DOCKETED

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Description:	Otay Mesa Executive Summary and Analysis
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CALIFORNIA ENERGY COMMISSION
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SACRAMENTO, CA 95814-5512
www.energy.ca.gov

DATE: November 17, 2015

TO: Interested Parties

FROM: Dale Rundquist, Compliance Project Manager

SUBJECT: **Otay Mesa Energy Center (99-AFC-5C)**
Staff Analysis Petition to Amend Hot Gas Path Components

On May 26, 2015, a petition was docketed with the California Energy Commission (Energy Commission) for the Otay Mesa Energy Center, LLC, requesting to amend the Final Decision for the Otay Mesa Energy Center (Otay Mesa). The modifications proposed in the petition would replace certain combustion section components (turbine blades, nozzles and associate structural elements) with Advanced Gas Path components on the two existing combustion turbines at Otay Mesa. Staff prepared an analysis of this proposed change that can be reviewed on the Energy Commission's website for this facility.

The combined-cycle, natural gas-fired, electricity-generating facility was certified by the Energy Commission in its Decision on April 23, 2001, and began commercial operation on October 3, 2009. The facility is located in the Otay Mesa area in western San Diego County, California.

Energy Commission staff (staff) reviewed the petition and assessed the impacts of this proposal on environmental quality and on public health and safety. In the Staff Analysis, staff proposes two new **Traffic and Transportation** Conditions of Certification **TRANS-7** and **TRANS-8** because it is staff's opinion that, with the implementation of these new conditions, the facility would remain in compliance with applicable laws, ordinances, regulations, and standards, and the proposed modifications would not cause a significant impact on the environment (Cal. Code Regs., tit. 20, § 1769). Energy Commission staff intends to recommend approval of the petition at the January 2016, Business Meeting of the Energy Commission.

The Energy Commission's webpage for this facility, http://www.energy.ca.gov/sitingcases/otaymesa/index.html, has a link to the petition and the Staff Analysis on the right side of the webpage in the box labeled "Compliance Proceeding." Click on the "Documents for this Proceeding (Docket Log)" option. After the Final Decision, the Energy Commission's Order regarding this petition will also be available from the same webpage.

This notice has been mailed to the Energy Commission's list of interested parties and property owners adjacent to the facility site. It has also been e-mailed to the facility listserv. The listserv is an automated Energy Commission e-mail system by which

information about this facility is e-mailed to parties who have subscribed. To subscribe, go to the Commission's webpage for this facility, cited above, scroll down the right side of the project webpage to the box labeled "Subscribe," and provide the requested contact information.

Any person may comment on the Staff Analysis. Those who wish to comment on the analysis are asked to submit their comments by 5:00 p.m., December 17, 2015. To use the Energy Commission's electronic commenting feature, go to the Energy Commission's webpage for this facility, cited above, click on the "Submit e-Comment" link, and follow the instructions in the on-line form. Be sure to include the facility name in your comments. Once submitted, the Energy Commission Dockets Unit reviews and approves your comments, and you will receive an e-mail with a link to them.

Written comments may also be mailed or hand-delivered to:

California Energy Commission
Dockets Unit, MS-4
Docket No. 99-AFC-5C
1516 Ninth Street
Sacramento, CA 95814-5512

All comments and materials filed with and approved by the Dockets Unit will be added to the facility Docket Log and become publically accessible on the Energy Commission's webpage for the facility.

If you have questions about this notice, please contact Dale Rundquist, Compliance Project Manager, at (916) 651-2072, or by fax to (916) 654-3882, or via e-mail to dale.rundquist@energy.ca.gov.

For information on participating in the Energy Commission's review of the petition, please call the Public Adviser at (800) 822-6228 (toll-free in California) or send your e-mail to publicadviser@energy.ca.gov. News media inquiries should be directed to the Energy Commission Media Office at (916) 654-4989, or by e-mail to mediaoffice@energy.ca.gov.

Mail List 708
Otay Mesa Listserv

OTAY MESA ENERGY CENTER (99-AFC-5C)

Petition to Amend Hot Gas Path Components

Executive Summary

Dale Rundquist

INTRODUCTION

On May 26, 2015, a petition was docketed with the California Energy Commission (Energy Commission) for the Otay Mesa Energy Center, LLC, requesting to amend the Final Decision for the Otay Mesa Energy Center (Otay Mesa). The modifications proposed in the petition would replace certain combustion section components (turbine blades, nozzles and associate structural elements) with Advanced Gas Path (AGP) components on the two existing combustion turbines at Otay Mesa.

The purpose of the Energy Commission's review process is to assess any impacts the proposed modifications would have on environmental quality and on public health and safety. The process includes an evaluation of the consistency of the proposed changes with the Energy Commission's Final Decision and an assessment of whether the project, as modified, would remain in compliance with applicable laws, ordinances, regulations, and standards (LORS) (Cal. Code Regs., tit. 20, § 1769).

Energy Commission staff (staff) has completed its review of all materials received. The Staff Analysis below is staff's assessment of the project owner's proposal to amend the Otay Mesa Final Decision.

PROJECT LOCATION AND DESCRIPTION

Otay Mesa is a combined-cycle, natural gas-fired, electricity-generating facility, located in the Otay Mesa area in western San Diego County, California. The project was certified by the Energy Commission in its Decision on April 23, 2001, and began commercial operation on October 3, 2009.

DESCRIPTION OF PROPOSED MODIFICATIONS

The modifications proposed in the petition would replace certain combustion section components (turbine blades, nozzles and associate structural elements) with AGP components on the two existing combustion turbines at Otay Mesa. The AGP replacement components will increase the combined generating capability of both turbines by approximately 15 MW and will improve the heat rate of the entire plant.

NECESSITY FOR THE PROPOSED MODIFICATIONS

Improvements have been made in the design of hot gas path components such as turbine blades, nozzles, and associated structural elements that are made from advanced materials that can withstand higher temperatures. These AGP components are functionally identical to existing equipment and will increase the combined generating capability of both turbines, regardless of ambient temperature.

STAFF'S ASSESSMENT OF THE PROPOSED PROJECT CHANGES

Energy Commission technical staff reviewed the petition for potential environmental effects and consistency with applicable LORS. Staff's conclusions in each technical area are summarized in **Executive Summary Table 1**, below. Staff has determined that the technical or environmental areas of Biological Resources, Cultural Resources, Facility Design, Geological Hazards and Resources, Land Use, Noise and Vibration, Paleontological Resources, Transmission Line Safety and Nuisance, and Transmission System Engineering are not affected by the proposed changes.

For the technical areas of Air Quality, Hazardous Materials Management, Socioeconomics, Soil and Water Resources, Visual Resources, Waste Management, and Worker Safety and Fire Protection, staff has determined the project would continue to comply with applicable LORS and no changes to any conditions of certification are necessary to ensure no significant impacts occur. Staff notes the following for these technical areas:

- **Air Quality.** The petitioner is proposing to replace the hot gas path components on the two existing turbines at the Otay Mesa Generating Project (Project). The replacements would be functionally identical to the existing equipment, however they would be made from advanced materials designed to withstand higher temperatures. The replacements would improve the turbine efficiency and the generating capability would increase by 15 MW. These new components are more durable, improving unit reliability and reducing maintenance outage frequently and duration. These hot gas path components are routinely replaced during maintenance outages due to degradation from thermal cycling and high temperatures. They are scheduled to be replaced during the next planned major maintenance outage in spring 2016.

  The Project would continue to meet all existing heat input requirements and established emission limits, and comply with applicable laws, ordinances, regulations and standards (LORS). The petitioner submitted a letter to the San Diego Air Pollution Control District (SDAPCD) outlining the planned work. The SDAPCD determined that the replacement of the hot gas components with upgraded materials would be considered routine maintenance of the equipment and no permitting actions would be required. In addition, no changes to the Project's Conditions of Certification would be required for the replacement.

  Staff has not identified any significant Air Quality impacts from the Petition to Amend with the Project's continued compliance with the established Air Quality Conditions of Certification. There would be no significant Air Quality impacts from the proposed amendment to any population within the Otay Mesa Generating Project's six-mile radius, including any environmental justice population. Therefore staff is proposing to process the request as a Staff Approved Project Modification.

- **Hazardous Materials Management.** During the installation of the advanced combustion components for the two existing turbines, several hazardous materials will be used onsite. Similar to equipment maintenance activities, these materials would include solvents, gasoline, lubricants, and welding gases which are already included in the annual compliance report under existing Condition of Certification **HAZ-1**. No extremely hazardous or regulated hazardous materials will be used on site specifically for the advanced combustion components for the two existing turbines. Therefore, with the petitioner's continued compliance with existing conditions of certification, **HAZ-1** specifically, the proposed modification would not have a significant effect on the environment and would continue to comply with all applicable LORS.
- **Socioeconomics.** The proposed modification would not require a large number of construction workers or take an extensive amount of time (less than a month). Otay Mesa is located in the San Diego-Carlsbad-San Marcos Statistical Area[1], which has a large supply of construction workers, so the modifications would not cause workers to relocate to the project area. **SOCIO-1**, which requires recruiting employees and procuring materials and supplies within San Diego County first and outside the county second, would be applicable to this project modification.
- **Soil and Water.** It is possible that the proposed modification could result in a change in water use. If the water use increases, it is not expected to be significant. The generation capacity could go up by three percent (a nominal 510 MW to approximately 525 MW). The improved heat rate would improve fuel efficiency as well as water use efficiency. This change is small enough that it is within the range of operational fluctuations. Even if the change increases annual water use by three AFY, the use is still far below the rate contemplated in the Final Decision, 385 AFY.
- **Visual Resources.** As stated in the *Otay Mesa Energy Center Final Staff Assessment*, "The hot combustion emissions from the stacks would rarely be visible. … [C]onsidering the warm and hot start-ups throughout the year, no visible vapor plume should occur. With the infrequent cold start-ups (2-3 times per year), a brief slight brown tint to the stack emissions may occur. The emissions should be inconspicuous and not cause a significant adverse visual impact." The proposed modifications to the two existing combustion turbines would not change this conclusion.
- **Waste Management.** The evaluation of the proposed project and the mitigation measures are intended to reduce the risks and environmental impacts associated with handling, storing, and disposing of waste. The proposed petition, would not result in, or require any changes to conditions of certification. The proposed petition also would not result in any new or unconsidered environmental impacts.

[1] Metropolitan and nonmetropolitan area occupational employment and wage estimate information for San Diego, Carlsbad, and San Marcos, CA.

- **Worker Safety and Fire Protection.** The installation of advanced combustion components would include replacement of the turbine blades, nozzles, and associated structural elements. Activities to be performed for the required installation would comply with worker safety and fire safety requirements already contained in health and safety plans utilized for construction of the main facility per Condition of Certification **WORKER SAFETY-1**.

Staff determined that the technical area of **Traffic and Transportation** would be affected by the proposed project changes and has proposed new Conditions of Certification **TRANS-7** and **TRANS-8** in order to assure compliance with LORS and to reduce potential environmental impacts to a less than significant level. The proposed conditions of certification are provided in the Traffic and Transportation Staff Analysis section below.

Executive Summary Table 1
Summary of Impacts for Each Technical Area

TECHNICAL AREAS REVIEWED	STAFF RESPONSE			New or Revised Conditions of Certification Recommended
	Technical Area Not Affected	No Significant Environmental Impact or LORS Inconsistency*	Process As Amendment	
Air Quality		X		
Biological Resources	X			
Cultural Resources	X			
Facility Design	X			
Geological Hazards & Resources	X			
Hazardous Materials Management		X		
Land Use	X			
Noise & Vibration	X			
Paleontological Resources	X			
Socioeconomics		X		
Soil & Water Resources		X		
Traffic & Transportation			X	YES
Transmission Line Safety & Nuisance	X			
Transmission System Engineering	X			
Visual Resources		X		
Waste Management		X		
Worker Safety & Fire Protection		X		

*There is no possibility that the proposed modifications may have a significant effect on the environment, and the modifications will not result in a change in or deletion of a condition adopted by the Commission in the Final Decision, or make changes that would cause project noncompliance with any applicable laws, ordinances, regulations, or standards (Cal. Code Regs., tit. 20, § 1769 (a)(2)).

STAFF RECOMMENDATIONS AND CONCLUSIONS

Staff concludes that the following required findings, mandated by Title 20, California Code of Regulations, section 1769 (a)(3), can be made, and staff recommends approval of the petition by the Energy Commission:

- The proposed modification(s) would not change the findings in the Energy Commission's Decision pursuant to Title 20, California Code of Regulations, section 1755;
- There would be no new or additional unmitigated, significant environmental impacts associated with the proposed modification;
- The facility would remain in compliance with all applicable LORS;
- The modification proposed in the petition would increase the combined generating capability of both turbines by approximately 15 MW and improve the heat rate of the entire plant;
- The proposed modification(s) would be beneficial to the public because the generating capability would increase by 15 MW and Otay Mesa would continue to meet all existing heat input requirements and emission limits; and
- The proposed modification is justified because the AGP technology was not available at the time of the April 2001 Energy Commission Decision.

OTAY MESA ENERGY CENTER (99-AFC-5C)

Petition to Amend Hot Gas Path Components

Traffic and Transportation

James Adams

INTRODUCTION

The owner of the Otay Mesa Energy Center (Otay Mesa) proposes installing new Advanced Gas Path (AGP) components on the two existing combustion turbines. The AGP components will improve the turbine heat rate and increase project generating capacity by approximately 15 megawatts. Staff has completed the first thermal plume modeling analysis for Otay Mesa (see **Appendix-1** to this analysis), which shows that staff's threshold velocity of 4.3 meters per second (m/s) is predicted to occur up to 1,020 feet above ground level (AGL). From ground level to this elevation is where low-flying aircraft could experience moderate to severe turbulence if they flew over Otay Mesa. This is a small increase in the height of the plumes predicted for the existing combustion turbines. The installation of the new equipment will be done as part of a normal maintenance outage with no additional truck trips beyond the volume considered in the Commission Decision for operation of Otay Mesa.

LAWS, ORDINANCES, REGULATIONS AND STANDARDS (LORS)

Implementation of the Petition to Amend (PTA) will require the project owner to continue to comply with California Streets and Highways Code, Sections 117 and 660-72, and California Vehicle Code 35780 et seq., which require permits for the transportation of oversized loads on county roads. Thus, Condition of Certification **TRANS-1** from the Commission Decision applies to the amendment.

ANALYSIS

The potential impact of thermal plumes on aviation activities was not considered or analyzed in the October 2000 Final Staff Assessment (FSA) or the April 2001 Energy Commission Decision in the Otay Mesa proceeding. Staff's approach to analyzing the effects of power plants on aviation safety substantially changed after the Blythe Energy Project (99-AFC-8) began operating in July 2003. Shortly thereafter, staff was advised that pilots were experiencing moderate to severe turbulence when flying over the project's cooling towers. After a lengthy compliance investigation, staff began to perform plume modeling analyses for any power plant proposed in relatively close proximity to an operating airport (approximately three miles or less). In addition, new mitigation measures were developed to advise the Federal Aviation Administration (FAA) and pilots using the airports near power plants about potential impacts of thermal plumes on low-flying aircraft.

The more rigorous aviation safety analysis was conducted during the Pio Pico Energy Center (PPEC) proceeding as described in the September 2012 Energy Commission Decision in the PPEC siting case. The PPEC site is immediately adjacent to the Otay

Mesa site and is approximately three miles east of the Brown Field Municipal Airport. The PPEC Decision notes Brown Field Municipal Airport is owned and operated by the city of San Diego as a general aviation airport and is frequently used by the military and law enforcement agencies. Brown Field Municipal Airport has two runways: Runway 8L/26R, 7,920 feet long and 150 feet wide with a pattern altitude of 1,000 feet above ground level (AGL); and Runway 8R/26L, 3,180 feet long and 75 feet wide with a pattern altitude of 600 feet AGL. The U.S. Department of Homeland Security, U.S. Customs, San Diego County Fire Department, Border Protection, and branches of the military have aircraft (planes and helicopters) within the project area.

Due to prevailing winds in the area, most aircraft take-off heading west from Brown Field Municipal Airport and do not traverse the PPEC or Otay Mesa sites. Most aircraft approaching Brown Field Municipal Airport do not overfly the sites either; approximately 75 percent of aircraft approaching Brown Field Municipal Airport enter the traffic pattern from the north and west of Donovan State Prison. **Traffic and Transportation Figure 2** from the PPEC FSA (attached) shows the aircraft traffic patterns and has been modified to depict the Otay Mesa site. It should be noted that aircraft from the east do fly over the Otay Mesa general area but at a relatively high elevation to provide adequate separation from the local foothills.

Because high velocity thermal plumes could present a potentially significant hazard to aircraft performing overflights of the PPEC at low altitudes, the Energy Commission Decision in the PPEC proceeding included Conditions of Certification TRANS-8 and TRANS-9. TRANS-8 requires lighting of the exhaust stacks to alert pilots to the presence of the facility and reduce the potential for inadvertent overflight and exposure to high-velocity thermal plumes. TRANS-9 provides a means to advise pilots of the potential hazard to flight associated with the plumes and the need to avoid overflight of the facility below 1,720 feet AGL[2]. These measures include: issuance of a Notice to Airmen (NOTAM); amendment of the Airport/Facility Directory; revision of the San Diego Sectional Chart; and addition of a new remark to the Automated Surface Observing System (ASOS). The PPEC Decision noted that pilots would have the flexibility to avoid direct overflight of the PPEC while conducting their normal operations because aircraft do not need to fly over the PPEC site to enter or depart the traffic pattern and the airspace is wide-open in the general area.

Installation of the AGP components at Otay Mesa would have a small effect on the existing high velocity thermal plumes emitted from its two 100-foot tall exhaust stacks during operation. As shown in Appendix 1, for the existing facility, the average plume velocity during duct firing is calculated to drop below 4.3 m/s at 980 feet AGL. After installation of the AGP components, the 4.3 m/s plumes would extend to 1,020 feet AGL during duct firing. As noted in the PPEC Decision, the FAA has formally acknowledged plume hazards by amending the Aeronautical Information Manual to establish thermal

[2] A petition to amend the PPEC is currently pending Commission approval, which would increase the heat input to the PPEC gas turbines by approximately 10 percent. The increase in heat input would increase the height of the thermal plumes emitted from the turbine exhaust stacks; therefore staff proposes to modify TRANS-9 to specify that direct overflight should be avoided below 2,000 AGL.

plumes as flight hazards. It acknowledges…"Some studies do predict that the significant turbulent effects of an exhaust plume can extend to heights of over 1,000 feet above the height of the top of the stack or cooling tower…A pilot should steer clear of exhaust plumes by flying on the upwind side of the smokestacks or cooling towers" (FAA 2014). Staff believes that aircraft used by the military and law enforcement agencies identified above use the airspace around Otay Mesa, and could experience turbulence from the exhaust stacks (and the two air-cooled condensers), so they should be advised to not fly directly over the Otay Mesa facility. Similar to the PPEC, the facility should be marked with aviation warning lights to identify the project's location to pilots flying at night.

CONCLUSIONS AND RECOMMENDATIONS

Staff has reviewed the petition for potential environmental effects and consistency with applicable LORS. Staff is proposing two new conditions of certification to ensure pilots are aware of the need to avoid direct overflight of Otay Mesa. The installation of the AGP will not require any additional truck trips beyond the volume considered in the Commission Decision for operation of Otay Mesa and will not have a significant effect on traffic flows on the local roads. Implementation of existing Condition of Certification **TRANS-1** would ensure the project continues to be consistent with the applicable traffic-related LORS identified above.

PROPOSED MODIFICATIONS TO CONDITIONS OF CERTIFICATION

To provide pilots with warning of potential aviation hazards, staff is proposing Conditions of Certification **TRANS-7** and **TRANS-8** for Otay Mesa. **TRANS-7** would require lighting of the exhaust stacks, consistent with FAA requirements, alerting pilots to the presence of the facility and reducing the potential for inadvertent overflight and exposure to high-velocity thermal plumes. **TRANS-8** would require the project owner to consult with the FAA to notify all pilots using the Brown Field Municipal Airport and airspace above Otay Mesa of potential air hazards. Although the 4.3 m/s plume velocity is predicted to occur up to 1,020 feet AGL, the adjacent Pio Pico Energy Center plume velocity of 4.3 m/s is predicted to occur at 1,910 feet AGL. In order to increase the margin of safety, staff recommends no overflight for both Otay Mesa and Pio Pico below 2,000 feet AGL. **Underline and bold** is used to identify new conditions.

TRANS- 7 Obstruction Marking and Lighting - The project owner shall install obstruction marking and lighting on the exhaust stacks consistent with FAA requirements, as expressed in the following documents:

- **FAA Advisory Circular 70/7460-1K**
- **FAA Safety Alert for Operators (SAFO) 09007.**

Lighting shall be operational 24 hours a day, 7 days a week for the life of project operation. Upgrades to the required lighting configurations, types, location, or duration shall be implemented consistent with any changes to FAA obstruction marking and lighting requirements.

Verification: Within 60 days after Energy Commission approval of the Petition to Amend, the project owner shall submit to the CPM for approval final design plans that depict the required air traffic obstruction marking and lighting.

Within 60 days after CPM approval of the final design plans, the project owner shall install permanent obstruction marking and lighting consistent with FAA requirements and shall inform the CPM in writing within 10 days of installation that the lighting is ready for inspection.

TRANS-8 Pilot Notification and Awareness - The project owner shall initiate the following actions to ensure pilots are aware of the project location and potential hazards to aviation:

- **Submit a letter to the FAA requesting a Notice to Airmen (NOTAM) be issued advising pilots of the location of the Otay Mesa Energy Center and recommending avoidance of overflight of the project site below 2,000 feet AGL. The letter should also request that the NOTAM be maintained in active status until the Los Angeles Section Chart and Airport Facility Directories (AFDs) identified below have been updated;**
- **Submit a letter to the FAA requesting a power plant depiction symbol be placed at the Otay Mesa Energy Center site location on the Los Angeles Sectional Chart with a notice to "avoid overflight below 2,000 feet AGL";**
- **Submit a request to and coordinate with the Brown Field Municipal Airport Manager to add a new remark to the Automated Surface Observing System (ASOS) identifying the location of the Otay Mesa Energy Center and advising pilots to avoid direct overflight below 2,000 feet AGL as they approach or depart the airport; and**
- **Request that Southern California Terminal Radar Approach Control (TRACON) and/or the San Diego Air Traffic Control Center submit aerodrome remarks describing the location of the Otay Mesa Energy Center and advising against direct overflight below 2,000 feet AGL to the:**
  1. **FAA Airport/Facility Directory – Southwest U.S.,**
  2. **Jeppesen Sanderson Inc. (Airway Manual Services - Western U.S. Airport Directory), and**
  3. **Pilot's Guide to California.**

Verification: Within 60 days after Energy Commission approval of the Petition to Amend, the project owner shall submit draft language for the letters of request to the FAA (including Southern California TRACON) and Brown Field Municipal Airport to the CPM for review and approval.

Within 60 days after CPM approval of draft language for the letters of request to the FAA (including Southern California TRACON), the project owner shall submit the required letters of request to the FAA and request that Southern California TRACON submit aerodrome remarks to the listed agencies. The project owner shall submit copies of these requests to the CPM. A copy of any resulting correspondence shall be submitted to the CPM within 10 days of receipt.

If the project owner does not receive a response from any of the above agencies within 45 days of the request, the project owner shall follow up with a letter to the respective agency or agencies to confirm implementation of the request. A copy of any resulting correspondence shall be submitted to the CPM within 10 days of receipt.

The project owner shall notify the CPM within 10 days if notified that any or all of the requested notices cannot be implemented. Should this occur, the project owner shall appeal such a determination, consistent with any established appeal process and in consultation with the CPM. A final decision from the jurisdictional agency denying the request, as a result of the appeal process, shall release the project owner from any additional action related to that request and shall be deemed in compliance with that portion of this condition of certification.

The project owner should provide the CPM copies of the correspondence with the FAA regarding changes to the applicable charts and AFD, the Jeppesen Sanderson Airway Manual-Western U.S. Airport Directory, and the California Pilot's Guide as well as any responses which could include when the applicable changes will appear in future editions of these publications. The project owner shall acquire these publications when they become available and provide the CPM copies of the relevant portion of the charts and publications to verify that the changes have been made. In addition, the project owner must advise the CPM when the remark about avoiding direct overflight of the Otay Mesa Energy Center has been added to the Brown Field Municipal Airport ASOS.

REFERENCES

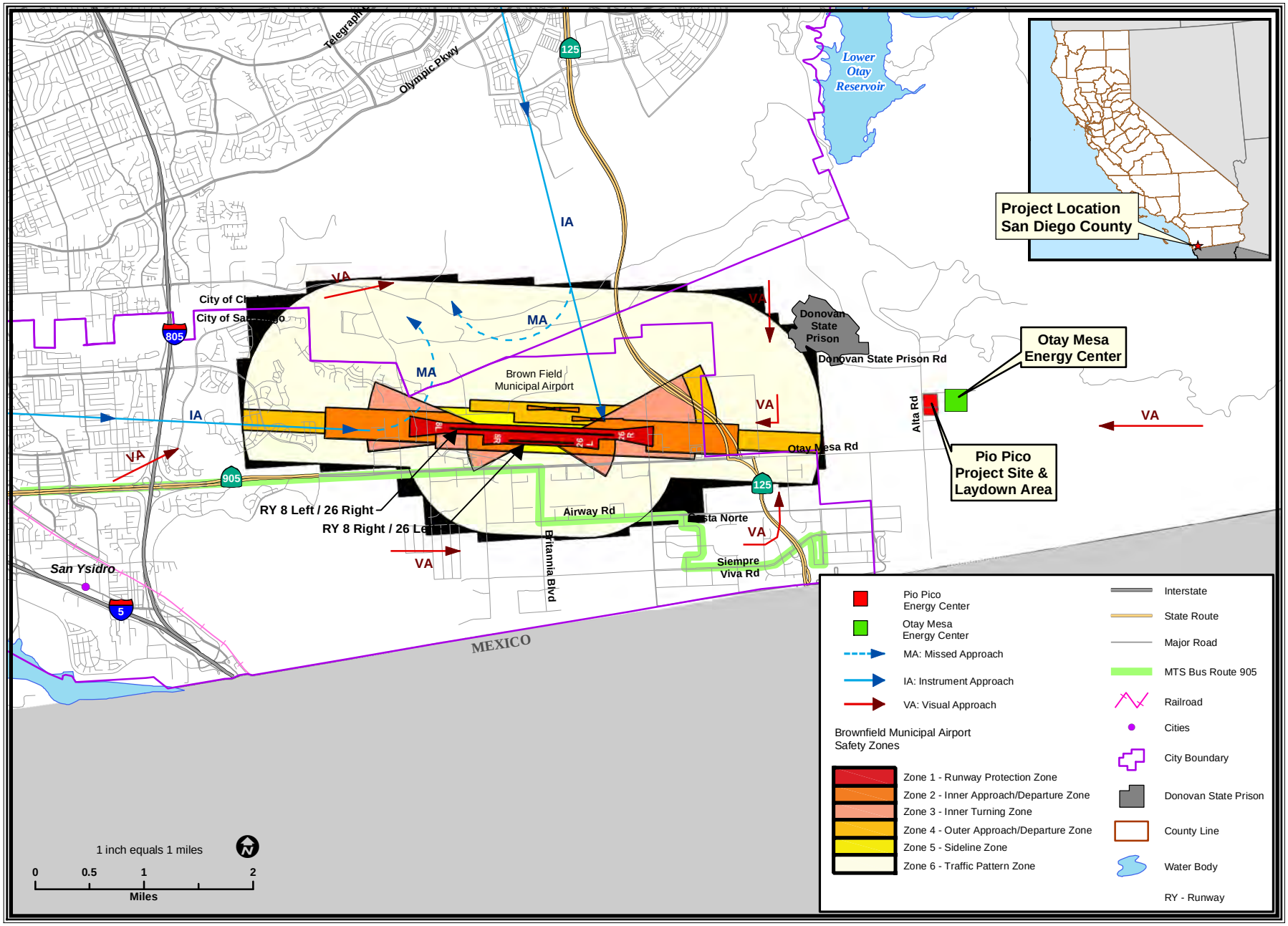
California Energy Commission 2012. California Energy Commission (Docket No. 11-AFC-01). Final Commission Decision for Pio Pico Energy Decision dated September 2012.

Federal Aviation Administration 2014. *Aeronautical Information Manual*. Change 1, July 24, 2014.

Otay Mesa Energy Center, LLC. 2015. Petition for a Staff Approved Modification. Dated May 14, 2015.

TRAFFIC AND TRANSPORTATION - FIGURE 2

Pio Pico Energy Center/Otay Mesa Energy Center - Local Transportation Setting



CALIFORNIA ENERGY COMMISSION, SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION

SOURCE: California Energy Commission, San Diego County: Airport Land Use Commission, URS Corporation, Multinet & Metropolitan Transist System (MTS)

TRAFFIC AND TRANSPORTATION-APPENDIX-1
Petition to Amend
Plume Velocity Analysis
Prepared By: Wenjun Qian, Ph.D., P.E.

INTRODUCTION

On May 26, 2015, a petition was docketed with the California Energy Commission (Energy Commission) for the Otay Mesa Energy Center, LLC, requesting to amend the Final Decision for the Otay Mesa Energy Center (Otay Mesa). The petition proposes to replace certain combustion section components with Advanced Gas Path (AGP) components on the two existing combustion turbines at OMEC. The following provides the assessment of the impact of the proposed modifications to the plume vertical velocities from the two exhaust stacks. Staff completed calculations to determine the worst-case vertical plume velocities at different heights above the stacks to determine risk to light aircraft due to the facility owner proposed modifications. Since this analysis had not been done for the originally-approved design, the analysis was conducted for both the approved design and with the requested AGP changes.

PROJECT DESCRIPTION

OMEC plans to replace certain combustion section components with Advanced Gas Path (AGP) components (turbine blades, nozzles and associate structural elements) on the two existing combustion turbines at the project (OMEC 2015). The AGP replacement components would improve the turbine heat rate and generate power more efficiently. The improved efficiency would be obtained by increasing the turbine firing temperature, which would cause changes in exhaust stack temperature and vertical velocity.

On November 3, 2015, Otay Mesa Energy Center, LLC, confirmed that the replacement AGP components would not cause a significant change in the air cooled condenser (ACC) exhaust parameters. The data shows that the thermal plume effects would be nearly identical before and after the components replacement.

PLUME VELOCITY CALCULATION METHOD

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

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

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

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

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

Where: V = vertical velocity (m/s), plume-average velocity
a = plume top-hat radius (m, increases at a linear rate of $a = 0.16*(z- z_v)$
F_o= initial stack buoyancy flux m^4/s^3
z = height above ground (m)
z_v= virtual source height (m)
V_{exit}= initial stack velocity (m/s)
D = stack diameter (m)
T_a= ambient temperature (K)
T_s= stack temperature (K)
g = acceleration of gravity (9.8 m/s^2)

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

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

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

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

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

On September 24, 2015, the Federal Aviation Administration (FAA) released a guidance memorandum (FAA 2015) recommending that thermal plumes be evaluated for air traffic safety. FAA determined that the overall risk associated with thermal plumes in causing a disruption of flight is low. However, it determined that such plumes in the vicinity of airports may pose a unique hazard to aircraft in critical phases of flight (such as take-off and landing). In this memorandum a new computer model, different than the

analysis technique used by staff and identified above, to evaluate vertical plumes for hazards to light aircraft was identified as being prepared under FAA funding and available for use in evaluating exhaust plume impacts. This new model, the MITRE Exhaust Plume Analyzer, was identified as a potentially effective tool to assess the impact exhaust plumes may impose on flight operations in the vicinity of airports. The Exhaust Plume Analyzer was developed to evaluate aviation risks from large thermal stacks, such as turbine exhaust stacks. However, at this time the Exhaust Plume Analyzer model cannot be used to provide reasonable risk predictions on most variable exhaust temperature thermal plume sources, such as cooling towers and air cooled condensers, etc.

The FAA has not provided guidance on how to evaluate the risk frequency isopleth output of the Exhaust Plume Analyzer model, but states in their memorandum that they intend to update their guidance on near-airport land use, including evaluation of thermal exhaust plumes, in fiscal year 2016.

In the meantime, this appendix uses the method previously used to be consistent with staff assessments done for other projects (called the “Spillane approach”) and because the previous method is described in the FAA materials as providing similar risk assessments for light aircraft. Staff will consider using the new method to the extent that it is applicable after conducting further review of the FAA methodology and once FAA develops guidance on how to evaluate the output of the Exhaust Plume Analyzer.

VERTICAL PLUME VELOCITY ANALYSIS

GAS TURBINE/HRSG DESIGN AND OPERATING PARAMETERS

The design and operating parameter data for each gas turbine/heat recovery steam generator (HRSG) stack exhaust before AGP (Non-AGP) and after AGP replacement are provided in **Plume Velocity Table 1.** The calm wind condition vertical plume velocities were calculated for OMEC for the current operating design and for the proposed changes with the results shown below in **Plume Velocity Table 2**.

The conditions modeled are worst case operating conditions under 37°F ambient temperature. Staff also modeled plume velocities using the exhaust parameters at higher ambient temperatures and determined that results for higher ambient temperatures did not exceed the results for the 37°F ambient conditions.

Plume Velocity Table 1
OMEC Gas Turbine/HRSG Operating and Exhaust Parameters

	AGP		Non-AGP	
Ambient Temperature (°F)	37			
Stack Height (ft)	160			
Stack Diameter (ft)	18.4			
Duct Firing	Unfired	Fired	Unfired	Fired
Stack Velocity (ft/s)	65.4	66.3	64.9	66.9
Exhaust Temperature (°F)	192.3	199.3	190.4	198.1

PLUME VELOCITY CALCULATION RESULTS

Using the Spillane calculation approach, the plume average vertical velocity at different heights above ground was determined by staff for calm wind conditions. Staff's calculated plume average velocity values are provided in **Plume Velocity Table 2**.

A plume average vertical velocity of 4.3 meters per second (m/s) has been determined by staff to be the critical velocity of concern to light aircraft. This is based on the Australian Civil Aviation Safety Authority (CASA) advisory circular (CASA 2003). Vertical velocities below this level are not of concern to light aircraft.

The separation between the two stacks is 40 meters (m). Before the plume velocity lowers to below levels of concern, the exhaust plumes may spread enough to significantly merge if the stack separation is not large enough. The plumes will begin to merge when the plume diameter is the same as the separation and is assumed to be fully merged when the plume diameter is twice the stack separation. Therefore, the plume velocities are calculated as a single gas turbine exhaust and the worst case combined gas turbine exhaust (equivalent to two gas turbines using Equation 5 listed above) as presented in **Plume Velocity Table 2.**

Plume Velocity Table 2
OMEC Gas Turbine/HRSG Plume Height (ft)[a] and Vertical Plume Velocities (m/s)

Height Above Ground Level (ft)	AGP				Non-AGP			
	Non-duct fired		Duct fired		Non-duct fired		Duct fired	
	Single plume (m/s)	Two plumes merged (m/s)	Single plume (m/s)	Two plumes merged (m/s)	Single plume (m/s)	Two plumes merged (m/s)	Single plume (m/s)	Two plumes merged (m/s)
300	8.48	Not merged	8.60	Not merged	8.42	Not merged	8.67	Not merged
400	5.97	Not merged	6.06	Not merged	5.94	Not merged	6.09	Not merged
500	5.03	Not merged	5.11	Not merged	5.00	Not merged	5.12	Not merged
600	4.50	5.36	4.57	5.44	4.48	5.32	4.58	5.45
700	4.15	4.94	4.22	5.02	4.13	4.91	4.23	5.02
800	3.89	4.63	3.96	4.70	3.87	4.60	3.96	4.71
900	3.69	4.39	3.75	4.46	3.67	4.37	3.76	4.47
1,000	3.53	4.19	3.58	4.26	3.51	4.17	3.59	4.27
1,100	3.39	4.03	3.44	4.09	3.37	4.01	3.45	4.10
1,200	3.27	3.89	3.32	3.95	3.25	3.87	3.33	3.96
1,300	3.17	3.77	3.22	3.83	3.15	3.75	3.22	3.83
1,400	3.08	3.66	3.13	3.72	3.06	3.64	3.13	3.72
1,500	3.00	3.56	3.04	3.62	2.98	3.54	3.05	3.62
1,600	2.92	3.48	2.97	3.53	2.91	3.46	2.97	3.54
1,700	2.86	3.40	2.90	3.45	2.84	3.38	2.91	3.45
1,800	2.80	3.32	2.84	3.38	2.78	3.31	2.84	3.38
1,900	2.74	3.26	2.78	3.31	2.72	3.24	2.79	3.31
2,000	2.69	3.20	2.73	3.25	2.67	3.18	2.73	3.25
2,100	2.64	3.14	2.68	3.19	2.63	3.12	2.69	3.19

Note:
a. 1 ft = 0.3048 m

Before the AGP replacement, the gas turbine plume average velocity is calculated to drop below 4.3 m/s at a height of approximately 650 feet without duct firing and 680 feet with duct firing for the single turbine plume (N=1). The plume diameter would be around 46 m at the height of 650 feet, which is larger than the separation of the two stacks (40 m). Therefore the merging of the two turbine plumes should be considered. In the case of two plumes fully merging (N=2), the average velocity is calculated to drop below 4.3 m/s at the height of 940 feet without duct firing and 980 feet with duct firing before the AGP replacement.

After the AGP replacement, the gas turbine plume average velocity is calculated to drop below 4.3 m/s at a height of approximately 660 feet without duct firing and 680 feet with duct firing for the single turbine plume (N=1). The plume diameter would be around 47 m at the height of 660 feet, which is larger than the separation of the two stacks (40 m). Therefore the merging of the two turbine plumes should be considered. In the case of two plumes fully merging (N=2), the average velocity is calculated to drop below 4.3 m/s at the height of 950 feet without duct firing and 980 feet with duct firing after the AGP replacement.

It should be noted that **Plume Velocity Table 2** is based on a calculation procedure that does not indicate how the plumes begin to merge. It's not likely that the two plumes would be fully merged. However, staff has performed the worst-case plume velocity analysis by assuming the two plumes would be fully merged.

WIND SPEED AND TEMPERATURE STATISTICS

Plume Velocity Table 3 provides the wind speed and temperature statistics for Otay Mesa during 2010-2012 that staff obtained from the Pio Pico Energy Center Petition to Amend Hourly Heat input (PPEC 2014). These data are not needed or used to evaluate plume rise, which is conducted assuming calm wind conditions. However, these data are useful in evaluating the likelihood of having calm wind conditions.

Calm conditions/ low wind speeds are not frequent in the site area but they do occur, which is the condition most favorable for the formation of higher vertical velocity thermal plumes from gas turbines/HRSGs and ACCs.

PLUME VELOCITY Table 3
Wind Speed and Temperature Statistics for Otay Mesa

Wind Speed		Temperature		Temperature and Wind Speed	
≤ 1 m/s	25.9%	≤ 40°F	0.2%	≤ 1 m/s, ≤ 40°F	0.1%
≤ 2 m/s	55.9%	≤ 50°F	8.6%	≤ 1 m/s, ≤ 50°F	4.1%
≤ 3 m/s	74.9%	≤ 60°F	46.2%	≤ 1 m/s, ≤ 60°F	17.3%

Source: Staff data reduction of Otay Mesa meteorological data (PPEC 2014)

CONCLUSIONS

The assessment of worst case vertical plume average velocities for the existing gas turbines/HRSG determined that the 4.3 m/s vertical wind speed would not occur at or above 980 feet above ground level during duct firing. The assessment for the change after the AGP upgrade indicated that vertical plume velocities would not exceed 4.3 m/s vertical wind speed at heights at or above 980 feet above ground level during duct firing. Thus, the analysis indicates that with the proposed amendments, there would not be a change in the height above ground where the plume velocity drops below 4.3 m/s.

Ambient conditions (wind speeds less than 1 m/s) conducive to the formation of thermal plume velocities of concern would occur on average approximately 25.9 percent of the time. However, the combined possibility of wind speeds less than 1 m/s and temperature less than 40°F (this temperature is close to the 37°F used in the analysis) would only be about 0.1 percent of the time on average.

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