EHC Research Brief

Air Quality Impacts of Two Possible Power Plants Located on the Chula Vista Bayfront

Environmental Health Coalition

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Purpose and Background

This brief summarizes the results of screening level air quality modeling of two possible power plants located near the site of the existing South Bay Power Plant in Chula Vista, CA. The modeling was performed by Environ International Corporation and is detailed in a technical memorandum to Environmental Health Coalition (EHC) dated November 9, 2005, and in an addendum to the memorandum dated February 9, 2006.

Built in the 1960s, the existing South Bay Power Plant (SBPP) is an out-dated, inefficient, and environmentally destructive plant that needs to be shut down as soon as possible. The SBPP is currently owned by the Port of San Diego, and is leased to Duke Energy North America. Duke recently sold its interests in the SBPP to LS Power, and has been in negotiations with the Port of San Diego regarding the terms of lease transfer, as well as the terms of a future lease for site control to build a replacement power plant. At the time this AQ modeling project was initiated, Duke had communicated to EHC their intention to replace the current SBPP with an approximately 650 MW natural gas power plant on a site just south of the current plant.

While a new plant would almost certainly emit less pollution per megawatt of power it produces, given current information available, EHC cannot assume that the shut down of the existing plant and its replacement with a new one will result in a net air quality improvement. In a letter dated February 28, 2006, Duke Energy stated that their criteria for an acceptable project could allow future plant emissions up to "*average* historical emissions levels" of the existing plant. In addition, the current plant's hours of operation are limited due to regulatory constraints on the temperature of the superheated water it can emit into the Bay. A new plant would not use Bay water for cooling, and so would not be subject to this limitation.

Even if the shut down of the current plant and its replacement with another large power plant on site were to result in some net air quality benefit, the fact is that Chula Vista's air quality is currently unhealthy and in violation of air quality standards. Chula Vista residents thus deserve the largest reduction in air pollution possible, not just a marginal improvement over current conditions.

EHC has asked Duke and the Port of San Diego on numerous occasions over the last several years to perform an analysis of the air quality impacts that would be created by their proposed replacement plant. To our knowledge, this analysis has not been completed.

In order to assess the potential air quality impacts of a new plant on the Bayfront, EHC commissioned this screening level air quality modeling to provide an analysis of the air quality impacts that would be created by: 1) A large ~650 MW power plant such as the one that had been proposed by Duke Energy; and 2) A much smaller ~ 65 MW plant. We chose to model the smaller plant to provide information on air quality impacts that

would result from a plant that is significantly smaller than the current ~700 MW and proposed 650 MW power plants, as a basis for comparison for the public and decision-makers.

Informed by the findings of this air quality modeling, we list EHC's policy recommendations for the decommissioning of the existing SBPP.

Findings

- A large 650 MW plant located on the Chula Vista Bayfront would result in 3-4 times higher particulate matter (PM) levels than a smaller 65 MW plant.

- PM air quality impacts from the larger plant would travel much farther into the community than would impacts from the smaller plant. Elevated PM levels from the 650 MW plant are predicted to extend to distances that would put numerous residences and over 60 schools and preschools at risk.[1] For the 65 MW plant, the distances to which elevated PM levels are predicted to occur would not threaten schools, but could impact some residences.

- Pollution from a large plant would perpetuate poor air quality for Chula Vista residents. Chula Vista air quality is in violation of national and state standards for particulate matter.[52]

- Estimated cancer risks from toxic air contaminants emitted by each of the plants are above the 1 in a million significance threshold designated in the Clean Air Act.[3] Cancer risks from the 650 MW plant are about 3 times higher than those from the smaller plant.

Policy Recommendations

- **Focus on Renewable Energy:** Current plant should be replaced with an energy strategy that expands the region's renewable energy supply through solar and wind generation. This is consistent with the San Diego's Regional Energy Strategy and the California Public Utility Commission's "preferred loading order" of energy sources. The process for determining this strategy should be launched by the Port, the City of Chula Vista and community stakeholders immediately.

- **Implement Community Choice Aggregation:** The City of Chula Vista should implement Community Choice Aggregation and other similar programs, in a manner which would improve the City's ability to expand existing renewable energy programs and quality green collar jobs.

- **Build a small, low-polluting replacement plant, only if necessary.** If complete replacement with renewable energy is not possible, consideration should be given to construction of a small plant which:
    1. Uses “dry-cooling” technology, which will not require using bay water, and without cooling towers that would impact the Bayfront’s aesthetics and economic development.
    2. Strives to significantly reduce air pollution. Current air pollution emissions contribute to unacceptable burdens to downwind communities. The Port District should work with Duke Energy and LS Power to ensure that any replacement strategy results in much cleaner air.

- **Ensure Community Involvement:** Decisions about the replacement of the South Bay Power Plant should involve the most impacted community—residents in western Chula Vista and South San Diego. The Port District and the City of Chula Vista should convene a stakeholder process modeled on the Bayfront Citizen’s Advisory Committee or the Power Plant Working Group.

- **Phase-out Once-Through Water Cooling:** The Port District and the City of Chula Vista should support state-wide efforts to develop and implement timely phase-out plans for Once-Through Water Cooling (OTC) of new and existing power plants.

- **Defeat Sunrise Powerlink:** Cities, the county, and SANDAG’s Energy Working Group should act immediately to oppose projects like Sunrise Powerlink that would also exploit communities and are incorrectly purported as the only alternative to large power plants.

- **Adopt building efficiency standards:** The Port District, the City of Chula Vista, and SANDAG should adopt building standards that require that all new buildings, developments, and retrofits be designed to use half of the fossil fuel energy of the country average for that building type.

Summary of the Air Quality Modeling Analysis

1. Assumptions for the Two Plants Modeled

A. *650 MW Plant*

This plant is an approximately 650 MW combined cycle plant that would use wet-cooling towers. This configuration reflects what Duke Energy would have been likely to propose. Duke did not provide EHC detailed information about the proposed plant. EHC thus configured the plant based on what information we had, and based on other plants that have been recently permitted or proposed in California by Duke Energy.

This configuration was modeled after the Duke Avenal Facility, located in Central California. GE turbines were selected for the plant, as Duke has used GE turbines on all its permitted or proposed power plants in California. The gross capacity of the Avenal plant was estimated to be about 660 MW. The net capacity would have been slightly lower.[4] Details on this configuration are provided in Appendix A and in the Environ Technical Memorandum.

B. *65 MW Plant*

This plant is an approximately 65 MW combined cycle intermediate base load plant that would use wet-cooling towers. EHC chose to have this much smaller plant modeled to provide an analysis of the reduced air quality impacts that would result from having a smaller plant at the site.

Plants in this size range are usually “peaker plants” that only run at times of peak demand. Peaker plants are simple cycle plants with relatively low efficiency that are subject to less strict pollution regulations. These are not a preferred generating option from an environmental perspective, so we did not model this type of plant.

The plant that was modeled consisted of a turbine rated at 63 MW net power generation for combined cycle operation. The gross power generation from this plant would be slightly higher. Details on this configuration are provided in Appendix A.

2. Location of the Power Plants

The plants were modeled to be located at a site that has been identified by Duke Energy and the Port of San Diego as the site of a possible replacement plant. The site is on Port of San Diego property on a 33 acre parcel (APN 6170110900). The footprint

available for the plants would likely be up to a maximum of only about 12 acres, as SDG&E is not likely to allow a plant to be built on their easement (east side of parcel). Much of the site may eventually be taken up by an SDG&E substation. For the AQ modeling, emission sources were assumed to be in a 'worst-case' position, that is, as far east and toward residences as possible within the likely footprints of the plants.

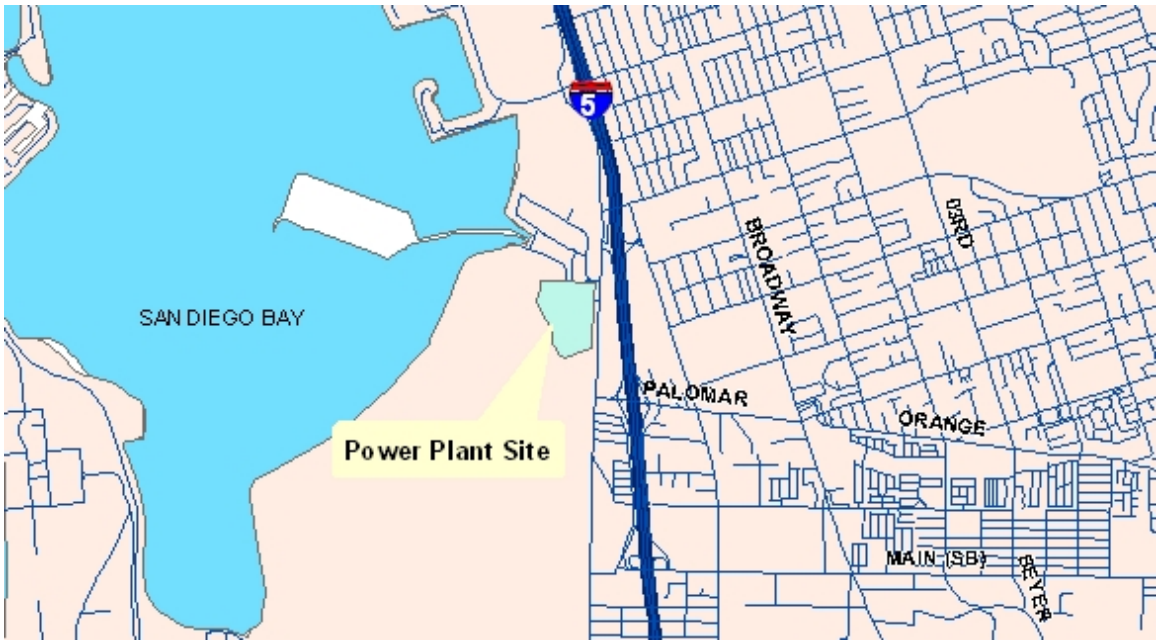


Figure 1. Port of San Diego leasehold on which a power plant has been proposed to be sited.

3. Air Quality Modeling Strategy

A. *Overall Strategy*

Environ used a screening level air quality model to estimate air pollution levels at varying distances from the plant. To determine the total criteria air pollution impacts from the two plants, the incremental criteria air quality impacts from the plants were added to the maximum monitored levels measured at the Chula Vista air monitoring station, as is standard practice. These levels were then compared to applicable standards. For toxic air contaminants, health risks were estimated based on the predicted pollution levels. These risks were then compared to applicable standards of significance.

B. *Model*

Environ used SCREEN3 to model air quality impacts from the two hypothetical plants. This is a standard EPA approved screening level air quality model that is considered to be conservative in its predictions. That is, it is more likely to over predict rather than under predict pollution impacts. The SCREEN3 model estimates the level of air quality

impact, and the distance from the proposed replacement plant location at which that impact would occur. SCREEN3 assumes worst-case weather conditions but does not incorporate local weather conditions into the estimates. It thus does not predict the direction from the plant at which the air quality impacts will occur. As is illustrated in Figure 2, however, the dominant wind direction in Chula Vista comes from the south and southwest, so the impacts would be likely to fall to the east and northeast of the proposed power plant site.[5]

C. *Operating Assumptions*

Consistent with standard air quality modeling methods, the modeling assumed maximum levels of operation under normal operating conditions. The plants were assumed to be running at full capacity- 365 days a year and 24 hours a day- and in accordance with applicable emission regulations.

D. *Pollutants Modeled*

All criteria air pollutants were modeled and compared to applicable National and California air quality regulations.[6] 'Criteria air pollutants' are the major air pollutants that were established by the Clean Air Act and include particulate matter and smog-forming pollutants like nitrogen dioxides. These pollutants are regulated under a special regulatory structure. Toxic air contaminants, which fall under a different regulatory structure than criteria pollutants, were also modeled.[7] These include substances such as benzene and formaldehyde.

E. *Reduced Air Quality Impacts from Closure of the Existing Plant*

The building of another plant in the South Bay will almost certainly be accompanied by the shut down of the existing South Bay Power Plant. EHC did not ask ENVIRON to evaluate the reduced air quality impacts from closure of the existing plant as part of this analysis.

To factor in the reduced impacts of the current plant, one might try to adjust the maximum monitored levels of pollutants to which the incremental impacts from either of the two possible replacement plants are added. One might reduce the monitored pollutant levels to account for the contribution that comes from the current South Bay Power Plant. EHC did not ask Environ to do so in this analysis for the following reasons:

1) It cannot be assumed that the highest level of a given pollutant measured at the one monitoring station in Chula Vista was the result of the existing power plant's pollution plume. The pollutants created by power plants also are created by other sources. For example, particulate matter comes from cars and trucks, construction equipment, and other sources in addition to power plants. The date of the highest monitored pollution level (Dec 5, 2003) actually corresponded to higher particulate matter levels region-wide, and so was likely to have mostly been a product of atmospheric conditions and other pollution sources, and not of emissions from the existing power plant [8] ;

2) Environ's approach is consistent with the practice of governmental agencies. For example, in the air quality assessment performed for the permitting of a replacement of a large coastal power plant at Morro Bay, the California Energy Commission did not attempt to factor in reduced impacts from the shut down of the current 1,000 MW Morro Bay plant. They simply used the maximum monitored level, and added the incremental air quality impacts from the new plant to that level. They did this to be more conservative and health protective in their approach [9] ; and

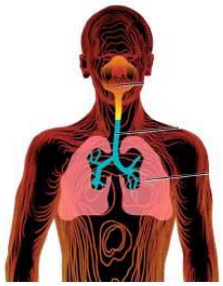
3) Another challenge to accounting for reduced air quality impacts from the existing South Bay Power Plant is that no representative air quality modeling has been performed for the existing plant. The only air quality assessments that have been done for the SBPP assumed the plant was running on 33% fuel oil, which is not representative of the SBPP's normal operation, nor the plant's operation on the day of the highest monitored level.[10] The plant runs only on natural gas unless there is a 'force mejeure' natural gas curtailment, which can happen, but is relatively uncommon. The modeling that has been done for the existing SBPP is also not representative of real conditions because the modeling used Miramar weather data and not data from the Chula Vista monitoring station. The dominant wind direction at Miramar is from the northwest, while in Chula Vista, the dominant wind direction is from the west and southwest.[11]

4. Modeling Results

A. *Criteria Pollutants*

The model's estimated criteria pollutant impacts of greatest concern were the particulate matter impacts. A battery of studies have linked PM to a number of health hazards, including increased rates of asthma and lung disease, decreased lung function, heart attacks and premature death.[12]

Particulate matter is primarily a product of the incomplete combustion of fossil fuels. Particulate matter that is 2.5 microns or less ($PM_{2.5}$) is especially of concern, as these particles are more likely to travel deep into the lungs where they can seriously damage lung tissue. They are so small that they can get into the blood stream through the lungs, and carry pollutants that are adsorbed to the particles throughout the body.[13] Particulate matter that is 10 microns or less (PM_{10}) is also a concern, as particles in this size range have also been linked to health problems.



The predicted particulate matter impacts from the ~650 MW plant are considerably greater than those from the ~65 MW plant. The predicted 24-hour and annual $PM_{2.5}$ impacts from the larger plant are about three times those of the smaller plant, and the

predicted 24-hour and annual PM_{10} impacts are about four times those of the smaller plant.

The predicted maximum incremental 24-hour $PM_{2.5}$ impact for the ~650 MW plant was 14 ug/m^3, for a total impact of 55 ug/m^3 when added to the maximum monitored level of 41 ug/m^3. The incremental 24-hour $PM_{2.5}$ impacts for the smaller ~65 MW plant was 5 ug/m^3, for a total impact of 46 ug/m^3. The total impacts for both plants are significantly elevated over the new proposed NAAQS of 35 ug/m^3 for 24-hour $PM_{2.5}$[14] (Table 1).

The predicted total 24-hour impact for PM_{10} is 87ug/m^3 (incremental is 22 ug/m^3) for the 650 MW plant and 70 ug/m^3 (incremental is 5 ug/m^3) for the 65 MW plant. These total impacts exceed the California Ambient Air Quality Standard for 24-hour PM_{10} of 50 ug/m^3 and the larger plant's total impacts exceed the new proposed national standard of 70 ug/m^3 [15] (Table 1).

These impacts fall on an area that is already in violation of air quality standards. The local San Diego Air Pollution Control District's monitoring station in Chula Vista registers violations of National and California air quality standards for particulate matter. The 24-hour and annual PM_{10} California Ambient Air Quality Standards (CAAQS) are violated in Chula Vista. The annual $PM_{2.5}$ CAAQS and the 24-hour $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) are also violated in Chula Vista, based on the US EPA's new proposed standards for particulate matter published in January 2006.[16]

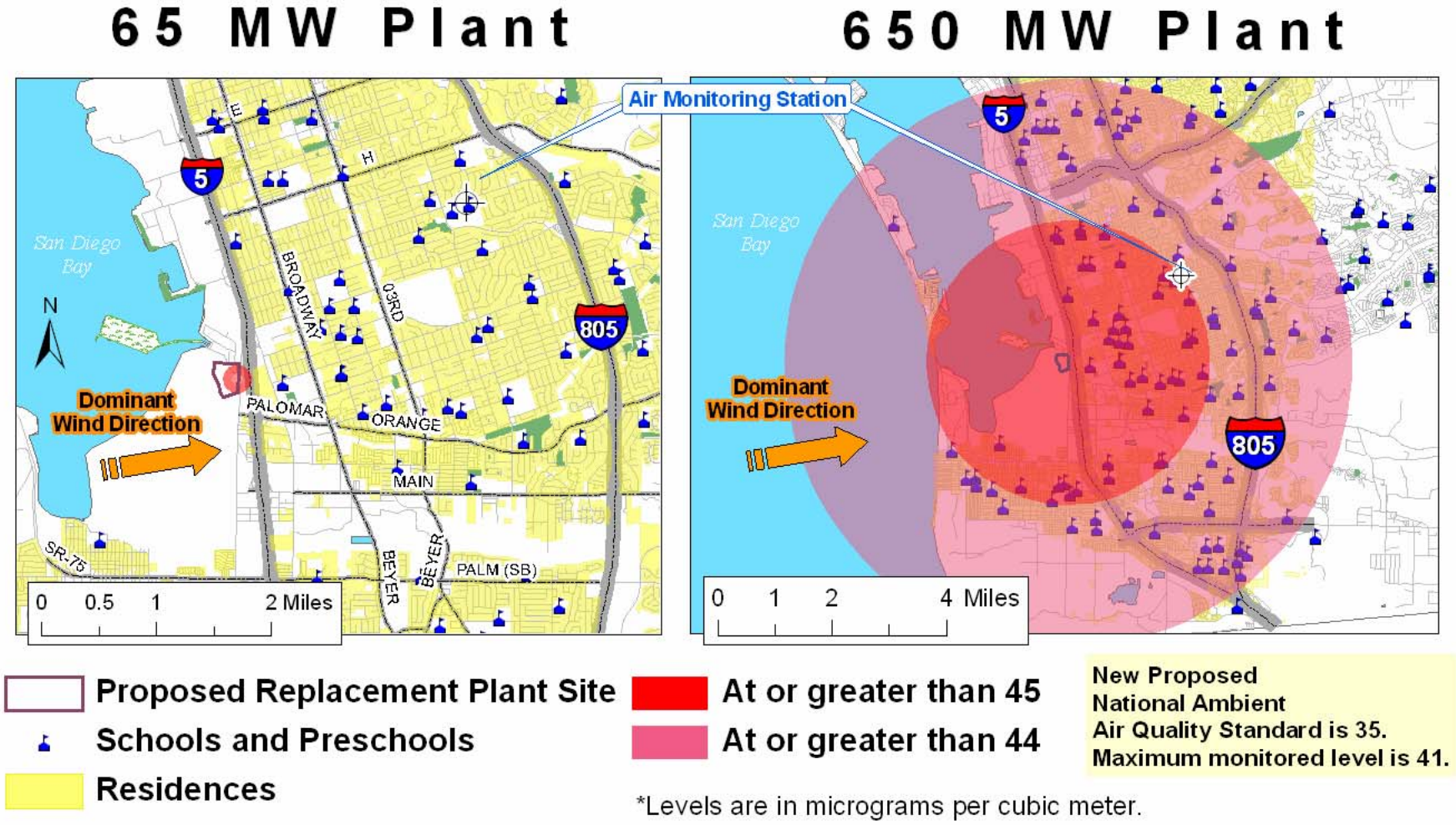
Other criteria pollutant impacts predicted from the plant were not predicted to be considerably elevated compared to the National and California air quality standards.

B. *Location of Particulate Matter Impacts*

For the ~650 MW plant, the modeling predicted elevated PM levels at considerable distances from the plant. At a distance of as far as 4,000 meters (4 km) from the plant, predicted $PM_{2.5}$ levels were at 45 ug/m^3 or higher, significantly elevated above the maximum monitored level of 41 ug/m^3. At a distance of as far as 8,000 meters (8 km) from the plant, predicted $PM_{2.5}$ levels were at 44 ug/m^3 or higher, still significantly elevated above the maximum monitored level of 41 ug/m^3 (Figure 2). These elevated PM impacts from the 650 MW plant are predicted to extend to a distance that threatens numerous residences and over 60 schools, a particular concern given that children are more susceptible to the health hazards of air pollution.[17]

For the 65 MW plant, predicted $PM_{2.5}$ levels were at 45 ug/m^3 or higher only to about 200 meters from the plant (Figure 2). At 400 meters, the incremental impact from the plant is only about 1 ug/m^3, and by 1100 meters, the impacts are negligible. Elevated PM impacts from the 65 MW plant extend to a distance that does not threaten schools, but does cover some residences that are close to the plant.

The dominant wind direction in Chula Vista comes from the south and southwest, so the impacts would be most likely to fall to the east and northeast of the proposed power plant site.[18]



Map sources: Environ Corp. Technical Memo prepared for EHC, Nov 9, 2005 and SDAPCD Wind rose for CV Monitoring Station, 2000.

Figure 2. Location of total 24-hour $PM_{2.5}$ impacts from the two plants, and location of nearby sensitive receptors.

Table 1. Summary of particulate matter impacts from the two possible plants.

Pollutant	Averaging Time	Units	Maximum Incremental Impact		Maximum Monitored level at Chula Vista Station (2000-2004)	Total Impact (Impact from plant plus maximum monitored level)		Exceeds National Standard?		Exceeds California Standard?	
			650	65		650	65	650	65	650	65
$PM_{2.5}$	24-hour	ug/m^3	14	5	41	55	46	yes[1]	no[1]	-	-
	Annual	ug/m^3	3	1	16	18	17	yes[2]	yes[2]	yes[5]	yes[5]
PM_{10}	24-hour	ug/m^3	22	5	65	87	70	yes[3]	no[3]	yes[6]	yes[6]
	Annual	ug/m^3	4	1	28	32	29	no	no[4]	yes[7]	yes[7]

1) NAAQS is 35 ug/m^3
2) NAAQS is 15 ug/m^3
3) NAAQS is 70 ug/m^3
4) NAAQS is 50 ug/m^3
5) CAAQS is 12 ug/m^3
6) CAAQS is 50 ug/m^3
7) CAAQS is 20 ug/m^3

1, 3, and 6 to the left reflect the new NAAQS proposed by the EPA as of January 2006. See: http://www.epa.gov/air/particles/fs20051220pm.html. These are not in regulatory effect yet, but reflect the most current scientific information on the health impacts of particulate matter. The current standards are 65 ug/m^3 for 24-hour $PM_{2.5}$ and 150 for 24-hour PM_{10}.

C. *Toxic Air Contaminants*

Toxic air contaminants (TACs) are air pollutants that are not regulated under the structure of the 'criteria air pollutant' regulations. These substances are regulated in terms of the risk that they pose to workers and residents. Consistent with standard modeling procedure, TAC emissions from the two possible plants were evaluated for their contribution to health risks, including cancer, and acute, and chronic non-cancer health risk in this analysis.

The maximum cancer risk estimated for the 650 MW plant was 2.98 cancer cases per million and for the 65 MW plant was 1.14 cancer cases per million. For both plants, polycyclic aromatic hydrocarbons (PAHs) contributed most to the cancer risk. The location of the maximum cancer risk impacts was at the nearest residence located 350 meters from the site to the east.

A number of federal, state, and local regulations identify cancer risks above 1 in a million to be significant. For example, in the Clean Air Act (Section 112, U.S.C. 42 Sec. 7412), the EPA is instructed to adopt regulations that will lower cancer risks from industries or categories of industries to less than 1 in a million. Also, the San Diego Air Pollution Control District requires new sources to lower cancer risks from a facility to below 1 in a million if technically feasible (SDAPCD Rule 1200).[19]

5. Uncertainties

Air quality modeling is a useful tool that enables the public and decision makers to evaluate the risks posed by a particular project prior to the decision to construct it. It is important to keep in mind that - as is true of any such modeling - there are uncertainties in this analysis. These include uncertainties in the emission estimates, and the modeling parameters and assumptions.

In some ways, Environ's air quality modeling strategy may over predict impacts. For example, the SCREEN3 model is more likely to over predict rather than under predict impacts. Also, maximum operating conditions were assumed, which may not be representative of typical annual operations. However, some of the impacts of greatest concern are those that occur over a shorter period, like 24-hours, a period over which maximum operating assumptions are more likely to occur.

In some ways, Environ's analysis may under predict impacts. For one, the maximum monitored level that was used to characterize current air quality in Chula Vista may not be representative of air pollution levels closer to the plant. The Chula Vista Air Monitoring Station is well removed from major air pollution sources such as the freeways. People living closer to Interstate 5 (who are also closer to the plant) are likely to be subject to higher levels of pollution than what is measured at the monitoring station. Also, the model did not account for secondary PM formation, which would add to the total PM emissions attributable to the plant.

References

[1] According to data provided by the San Diego Association of Governments web site, there are 67 schools and preschools within 8 km of the proposed site of a replacement plant. This is the distance to which total $PM_{2.5}$ impacts were predicted to be 44 ug/m^3 or above.

[2] San Diego Air County Air Pollution District. Monitoring data from the Chula Vista monitoring station 2000-2005. Available at: http://www.sdapcd.org/air/reports/smog.pdf

[3] In the Clean Air Act (Section 112, U.S.C. 42 Sec. 7412) the EPA is instructed to adopt regulations that will lower cancer risks from industries or categories of industries to less than 1 in a million. Also, the San Diego Air Pollution Control District requires new sources to lower cancer risks from a facility to 1 in a million if technically feasible (SDAPCD Rule 1200).[3]

[4] The generating capacity of a plant depends on a number of factors such as the efficiency of the units working in tandem and other factors. The California Energy Commission requires that a plant be estimated to within 50 MW of its final generating capacity during the permitting process.

[5] Based on wind rose from the San Diego Air Pollution Control District for their Chula Vista monitoring station, year 2000, sent by Ralph DeSiena by e-mail September 15, 2005.

[6] The model did not account for secondary PM formation, and so was likely to have under predicted emissions of particulate matter. Secondary PM formation is not likely to affect the air quality impacts in areas near the power plant, but does underestimate overall emissions from the plant into the air basin.

[7] Regulations for toxic air contaminants were developed more recently than those for criteria pollutants, and TACs fall under a different regulatory structure than the criteria pollutants. TACs are compounds that are known or suspected to cause cancer or other adverse health effects. The term 'toxic air contaminants' is interchangeable with the term 'hazardous air pollutants' (HAPs). The Clean Air Act lists hundreds of compounds that are considered to be hazardous air pollutants and requires the EPA to develop measures to control significant sources of these pollutants.

[8] Bill Brick. Senior meteorologist. San Diego Air Pollution Control District. Personal Communication by e-mail, February 15, 2006.

[9] California Energy Commission. Final Staff Assessment for the Morro Bay Power Plant Project. November 2001. Page 3.1-15

[10] Bill Brick. Senior meteorologist. San Diego Air Pollution Control District. Personal Communication by e-mail, February 15, 2006.

[11] California Air Resources Board (2004) Community Health Neighborhood Assessment Program's Barrio Logan Final Report. Page 69 and SDAPCD wind rose for Chula Vista sent by Ralph DeSiena by e-mail September 15, 2005.

[12]US Environmental Protection Agency. Health and Environmental Effects of Particulate Matter http://www.epa.gov/ttn/oarpg/naaqsfin/pmhealth.html. Accessed February 17, 2006.

[13] Lipmann, M. et. al. (2003). The U.S. Environmental Protection Agency Particulate Matter Health Effects Research Centers Program: A Midcourse Report of Status, Progress, and Plans. *Environmental Health Perspectives* 111 (8) 1074-1092.

[14] See: US EPA website. Fact sheet on new particulate matter standards proposed as of January 2006. http://www.epa.gov/air/criteria.html These are not in regulatory effect yet, but reflect the most current scientific information on the health impacts of particulate matter. Accessed February 14, 2006. The current standard is 65 ug/m^3 for 24-hour $PM_{2.5}$.

[15] Ibid.

[16] Ibid.

[17] US Environmental Protection Agency. Health and Environmental Effects of Particulate Matter http://www.epa.gov/ttn/oarpg/naaqsfin/pmhealth.html. Accessed February 17, 2003.

[18] Based on wind rose from the San Diego Air Pollution Control District for their Chula Vista monitoring station, year 2000, sent by Ralph DeSiena by e-mail September 15, 2005.

[19] The San Diego Air Pollution District uses different risk levels as regulatory requirements for *existing* facilities per the Air Toxics AB2588 Hot Spots Program. SDAPCD requires facilities with cancer risks above 100 in a million to implement risk reduction measures and facilities with a cancer risk of more than 10 in a million to notify surrounding residents of the increased risk (SDAPCD Rule 1210).