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Filer:	Eric Veerkamp
Organization:	Metcalf Energy Center, LLC
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Metcalf Energy Center

(99-AFC-3C)

Amendment No. 6

Submitted by

Metcalf Energy Center, LLC

March 2016

Contents

Executive Summary

Metcalf Energy Center, LLC, as project owner, petitions the California Energy Commission (CEC or Commission) to amend the certification for the Metcalf Energy Center (MEC) (99-AFC-03 (Decision). This Amendment No. 6 (Amendment) requests a modification of Condition of Certification VIS-10 regarding the manner of regulation of visible plumes.

Section 1.0 provides an overview of the Amendment and a review of the ownership of the MEC. Section 2.0 sets forth and describes the proposed modification, and addresses the necessity of the changes and the consistency of the changes with the Decision. Section 3.0 assesses the potential environmental effects of the proposed changes, the MEC's continued compliance with all laws, ordinances, regulations and standards, and the consistency of the changes with the Commission Decision certifying the facility. This assessment confirms that adoption of the Amendment will not result in any significant, unmitigated adverse environmental impacts. The MEC will continue to comply with all applicable laws, ordinances, regulations and standards.

1.0 Introduction

1.1 Overview

By this amendment Metcalf Energy Company, LLC, petitions the Commission to amend Condition of Certification VIS-10 to ensure that the threshold regarding the regulation of visible plumes is consistent with the threshold applicable to other similarly situated projects that were licensed after MEC.

This Amendment contains all of the information that is required pursuant to the Siting Regulations (California Code of Regulations [CCR] Title 20, Section 1769, Post Certification Amendments and Changes). The information necessary to fulfill the requirements of Section 1769(a)(1) is contained in Sections 1.0 through 5.0 as summarized in Table 1 below.

TABLE 1

Informational Requirements for Post-Certification Amendments and Changes

Section 1769(a)(1) Requirement	Section of Petition Fulfilling Requirement
(A) A complete description of the proposed modifications, including new language for any conditions that will be affected	Section 2.1—Proposed modifications
(B) A discussion of the necessity for the proposed modifications	Section 2.2
(C) If the modification is based on information that was known by the petitioner during the certification proceeding, an explanation why the issue was not raised at that time	Section 2.2
(D) If the modification is based on new information that changes or undermines the assumptions, rationale, findings, or other bases of the final decision, an explanation of why the change should be permitted	Sections 3.2
(E) An analysis of the impacts the modification may have on the environment and proposed measures to mitigate any significant adverse impacts	Section 3.0
(F) A discussion of the impact of the modification on the facility's ability to comply with applicable laws, ordinances, regulations, and standards;	Section 3.3

TABLE 1

Informational Requirements for Post-Certification Amendments and Changes

Section 1769(a)(1) Requirement	Section of Petition Fulfilling Requirement
(G) A discussion of how the modification affects the public	Section 4.0
(H) A list of property owners potentially affected by the modification	Section 5.1
(I) A discussion of the potential effect on nearby property owners, the public and the parties in the application proceedings.	Section 5.2

1.2 Ownership of Metcalf Energy Center

Metcalf Energy Center, LLC, a wholly owned subsidiary of Calpine Corporation, is the owner of the Metcalf Energy Center.

1.3 Summary of Environmental Impacts

The Siting Regulations require that an analysis be conducted to address the potential impacts the proposed project change may have on the environment and proposed measures to mitigate any potentially significant adverse impacts (Title 20, CCR, Section 1769 (a)(1)(E)). The regulations also require a discussion of the impact of the proposed change on the facility's ability to comply with applicable laws, ordinances, regulations and standards ("LORS") (Title 20, CCR Section 1769 (a)(1)(F)).

Section 3.0 of this Amendment includes a discussion of the potential environmental impacts associated with the proposed modification to VIS-10 and a discussion of the consistency of the modification with LORS. Section 3.0 concludes that there would be no significant environmental impacts associated with implementing the actions specified in this Amendment and that the project as modified would comply with all applicable LORS.

The proposed changes to VIS-10 will not adversely impact the environment. The proposed change in wording will not result in any physical change in the project or to the environment. The design of the plant will remain the same. The level of visible plume emissions will continue to be as the Commission Decision stated "extremely slight", "will occur only in very limited meteorological circumstances for a minimal number of annual hours", and "no significant impact will result from the project's visible plumes, to the extent such plumes occur at all." (Decision, p. 369). Therefore, there is no possibility of any significant adverse environmental impacts resulting from the proposed modification of VIS-10.

2.0 Description of Project Changes

This section includes a complete description of the proposed modification consistent with the Siting Regulations (Title 20, CCR, Section 1769 (a)(1)(A)).

2.1 Changes to Condition of Certification VIS-10

By way of background, the Decision for the MEC describes the likelihood of visible plume formation at the MEC as follows:

> Visible plumes may form from water vapor exhausted from the cooling tower and HRSGs. The visibility of this normally translucent vapor is dependent upon ambient temperature and relative humidity. Applicant proposes to use wet/dry (hybrid) cooling towers and an economizer bypass system on the HRSGs to abate plume formation. (2/15/01 RT 311-319; Ex.106. pp. 1-4.) With these abatement measures, no visible plumes will be formed when meteorological conditions are above 30 degrees Fahrenheit and the relative humidity is below 90 percent. (2/15/01 RT 315:9-13; 317-319; 322.) Applicant's expert witness characterized the design of the proposed technology for the cooling tower as 'pushing the envelope' in terms of plume abatement insofar as size, thermal duty, and expected weather conditions are concerned. (Decision, p. 367)

In the original proceeding, the Applicant's testimony established that the project was designed to potentially produce a visible plume for an extremely limited number of hours – an estimated average of only five hours per year – "during daylight hours when there is not fog or rain having a potential to obscure the plume." (Decision, p. 367.) The Decision recognized that:

> Staff performed an independent analysis and agreed: that the proposed abatement systems will substantially reduce the potential for plume formation; the total number of hours per year with the potential for plume formation will vary with weather conditions; the vast majority of hours during which plumes may form would be at night; and, either low fog or rain would likely occur during many of the daytime hours with the potential for visible plume formation. (Decision, pp. 368-369)

The Commission's original licensing decision for MEC held that the:

> Applicant has credibly established that its proposed design parameters are feasible and will reduce the potential for visible plume formation to a minimal number of non-fog, non-rain daylight hours per year. We simply cannot accept a

> characterization that plume formation for such an extremely small number of the 8760 hours in a year would be intolerable. Even if this results in a detectable impact, in our judgment such impact would not reasonably approach any level of significance. . . In sum, much of the discussion of record seems to be concerned with preventing the potential occurrence of visible plumes when the evidence establishes that this potential is extremely slight to begin with and, if it occurs, will occur only in very limited meteorological circumstances for a minimal number of annual hours. We therefore conclude that no significant impact will result from the project's visible plumes, to the extent such plumes occur at all. (Decision, p. 369)

Despite the Commission's strong findings, Staff continued to insist on extremely low limits on visible plume levels, which Applicant submitted were not supported by design, engineering or other data. However, in an effort to resolve this issue with Staff, the Applicant proposed the version of VIS-10 that was ultimately adopted by the Commission:

> Nevertheless, we recognize the need to ensure that visible plumes are in fact minimized, and that any plume formation is objectively verified. We have therefore modified Condition VIS-10 based on Applicant's suggestions. (Decision, p. 369.)

Since the Commission's Decision with respect to MEC, and for more recently licensed combined cycle power plants, the Commission has adopted a different approach to minimize visible plumes. In these more recent proceedings, the Staff has modeled the expected visible plume frequency using a plume frequency of 10 percent of seasonal (November through April) daylight no rain/no fog (SDNRNF) hours as an initial plume impact threshold trigger. If the proposed plant is not expected to trigger this threshold, the Staff simply recommends that the plant be required to be designed and constructed as proposed – i.e., there is no prescriptive limit on the number of SDNRNF hours during which visible plumes are permitted to occur.[1]

If, for example, this standard had been applied to MEC, the threshold would have been approximately 394 hours, which is 10% of the 3,941 SDNRNF applicable to the facility for the year 2012 (based on San Jose Airport hourly meteorology). When applied to Applicant's plume abated cooling tower design, where no visible plumes will be formed when meteorological conditions are above 30 degrees Fahrenheit and the relative humidity is below 90 percent, that standard would require that 394 hours have temperatures less than 30 degrees Fahrenheit with the associated relative humidity above 90 percent. Looking at the most recent four years (2012-2015) of hourly meteorology at San Jose Airport, there were no hours where the temperature was less than 30 degrees Fahrenheit with relative humidity above 90 percent. In fact, there were only 19 hours in the four-year period with temperatures less than 30 degrees Fahrenheit and most of these occurred during nighttime

[1] The Staff's current methodology is to further refine the analysis by performing a high visual contrast hours analysis of the SDNRNF plume hours if Staff finds that the cooling tower plume frequency would exceed 10 percent of SDNRNF hours, in order to determine if a visual impact analysis of the cooling tower plumes is warranted.

hours. Under these circumstances, the plume abatement design point for the plant coupled with the fact that it would be nearly impossible to have over 394 hours of ambient temperatures less than 30 degrees Fahrenheit, the project owner submits that MEC should not be required to adhere to a prescriptive hours-based cap. Because the process of using a threshold trigger of 10% of SDNRNF hours is the adopted methodology for projects licensed after MEC,[2] this amendment requests that condition of certification VIS-10 be revised to be consistent with other similarly situated projects that have been licensed after MEC.

The proposed change in wording will not result in any physical change in the project or to the environment. The design of the plant will remain the same. The level of visible plume emissions will continue to be, as the Commission Decision stated, "extremely slight", "will occur only in very limited meteorological circumstances for a minimal number of annual hours", and "no significant impact will result from the project's visible plumes, to the extent such plumes occur at all." (Decision, p. 369.)

In light of the above, this Amendment proposes the following modification of VIS-10:

VIS-10 The power plant shall be operated in a manner that helps visually integrate it with its surroundings. To accomplish these objectives, the power plant shall be designed and operated to minimize visible plumes. ~~The power plant shall be designed and operated to meet the following plume abatement standards:~~

~~• No plume from the HRSG stack shall be visible above the top of a HRSG stack during daylight, non-fog, non-rain hours.~~

~~• Cooling tower plumes shall not be visible for more than a total of fourteen (14) hours in any calendar year during daylight, non-fog, non-rain hours; provided, however, plumes created during any unplanned outages of the plume abatement control system shall not be counted against the fourteen (14) hour total.~~

~~The power plant shall be operated in a manner that meets these standards and shall immediately adjust its operations to meet the standards whenever weather or other conditions necessitate adjustments to operation to meet the standards. If more than two (2) violations of any standard or standards occur in any in any in any calendar year, the power plant shall prepare and submit a revised operating plan to the CPM that demonstrates how the plant will meet these standards.~~

[2] For example, see East Altamont Energy Center (01-AFC-04), Staff Plume Analysis, p. 6; Malburg Generating Station (01-AFC-5), Final Decision p. 5; Tesla Power Plant (01-AFC-21), Final Decision p. 443.

~~**Protocol: Prior to the start of construction, the project owner shall submit to the CPM for review and approval and to the City of San Jose for review and comment a plume abatement plan that describes how the power plant will be designed and operated to meet the standards for minimizing visible plumes during daylight hours. The plume abatement plan shall also identify any adjustments to operations that will be necessary to meet the standards whenever weather or other conditions necessitate adjustments to operations to meet the standards.**~~

~~**The plan shall include, but not be limited to:**~~

- ~~**The plant shall be designed to produce no visible plumes in conditions above 30 degrees Fahrenheit and below 90 percent relative humidity.**~~
- ~~**Operating procedures of the power plant to meet the standards for abatement of visible plumes during daylight hours.**~~
- ~~**Operating procedures for immediately adjusting power plant operations to meet the standards whenever weather or other conditions necessitate adjustments to meet the standards.**~~
- ~~**Procedures for monitoring and reporting the duration and frequency of occurrence of any visible plumes Including the installation of monitoring cameras.**~~

The project owner shall reduce the cooling tower and HRSG visible vapor plumes by the following methods:

- **The project owner shall reduce the cooling tower visible plumes through the use of a plume abated wet/dry cooling tower that has a plume abatement design point of 30°F and 90 percent relative humidity. This design will ensure that plumes are abated to the maximum extent possible for the stipulated design point.**

Verification: At least sixty (60) days prior to the start of construction of the powerplant, the project owner shall submit the proposed plume abatement plan to the CPM for review and approval and to the City of San Jose for review and comment. The project owner shall submit any required revisions within thirty (30) days of notification by the CPM. The project owner shall not begin construction of the power plant until the project owner receives written notification of approval of the plume abatement plan from the CPM.

2.2 Necessity of Proposed Changes

The Siting Regulations require a discussion of the necessity for the proposed modification to VIS-10 and whether the modification is based on information known by the petitioner during the certification proceeding (Title 20, CCR, Sections 1769 (a)(1)(B), and (C)).

As described in Section 2.1 above, modification of VIS-10 is necessary in order to ensure that the manner of regulating visible plumes at MEC is consistent with the manner that the Commission regulates other similarly situated power plants that were licensed after MEC. The project owner did not know at the time of approval of the Decision that the Commission would subsequently set a visible plume threshold substantially above the expected visible plume levels of the Metcalf Energy Project.

3.0 Environmental Analysis of Proposed Project Changes and Consistency with LORS

The modification proposed by this Amendment is evaluated below. The end of this section addresses the consistency of the proposed modification to Visual Resources Conditions of Certification VIS-10 with LORS.

The proposed modification has no possible potential impact on the following environmental disciplines: Biological Resources, Cultural Resources, Geology and Paleontology, Hazardous Materials Management, Land Use, Noise and Vibration, Socioeconomics, Soil and Water Resources, Traffic and Transportation, Waste Management, and Worker Safety and Fire Protection.

Three environmental disciplines are discussed below.

3.1 Changes to VIS-10

This Amendment modifies the requirements regarding the regulation of visible plumes. The Amendment does not change the design or operation of the plant and the amount of visible plumes that will occur in the future is not expected to vary significantly from current or historical levels. Accordingly, the proposed modification to VIS-10 will not result in any significant adverse environmental impact.

3.1.1 Air Quality

The proposed modification of VIS-10 will not cause any change to air quality.

3.1.2 Public Health

The proposed modification of VIS-10 will have no effect on public health.

3.1.12 Visual Resources

The proposed modification of VIS-10 will change the manner in which visible plumes are regulated, but will not change the design or operation of the plant, and the amount of

visible plumes that will occur in the future is not expected to vary significantly from current or historical levels. The levels of visible plumes will continue to be slight, minimal and well below the Commission's 10 percent threshold of significance. Therefore, the Amendment's changes to VIS-10 will not have a significant adverse impact to visual resources.

At the request of Commission Staff, an updated visual plume assessment, utilizing more recent meteorological data was conducted in 2015 by Atmospheric Dynamics, Inc.

The Seasonal Annual Cooling Tower Impact Program (SACTIP) was used to assess the frequency of plume occurrence using the most recent three years of meteorological data. The SACTIP assessment *did not* include the plume abatement design, thus the results would be an overestimate of plume impacts based on the 30/90 design of the abatement system in place at MEC. SACTIP contains algorithms for both natural and mechanical draft cooling towers arranged singly or in clusters. Plume merging and associated enhanced plume rise are treated by the routines contained in the model. While the SACTIP model does not have any official regulatory endorsement, this model has been applied for a large number of projects where cooling tower impact assessments were required. The characteristics of the tower and the preparation of the meteorological data set are discussed below.

A three (3) year meteorological data set was constructed using hourly surface observations from the San Jose Airport meteorological station, located near the project location, for the years 2012 through 2014. As discussed below, nighttime hours were removed from the meteorological data set as well as daytime hours where weather or other visibility-obscuring phenomenon would impair visibility.

Given the length of time of the data used in the SACTIP analysis, the data used are considered representative of the climatic conditions of the area where plume formation can occur. Even with this representative data set, short-term variability in conditions can affect the prediction of cooling tower plume impacts. Therefore, the results of the analysis are considered an indicator of likely occurrence and not an absolute predictor of events.

The SACTIP results for all seasons are summarized in the table below. Impacts are consistent between the seasons. This can be accounted for by the limited variation in seasonal tower characteristics and the lack of extreme seasonal meteorological ranges. The annual values indicate that the majority of visible plume lengths will be about 100 meters (328 feet). Larger downwind visible plume lengths are possible, but the downwind visible plume length will be less than 400 meters for 95 percent of all the hours where a visible plume will form. This results in a plume length exceeding 400 meters for only 5.0 percent of the time during the season. When translated into total hours for the season, on average, 163 hours per year will have plume lengths up to but not exceeding 400 meters. SACTIP also predicts that the probability that a visible plume height is relatively slight, averaging 30 meters, and has a median radius of 30 meters.

Seasonal Plume Characteristics from SACTIP

Season	*Annual*	*Winter*	*Spring*	*Summer*	*Fall*
Plume Characteristics (meters)					
Median Length	100	100	117	100	67
Median Height	30	43	30	30	30
Median Radius	30	30	30	30	30

The methodology used to produce this analysis is described in Appendix A.

3.2 Consistency of Amendment with the Certification and LORS

The Siting Regulations require a discussion of the consistency of the proposed project revisions with the applicable laws, ordinances, regulations, and standards (LORS) and whether the modifications are based upon new information that changes or undermines the assumptions, rationale, findings, or other bases of the final decision (Title 14, CCR Section 1769 (a)(1)(D)). If the project is no longer consistent with the certification, the petition for project change must provide an explanation for why the modification should be permitted.

This Amendment is consistent with all applicable LORS and is not based on new information that changes or undermines any bases for the Decision. The findings and conclusions contained in the Decision for the project are still applicable to the project as modified.

4.0 Potential Effects on the Public

This section discusses the potential effects on the public that may result from the modification proposed in this request for approval, per the Siting Regulations (Title 20, CCR, Section 1769(a)(1)(G)).

The proposed modification will not affect the public. Visible plumes from the proposed project will continue to be slight, minimal and well below the Commission's threshold of significance.

5.0 List of Property Owners and Potential Effects on Property Owners

5.1 List of Property Owners

In accordance with the Siting Regulations (Title 20, CCR, Section 1769(a)(1)(H)), the project owner will provide the Compliance Project Manager for the project a list of all property owners whose property is located within 500 feet of the project.

5.2 Potential Effects on Property Owners

This section addresses potential effects of the modification proposed in this Amendment on nearby property owners, the public, and parties in the application proceeding, per the Siting Regulations (Title 20, CCR, Section 1769 (a)(1)(I)).

The proposed modifications will not affect any property owners. Visible plumes from the proposed project will continue to be slight, minimal and well below the Commission's threshold of significance.

Appendix A

Visual Cooling Tower Plume Analysis

Metcalf Energy Center

San Jose, California

Submitted to

California Energy Commission

Submitted by

Metcalf Energy Center, LLC

Prepared by

Atmospheric Dynamics, Inc.

July 2015

ATMOSPHERIC DYNAMICS, INC
Meteorological & Air Quality Modeling

A revised meteorological and visual plume assessment, utilizing more recent meteorological data was conducted in 2015 by Atmospheric Dynamics, Inc. This detailed analysis is presented below.

The Seasonal Annual Cooling Tower Impact Program (SACTIP) was used to assess the frequency of plume occurrence using the most recent three years of meteorological data. The SACTIP assessment did not include the plume abatement design as doing so would result in no plume formation via the modeling outputs. Thus, the results would be an overestimate of plume impacts based on the 30/90 design of the abatement system in place at MEC. SACTIP contains algorithms for both natural and mechanical draft cooling towers arranged singly or in clusters. Plume merging and associated enhanced plume rise are treated by the routines contained in the model. While the SACTIP model does not have any official regulatory endorsement, this model has been applied for a large number of projects where cooling tower impact assessments were required. The characteristics of the tower and the preparation of the meteorological data set are discussed below.

The characteristics of the proposed cooling tower are listed in Table 1.1. These input parameters were obtained from the project's engineering consultant and is based on final as built design data for the facility.

A three (3) year meteorological data set was constructed using hourly surface observations from the San Jose Airport meteorological station, located near the project location, for the years 2012 through 2014. As discussed below, nighttime hours were removed from the meteorological data set as well as daytime hours where weather or other visibility-obscuring phenomenon would impair visibility.

Given the length of time of the data used in the SACTIP analysis, the data used are considered representative of the climatic conditions of the area where plume formation can occur. Even with this representative data set, short-term variability in conditions can affect the prediction of cooling tower plume impacts. Therefore, the results of the analysis are considered an indicator of likely occurrence and not an absolute predictor of events.

SACTIP default options were assumed for the input variables controlling the model's operation. The three (3) year data set was input into SACTIP to produce a three (3) year average frequency distributions for condensed plume length, condensed plume height, plume shadowing, and ground level fogging. Although the model provides information on plume shadowing and drift deposition, the focus of our analysis and the discussion that follows is on visible plume dimensions and ground based fogging.

Table 1.1 MEC Cooling Tower Input Parameters	
Parameter	**Value**
Type	linear mechanical draft 1 tower, 10 cells
Heat Dissipation Rate (MW)	All Seasons 450
Circulation Rate (gpm)	133,400
Total Tower Air Flow (kg/s)	9073
Max Drift Rate (%)	0.0005
Salt Concentration (mg/l)	9969
Orientation	Based on GA
Height (m)	18.16
Equivalent Total Cell Diameter (m)	34.2
Exit Velocity & Temperature	variable, calculated by the model assuming saturation conditions

Conditions favoring a long condensed plume occur more frequently in the fall and winter seasons, as atmospheric conditions, such as air temperature and relative humidity, are more favorable during these periods for plume formation. Also, plume formation tends to occur more frequently during nighttime hours and during adverse weather conditions. Since MEC has installed a lighting plan that minimizes illumination, these cooling tower plumes would not be visible at night. The SACTIP meteorological data set was modified by removing the nighttime hours, which accounted for 50% of all the hours in the three-year (3) data set. In addition, daytime observations with fog, precipitation, visibility less than three (3) miles, or ceiling heights less than 500 feet were excluded from the meteorological data set as under these conditions, a visible plume from the cooling tower would be obscured by these local weather phenomena. For the San Jose meteorological data set, these adverse weather conditions account for less than five percent of the total valid (daylight hours) observations. Table 1.2 summarizes these statistics.

Table 1.2					
Year	**Total hours**	**Day hours**	**Night Hours Removed from Analysis**	**Limited Visibility Hours Removed from Analysis**	**Total Hours Modeled With SACTIP**
2012	8760	4394	4366	194	3941
2013	8760	4394	4366	139	4255
2014	8760	4394	4358	200	4199

Thus, the three (3) year meteorological data set was modified by removing both nighttime hours and hours with weather obscuring phenomena. In total, these conditions accounted for 53% of all the hours (day, night, and obscuring weather) in the data set. The SACTIP was then applied to the remaining data set to assess the cooling tower plumes under daytime conditions/good visibility conditions. After removal of the specific hours, for each of the three years of data (2012-2014), there was less than one (1) percent of the total time period where the temperature was less than or equal to 30 degrees F. Of particular interest was the analysis of visible plume formation during the months when such formation is most likely, namely the fall and winter seasons. The occurrence of low temperatures coupled with high relative humidity occurs with a greater frequency during these seasons. Plume formation is favored during these types of low temperature/high humidity conditions since the ability of the atmosphere to absorb water vapor is greatly reduced because the air mass is at or near saturation. As such, the installation of the plume abatement technology will limit plume formation during most of the hours where the combination of low temperature and high humidity exist (30/90 design).

Looking at the most recent four years (2012-2015) of hourly meteorology at San Jose Airport, there were no hours where the temperature was less than 30 degrees Fahrenheit with relative humidity above 90 percent. In fact, there were only 19 hours in the four-year period with temperatures less than 30 degrees Fahrenheit and most of these occurred during nighttime hours.

Year, Month, Day, Hour	Temperature (ºF)	Relative Humidity (%)
2013,12,09,07	27	74
2013,12,10,07	28	74
2013,01,13,06	28	77
2013,01,13,07	29	88
2013,12,09,02	29	88
2013,12,09,03	29	71
2013,12,09,04	29	71
2013,12,09,05	29	74
2013,12,09,08	29	71
2013,12,10,04	29	74
2013,12,10,05	29	78
2013,12,10,06	29	78
2013,01,13,05	29	74
2013,01,13,08	30	81
2013,12,05,05	30	85
2013,12,05,06	30	74
2013,12,05,07	30	78
2013,12,10,03	30	68
2013,12,09,07	30	74

The results of the cooling tower analysis are summarized in the SACTIP modeling outputs and in Table 1.3 for the seasonal periods, which do not consider the 30/90 design. Figure 1.1 also presents plume lengths in percent hours per year. The modeling results are relatively consistent between the seasons. This can be accounted for by the limited variation in seasonal tower characteristics and the lack of extreme seasonal meteorological ranges. The annual values indicate that the majority of visible plume lengths will be about 100 meters (328 feet) or less. Larger downwind visible plume lengths are possible, but the downwind visible plume length will be less than 400 meters for 95 percent of all the hours where a visible plume could form. This results in a plume length exceeding 400 meters for only 5.0 percent of the time during the season and hours when plume formation would occur. When translated into total hours for the season, an average of 163 hours per year (3.9% of the total good hours per year) will have plume lengths up to but not exceeding 400 meters. SACTIP also predicts that the visible plume height is relatively low, averaging 30 meters, with a median radius of 30 meters.

TABLE 1.3 Seasonal Plume Characteristics from SACTIP

Season	*Annual*	*Winter*	*Spring*	*Summer*	*Fall*
Plume Characteristics (meters)					
Median Length	100	100	117	100	67
Median Height	30	43	30	30	30
Median Radius	30	30	30	30	30

Because of the plume-abated 30/90 cooling tower design that is in use at MEC, the cooling tower plumes will be a rare occurrence, appearing a few times at most during the coldest days of a year. However, on a few occasions during the year when temperatures are very low and humidity is high, water vapor plumes coming from the stacks may be visible for short periods of time. When cooling tower plumes do occur, they will tend to be present at night and in the early morning hours. Because of the measures that have been taken to reduce lighting at the plant, along with incorporation of the 30/90 plume abated design, visual plume formation will be minimal.

Based on detailed analysis which addresses the existing cooling tower design without abatement, no impacts to visual resources are expected to occur. Based on the 30/90 abatement design, and analyzing the meteorology at the site over the most recent four-year period, no plume formation during daylight hours are expected to occur.

Figure 1.1 Annual Cooling Tower Plume Length in Percent of Hours per Year