand to the City of Tracy for review and comment and to the CPM for approval.

The reason for the proposed modification is that neither the City of Tracy nor the CPM should be required to approve the projected monthly water demand. The interim water supply would be supplied according to any User Agreement with the City of Tracy under Condition of Certification **SOIL & WATER 11**.

Midway Power disagrees that Condition of Certification SOIL & WATER 14 is not necessary to ensure compliance with LORS or to mitigate any potential impact associated with the use of City of Tracy Reclaimed Water for the TPP.

Midway Power accepts Condition of Certification SOIL & WATER 15 with the following modifications.

**SOIL & WATER 15** The Project Owner shall convert from use of not use the interim water supply to reclaim water within for-more than 45 days once of the tertiary-treated water supply has becomeing available. This does not preclude the use of fresh water on an emergency basis should the reclaim water be unavailable after the initial switch to reclaim water.

With the acceptance of these conditions, Midway Power believes that it is not necessary for the Committee to explore or require the TPP to employ dry-cooling technology to ensure compliance with its recent water resource policies.

# **COMMENT 7**

Applicant shall provide testimony on the issue of whether the dry cooling alternative described in the record would be an "economically unsound" option for the life of the project compared with the Aqueduct fresh water proposal or the Tracy recycled water alternative. RESPONSE 7

Midway Power does not believe that an "option" for dry cooling adds any value to the Final Decision. While we disagree somewhat on the details and assumptions that have gone into Staff's analysis, we agree that an air cooled project would have a significant cost disadvantage over an evaporative cooled facility. Reasonable estimates, based on today's market would place that disadvantage on the order of \$6-8 million/year in lost income due to lower output, coupled with a capital cost comparable to the reclaim water option being considered.

As to the issue of "economically unsound," the phrase is ambiguous. Certainly if the 2001 California power crisis situation were to repeat itself, a dry cooled project would be very economically attractive. Even a very poor efficiency, outdated technology project could prosper in such an environment. However the current situation is that numerous projects relying on evaporative cooling have been permitted in the last several years, and those projects have inherent cost and efficiency advantages over a dry cooled facility. Undertaking the incremental construction of a dry cooled TPP in that market against an advantaged competition would be a poor business decision, unless a severe market condition could be essentially guaranteed. Likewise we would not envision a situation in which a long term offtake agreement eould be structured for a higher cost, lower efficiency facility in a market in which lower eost alternatives are readily available.

Due to our lack of ability to totally rule out the return of a long term power crisis situation in California, we therefore cannot say the project would be "economically unsound." However we believe all evidence to date would suggest that such a project would be significantly economically disadvantaged.

As a result of the above, Midway Power believes that should final contractual arrangements with Tracy not work out, we would need to reopen the TPP siting process through a formal amendment. Such amendment would need to evaluate an alternative water supply and subject to a review of its impacts and legal compliance.



# The Use of Ambient Measurements To Identify which Precursor Species Limit Aerosol Nitrate Formation

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#### ABSTRACT

A thermodynamic equilibrium model was used to investigate the response of aerosol NO, to changes in concentrations of HNO<sub>2</sub>, NH<sub>2</sub>, and H<sub>2</sub>SO<sub>2</sub>. Over a range of temperatures and relative humidities (RHs), two parameters provided sufficient information for indicating the qualitative response of acrosol NO<sub>2</sub>. The first was the excess of acrosol NH<sub>4</sub><sup>+</sup> plus gas-phase NH, over the sum of HNO3, particulate NO3, and particulate SO<sup>12</sup> concentrations. The second was the ratio of particulate to total NO, concentrations. Computation of these quantities from ambient measurements provides a rnearts to rapidly analyze large numbers of samples and identify cases in which inorganic aerosol NO, formation is limited by the availability of NH<sub>2</sub>. Example calculations are presented using data from three field studies. The predictions of the indicator variables and the equilibrium model are compared.

#### INTRODUCTION

Elevated concentrations of particles of less than 10- $\mu$ m aerodynamic diameter (PM<sub>10</sub>) have been linked with daily mortality.<sup>1,2</sup> Some evidence suggests that health effects may be preferentially associated with particles of less than ~2.5- $\mu$ m aerodynamic diameter (PM<sub>2,2</sub>),<sup>3</sup> and new U.S.

#### IMPLICATIONS

A new method for analyzing ambient measurement data permits efficient estimation of the qualitative response of aerosol NO<sub>3</sub> to reductions of NH<sub>3</sub> or NO<sub>2</sub> emissions. Aerosol- and gas-phase measurements from one long-term and two short-term studies in California showed that, for most samples, aerosol NO<sub>3</sub> formation was not limited by the availability of NH<sub>3</sub>.

Environmental Protection Agency (EPA) ambient air quality standards have been promulgated for both  $PM_{2.5}$  and  $PM_{10}$ . In California, a substantial fraction of both  $PM_{2.5}$  and  $PM_{10}$  mass can consist of aerosol NO<sub>3</sub> during winter.<sup>4.5</sup> Thus, reduction of aerosol NO<sub>3</sub> may be necessary for meeting EPA ambient air quality standards for particulate matter in some areas.

Aerosol NO, derives from emissions of  $NO_x$ , but in a highly nonlinear manner. Gas-phase oxidation of  $NO_2$ yields HNO<sub>3</sub>; aqueous-phase reactions are unimportant by comparison.<sup>6</sup> During the day, HNO<sub>3</sub> is produced by reaction of NO, with OH:

$$OH + NO_2 \rightarrow HNO_1$$
 (R1)

At night, the following reactions become relatively more important:

$$O_3 + NO_2 \rightarrow NO_3 + O_2$$
 (R2)

$$NO_2 + NO_3 \leftrightarrow N_2O_5$$
 (R3, R4)

$$N_2O_3 + H_2O \rightarrow 2 HNO_3$$
 (R5)

The rate of  $HNO_3$  production, via reactions R1 through RS, is a nonlinear function of  $NO_x$  concentration.<sup>7</sup> When reaction R1 is limited by OH radical concentrations, decreases in the nonlimiting reactant,  $NO_2$ , will not decrease the rate of  $HNO_3$  formation until OH becomes nonlimiting. Reaction R1 becomes limited by radical concentrations as  $NO_x$  concentrations increase,<sup>8</sup> but whether the limiting reactant in reaction R1 is OH radical or  $NO_2$  depends on the rates of emissions of NO and  $NO_2$ , the rate of conversion of NO to  $NO_{2^2}$  and the rates of production

#### Blanchard et al.

and destruction of OH.<sup>6</sup> Reaction R1 is a sink for OH radical, whereas the competing reaction of OH with hydrocarbon species (RH) regenerates OH radical:<sup>8</sup>

$$RH + OH + O_2 \rightarrow RO_2 + H_2O$$
 (R6)

$$RO_2 + NO + O_2 \rightarrow R'CHO + HO_2 + NO_2$$
 (R7)

$$HO_1 + NO + O_2 \rightarrow OH + NO_2$$
 (R8)

The ratio of hydrocarbon species concentrations to NO<sub>4</sub> concentrations is, therefore, a key determinant of which reactant in reaction R1 limits the rate of production of  $HNO_3$ .

HNO<sub>3</sub> and NH<sub>3</sub> establish the following equilibrium:

HNO, 
$$(g) + NH_{1}(g) \leftrightarrow NH_{2}NO_{1}(a)$$
 (R9, R10)

where "g" and "a" denote the gas and acrosol phases, respectively. The formation of acrosol NO<sub>3</sub> via reaction R9 may be limited by the concentrations of either HNO<sub>3</sub> or NH<sub>3</sub>,<sup>9,10</sup> Concentrations of NH<sub>3</sub>, in turn, are affected by concentrations of H<sub>2</sub>SO<sub>4</sub> and HSO<sub>4</sub><sup>-</sup> via dissociation of aqueous H<sub>2</sub>SO<sub>4</sub> and reaction of HSO<sub>4</sub><sup>-</sup> or SO<sub>4</sub><sup>2-</sup> with NH<sub>3</sub>:

 $H_2SO_4$  (a)  $\leftrightarrow$  H<sup>+</sup> + HSO<sub>4</sub><sup>-</sup> (R10, R11)

 $HSO_4^- \leftrightarrow H^+ + SO_4^{2-}$  (R12, R13)

$$SO_4^2 + NH_1(g) \leftrightarrow (NH_4)_2SO_4 \quad (R14, R1S)$$

 $HSO_4^- + NH_3(g) \leftrightarrow (NH_4)HSO_4$  (R16, R17)

NH, may become limiting in reaction R9 because it reacts preferentially with H,SO<sub>4</sub> or HSO<sub>4</sub>-aerosol to form either (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> or NH<sub>4</sub>HSO<sub>4</sub> (reactions R14 and R16).<sup>67</sup> Reductions of SO<sub>2</sub>, while resulting in decreases of aerosol SO<sub>4</sub><sup>2-</sup>, can then lead to increases in aerosol NO<sub>2</sub>, as the NH, freed by the reverse reactions R15 and R17 becomes available to react with HNO, in reaction R9. NaNO, may also be generated via reaction of HNO, with NaCl in marine acrosol.<sup>11-13</sup> Whereas NH<sub>2</sub>NO<sub>2</sub> is typically found in the fine (PM2) aerosol fraction, NaNO, is more likely to occur in the coarse fraction (PM<sub>10</sub> less PM<sub>2.5</sub>).<sup>14.15</sup> Concentrations of NH<sub>3</sub>, HNO<sub>4</sub>, and NH<sub>4</sub>NO<sub>4</sub> (a) are frequently consistent with predictions based on the assumption of thermodynamic equilibrium.<sup>16</sup> However, departures from equilibrium have been shown to correlate with the time constants of equilibration, thus indicating that transport can limit aerosol NO, formation under some conditions.<sup>17</sup>

Because of the nonlinear relation of aerosol  $NO_3$  to concentrations of  $NO_3$  and other gas-phase species, and the possibility of nonequilibrium partitioning of  $NO_3$ .

between the gas and aerosol phases, complete prediction of the effects of reductions of  $NO_x$  or  $SO_2$  emissions on aerosol  $NO_3$  concentrations requires coupling gas-phase with aerosol models and treating nonequilibrium situations. Some equilibrium aerosol models have been incorporated into gridded emissions-driven atmospheric-chemistry models.<sup>17,18</sup> Also, aerosol models capable of treating both equilibrium and transport have been developed<sup>12,19</sup> and in some cases incorporated into 3-dimensional models.<sup>18,20</sup> However, in most cases, emissions and other data needed for driving and testing gridded, emissions-driven aerosol models are lacking or inaccurate; emissions of  $NH_3$  are especially uncertain.<sup>21</sup> Procedures for rigorously evaluating 3-dimensional aerosol model applications have not been developed.

When the assumption of thermodynamic equilibrium is warranted, thermodynamic equilibrium models can be used to predict the effects of changes of NH, and HNO, concentrations on acrosol NO, levels.10 Such models permit evaluation of NH, limitation (reaction R9), but do not incorporate the gas-phase reactions leading to HNO, production (reactions R1 through R5) and so cannot address the response of HNO<sub>4</sub> to changes in NO<sub>2</sub> concentrations. Equilibrium models are nonetheless useful for predicting where and when aerosol NO, might exhibit little or no response to reductions in HNO, as a result of NH<sub>1</sub>-limiting conditions. SEQUILIB<sup>22</sup> has been used to predict the effects of emission reductions on acrosol NO<sub>3</sub> in Phoenix, AZ, by constructing model-predicted isopleths of particulate NO, concentration as a function of total (aerosol plus gas-phase) NO3 and NH3 concentrations for two samples." While it would be generally desirable to evaluate a large number of samples over a lengthy period of time, the construction of such isopleth plots for each sample involves substantial effort.

In the present work, the response of aerosol NO<sub>3</sub> to changes in concentrations of  $HNO_3$ ,  $NH_3$ , and  $SO_4^{-2-}$  is investigated using a thermodynamic equilibrium model. It is shown that, over a range of temperatures and relative humidities (RHs), simple parameters determined from ambient measurements may be used to indicate if an aerosol is sensitive to  $HNO_3$  or  $NH_3$ , without having to employ the thermodynamic model to construct detailed isopleth plots for each sample. Computation of two parameters from ambient measurements thus provides a means to rapidly analyze large numbers of samples and identify cases in which aerosol  $NO_3$  formation is limited by the availability of  $NH_4$ , provided thermodynamic equilibrium holds. The approach is illustrated using data from three field studies.

# SIMULATION OF EQUILIBRIUM AEROSOL COMPOSITION

The model "Simulating Composition of Atmospheric Particles at Equilibrium" (SCAPE2)<sup>23,27</sup> was used to simulate thermodynamic equilibrium reactions affecting particulate NO<sub>3</sub> concentrations. Farlier equilibrium models of the SO<sub>4</sub><sup>2-</sup>-NO<sub>3</sub>-NH<sub>3</sub> system, such as SEQUILIB,<sup>22</sup> have been superseded by SCAPE2.<sup>23,24</sup> A version dated October 1996 was used; it incorporates crustal elements<sup>25</sup> and carbonates<sup>26</sup> in addition to the SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub>, NH<sub>3</sub>\*, and Na\* species in the original model.

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Simulations with SCAPE2 were carried out here by varying humidity, temperature, and the concentrations of SO<sub>2</sub><sup>2+</sup>, HCl, Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, and CO<sub>2</sub><sup>2+</sup> as follows: (1) CO, concentration was set at 360 ppmv (the model then establishes equilibrium between the gas- and aqueousphase CO, concentrations, with the assumption that gasphase CO<sub>1</sub> concentrations are much larger than, and therefore unaffected by, the solid-phase CO<sub>3</sub><sup>2-</sup> concentrations); (2) total Cl<sup>-</sup> (as HCl), Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, and Mg<sup>2+</sup> concentrations were each set to either 0.2 or  $2 \mu g/m^3$ ; (3) total  $5O_4^{2-}$  concentration (as H<sub>2</sub>SO<sub>4</sub>) was set at 3, 10, or  $25 \,\mu g/m^3$ ; (4) temperature was set at 273 K (0 °C), 278 K (5 °C), 283 K (10 °C), 288 K (15 °C), 293 K (20 °C), 298 K (25 °C), 303 K (30 °C), or 308 K (35 °C); and (5) RH was set at 20, 40, 60, 80, or 95%. The species concentrations were selected to cover ranges that occurred in ambient samples (see later discussion), while the temperature and RH settings were chosen to cover a range of values typical of ambient conditions. For each of the 240 combinations of the preceding conditions, 100 simulations were carried out by varying the total NO, from 1 to 91  $\mu$ g/m<sup>3</sup> in increments of  $10 \,\mu g/m^3$  and by varying total NH, from 2 to  $38 \,\mu g/m^3$ in increments of 4 µg/m<sup>4</sup>. Isopleths of particulate NO<sub>4</sub> concentration as a function of total NO<sub>3</sub> and as NH, concentrations were constructed for each case. Functions that delineated the transition from NH<sub>2</sub>- to HNO<sub>2</sub>-limited regions of each isopleth plot were then identified.

A second series of simulations was carried out in which total NO<sub>3</sub> and SO<sub>4</sub><sup>2-</sup> were each varied from 1 to  $91 \mu g/m^3$  in increments of  $10 \mu g/m^3$ . Model results were obtained for a range of values of NH<sub>3</sub> (4, 16, 28, and 40  $\mu g/m^3$ ) at each of the preceding combinations of temperature, RH, and species concentrations, amounting to 320 sets of conditions. A total of 100 simulations were used to construct isopleth diagrams for each combination.

#### Indicators of Ammonia- and Nitrate-Limited Regimes

For a range of temperatures and RHs, isopleths of particulate NO<sub>3</sub> concentrations as a function of total NO<sub>3</sub> and total NH<sub>3</sub> are approximately L-shaped, with a fairly sharp transition between horizontal and vertical contours (Figure 1). Each plot can be divided approximately into  $HNO_3$ and  $NH_3$ -limited regions. Where the isolines are horizontal, aerosol NO<sub>3</sub> formation is not  $NH_3$ -limited, nearly all the NO<sub>3</sub> exists in the particulate phase, and reductions of total NO<sub>3</sub> yield approximately equal reductions of particulate NO<sub>3</sub>. Where the isolines are vertical, aerosol NO<sub>3</sub> formation is NH<sub>3</sub>-limited, less NO<sub>3</sub> exists in the particulate phase, and reductions of total NO<sub>3</sub> do not yield reductions of particulate NO<sub>3</sub>. Qualitatively similar results are obtained for intermediate RHs (40 and 60%), lower concentrations of SO<sub>4</sub><sup>2+</sup> (3 and 10  $\mu$ g/m<sup>3</sup>), and lower concentrations of HCl, Na<sup>+</sup>, Cl<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, and Ca<sup>2+</sup> (0.2  $\mu$ g/m<sup>3</sup>). Locations of the isopleths shifted as the concentrations of SO<sub>4</sub><sup>2-</sup> and other species were varied, but the shapes of the isopleths were similar to those plotted here.

Two indicators of the transition between the  $NH_{3}$ and  $NO_{3}$ -limited portions of the isopleth plots can be identified, and these are shown in Figure 1. The first indicator is a quantity defined here as "excess  $NH_{3}$ "

 $\begin{aligned} & \text{Excess NH}_{3} = [\text{NH}_{3}(g)] + [\text{NH}_{4}^{+}(a)] - 2\\ & [\text{SO}_{4}^{2*}(a)] - [\text{NO}_{3}^{-}(a)] - [\text{HNO}_{3}(g)] - [\text{HCI}(g)] + \\ & 2 [\text{Ca}^{2*}] + 2 [\text{Mg}^{2*}] + [\text{Na}^{+}] + [\text{K}^{+}] - [\text{CI}^{-}] \end{aligned} \tag{1}$ 

where all concentrations are in units of  $\mu mol/m^3$ . Equation 1 incorporates the key aerosol- and gas-phase species needed to delineate the transition between the two response regions shown in Figure 1. As indicated, the line of zero excess NH, approximately divides each subplot into HNO,limited and NH<sub>3</sub>-limited regions. The effectiveness of eq 1 in demarking this division is a reflection of the importance of SO<sub>4</sub><sup>2-</sup> and NH, (reactions R9, R14, and R16) in determining aerosol NO<sub>3</sub> concentrations; eq 1 also incorporates other species (e.g., Na<sup>+</sup>) whose concentrations affect the equilibrium concentration of aerosol NO<sub>3</sub>. The thermodynamically preferred forms of SO<sub>4</sub><sup>2-</sup> are aqueous or solid Na,SO<sub>4</sub> and (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, and a key determinant of the equilibrinm state is the molar ratio of total NH,\* and Na\* to  $SO_{a^{2}-2^{4}}$  Systems in which  $[NH_{a}(g)] + [NH_{a^{*}}(a)] + [Na^{*}] -$ 2  $[SO_4^{2+}(a)] > 0$  are  $SO_4^{2+}$ -poor, and the excess gas-phase NH<sub>3</sub> drives HNO<sub>3</sub> and HCl into the particulate phase.<sup>24</sup>

As shown in Figure 1, the line of zero excess NH, delineates the transition between NH, and HNO<sub>3</sub> limitation under all conditions, but the transition is not very sharp for a temperature of 303 K and an RH less than 80%. Even at temperatures from 293 to 303 K, the contours are less strictly vertical and horizontal than they are at 283 K and an RH of 80% or less. Where the contours are rounded at the transition, reductions of either HNO<sub>3</sub> or NH<sub>3</sub> concentrations produce reductions of aerosol NO<sub>3</sub> on both sides of the line of zero excess NH<sub>3</sub>. However, in the NH<sub>3</sub>-limited region, reduction of NH<sub>3</sub> produces a greater reduction of aerosol NO<sub>3</sub> than does an equivalent reduction of total NO<sub>3</sub>; in the HNO<sub>3</sub>-limited region, reduction of HNO<sub>3</sub> produces a greater reduction of aerosol NO<sub>3</sub> than does an equivalent reduction of NH<sub>3</sub>.



Figure 1. Isopleths of particulate NO<sub>3</sub> concentration ( $\mu$ g/m<sup>2</sup>) predicted by SCAPE2 as a function of total NH<sub>3</sub> and total NO<sub>3</sub>. The concentrations of other species were 25  $\mu$ g/m<sup>3</sup> for total SO<sub>4</sub><sup>2+</sup> (as H<sub>2</sub>SO<sub>4</sub>) and 2  $\mu$ g/m<sup>3</sup> for total CF (as HCI), Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, and K<sup>+</sup>.

A second departure from L-shaped contours is evident at an RH of 95% and temperatures less than ~283 K, where particulate NO, concentration responds to HNO, concentration even in the NH<sub>4</sub>-limited region (see Figure 1). The departure of the NO, isopleths from vertical in the NH,-limited region at an RH of 95% implies that more NO, exists in the aerosol phase than would be the case if the isopleths were vertical. The shape of the NO, isopleths at 95% RH closely resembled the shape of isopleths of aerosol liquid-water content (not shown), implying that the greater the liquid-water content, the more gas-phase NO, can be brought into the aerosol phase. We also examined NH, isopleths, which do not deviate from the L-shaped pattern at an RH of 95%. The NH<sub>4</sub>\* isopleths are vertical in the NH<sub>1</sub>-limited region because essentially all NH<sub>3</sub> is found in the aerosol phase, so higher liquid-water content cannot bring in more NH, from the gas phase. These results illustrate the need for exercising caution when considering samples having an RH of 95% or more; in the example analyses described later, samples having an RH of 95% or more are excluded.

The second indicator of the transition between the  $NH_{3}$ - and  $NO_{3}$ -limited portions of the (sopleth plots is the ratio of particulate to total  $NO_{3}$ . The transition between the vertical and horizontal contours of particulate  $NO_{3}$  is approximated by a value of this ratio of 0.9 for temperatures less than 293 K. At higher temperatures, a ratio of particulate to total  $NO_{3}$  exceeding 0.9 conservatively demarks the region of horizontal isopleths (HNO<sub>3</sub> responsiveness).

Example simulations in which SO<sub>4</sub><sup>2-</sup> concentrations were varied for fixed total NH, and RH are shown in Figure 2. lsopleths for the other NH<sub>3</sub> concentrations (4, 16, and  $40 \,\mu g/m^3$  were similar in shape but differed in their specific locations. Negative excess NH, occured to the right of the line of zero excess NH, and delineated the region of NH, limitation. In this region, decreases in total SO<sub>4</sub><sup>2+</sup> concentration increased particulate NO, concentrations by amounts that slightly exceeded (on a mass basis) the SO<sub>4</sub><sup>2-</sup> decreases. In such SO<sub>4</sub><sup>2-</sup>-rich systems, most NO<sub>3</sub> exists in the gas phase as HNO<sub>3</sub>; removal of SO<sub>4</sub><sup>2-</sup> frees NH<sub>3</sub> to react with HNO<sub>1</sub>, yielding aerosol NO<sub>3</sub> (reactions R1S and R17). In contrast, for excess NH, greater than zero, changes in total SO 2- have no effect on particulate NO3. Such systems are SO42-poor and the excess NH<sub>3</sub> has already driven most of the HNO<sub>3</sub> into the particulate phase, so SO<sub>4</sub><sup>2-</sup> reductions cannot increase aerosol NO<sub>3</sub> concentrations any further.

#### Estimation of Uncertainties in Calculating the Two Indicators

The variance in the estimate of excess NH<sub>3</sub> is the sum of the variances of the measurements that comprise excess NH<sub>3</sub>

$$\sigma_{\ell \kappa \sigma s NH_{3}}^{2} = \sigma_{NH_{3}}^{2} + \sigma_{NH_{3}}^{2} + \sigma_{HNO_{3}}^{2} + \sigma_{NO_{3}}^{2} + 4\sigma_{NO_{3}}^{2} + 4\sigma_{NO_{3}}^{2} + 4\sigma_{NO_{3}}^{2} + \sigma_{NO_{3}}^{2} + \sigma_{NO_{3}$$

where units are  $(\mu mol/m^3)^2$  (the factors of 4 appear for divalent species). If excess NH<sub>3</sub> is approximated in terms of SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub>, and NH<sub>3</sub> species only, the last six variances on the right side of the preceding equation are dropped. If variances represent laboratory measurement precision rather than accuracy, the formula above gives a lower bound. Letting *R* denote the molar ratio of particulate to total NO<sub>3</sub>, error propagation methods based on Taylor's series expansions<sup>29</sup> give

$$\sigma_{R}^{2} = R^{2} \left( 1 - R^{2} \right) \left( C V_{a}^{2} + C V_{r}^{2} \right)$$
(3)

where CV refers to the coefficient of variation (the ratio of the standard deviation to the concentration). The uncertainty in the computed ratio becomes smaller as R approaches either 0 or 1 and is otherwise dominated by the measurement having the larger uncertainty.

#### APPLICATIONS TO FIELD PROGRAMS

To illustrate the potential application of the indicator indices for NH<sub>4</sub>NO<sub>5</sub> formation, data were obtained from the following major air quality studies, all of which were carried out in California under the auspices of the California Air Resources Board and other sponsors: the 1988–1994 California Acid Deposition Monitoring Program (CADMP);<sup>29-31</sup> the 1987 Southern California Air Quality Study (SCAQS);<sup>42,44</sup> the 1990 San Joaquin Valley Air Quality Study (SJVAQS);<sup>44,35</sup> and the 1995 Integrated Monitoring Study (IMS9S).<sup>36,37</sup> These studies were initially selected because their databases included measurements of all species needed. However, the SJVAQS and summer SCAQS data were not used, since those measurements were made when secondary particulate concentrations were generally low.

The SCAQS and IMS9S were short-term studies, while the CADMP data cover a multiyear period. The SCAQS measurements were obtained with a 4- to 6-hr time resolution on 6 days at six sites in the Los Angeles area: Anaheim, Burbank, downtown Los Angeles, Hawthorne, Long Beach, and Riverside. The CADMP database<sup>29-31</sup> provides a long-term record (mid-1988 to September 1994, with sampling once every 6 days) of gas-phase species (NO<sub>5</sub>,  $NH_{3'}$  SO<sub>3'</sub> and HNO<sub>3</sub>) and major inorganic constituents of both PM<sub>10</sub> and PM<sub>2.5</sub> size fractions at 12-hr resolution at 10 locations: four in Southern California (Santa Barbara, Long Beach, downtown Los Angeles, and Azusa); one in the San Francisco area (Fremont); two in the Central Valley (Sacramento and Bakersfield); two in the Sierra Nevada (Yosemite and Sequoia National Parks); and one along the coast near Oregon (Gasquet). The IMS95 data Blanchard et al.



Figure 2. Isopleths of particulate NO<sub>3</sub> concentration ( $\mu g/m^3$ ) as a function of total SO<sub>3</sub><sup>2+</sup> and total NO<sub>3</sub> for total NH<sub>3</sub> concentration of 28  $\mu g/m^3$ , RH of 80%, and four temperatures.

include extensive, short-term measurements with a 3-hr time resolution on 10 days in December 1995 and January 1996 at four core monitoring sites in central California. The sites were in Bakersfield and Fresno, the two largest cities in the San Joaquin Valley, and the Kern Wildlife Refuge and Chowchilla, which are nonurban locations.

Previous studies have shown that the concentrations of the gas and aerosol phases of most SCAQS samples were consistent with thermodynamic equilibrium.<sup>12,18</sup> However, many summer SCAQ5 samples from Long Beach were not at equilibrium,<sup>12</sup> and measurements (not used here) from San Nicolas Island, located ~100 km offshore, were also not consistent with thermodynamic equilibrium.<sup>48</sup> In the present study, only the winter SCAQS data are used, and no data are used from San Nicolas Island. The SCAQS PM concentrations were higher during winter than during summer, so the winter samples are of more interest from a regulatory perspective. The better agreement between SCAPE-predicted and measured gas-aerosol partitions for winter than for summer SCAQS samples is probably because the winter samples were more concentrated<sup>38</sup> and their relative measurement uncertainties were lower. The deviations between predicted and measured values for some samples were such that more aerosol NO<sub>3</sub> was measured than predicted, which has been attributed to variations of temperature and humidity within the 4- to 7-hr periods during which SCAQS samples were collected, and possibly to the presence of supersaturated water.<sup>48</sup> The measured and calculated concentrations also showed better agreement for PM<sub>2.5</sub> than for PM<sub>10</sub>,<sup>30</sup> which may be a consequence of longer equilibration times for larger particles.<sup>12,48</sup> Only the PM<sub>2.5</sub> measurements are used in the present study.

SCAPE2 was used here to calculate the equilibrium partition of NO<sub>3</sub> and NH<sub>4</sub><sup>+</sup> at all CADMP and IMS9S sites, as has been done previously for the SCAQS data.<sup>44</sup> Only data that were not flagged in any way as suspect and that also had accompanying meteorological measurements were used. The inputs to the calculation were temperature, RH, the measured total NO<sub>3</sub> (denuder-difference HNO<sub>3</sub> plus the particulate NO<sub>3</sub> downstream of the denuder), total NH<sub>4</sub><sup>+</sup> (NH<sub>3</sub> plus particulate NH<sub>4</sub><sup>+</sup>), SO<sub>4</sub><sup>2+</sup>, Cl<sup>-</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, and K<sup>+</sup> concentrations. All aerosol measurements were taken from the PM<sub>2.5</sub> portion of the data. For each sampling period (3- to 12-hr duration), mean temperatures and dew-point temperatures were computed from which the mean RH was determined.

In each case, the output of the calculation was a prediction of the partition between the aerosol and gas phases. For nearly all samples, the differences between predicted and actual partitions were not significantly greater than measurement uncertainties, which varied from ~1 to 10 µg/m<sup>1</sup>, depending on species and concentration. The measurement uncertainties were estimated from the replicability of two collocated samplers, which does not reflect possible measurement biases, but does provide some indication of the potential significance of the deviations between predicted and measured values. Filter-pack measurements of actosol NO, and HNO, are known to be biased low and high, respectively, due to the temperature-dependent dissociation of aerosol NO<sub>3</sub> on filters after collection.<sup>29,39</sup> Conversely, the CADMP denuder-difference HNO, measurements are thought to be biased low, though the total NO<sub>3</sub> concentrations are likely accurate.<sup>40,31,40</sup> When sampling replicability and possible biases are considered, the equilibrium assumption is not refuted for the CADMP data.

For IMS95 data, the largest deviations between predictions and measurements were associated with samples having RHs in excess of ~95%. During IMS95, many days had some amount of precipitation, and RHs greater than -95% were usually associated with fog or rain. When fog or cloud droplets are present, the total NH<sub>3</sub> and NO<sub>3</sub> concentrations determined from the gas and aerosol phases cannot be assumed to accurately reflect aqueous-phase concentrations, since most fog, clond, or rain droplets would be excluded by the  $PM_{10}$  and  $PM_{2.5}$  cut points of the samplers. The equilibrium assumption was not refuted for other samples.

For all data sets, samples having RHs exceeding 95%, were excluded from subsequent calculations. As previously noted, the SCAQS summer data were also excluded. In addition, samples having aerosol NO<sub>3</sub> concentrations of less than 1  $\mu$ g/m<sup>3</sup> or aerosol NH<sub>4</sub><sup>+</sup> concentrations of less than 0.3  $\mu$ g/m<sup>3</sup> were not subsequently analyzed, as such low concentrations are of lesser interest and approach the lower quantifiable limits of the laboratory measurements.<sup>29,41</sup> The number of samples for each site and their mean concentrations of selected species are summarized in Table 1.

#### **Criterion of Equilibrium**

It is expected that more routine application of the methods described earlier would be carried out without concomitant application of a thermodynamic equilibrium model. Therefore, it is desirable to have available a datadriven method for characterizing the adequacy of assuming thermodynamic equilibrium. An indicator of equilibrium ( $C_{ab}$ ) may be computed when size-segregated data are available<sup>12</sup>

$$C_{\mu\mu} = 1 - (1/2) \int_{0.05}^{D_{\mu}N_{\mu}} M_{\mu}(D_{\mu})/M_{\mu}^{\perp} - M_{\mu}(D_{\mu})/M_{\mu}^{\perp} \mid dD_{\mu} (4)$$

where  $D_p$  is aerodynamic particle diam,  $M_a$  is moles of  $NO_{3^{12}}$  and  $M_a$  is moles of  $NH_4^*$ . The  $C_{an}$  is determined by integration over the size range from 0.05 µm to  $D_{p,Na^{12}}$  where  $D_{p,Na^{12}}$  is the size below which the number of moles of Na<sup>+</sup> is less than one-tenth the number of moles of  $NH_4^{+,12}$  The  $C_{an}$  varies from 0 to 1 and characterizes the degree of similarity in the size distributions of  $NH_4^{+}$  and  $NO_3$  (the value of 1 is obtained for identical size distributions). It serves as an indicator of equilibrium based on the finding that the size distributions of  $NH_4^{+}$  and  $NO_3$  must be the same for equilibrium to prevail.<sup>12</sup>

For the winter SCAQS samples, most of the  $C_{av}$  values exceeded -0.8, indicating samples close to equilibrium.<sup>12</sup> No size-segregated samples were available in the CADMP data. In the IMS95 study, 12 samples, each of 12-hr duration, were obtained at Bakersfield using a micro-orifice uniform deposit impactor (MOUDI)<sup>42</sup> having 9 size ranges. A discrete equivalent of the  $C_{av}$  equilibrium indicator<sup>12</sup> was computed, yielding values of 0.94-0.98 (indicating nearequilibrium conditions) for 9 of the 12 samples. The remaining three samples, which had the lowest concentrations of particulate NO<sub>3</sub> and NH<sub>4</sub><sup>+</sup>, had indicator values of 0.88, 0.71, and 0.52. Although the latter two are suggestive of departures from equilibrium, measurement uncertainties exceeded the recorded concentrations on about half the size ranges (acrosol NO<sub>3</sub> concentrations

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Table 1. Mean concentrations of selected species, by network and site, for samples used in the analyses (see text).

Network	Site*	Sample Collection Period	Sample Duration (hr)	Number of . Samples	Mean Concentration ( $\mu$ g/m <sup>3</sup> )				
					HNO, "	NH <sub>3</sub>	NO <sub>3</sub> *	NH <sub>2</sub> H	so,⊁
IMS95	Bakersfield	Dec 95-Jan 96	3	34	2.6	6.9	15.9	5.3	2.5
	Fresno	Dec 95–Jan 96	З	27	2.7	5.8	16.3	4.7	2.3
	Kern Wildlife	Dec 95–Jan 96	3	24	7.2	4.9	20.5	5.8	2.1
	Chowchilla	Dec 95-Jan 96	3	12	1.1	8.1	16.5	5.3	2.4
CADMP	Azusa	May 88–Sept 94	12	281	8.1	6.3	5.0	2.6	3.9
	Bakersfield	May 88–Sept 94	12	129	3.6	13.8	14.8	4.3	3.1
	Fremont	June 88–Sept 94	12	115	2.7	4.1	9.1	2.2	19
	Los Angeles	May 88–Sept 94	12	283	7.0	8.3	5.0	2.5	4.0
	Long Beach	May 88-Sept 94	12	229	4.2	6.7	7.9	2.5	4.2
	Sacramento	Oct 88-Sept 94	12	51	2.2	9.5	8.0	2.4	1.8
	Santa Barbara	Apr 88-Sept 94	12	18	2.7	2.7	4.5	1.8	4.2
	Sequoia N.P.	May 88-Sept 94	12	7	1.1	1.4	3.6	0.9	1.4
	Yosemite N.P.	May 88-Sept 94	12	3	0.5	3.9	3.4	8.0	1.2
SCAQS	Anaheim	Nov 87-Dec 87	46	25	2.0	9.2	34.6	14.9	4.5
	Burbank	Nov 87-Dec 87	46	27	7.3	7.0	28.9	11.0	4.1
	Central LA	Nov 87-Dec 87	46	26	1.8	7.7	31.5	11.9	5.0
	Hawthorne	Nov 87-Dec 87	46	26	1.2	7.9	24.4	9.6	5.8
	Long Beach	Nov 87-Dec 87	4–6	26	1.6	6.0	22 1	10 <b>1</b>	4.8
	Riverside	Nov 87-Dec 87	46	17	0.3	38.0	32.3	17.6	4.0

<sup>3</sup>CADMP site al Gasquet had no samples with aerosol NO<sub>3</sub> exceeding 1 µg/m<sup>3</sup>; <sup>6</sup>By denuder difference for IMS95 and SCAQS and by filler-pack for CADMP; <sup>6</sup>Denuded for IMS95 and SCAQS; nondenuded for CADMP; <sup>6</sup>Denuded for IMS95 and CADMP.

were less than 0.4  $\mu$ g/m<sup>3</sup> on all size ranges of the sample with  $C_{an} = 0.52$ ). Thus, measurement errors, rather than departures from equilibrium, might account for the lower indicator values. While PM<sub>2.5</sub>, rather than MOUDI, samples were used for subsequent analyses, the MOUDI data do reinforce the need to restrict data analyses to samples for which measurement uncertainties are not greater than the recorded concentrations. As previously noted, samples having particulate NO<sub>3</sub> concentrations of less than 1  $\mu$ g/m<sup>3</sup> were excluded from analyses.

Computation of the C<sub>m</sub> indicator requires size-differentiated samples, which typically are not available. A simplified version of  $C_{\mu\nu}$  is next considered here, calculated using concentrations from the PM2.5 and PM10 size fractions. The speciated PM2.5 and PM10 concentration data from the SCAQS were used to compute the value of the simplified  $C_{an}$ , which was then compared to published values of  $C_{an}$  for the same data.<sup>12</sup> Although the correlation was modest ( $r^2 = 0.41$ ), both  $C_{an}$  and the simplified version tended to exceed a value of -0.8 together or to fall below that value together. Lacking other means for evaluating the equilibrium assumption, computation of the simplified  $C_{m}$  could be used as a screening test, with values less than -0.8 indicating samples for which an equilibrium approximation might be inappropriate. Surrogate C<sub>av</sub> values were computed for the CADMP and IMS95 sites

and generally exceeded 0.9 for particulate NO<sub>3</sub> concentrations in excess of 10  $\mu$ g/m<sup>3</sup>. These analyses agree with the SCAPE-predicted partitions and the MOUDI-based  $C_{\mu r}$  values in indicating that most of the samples were close to equilibrium.

#### The Limiting Reactants

Two approaches were used for identifying which reactant (HNO<sub>3</sub> or NH<sub>3</sub>) limited the formation of aerosol NO<sub>3</sub>. First, SCAPE2 was used to predict aerosol NO<sub>3</sub> concentrations after either total NH<sub>3</sub> or total NO<sub>3</sub> concentrations were reduced. These predictions were compared with current aerosol NO<sub>3</sub> concentrations, as predicted by SCAPE2, to determine the aerosol NO<sub>3</sub> reduction. Calculations were made for mass reductions of either total NO<sub>3</sub> or total NH<sub>3</sub> of 10, 20, and 40%. Second, excess NH<sub>3</sub> (as previously defined) was computed for each of the monitoring locations in each database using the PM<sub>2.5</sub> size fraction measurements of all inorganic species and the measurements of the gas-phase species, HNO<sub>3</sub>, and NH<sub>3</sub>. Measurement uncertainties were also used to compute an uncertainty in each value of excess NH<sub>3</sub>.

The results indicated that the majority of samples had excess  $NH_3$  exceeding zero (Figure 3). The modelpredicted fractional  $NO_3$  reductions, also shown in Figure 3, are the ratios of the decrease in aerosol  $NO_3$  to the



**Figure 3.** Fractional reduction in aerosol NO<sub>3</sub> following reduction of either total NO<sub>3</sub> or total NH<sub>3</sub> vs. excess NH<sub>3</sub> for data from the SCAOS, IMS95, and CADMP sites. The decreases in aerosol NO<sub>3</sub> were computed by epplying SCAPE2 to the available data (base case) and comparing the predicted base-case aerosol NO<sub>3</sub> to the aerosol NO<sub>3</sub> that was predicted after reducing either the total NO<sub>3</sub> concentration (HNO<sub>3</sub> precursor reduction) or the total NH<sub>3</sub> concentration (NH<sub>3</sub> precursor reduction) of each sample by 20% of its base-case value. The fractional reduction is base-case NO<sub>3</sub> concentration minus reduced-precursor NO<sub>3</sub> cencentretion, divided by base-cese NO<sub>3</sub> concentration. The CADMP data are split into temperatures below or above 290 K.

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base-case total NO<sub>3</sub> concentration (base-case NO, concentration minus reduced-precursor NO<sub>3</sub> concentration, divided by base-case NO<sub>5</sub> concentration). Since a fractional NO<sub>3</sub> reduction was computed for each sample by running the model with reduced concentrations of either total NH<sub>3</sub> (precursor decreased: NH<sub>3</sub>) or total NO<sub>3</sub> (precursor decreased: HNO<sub>4</sub>), the outcomes of the two different precursor reductions may be compared. The model predicted that the majority of samples having positive excess NH<sub>3</sub> would show greater reductions of aerosol NO<sub>3</sub> if total NO<sub>3</sub> rather than total NH<sub>3</sub> were reduced (see Figure 3). The results for 10 and 40% reductions of total NO<sub>3</sub> or total NH<sub>3</sub> are qualitatively similar to those shown in Figure 3 for 20% reductions.

The CADMP data include more samples and more sites than do the SCAQS or IMS95 data (see Table 1). The CADMP data also exhibit a greater range of temperatures (272-303 K, mean 289 K) and RHs (13-94%, mean 51%) than do the data from SCAQS (281-299 K, mean 289 K; RH of 26-93%, mcan 60%) and IMS95 (276-290 K, mean 283 K; RH of 41-95%, mean 79%). The greater number of samples and larger range of conditions lead to more variability in the results for the CADMP samples (see Figure 3). In part, some of the variability is attributable to measurement uncertainties: among all three data sets, the standard deviations of the measured excess NH, (eq 2) were typically in the range of 0.05-0.2 µmol/m<sup>3</sup>. However, some variability is also related to temperature and RH conditions. The CADMP data are split into temperatures below or above 290 K to illustrate the effects of temperature (see Figure 3). At temperatures below 290 K, the distinction between model-predicted NO, reductions following either NH, or HNO, precursor reduction is sharper than at temperatures above 290 K (see Figure 3). As previously discussed, the distinction between the NH,-limited and HNO<sub>i</sub>-limited regimes is not as sharp for temperatures of 293 and 303 K as it is for temperatures of 273 and 283 K when RH is less than 80% (see Figure 1).

The transition between NH<sub>3</sub> limitation and HNO<sub>3</sub> limitation occurred when excess NH<sub>3</sub> was zero in the model simulations (see Figure 1). At the transition, reductions of either precursor reduce the aerosol NO<sub>3</sub> concentrations with approximately equal effectiveness (see Figure 1). In the ambient SCAQ5, IMS95, and lower-temperature (<290 K) CADMP data, the fractional aerosol NO<sub>3</sub> decrease occurring when total NO<sub>3</sub> was reduced was approximately equal to that occurring when total NH<sub>3</sub> was reduced for samples with excess NH<sub>3</sub> of ~0 to 0.1 µmol/m<sup>3</sup> (see Figure 3). For CADMP data with T ≥ 290 K, the variability of the results in Figure 3 precludes identification of a definitive value of excess NH<sub>3</sub> at which the precursor reductions yielded equal NO<sub>3</sub> reductions, though the equal-reduction value nearly always occurred for excess NH<sub>3</sub> in the range of -0 to 0.2 µmol/m<sup>3</sup>. Thus, in all data sets, the transition between NH<sub>3</sub> limitation and HNO<sub>3</sub> limitation occurred for samples having values of excess NH<sub>3</sub> slightly above zero, rather than at zero. The small difference may be an artifact of our calculation of excess NH<sub>3</sub>, which excluded HCl, for which measurements werc unavailable (see eq 1).

The consistency between the model predictions and the value of excess NH, may be evaluated quantitatively as follows. We define samples as NH,-limited when excess NH, is less than zero, as HNO,-limited when excess NH, exceeds 0.1 µmol/m<sup>3</sup>, and as transitional for excess NH<sub>3</sub> of 0-0.1  $\mu$ mol/m<sup>3</sup> (Table 2). The transitional region represents the samples for which reduction of either precursor reduces particulate NO<sub>3</sub> concentrations (it is not symmetric around 0 because our values of excess NH, may be high due to the absence of HCl data). The model predicted that 39 of the 40 NH<sub>3</sub>-limited samples would show greater reductions of aerosol NO<sub>1</sub> when NH, was reduced than when total NO, was reduced (see Table 2). It also predicted that 167 of the 168 SCAQS and IMS95 HNO,-limited samples, and 931 of the 986 CADMP HNO,-limited samples, would show greater reductions of aerosol NO, when total NO, was reduced than when total NH, was reduced (see Table 2). The excess NH, criterion was, therefore, highly consistent with model predictions.

Of the 2S transitional SCAQ5 and IM595 samples, 21 were HNO<sub>3</sub>-limited, so for those two studies, the transition between the NH<sub>3</sub>-limited and HNO<sub>3</sub>-limited regions was very sharp at zero excess NH, However, the greater variability observed in the long-term CADMP data set may be more typical of ambient measurements than the lesser variability of the short-term SCAQS and IM595 data, so, in general, it is more appropriate to use the excess NH,\* criterion to divide the data into three subsets, which include a set of transitional values. The largest group of misclassifications were the 55 CADMP samples with excess NH, exceeding 0.1 µmol/m3 that were predicted by the model to show greater reductions of particulate NO, in response to NH, reductions than in response to HNO, reductions. However, 40 of these SS samples had aerosol NO<sub>4</sub> concentrations of 5  $\mu$ g/m<sup>3</sup> or less, and all had predicted NO3 reductions less than 0.4 µg/m<sup>4</sup> (temperatures were 288-302 K and the RH range was 18-65%), so most had concentrations close to the levels of measurement uncertainty. In comparison with model predictions, the overall excess NH, misclassification rate was less than 5%.

In the SCAQS database, excess  $NH_3$  was consistently positive at Riverside, exceeding about 1 µmol/m<sup>3</sup> over a wide range of particulate  $NO_3$  concentrations. In contrast, excess  $NH_3$  was negative over a range of particulate  $NO_3$ concentrations at Burbank. Thus, Riverside was generally

		Exc	n³)	
Study	Madøl Prediction®	cO (Humber of Samples)	0–0.1 (Number of Samples)	≥0.1 (Number of Samples)
SCAQS	NH,	- 14	1	1
	HNO,	0	9	99
IMS95	NH,	10	3	0
	HNO,	1	12	68
CADMP	NH	16	53	55
	HNŐ,	Ο.	61	931

**Table 2.** Comparison of zerosol NO<sub>3</sub> precursor limitation predicted by the thermodynamic equilibrium model and by the criterion of excess NH<sub>4</sub>.

"The precursor whose reduction led to the larger reduction of aerosol NO\_.

 $NH_3$ -rich while Burbank was usually  $NH_3$ -limited. The other SCAQS sites showed a mix of conditions. Most of the CADMP data showed only positive excess  $NH_3$  and no evidence of  $NH_3$  limitation. Most of the IMS95 measurements had positive excess  $NH_3$  concentrations; about one-third of the samples from Kern Wildlife Refuge had near-zero or negative excess  $NH_3$ . For the IMS95 data, excess  $NH_3$  determined for the 3-hr samples was compared with excess  $NH_3$  computed after aggregating the measurements to 24-hr averages. Excess  $NH_3$  determined from each 24-hr average reproduced the mean of the excess  $NH_3$  computed from the constituent 3-hr samples, but did not reflect the full range of variation.

Our computation of excess NH, used all species listed in eq 1 except HCl (for which no measurements were available). Other databases may lack measurements such as aerosol Cl<sup>-</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup>, or Na<sup>+</sup>. We recomputed excess NH, without these five species and obtained values nearly identical to the excess NH, concentrations used here. For example, the 1116 CADMP measurements yielded a regression of the full excess NH, (eq 1, without HCl) against the recomputed excess NH<sub>2</sub>, having parameters as follows: full excess NH<sub>3</sub> = 0.019 + 0.997 × recomputed values,  $r^2 = 0.996$ . Thus, the mean difference was less than  $0.02 \,\mu$ g/m<sup>3</sup>. For application to typical PM<sub>2,5</sub> data, five measurements, therefore, suffice for computation of excess NH<sub>3</sub>: aerosol NH<sub>4</sub>\* plus gas-phase NH, minus the sum of HNO<sub>3</sub> (gas), particulate NO<sub>3</sub>, and particulate 50<sup>2-</sup> concentrations.

Samples were also classified as  $NH_3$ - or  $HNO_3$ -limited using the ratio of particulate to total  $NO_3$ . Samples having ratios of particulate to total  $NO_3$  in excess of 0.9:1 showed model-predicted fractional aerosol  $NO_3$  decreases that were substantially greater when total  $NO_3$  was reduced than when total  $NH_3$  was reduced. Conversely, for ratios of particulate to total  $NO_3$  less than 0.3:1–0.5:1, the model-predicted fractional aerosol  $NO_3$  decreases were greater for reduction of total  $NH_3$  than for reduction of total  $NO_3$ .

#### CONCLUSIONS

The response of aerosol NO<sub>3</sub> to changes in concentrations of HNO<sub>3</sub>, NH<sub>3</sub>, and H<sub>2</sub>SO<sub>4</sub> was investigated using a thermodynamic equilibrium model. Over a range of temperatures (273–303 K) and RHs (20–95%), two parameters were found to provide sufficient information for indicating the qualitative response of aerosol NO<sub>3</sub> concentrations to changes in concentrations of the gas-phase species. The first parameter is the excess of aerosol NH<sub>4</sub><sup>+</sup> plus gas-phase NH<sub>3</sub> over the sum of HNO<sub>3</sub> (gas), particulate NO<sub>3</sub>, and particulate SO<sub>4</sub><sup>1-</sup> concentrations. The second is the tatio of particulate to total NO<sub>3</sub> concentrations. Computation of these quantities from ambient measurements provides a means to rapidly analyze large numbers of samples and identify cases in which inorganic aerosol NO<sub>3</sub> formation is limited by the availability of NH<sub>4</sub>.

For application to any specific situation, the accuracy of assuming equilibrium should be assessed. Proximity to equilibrium may be evaluated by showing agreement between the predictions of a thermodynamic equilibrium model and measurements, or by using an indicator ratio,<sup>12</sup> which requires size-fractionated measurements. When neither of these approaches can be carried out, computation of the equilibrium indicator ratio using only  $PM_{10}$  and  $PM_{2.5}$   $NO_3$  and  $NH_4^+$  concentrations provides some indication of departures from equilibrium.

Computation of excess NH<sub>3</sub> requires accurate measurements of total NH<sub>1</sub> (NH<sub>3</sub> gas and fine-fraction aerosol NH<sub>4</sub>\*), total NO<sub>3</sub> (HNO<sub>3</sub> gas and fine-fraction aerosol NO<sub>3</sub>), and aerosol SO<sub>4</sub><sup>2-</sup>. Computation of the ratio of aerosol to total NO<sub>4</sub> requires accurate measurements of HNO<sub>3</sub> gas and aerosol NO<sub>3</sub>. While computation of excess NH<sub>3</sub> requires more measurements than does the computation of the ratio of particulate to total NO<sub>3</sub>, excess NH<sub>3</sub> was the more reliable indicator according to simulation results and example applications. Measurements of temperature and RH are required to confirm the applicability of the criteria to specific cases. Measurements of NO<sub>4</sub> and NO<sub>4</sub>, though not required, could provide useful supporting information.

The indicator approach has been illustrated using data from three California field studies. Limiting precursors were identified using both the indicators and a thermodynamic equilibrium model. The two methods yielded consistent results, and the majority of samples examined did not show evidence of NH<sub>4</sub> limitation.

#### ACKNOWLEDGMENTS

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#### About the Authors

Dr. Charles L Blanchard and Dr. Philip M. Roth are principals of Envair, an unincorporated association of scientists providing research and consulting services in the environmental and earth sciences; and Ms. Shelley J. Tanenbaum is a staff scientist with Envair. Dr. Blanchard can be reached by phone: (510) 525-6231; fax: (510) 526-2634; e-mail: clb@wenet.net; and mail: 526 Cornell Ave., Albeny, CA 94706, Dr. Rolh is currently co-principal Investigator for the Celifornie Regional PM25/PM16 Air Quality Study. Dr. Steve D. Ziman is senior staff scientist for air issues with the Health, Environment and Safety Group of Chevron Research and Technology Co. Professor John H. Seinfeld is the Louis E. Nohl Professor at the California Institute of Technology. His research interests are in atmospheric chemistry and aerosols.

# **EXHIBIT 176**



# STATE OF CALIFORNIA

Energy Resources Conservation and Development Commission

In the Matter of:

DOCKET NO. 01-AFC-21

Application for Certification for the Tesla Power Project SOCIOECONOMICS TESTIMONY OF MANISHA KOTHARI

I, Manisha Kothari, declare as follows:

- 1. I am presently employed by URS Corporation as an Environmental Planner.
- 2. A copy of my professional qualifications and experience been previously submitted and docketed.
- 3. I prepared the attached supplemental testimony relating to Socioeconomics for the Tesla Power Project (California Energy Commission Docket Number 01-AFC-21).
- 4. It is my professional opinion that the attached prepared supplemental testimony is valid and accurate with respect to issues that it addresses.
- 5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed at Oakland, CA on March 31, 2004.

Mantho Kothari

# **TESTIMONY OF MANISHA KOTHARI**

### SOCIOECONOMICS

### Comment #1:

The parties shall identify the school district(s) where the TPP site is located and provide testimony on whether the school impact fee required by Condition SOCIO-I should be on subject to an agreement between Alameda and San Joaquin Counties to ensure that the impact fee is distributed appropriately to the affected school districts.

#### Response #1:

The TPP site is located on Midway Road in Livermore. The plant site falls under both the Mountain House Elementary School District (K-8) and the Tracy Unified School District (for grades 9-12), which are in Alameda and San Joaquin counties, respectively.

By state law, school districts are authorized to assess developer impact fees to offset the cost of providing facilities for students resulting from new development. These fees are used to fund the construction of new school facilities and the reconstruction of, modernization of, and/or addition to existing school facilities made necessary by development projects.

In the case of the TPP site, the assessment of the developer impact fee would be determined based on the square footage of the prospective plant. Before Alameda County issues a permit for the plant, the developer would have to obtain a signed Certificate of Compliance from each of the two relevant school districts. Based on the resolution in place to adopt a developer impact fee, the Mountain House Elementary School District would receive ¼ of the total developer impact fees, and the Tracy Unified School District would receive ¼ of the fees. Once these fees are paid, the developer can obtain the required signatures on the Certificate of Compliance from the two school districts.

No new agreements are needed to ensure the fee distribution between the school districts.

### References:

Highlander, Lou. Alameda County, Office of Education. Personal communication. March 12, 2004.

Nolan, Dorris. Tracy Unified School District. Personal communication. March 11, 2004.

Stay, Susan. Alameda County, Office of Education. Personal communication. March 16, 2004

## Comment #2:

The record fails to address whether the impact of AB 81 on County property tax revenues could affect the anticipated \$6 million per year property tax from the TPP. The parties shall provide evidence of an agreement and/or another method that would insure a minimum property tax payment to Alameda County in the event that the BOE's property assessment for TPP is reduced (Cf. Socioeconomics, Revised PMPD for Morro Bay Power Plant Project, CEC Docket No. 00-AFC-12.)

## **Response #2:**

As an electric generation facility larger than 500 MW, the proposed TPP would fall under the State Board of Equalization's assessment jurisdiction. The TPP site would be subject to AB 81. The value of the TPP would be assessed annually using a number of value indicators including eurrent economic conditions (the supply and demand for electricity in the area, for example). The power plant would be considered a wasting asset; as such, the value would be likely to depreciate annually, subject to economic conditions. According to the State Board of Equalization, there is not likely to be any significant difference between its valuation and a valuation earried out by the County. This is because properties that fall under the County's jurisdiction are subject to Proposition 13 and Proposition A, which provides upward and downward valuation protection for properties in California.

Alameda County would be responsible for collecting revenues based on the State Board of Equalization's assessment. No other agreements would be required for the tax assessment or collection from the proposed plant.

#### References:

- Lee, Octavio. Principal Property Appraiser, Valuation Division. California State Board of Equalization. Personal communication. March 16, 2004
- Loza, Dan. Alamcda County Assessor's Office. Personal Communication. March 11 and March 16, 2004.

# **AREAS OF EXPERTISE**

- Socioeconomic analysis
- Environmental Documentation
- Project Planning / Coordination
- Political Risk
   Assessment

# EDUCATION

Georgetown University: M.S., Foreign Service, 1998

University of California, Berkeley: B.A., Political Science, B.A., Communications, 1996

# PROFESSIONAL HISTORY

URS, Environmental Planner, July 2002-Present

U.S. Trade and Development Agency, Country Manager for South and Southeast Asia, January 1999 – March 2002

International Equity Partners, LLP, Associate, January 1997 – May 1998

# LANGUAGES

Hindi (native), Thai (fluent), and French (basic level)

# **REPRESENTATIVE EXPERIENCE**

Ms. Kothari has extensive experience with the oversight, planning, and coordination of environmental projects internationally. She has experience writing and reviewing environmental documentation and working with tcchnical contractors to draft scopes of work for small and large-scale infrastructure projects. Ms. Kothari has actcd as a facilitator for multi-national project coordination with various government institutions throughout South and Southeast Asia. She also has experience in budget preparation and management.

• San Bernadino Vegetation Management Project; San Benadino, CA

Prepared socioeconomic analysis report for Federal Emergency Management Agency (FEMA). The report is part of an Environmental Assessment for a vegetation management project to reduce the risk of wildfirc in the foothills of the San Bernadino Mountains. Tasks for the project included collecting and analyzing data, preparing environmental documentation, and conducting interviews.

• Interstate 80 / State Route 4 Interchange Improvement Project; Contra Costa County, CA

Principal author of the Community Impact Assessment (socioeconomic analysis) Report for the project's Environmental Document. Tasks included collecting and analyzing socioeconomic data and preparing reports. Also coordinating technical reports to produce comprehensive Environmental Document.

 Richmond Field Station Remediation Project; Richmond, CA

Task Leader for the Initial Study and Mitigated Negative Declaration for a hazardous materials' remediation project on a University of California, Berkeley-owned research facility. Tasks included: conducting socioeconomic analysis, preparing project schedule, coordinating preparation of technical reports, preparing summaries, and authoring environmental document.

• Chuuk Housing Programmatic Environmental Assessment; Federated States of Micronesia Principal author of a Programmatic Environmental Assessment and Finding of No Significant Impact for the Chuuk Housing Project. The environmental document was prepared to establish National Environmental Policy Act (NEPA) compliance for a project to rebuild 230 homes following a devastating tropical storm on the islands of Chuuk, in the Federated States of Micronesia. Tasks included: reviewing field notes, analyzing data, and preparing NEPA document for client.

# • Toomes Creek Mitigation Area Project; Tehama County, CA

Co-authored the Initial Study and Mitigated Negative Declaration for environmental compliance for a mitigation project to develop habitat for the threatened Valley Elderberry Longhorn Beetle. Also served as Task Leader for the preparation of the Draft Habitat Management and Monitoring Plan Tasks included the preparation of reports and assistance with project planning and coordination.

• Fuels Quality Upgrading and Hydrocracker Project; Gujarat, India

Worked with a local private sector developer to define the scope of work and budget for an economic and technical feasibility study. The project involved developing a Hydrocracker and additional processing units at a refinery in Gujarat, India.

# • Mangalore IGCC Project Technical Assistance; Mangalore, India

Worked with India's Birla Group and Indian financial institutions to structure a Technical Assistance project for a 448 MW power plant in Mangalore, India. The Technical Assistance was to prepare a Detailed Project Report (DPR) that would enable the project to obtain government clearances and financing. The project was designed to use environmentally-sound Integrated Gasification Combined Cycle (IGCC) technology to deliver power in an ecologically sensitive region.

• Arsenic Water Treatment Project, Dhaka, Bangladesh Worked closely with the Government of Bangladesh and the World Bank to develop a pilot program testing technology applications for the removal of arsenic from groundwater throughout Bangladesh. Carried out site investigations and coordinated preparation of final environmental documentation for the project. Regularly reviewed progress reports and test data from 250 locations. Managed the project schedule and budget.

# **EXHIBIT 177**



# SUPPLEMENTAL TESTIMONY OF DUANE MCCLOUD AND SCOTT BUSA

# WATER RESOURCES

# COMMENT 1

Applicant shall provide evidence on where TPP will obtain potable water for domestic uses.

# **RESPONSE 1**

If reclaim water was to be used for the project, restrictions on its use would prevent us from its utilization for domestic requirements. Accordingly potable water would need to be transported to the site by bulk truck from Tracy or Livermore and stored in a potable water storage tank for sanitary uses. An average potable water usage of 1.0 gpm translates into a 3000 gallon delivery once every other day, which represents a minimal impact on traffie.

Drinking water would be bottled in either scenario.

# **COMMENT 2**

The record does not indicate whether the City of Tracy will include denitrification in its tertiary treatment process or whether the TPP would install water treatment technology at the site or whether the TPP would install water treatment technology at the site or whether the biocide treatment required by Condition Public Health-1 would result in sufficient denitrification to ensure effective removal of microorganisms in the cooling tower. The parties shall provide testimony that would resolve this issue.

# **RESPONSE 2**

The City of Tracy upgrades for Title 22 include activated sludge nitrification and selective anoxic denitrification, in addition to much higher levels of disinfection and filtration.

The presence of animonia in water is a primary factor effecting disinfection effectiveness in an aerobic system. This is due to animonia's tendency to combine with free oxidants, especially halogens, rendering them less effective. Nitrification is the process through which animonia is converted to first nitrites and then nitrates. It is virtually impossible to meet Title 22 standards for disinfection with high levels of animonia present, and accordingly nitrification is almost always employed as a part of advanced wastewater treatment processes.

Denitrification is conversion of nitrates to oxygen and nitrogen. As gases both of these products are then generally removed from the water. Denitrification is often employed based on the sensitivity of the receiving stream. While nitrates are generally not good

bacterial food in an aerobic system, they can function as algae food in an open body of water creating environmental impacts.

The expected impacts on these constituents from the Tracy upgrades are a significant reduction in ammonia, from an average of 15 mg/l to 0.5 mg/l, and a modest increase in nitrate from 5 mg/l to 10 mg/l. Denitrification will account for a significant nitrate reduction (83%) in this case, as the theoretical nitrate level, after ammonia conversion, would have been around 58 mg/l.

As indicated above, the primary driver for nitrification is disinfection effectiveness. Meeting the Title 22 requirements through the processes outlined above will result in no additional treatment required at TPP to address nitrogen balance in the water. A complete disinfection program, based on industry and CTI guidelines, will be utilized in the plant water systems to ensure that microorganism control is maintained once the water gets to the project.

The above references and numbers are from the Final EIR for the Tracy Wastewater Treatment Plant Expansion, dated September 2002.

# **COMMENT 5**

Applicant estimates the capital cost of its proposed cooling tower installation would be about \$18 million. This appears to be a low estimate compared with the cost of the cooling tower installation for a power plant project half the size of the TPP. Applicant shall provide evidence confirming that its cost estimate for the cooling tower is accurate or provide a corrected estimate, if appropriate.

# **RESPONSE 5**

The values provided in Table 3.10-5 of the AFC are not total system costs for either a wet or dry system. They are instead installed costs for just the major components that would differ between the three options. The total system costs of any of the three options would be higher, although likely by a fairly constant amount across the list. For example while the wet tower would have more feet of piping and pumps, the dry cooling would have much larger piping and structural support requirements. Civil and landscaping needs would also be greater for the larger dry cooling layouts. We believe that the cost difference in the options shown to be accurate, even though we acknowledge that the absolute values given are too low for a total system cost.

Table 3.10-5 however does not capture the difference in water treatment capital and infrastructure costs. For example the ZLD system costs would increase for a larger water usage, similar to the increase being debated for the higher TDS impact for reclaim water. In the case of a completely dry cooled plant, water demand would be much lower, on the order of 10% of a wet plant, for boiler makeup and inlet air cooling. However that 10% would still require both a supply pipeline and ZLD system, however much smaller.
Whether that supply comes from the Aqueduct or Tracy most of the pipeline costs being considered for a wet cooled plant would still be incurred. This was reflected in Staff's summaries. The ZLD system would also be much smaller and different in nature, primarily processing a straight RO reject instead of a cooling tower sidestream as currently envisioned. As a result it would consist only of an evaporator-crystallizer and dewatering equipment, of a size similar to the system currently envisioned for the aqueduct water supply. Instead of the total capital cost range of \$19MM to 22MM being carried for the wet system ZLD a number in the \$4-5 MM range is more likely. These capital numbers are consistent with analysis in the FSA Appendix Table 5. As indicated previously we believe that the lost revenue number associated with dry cooling is much higher.

### COMMENT 6

Applicant shall provide testimony on the status of negotiations with the City of Tracy for an agreement to supply tertiary treated recycled water to the TPP

#### **RESPONSE 6**

Midway Power and the City of Tracy have been negotiating for the reclaimed water supply to be delivered by the City of Tracy. The City of Tracy did provide a draft agreement in December 2003 to Midway Power. The draft agreement included provisions such as interpretability, additional costs, no provision for backup supply and other provisions that pose substantial issues for the project. A meeting was held in January 2004 and Midway Power has been preparing modifications to the draft agreement. Midway Power is committed to negotiating an agreement with the City of Tracy.

Toward that end, Midway Power is willing to accept Condition of Certification SOIL & WATER 11 which requires the Project Owner to secure a User Agreement for Reclaimed Water from the City of Tracy at least 60 days prior to project operation. However, we request some additional clarifying language to ensure that the User Agreement can encompass interim and backup supply water in addition to the Reclaimed Water. Therefore we propose SOIL & WATER 11 be modified as follows:

**SOIL & WATER 11** The Project Owner shall secure a User Agreement for Reclaimed Water *and any interim and backup water* from the City of Tracy for the TPP's process and cooling water supply.

<u>Verification</u>: At east 60 days prior to the start of Project operation, the Project Owner shall submit to the CPM a copy of its User Agreement for Reclaimed Water *and any interim and backup water* from the City of Tracy to supply reclaimed water *and any interim and backup water* to the TPP for power plant cooling and other industrial processes. Additionally, Midway Power accepts Condition of Certification SOIL & WATER 12 which would require the use of reclaimed water as the TPP's primary water supply source for cooling and landscape irrigation. Midway Power also accepts Condition of Certification SOIL & WATER 13 with the following modification:

**SOIL & WATER 13** In the event the TPP is constructed prior to the availability of recycled water and an interim water supply is to be used, the Project Owner shall submit a schedule of *projected* monthly water demand to the City of Tracy for review and comment and to the CPM for approval.

The reason for the proposed modification is that neither the City of Tracy nor the CPM should be required to approve the projected monthly water demand. The interim water supply would be supplied according to any User Agreement with the City of Tracy under Condition of Certification SOIL & WATER 11.

Midway Power disagrees that Condition of Certification **SOIL & WATER 14** is not necessary to ensure compliance with LORS or to mitigate any potential impact associated with the use of City of Tracy Reclaimed Water for the TPP.

Midway Power accepts Condition of Certification SOIL & WATER 15 with the following modifications.

**SOIL & WATER 15** The Project Owner shall *convert from use of* not use the interim water supply to reclaim water within for more than 45 days once of the tertiary-treated water supply has becomeing available. This does not preclude the use of fresh water on an emergency basis should the reclaim water be unavailable after the initial switch to reclaim water.

With the acceptance of these conditions, Midway Power believes that it is not necessary for the Committee to explore or require the TPP to employ dry-cooling technology to ensure compliance with its recent water resource policies.

# COMMENT 7

Applicant shall provide testimony on the issue of whether the dry cooling alternative described in the record would be an "economically unsound" option for the life of the project compared with the Aqueduct fresh water proposal or the Tracy recycled water alternative. RESPONSE 7

Midway Power does not believe that an "option" for dry cooling adds any value to the Final Decision. While we disagree somewhat on the details and assumptions that have gone into Staff's analysis, we agree that an air cooled project would have a significant cost disadvantage over an evaporative cooled facility. Reasonable estimates, based on today's market would place that disadvantage on the order of \$6-8 million/year in lost income due to lower output, coupled with a capital cost comparable to the reclaim water option being considered.

As to the issue of "economically unsound," the phrase is ambiguous. Certainly if the 2001 California power crisis situation were to repeat itself, a dry cooled project would be very economically attractive. Even a very poor efficiency, outdated technology project could prosper in such an environment. However the current situation is that numerous projects relying on evaporative cooling have been permitted in the last several years, and those projects have inherent cost and efficiency advantages over a dry cooled facility. Undertaking the incremental construction of a dry cooled TPP in that market against an advantaged competition would be a poor business decision, unless a severe market eondition could be essentially guaranteed. Likewise we would not envision a situation in which a long term offtake agreement could be structured for a higher cost, lower efficiency facility in a market in which lower cost alternatives are readily available.

Due to our lack of ability to totally rule out the return of a long term power crisis situation in California, we therefore cannot say the project would be "economically unsound." However we believe all evidence to date would suggest that such a project would be significantly economically disadvantaged.

As a result of the above, Midway Power believes that should final contractual arrangements with Tracy not work out, we would need to reopen the TPP siting process through a formal amendment. Such amendment would need to evaluate an alternative water supply and subject to a review of its impacts and legal compliance.

### STATE OF CALIFORNIA

State Energy Resources Conservation and Development Commission

In the Matter of:

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Docket No. 01-AFC-21

Application for Certification for the Tesla Power Project By Midway Power LLC PROOF OF SERVICE

I, Carole Phelps, declare that on April 1, 2004, I deposited copies of the attached **Applicant's Testimony (with Exhibits), for the Tesla Power Project** with first class postage thereon fully prepaid and addressed to the following:

### DOCKET UNIT

I have sent the original signed document plus the required 12 copics to the address below:

CALIFORNIA ENERGY COMMISSION DOCKET UNIT, MS-4 ATTN: Docket No. 01-AFC-21 1516 Ninth Street Sacramento, CA 95814-5512

#### \*\*\*\*\*

I have also sent individual copies to:

### APPLICANT

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### **INTERESTED AGENCIES**

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Alameda County Community Development Agency, Planning Department Attn: Bruce H. Jensen, Planner 399 Elmhurst Street, Room 136 Hayward, CA 94544

## **OTHER INTERESTED PARTIES**

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

mole Phi Carole Phelps