

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET
SACRAMENTO, CA 95814-5512



DATE: November 1, 2002

TO: Interested Parties

FROM: Nancy Tronaas, Compliance Project Manager

SUBJECT: **Pastoria Energy Facility (99-AFC-7C)**
Staff Analysis of Petition to Modify VIS-7—Plume Abatement

On June 3, 2002 the California Energy Commission (Energy Commission) received a petition to amend the Energy Commission Decision, certified in December 2000, for the Pastoria Energy Facility (PEF). PEF is a nominally-rated 750MW combined-cycle natural gas power plant currently under construction. The site is located approximately 30 miles south of Bakersfield, and 6.5 miles east of I-5 at Grapevine. The project owner requests to eliminate the passive plume abatement system from the project's cooling tower design, and to delete visual resources Condition of Certification VIS-7 that sets forth maximum dimensions of the cooling tower plumes.

Energy Commission staff reviewed the petition to assess the impacts of this proposal on environmental quality, public health, and safety and found that the only technical area that is affected by this proposed project change is visual resources. Staff concurs with the project owner that the passive plume abatement system approved in the December 2000 Decision would not be effective in cooling tower plume reduction, and that unabated cooling tower plumes would not result in significant adverse direct or cumulative visual environmental impacts due to the expected plume size, infrequent occurrence, and distance to affected viewpoints.

However, to assure that the cooling towers are installed as stated in the petition, staff recommends revisions to VIS-7 rather than deletion of the condition. It is staff's opinion that, with the implementation of revised VIS-7, the project will remain in compliance with applicable standards and that the modification will not result in significant environmental impacts (*Title 20, California Code of Regulations, Section 1769*).

The attached staff analysis is provided for your information and review. Energy Commission staff intends to recommend approval of the petition at the December 11, 2002 Business Meeting of the Energy Commission. If you have comments on this proposed project change, please submit them to me at the address above. All written comments must be received by 5:00 P.M., December 10, 2002. If you have any questions, you may telephone me at (916) 654-3864 or at the compliance program's toll-free number at (800) 858-0784, contact me by e-mail at ntronaas@energy.state.ca.us.

Attachment

**Pastoria Energy Facility
Petition to Delete VIS-7 (Plume Abatement)
Staff Analysis
October 30, 2002**

Introduction

Condition of Certification VIS-7 requires the project owner to “design and operate the Pastoria Energy Facility (PEF) to mix dry ambient air with the saturated air exiting the cooling towers to prevent the formation of visible water vapor plumes longer than 60 meters, higher than 60 meters, and wider than 30 meters.” In their petition, the current project owner, Calpine, argues that the “passive plume abatement” design required by VIS-7 (and proposed by the former project owner) is not an effective means of controlling plume formation.

During the licensing process for the PEF project, information indicating performance and operating problems for the proposed passive plume abatement system was not available. Calpine, through their cooling tower vendor (Marley Cooling Technologies) has identified potential significant operating problems, such as increased tower ice formation, for the originally proposed passive plume control design. This ice formation would restrict the air flow in the tower (in the inlet, through the heat transfer fill material, or in the mist eliminator), reducing the heat rejection capability of the tower and effectively negating the passive plume abatement.

Additionally, Calpine and Energy Commission staff have performed plume modeling analyses, using models unavailable at the time of the original licensing process, that indicate that the proposed passive plume abatement design, assuming it would not create operating problems, would not have been able to meet the plume size requirements of Condition of Certification VIS-7. The analysis indicates that the passive plume abatement is not effective in reducing plume sizes when the ambient relative humidity approaches saturation.

Staff concurs that the passive plume abatement required by VIS-7 would not be capable of controlling PEF’s cooling tower plumes to meet the specified size criteria under all ambient conditions. Calpine is requesting in the petition that condition VIS-7 be deleted. Calpine asserts that elimination of VIS-7 will not result in significant adverse visual impacts and that visible plumes will occur infrequently with the design proposed for the cooling towers (unabated).

Project Description

The unabated cooling tower design presently proposed by Calpine is an 8-cell tower and a 4-cell tower in 1x8 and 1x4 configurations. Table 1 provides the operating parameters for the proposed towers.

Table 1 – Cooling Tower Exhaust Parameters

Parameter	8-Cell Cooling Tower	4-Cell Cooling Tower
Stack Height	15.7 meters	
Number of Cells	8 Cells (1 by 8 configuration)	4 Cells (1 by 4 configuration)
Stack Diameter	10.8 meters per cell	
Tower Dimensions	124.4 m length by 18.3 m width	62.2 m length by 18.3 m width
Tower Heat Rejection	348.75 MW	175.6MW
Tower Inlet Air Flow Rate ¹	6,538 kg/s	3,294 kg/s
Liquid to Gas (L/G) Ratio	1.3486	1.3480
Exhaust Temperature ² (@ 100% RH)	64°F to 98.2°F	
Exit Velocity ³	7.79 m/s	7.85 m/s
Exhaust mass flow rate	51,888,000 lbs/hr	26,141,670 lbs/hr
Exhaust Molecular Weight	28.8 (assumed)	
Moisture Content (% by weight)	2.3% @ design	

¹ – Estimated from outlet flow rate

² – For ambient conditions during daylight no fog hours.

³ – For ambient conditions during daylight no fog hours where visible plume is predicted.

Applicable Laws, Ordinances, Regulations and Standards

The PEF project is located on private land and is thus not subject to federal land management requirements. No roadways in the project vicinity are designated or eligible State Scenic Highways (California Scenic Highway System, <http://www.dot.ca.gov/hq/LandArch/scenic/cahisys.htm>). Thus, the project is not subject to state regulations pertaining to scenic resources. The project is located in Kern County. Staff reported in the FSA that Kern County had no specific policies on visual or aesthetic resources that applied to the PEF. Staff confirmed with a recent phone call to the Kern County Planning Department that this continues to be the case.

Analysis

In the Final Staff Assessment (FSA), staff performed its analysis of the cooling tower (abated) visible plumes based on plume frequency and size data provided by the applicant. Staff found that the estimated maximum cooling tower plumes (less than 60 meters long, 30 meters high, and 40 meters wide) would not cause significant adverse visual impacts to travelers on Interstate 5 (I-5) or residences on Laval Road because either these plumes would barely be visible or rarely occur. Because staff’s analysis was based on modeling assumptions that included the applicant’s proposed method of plume abatement, staff proposed Condition VIS-7 to ensure that this method was implemented.

With contractor assistance, staff now has the ability to perform the visible plume modeling itself, only relying on the applicant for cooling tower design and operating parameter data needed for the modeling. Staff’s current approach to visible plume analysis is to use a plume frequency of 10 percent of seasonal daylight no rain/no fog “clear” hours as a threshold for determining whether plumes have the potential to cause significant adverse visual impacts. If this threshold is met or exceeded, staff calculates the dimensions of the reasonable worst case (10th percentile) plume and performs a detailed assessment of the visual impacts of the predicted plume. Staff assesses the

level of visual change that would be caused by these plumes in terms of their visual contrast, dominance, and view blockage. The determination of whether the plumes would cause significant visual impacts is made after considering the level of visual sensitivity of the existing setting and the anticipated level of visual change.

Plumes have the greatest potential to cause adverse visual impacts during clear meteorological conditions. For projects such as PEF for which the available meteorological data set categorizes sky cover (i.e., clouds) in 10 percent increments, staff includes in the “clear” category a) all hours with total sky cover equal to or less than 10 percent plus b) half of the hours with total sky cover 20-100 percent that have an unlimited ceiling height. The rationale for including these two components in this category is as follows: a) plumes typically contrast most with the sky under clear conditions, and when total sky cover is equal to or less than 10 percent, clouds either do not exist or they make up such a small proportion of the sky that conditions appear to be virtually clear; and b) for a substantial portion of the time when total sky cover is 20-100 percent and there is an unlimited ceiling height, clouds do not substantially reduce the plumes’ contrast with the sky; staff estimates this time as approximately half of these hours.

Staff modeled the PEF cooling tower plume frequency using the Combustion Stack Visible Plume (CSVP) model, which has been modified to predict plumes from cooling towers. Table 2 presents the results of the CSVP modeling.

**Table 2 – Staff Predicted Hours with Cooling Tower Visible Plumes
CSVP Model – Bakersfield 1990 to 1995 Meteorological Data**

	100% Load	
	Total	Percent
Seasonal Daylight No Rain No Fog Hours	3,298	37.6%
Seasonal Daylight No Rain No Fog High Contrast Hours	1,135	12.9%

The frequencies are determined based on 8,773 seasonal daylight no rain no fog hours from 1990 to 1995.

The CSVP model predicts that the PEF unabated cooling towers will emit a visible plume 12.9 percent of the SDNRNF hours during clear viewing conditions. Because plume frequency exceeds staff’s 10 percent threshold, staff has calculated the 10th percentile plume dimensions and conducted a visual analysis of the predicted plume (see below). The 10% SDNRNF High Contrast hours plume dimensions for the 8-cell and 4-cell towers are as follows:

8-Cell Tower

- Plume Length – 19 meters (62 feet)
- Plume Height – 54 meters (177 feet)
- Plume Width – 21 meters (69 feet)

4-Cell Tower

- Plume Length – 13 meters (43 feet)
- Plume Height – 40 meters (131 feet)

Plume Width – 15 meters (49 feet)

The modeled tower length does not include the length of each tower which is 124.2 meters and 62.2 meters for the 8 and 4-cell towers, respectively. Thus, when the wind is blowing along the long axis of the tower, the plumes from the 8 and 4-cell towers would be 143.2 meters (470 feet) and 75.2 meters (247 feet) long, respectively.

Key Observation Point (KOP) 2, selected to represent I-5 motorists' view of the PEF project, is located about 5.2 miles west of the project site. In the FSA, staff found the visual sensitivity (which considers visual quality, viewer concern, and viewer exposure) at KOP 2 to be moderate to high. The cooling tower plumes would appear as billowing linear to irregular forms with irregular and changing outlines, unlike the dominant forms and lines established in the existing setting. Because of the distance of the cooling tower plumes from KOP 2, the visibility of the plumes would be diminished. Therefore, form and line contrast would be reduced from high down to moderate. The white color of the plumes would contrast moderately with the tan and taupe colors of the hills in the background. Visual contrast is considered to be moderate overall. The 10th percentile plumes would increase the horizontal extent of the PEF project and would extend somewhat higher than the three, 150-foot tall HRSG stacks. The plumes would appear small in comparison to the wide field of view available at KOP 2, and would occupy a very small portion of the overall setting at the foot of the Tehachapi Mountains. The movement of the plumes would contribute to their conspicuousness. However, because the plumes would be seen entirely against the backdrop of the dominant Tehachapi Mountains, the plumes would be substantially less prominent than they would be if backdropped by the sky. The overall dominance rating of the plumes is considered subordinate (low). The plumes would block a very small portion of the hills in the background, so the severity of the view blockage is considered low. The overall visual change at KOP 2 would be low to moderate due to the moderate contrast and low dominance and view blockage ratings. When considered within the context of moderate to high overall visual sensitivity, the low to moderate visual change would cause an adverse but less than significant impact at this KOP.

KOP 3, selected to represent the closest publicly accessible view of the PEF project, is located at a point on Laval Road about 2.6 miles north of the project site. Travelers on Laval Road consist primarily of workers engaged in agricultural activities. In the FSA, the overall visual sensitivity of travelers on Laval Road was considered low to moderate. From KOP 3, the plumes would appear small compared to the expansive nature of the dominant landforms. Considering the low to moderate visual sensitivity, the visual impact of the plumes from this vantage point would be adverse but less than significant. In the FSA, staff determined that KOP 3 was somewhat representative of views from residences (about 12) approximately two miles west of this vantage point and approximately 4 miles from the power plant site. The overall visual sensitivity for these residential viewers was considered moderate. Given the distance of the residences to the project site (about 4 miles), the visual change that would be experienced by these residential viewers would be comparable to the change at KOP 2. When considered

within the context of the moderate visual sensitivity at KOP 3, the low to moderate visual change would cause an adverse but less than significant impact.

Cumulative impacts to visual resources could occur where project facilities or activities occupy the same field of view as other built facilities or impacted landscapes. It is also possible that a cumulative impact could occur if a viewer's perception is that the general visual quality of an area is diminished by the proliferation of visible structures, even if the new structures are not within the same field of view as the existing structures. The significance of the cumulative impact would depend on the degree to which (1) the viewshed is altered; (2) visual access to scenic resources is impaired; (3) visual quality is diminished; or (4) the project's visual contrast is increased.

In the FSA, staff concluded that the PEF project (including visible plumes) would not contribute substantially to cumulative visual impacts. Staff did not consider the contribution of existing industrial plumes to cumulative visual impacts because staff was not aware that any actually occurred in the project viewshed. Calpine provides evidence in their petition that the viewshed does include an existing industrial plume from an asphalt batch plant located on Edmonston Pump Station Road.

Based on photographs taken on March 6, 2002 included in the petition, the asphalt batch plant plumes would appear to be barely visible from Interstate 5 and Laval Road. Staff spoke with a representative of the San Joaquin Valley Air Pollution Control District who informed staff that the batch plant does not operate much during the winter and that the facility's visible plumes are mostly from drying operations in the summer (Oldershaw 2002). The PEF's cooling tower plumes would occur very infrequently during the summer (approximately 3.4 percent of daytime hours during a May to October timeframe). Because of the limited visibility of the batch plant plume and the limited duration its plumes would overlap in time with the PEF cooling tower plumes, the resulting cumulative visual impact of the unabated PEF cooling towers would not be significant.

Calpine also provided photographs of agricultural-related smoke plumes and a map showing the location of agricultural burning locations in the project area. Calpine's petition also included lists of agricultural burning permits issued during 1999, 2000, and 2001. These burns appear to occur every month of the year. The smoke from the agricultural burns would likely reduce the visibility of the PEF cooling tower plumes. Thus, the information further supports that the cumulative visual impact would not be significant.

Conclusion

Staff concludes that the proposed unabated cooling towers will not cause significant direct or cumulative adverse visual impacts. To ensure that the cooling towers installed will match the profile and visible plume frequency evaluated in this analysis, staff proposes a revised version of VIS-7 as follows:

Recommended Revisions to Condition of Certification

(Deleted text is shown in ~~strikeout~~, new text is underlined)

~~**VIS-7** The project owner shall design and operate the project to mix dry ambient air with the saturated air exiting the cooling towers to prevent formation of plumes longer than 60 meters, higher than 60 meters, and wider than 30 meters.~~

~~The project owner shall develop and submit a plan to achieve this performance standard to the CPM for review and approval. If the CPM notifies the project owner that revisions of the plan are needed before the CPM will approve the plan, the project owner shall prepare and submit to the CPM a revised plan.~~

~~The plan shall not be implemented until it is approved. The project owner shall notify the CPM when the plan has been implemented. At least 90 days before ordering any equipment to be used to limit the size of cooling tower plumes, the project owner shall provide the plan to the CPM for review and approval. If the CPM notifies the project owner that any revisions of the plan are needed before the CPM will approve the plan, within 30 days of receiving that notification the project owner shall submit to the CPM a revised plan. The project owner shall notify the CPM within seven days after implementing the plan.~~

VIS-7 The project owner shall ensure that the two Pastoria cooling towers purchased are installed and operated as specified in the verification below.

Verification: At least 30 days prior to ordering the cooling towers, the project owner shall provide to the CPM for review and approval the final design specifications of the cooling towers. The project owner shall not order the cooling towers until notified by the CPM that the designs have been approved.

The project owner shall show, by providing confirming vendor specifications (either in draft purchase specifications to the vendor, or design specifications from the vendor), that the two cooling towers being purchased will meet the following specified design parameters:

	<u>Design Parameter Values</u>	
<u>Design Parameter</u>	<u>Four-Cell Cooling Tower</u>	<u>Eight-Cell Cooling Tower</u>
<u>Manufacturer</u>	<u>Marley Cooling Towers</u>	<u>Marley Cooling Towers</u>
<u>Model Number</u>	<u>F4108.5-6.0-04</u>	<u>F4108.5-6.0-08</u>
<u>Heat Load</u>	<u>149.81 MMBtu/hr/cell</u>	<u>148.75 MMBtu/hr/cell</u>
<u>Range</u>	<u>17°F</u>	<u>17°F</u>
<u>Water Flow Rate</u>	<u>17,625 gpm/cell</u>	<u>17,500 gpm/cell</u>
<u>Fan Model</u>	<u>384HP7-10</u>	<u>384HP7-10</u>
<u>Design L/G</u>	<u>1.348</u>	<u>1.3486</u>
<u>Exhaust Flow Rate</u>	<u>108,900 lb/min/cell</u>	<u>108,100 lb/min/cell</u>

The necessary design/vendor specifications shall also include: the physical size of the cooling towers, the fogging frequency curves for the cooling towers, and curve equations to determine the operating exhaust temperature based on the ambient temperature, relative humidity and heat rejection load condition.

The project owner shall provide a written certification in each Annual Compliance Report that the cooling towers have consistently been operated within the specified design parameters. If determined to be necessary to ensure operational compliance, based on legitimate complaints received or other physical evidence of potential non-compliant operation, the project owner shall monitor the cooling tower operating parameters in a manner and for a period as specified by the CPM. For each period that the cooling tower operation monitoring is required, the project owner shall provide to the CPM the cooling tower operating data within 30 days of the end of the monitoring period. The project owner shall include with this operating data an analysis of compliance and shall provide proposed remedial actions if compliance cannot be demonstrated.