

State of California  
AIR RESOURCES BOARD

**Final Statement of Reasons for Rulemaking,  
Including Summary of Comments and Agency Responses**

THE ADOPTION OF A PROPOSED REGULATION TO REDUCE GREENHOUSE GAS  
EMISSIONS FROM SEMICONDUCTOR OPERATIONS

Public Hearing Date: February 26, 2009  
Agenda Item No.: 09-2-3

**I. GENERAL**

**Introduction and Background**

In this rulemaking, the Air Resources Board (ARB or Board) is adopting a new regulation to reduce greenhouse gas (GHG) emissions from semiconductor operations. The regulation establishes emission standards that are achieved by using process optimization, alternative chemistries, and/or abatement to reduce emissions from chemical vapor deposition (CVD) chamber cleaning and etching processes. The "Staff Report: Initial Statement of Reasons for Proposed Regulation to Reduce Greenhouse Gas Emissions from Semiconductor Operations" (ISOR), released to the public on January 9, 2009, is incorporated by reference herein. This Final Statement of Reasons (FSOR) summarizes the written and oral comments received during the 45-day comment period preceding the February 26, 2009, public hearing and at the hearing itself, and contains ARB's responses to those comments.

The rulemaking was initiated by a Notice of Public Hearing, released to the public on January 9, 2009. The ISOR, which describes the rationale for the proposal, was made available for public comment the same day. The text of the proposed regulation was included as Appendix A to the ISOR and adds new sections 95320, 95321, 95322, 95323, 95324, 95325 and 95326, title 17, to the California Code of Regulations (CCR). The hearing notice and ISOR were also posted on the ARB internet site for the rulemaking at:  
<http://www.arb.ca.gov/regact/2009/semi2009/semi2009.htm>.

**Description of Board Action**

On February 26, 2009, the Board held a public hearing to consider the regulation to reduce GHG emissions from semiconductor operations. ARB staff presented a summary of the proposed regulation and two parties provided oral testimony at the public hearing. After further questions and discussions, the Board adopted resolution 09-22 without modifications.

The Board directed staff to prepare correspondence to the United States Environmental Protection Agency (U.S. EPA) urging the agency to consider applying California's requirements to semiconductor operations nationwide.

### **Documents Incorporated by Reference**

The following documents are incorporated by reference in the regulation:

(1) "Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change," Table 2.14; and (2) "2006 IPCC Guidelines for National Greenhouse Gas Inventories," Volume 3, Industrial Processes and Product Use, Chapter 6 Electronics Industry Emissions.

The two documents listed above are readily available from the ARB upon request and were made available in the context of this rulemaking in the manner specified in Government Code section 11346.5(b). The first document is a table of 62 compounds, their chemical formula, atmospheric lifetime, radiative efficiency, and global warming potentials (GWP) for various time horizons, making it complex and having a limited audience. The ISOR contains the GWP values for the seven compounds specifically listed in the regulation.

The second document is incorporated by reference because it would be cumbersome and otherwise impractical to print it in the CCR. Existing ARB administrative practice has been to have calculation methods and similar documents incorporated by reference rather than printed in the CCR because these calculation methods are highly technical and complex. The document is also complex and would have a limited audience in the CCR. Because the ARB has never printed calculation methods and similar documents in the CCR, the directly affected public is accustomed to the incorporation format utilized therein. In addition, printing portions of the calculations that are incorporated by reference would be unnecessarily confusing to the affected public.

### **Economic and Fiscal Impacts**

In developing the regulatory proposal, ARB staff evaluated the potential economic impacts on air districts, the State, and businesses. The Board's Executive Officer has determined that this regulatory action will impose a mandate upon and create costs to local air pollution control and air quality management districts (the "districts"). However, these costs to the districts are recoverable by fees that are within the districts' authority to assess (see Health and Safety Code sections 42311 and 40510). Therefore, this regulatory action imposes no costs on local agencies that are required to be reimbursed by the State pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, and does not impose a mandate on local agencies that is required to be reimbursed pursuant to Section 6 of Article XIII B of the California Constitution.

Since the districts have the primary responsibility to enforce this measure, the State will only incur costs associated with oversight activity. ARB staff estimates a need for one position at \$170,000 in the Enforcement Division to handle oversight responsibilities. However, ARB will not need to increase its budget until the 2011-2012 fiscal year. Additionally, the University of California at Berkeley will be impacted with an annual cost of \$600 to produce an annual report and maintain records.

ARB staff evaluated the potential economic impacts on businesses subject to the regulation. Initial capital costs and annual recurring costs amount to \$3.7 million per year, or an average of \$21 per metric ton of carbon dioxide equivalent reduced. These impacts are detailed in Chapter VII and Appendix C of the ISOR.

The Board's Executive Officer has determined, pursuant to title 1, California Code of Regulations, section 4, that this regulatory action will affect small businesses. Thirty-three small businesses will be required to perform recordkeeping and make annual reports. However, five small businesses will be required to reduce emissions at an estimated average cost of \$89,000 per year. In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the Executive Officer has found that the reporting requirements in the regulations and incorporated documents that apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

The Board's Executive Officer has also determined that this regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states.

In accordance with Government Code section 11346.3, the Executive Officer has determined that this regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses and the elimination of existing businesses within the State of California, nor the expansion of businesses currently doing business within the State of California.

### **Consideration of Alternatives**

The Board has determined that no reasonable alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency, would be more effective in carrying out the purpose for which the regulatory action was proposed, or which would be as effective and less burdensome to affected private persons or business, than the action taken by ARB.

## **II. SUMMARY OF COMMENTS AND AGENCY RESPONSE**

### **45-day Written Comment Submittals**

The following organizations and individuals provided written comments during the 45-day comment period:

<u>Abbreviation</u>	<u>Commenter</u>
BAAQMD	Jack Broadbent Bay Area Air Quality Management District (BAAQMD)
May	Terry May
Micrel	Charles Wurm Micrel Semiconductor
NEC	Mr. Gabe Kim NEC Electronics, Inc.

The BAAQMD letter indicates the district's support for the regulation as proposed. Mr. May's letter disputes the existence of global warming. Mr. Wurm of Micrel expressed concern that the elimination of the use of GHGs in semiconductor manufacturing would be extremely problematic as these gases are essential for semiconductor manufacturing. Mr. Kim of NEC expressed six major concerns with the regulation. In summary, these are:

1. The proposed emission reduction target is too aggressive;
2. Using 2006 as the base year ignores prior emission reductions;
3. The economic impact analysis conclusions are inaccurate;
4. Tier 1 companies are being unfairly targeted;
5. NEC opposes the proposed tier system; and
6. No specific guidance is provided for air district permitting.

Mr. Gus Ballis of NEC also provided written comments at the February 26, 2009 hearing. Mr. Kim's and Mr. Ballis' written comments are nearly identical. Each of the six concerns contained multiple comments, which are addressed in the Written Comment Summary and Agency Response section of this FSOR.

**Oral Testimony Received at the February 26, 2009 Board Hearing:**

The following organizations and individuals presented oral testimony at the hearing on February 26, 2009.

<u>Abbreviation</u>	<u>Commenter</u>
NEC	Mr. Gus Ballis NEC Electronics, Inc.
SCAQMD	Ms. Jill Whynot South Coast Air Quality Management District (SCAQMD)

Mr. Ballis of NEC Electronics, Inc. summarized concerns raised in earlier written comments submitted by Mr. Kim of NEC. He also noted the difficulty of raising the necessary capital in recessionary times to purchase and install abatement equipment. He indicated that the Roseville facility is losing several million dollars per month and it is uncertain whether its production will be relocated to Japan. Ms. Whynot of SCAQMD stated concerns about possible increases in the use of nitrogen trifluoride (NF<sub>3</sub>), a highly potent GHG, and the generation of hydrogen fluoride (HF), a toxic byproduct. SCAQMD recommended that the regulation include language to ban the new and existing use of NF<sub>3</sub>.

## **Written Comment Summary and Agency Response**

Set forth below is a summary of written comments made regarding the specific regulatory action proposed with the agency response to each comment.

### **Comment by BAAQMD**

1. Comment: The BAAQMD supports this regulation as proposed and believes it will help reduce GHG emissions in California.

Agency Response: The ARB staff appreciates BAAQMD's support of the proposed regulation.

### **Comment by May**

1. Comment: Global warming is not occurring and the regulation will only result in lost jobs.

Agency Response: The ARB staff disagrees with this assertion. California's Legislature declared, through the passage of Assembly Bill 32, that global warming threatens the economic well-being, public health, natural resources and the environment of California. The legislation mandates that ARB act to mitigate the impacts of global warming on the state by reducing emissions of GHGs. The regulation is one among many actions ARB staff is taking to respond to this mandate.

As stated in the ISOR, ARB staff does not expect a noticeable change in employment from this regulation. Employment in this sector represents 0.2 percent of the manufacturing jobs in California. Semiconductor operations responsible for one-half of the wafers processed in the state already meet the emission standards.

## **Comment by Micrel**

1. Comment: If the regulation eliminates the use of GHGs in semiconductor manufacturing, then it would be very problematic as these gases are extremely important for semiconductor manufacturing.

Agency Response: A similar viewpoint was expressed by members of the industry working group during regulation development. The regulation does not eliminate the use of GHGs, so this concern has been addressed.

## **Comments by NEC Electronics, Inc.**

### **A. Proposed Emission Reduction Target Is Too Aggressive**

1. Comment: A reduction of 0.18 million metric tons of carbon dioxide equivalent (MMT CO<sub>2</sub>e) by January 1, 2012 or January 1, 2014, is far too aggressive for this industry.

Agency Response: ARB survey data for 2006 indicate that businesses representing one-half of the wafers processed in California already meet the emission standards. Thus, the standards, which would achieve a 0.18 MMT CO<sub>2</sub>e reduction, are achievable by January 1, 2012 or January 1, 2014. The fact that many businesses are voluntarily meeting the standards demonstrates that cost-effective emission control technologies are currently available to reduce GHG emissions.

2. Comment: The financial impact on the semiconductor industry is going to be severe and affect our ability to be competitive in the global market.

Agency Response: ARB staff disagrees with the assertion that the regulation will have a severe financial impact. The financial impact on the semiconductor industry will be minimal for 69 out of 85 operations that already comply with the regulation. These operations will incur costs of only \$600 per year for recordkeeping and reporting. The 12 operations that already comply with the emission standards have remained competitive in the global market. Other operations that must reduce their emissions will incur greater cost impacts. However, the cost analysis in the ISOR indicates that the regulation will not significantly affect industry profitability and will achieve cost-effective emission reductions.

3. Comment: The regulation is not providing flexible compliance schedules. Section 38560.5(a) of the California Health and Safety Code calls for early reductions, but does not call for the two-year time period that ARB staff is proposing.

Agency Response: ARB staff disagrees with the assertion that the compliance schedule is not flexible. To accommodate this concern, operators such as NEC that are upgrading their process tools to newer technology are provided two additional years, until January 1, 2014, to comply with the regulation. The time extension minimizes cost impacts and avoids requiring abatement for tools that would soon be replaced with more efficient technology.

4. Comment: NEC feels a more reasonable target would be a 25 percent reduction by January 1, 2012 with another 25 percent reduction to be completed in two-year periods until the 2020 deadline. This would require ARB to lower the reduction target from 0.18 to 0.045 MMT CO<sub>2</sub>e.

Agency Response: Lowering the reduction target would not meet the requirement of AB 32 to achieve the maximum reduction that is technologically and economically feasible. This regulation is a discrete early action measure, which is intended to achieve early GHG reductions under AB 32. Staggering the reduction over multi-year periods complicates the regulation for industry by having multiple reduction targets and compliance dates. This approach also makes enforcement more difficult. Furthermore, the proposal by NEC would decrease the total inventory reduction from 56 percent to 14 percent initially, not 25 percent as claimed. The 25 percent reduction referred to by NEC, or 0.045 MMT CO<sub>2</sub>e, is 25 percent of the ARB's reduction goal, not 25 percent of the total emissions inventory.

5. Comment: Semiconductor emissions have already been reduced by 78 percent from 2000 to 2006.

Agency Response: Emissions data for 2000 and 2006 are not directly comparable because of significant differences in the methods used to derive estimates for these years. To conclude that emissions dropped 78 percent in that time period is therefore inaccurate. The estimate for 2000 was derived by using national emissions inventory data and applying a percentage multiplier for California. This percentage was based on U.S. Census Bureau data for the dollar value of California semiconductor shipments compared to U.S. shipments. While ARB staff realized that this percentage was a coarse approximation, and that the methodology was simplistic, the lack of other historical data necessitated its use until a survey was conducted.

After discussions with industry and other interested parties, ARB staff determined that the California emissions inventory overestimated the GHG emissions from the semiconductor industry. To refine the emissions estimate for 2006, ARB staff conducted a detailed

survey of actual greenhouse gas use by California's industry to determine emissions. This produced the estimate of 0.32 MMT CO<sub>2</sub>e for 2006, which is lower than the 1.23 MMT CO<sub>2</sub>e estimate for 2000 generated from census data.

6. Comment: In the current struggling economy, it may take several years to obtain the necessary capital for the expensive abatement equipment needed to comply with the standard.

Agency Response: ARB staff considered the time required to obtain necessary capital. Staff accommodated NEC's conversion plan to process larger wafers by providing a two year extension to the compliance deadline. This will also reduce NEC's cost since abatement equipment would not be required for process tools that are soon being replaced. ARB has an obligation to reduce GHG emissions without adversely affecting the state's economy as a whole. The regulation was adopted in February 2009 providing the industry a three to five year advance notice to accommodate financing concerns.

7. Comment: The end-of-pipe technology needed to meet the reduction target can only be accomplished by manifolded together several smaller thermal abatement units and doing this then creates other global warming gases.

Agency Response: Thermal abatement technology is commercially available, effective, and has been widely used by the industry. The global warming byproduct of thermal abatement devices is carbon dioxide (CO<sub>2</sub>). CO<sub>2</sub> is a less potent global warmer with a GWP of 1 compared to 6,500 to 23,900 for the abated gases. Therefore, the minor amount of CO<sub>2</sub> produced by abatement devices is not a significant concern.

8. Comment: Recovering condensed exhaust gases is a more promising technology than burning exhaust gases at high temperatures, but the design is still being tested. For these reasons, ARB staff should extend the compliance deadline over multiple incremental periods.

Agency Response: Waiting for a newer abatement technology with an unknown commercialization date would significantly delay emission reductions and would not meet the requirement for technological feasibility in AB 32.

## **B. Using 2006 as the Base Year Ignores Prior Emission Reductions**

1. Comment: By using a 2006 base year, voluntary emission reductions achieved by companies such as NEC are not being properly credited. ARB is directed in sections 38562 (b)(3) and 38563 of AB 32 to give credit

for voluntary early reductions of GHG emissions. ARB could use 2000 as the base year and apply the same percentage reduction to the emissions inventory as currently proposed or allow companies in the U.S. EPA's voluntary program to apply the difference between their 2000 and 2006 emissions to determine the credit for each company's early reduction.

Agency Response: Staff considered the voluntary reductions already achieved when developing the proposed standards. Two out of three California operations in the U.S. EPA's voluntary reduction program already comply with the proposed standards. NEC is the only California participant in the voluntary program that does not already comply with the proposed standards. When the ARB survey revealed that emissions were lower than predicted, the reduction goal was decreased from 0.5 to 0.18 MMT CO<sub>2</sub>e. Consequently, 12 of the 28 operations subject to the proposed standards are already in compliance.

### **C. The Economic Analysis Conclusions Are Inaccurate**

1. Comment: It appears that the intent of having different tiers is to impose a disproportionate cost burden upon those companies that ARB staff feels can best afford it. Given that the economic condition in California is at its worst since the Great Depression, how did ARB staff ascertain that the 13 companies required to reduce their emissions will be able to obtain \$22 million and have the necessary abatement projects completed by January 1, 2012? It is unreasonable to assume that a company should use all its net profits or obtain bank loans to comply with the standard.

Agency Response: ARB staff disagrees with the assertion that the tier structure is designed to impose a disproportionate cost burden on large companies. The Tier 1, 2, and 3 categories correspond to large, medium and small semiconductor operations. The tiers are based on semiconductor processing volumes and the standards are based on a technology assessment of ARB survey results. These results show that the complying market shares for Tiers 1, 2 and 3 are 57, 43 and 34 percent, respectively. Thus, compliance is greatest in Tier 1, which has the largest companies. While all tiers can achieve cost-effective reductions, the highest cost per metric ton of CO<sub>2</sub>e reduced is \$23.40 for mid-sized companies in Tier 2. The largest companies in Tier 1 will incur a lower average cost of \$20.70 per metric ton. Furthermore, the cost breakdown by tier is proportionate to the emission reductions for each tier. Tier 1, with 61 percent of the emissions reduction will incur 62 percent of the cost. Tiers 2 and 3, with 17 and 22 percent of the emissions reduction, respectively, will each incur 19 percent of the cost.

Regarding financing arrangements, it is a business decision as to how the cost of compliance is handled. If a business does not have sufficient

internal capital to comply with the regulation, financing arrangements must then be made within the marketplace.

2. Comment: Costs should be amortized over five years instead of the 10 years used in ARB's analysis. This would double ARB's estimate of cost per metric ton of CO<sub>2</sub>e reduction.

Agency Response: Staff believes amortizing costs over a 10 year equipment life is conservative since several industry members indicated that equipment can last 15 to 20 or more years. Amortizing costs over a five year period would be inconsistent with other rulemakings of the Board which consider the equipment lifetime. Also, the cost recovery factor, which considers the amortization period, only applies to initial capital cost, not annual operating and maintenance costs. Thus, a five year amortization period would increase the cost per metric ton of CO<sub>2</sub>e reduced by 50 percent, not 100 percent as stated by NEC.

3. Comment: The ARB staff analysis does not account for future growth in semiconductor production.

Agency Response: ARB staff considered the need for NEC to expand its production in California by providing companies that upgrade their equipment two additional years until January 1, 2014 to comply with the emission standards.

4. Comment: The financial impact of the proposed regulation will be severe enough that companies may curtail or terminate operations.  
Agency Response: No company has indicated they will curtail or terminate operations as a result of this proposed regulation. To the contrary, NEC has indicated they will expand their operations in California.
5. Comment: The emission reduction target will require over a 95 percent emission reduction for any new manufacturing equipment that will be needed to support future growth in production.

Agency Response: The regulation specifies that new operations are subject to the most stringent Tier 1 standard. Therefore, any new manufacturing operation would likely use new technology to meet this more stringent standard. If new operations must still use abatement to curtail 95 percent of the emissions, then the operation is being treated no differently from other Tier 1 businesses.

Emission reductions needed to meet the standards will vary depending upon the complexity and efficiency of an operation. For example, two out of five operations in Tier 1 already comply with the emission standard. One complying company in Tier 1 has no abatement, while the other

complying company uses process optimization, alternative chemistries and abatement. Based on ARB survey results, NEC will need to reduce emissions by 74 percent to meet the Tier 1 standard.

6. Comment: The cost of other regulations is not considered in the economic analysis. The Regional Water Quality Control Board lowered its discharge limits, which will require NEC to spend up to \$3 million by June 1, 2012 to meet this requirement.

Agency Response: ARB's responsibilities to reduce GHG emissions are clearly specified by AB 32. The cost of other environmental regulations is known to add to business costs, however, the Board must make decisions based on the cost of each regulation over which it has jurisdiction. To conclude that the cost of other non-air quality regulations should prevent the Board from fulfilling its legal responsibilities would be misguided. ARB must comply with the legal requirements of AB 32.

7. Comment: The cost of compliance is underestimated.

Agency Response: ARB staff disagrees with the assertion that compliance costs are underestimated. Staff relied on industry data to perform the cost analysis. Specifically, staff used NEC's cost estimate for their facility even though it exceeded estimates provided by the Semiconductor Industry Association. The methodology used for the cost analysis is consistent with that used for other rulemakings approved by the Board since 1990.

8. Comment: The economic analysis does not address leakage. If leakage of production occurs as we expect, the regulation will not mitigate, but exacerbate a problem that has a global effect. Another facility in another part of this planet will receive a lot of business that will inevitably be forced out of California by this proposed regulation. It will likely be a third-world country that is making a minimal effort to reduce emissions.

Agency Response: The potential for leakage was evaluated in the ISOR. According to the Semiconductor Industry Association, manufacturing in California has already declined because manufacturers have relocated to other states and overseas. No, or minimal, leakage is expected from the proposed regulation based on ARB staff discussions with industry. NEC testimony suggests that if their California production were lost it may likely return to Japan, which is not a third-world country. These factors imply that global warming will not be significantly impacted by California business moving to third-world countries where emission control requirements are less stringent.

9. Comment: The economic analysis is inaccurate when it states that there will be no significant impact on business. ARB staff should reevaluate the economic impact that this regulation will have on the California semiconductor industry.

Agency Response: In the ISOR, staff recognized that individual companies may experience impacts different than those projected in the analysis. However, the analysis, which includes cost data provided by NEC, still shows that technologies are available and that they are economically feasible.

According to U.S. census data for 2002, the semiconductor industry in California represented approximately \$10 billion annually in sales. The cost of the regulation is estimated at \$3.7 million per year, or 0.04 percent of sales. Considering the multi-billion dollar size of the industry, annual compliance costs for the industry are not excessive at less than one-tenth of one percent of revenues. In addition, staff performed the economic analysis using industry cost data, an appropriate cost recovery factor, and a standardized method recommended by Cal/EPA, which ensures consistency with previous cost analyses of ARB regulations. Therefore, staff does not see value in reevaluating this analysis.

#### **D. Tier 1 Companies Are Being Unfairly Targeted**

1. Comment: The proposed regulation unfairly targets companies, such as NEC, that produce more complex products that require the use of more GHG gases. A second survey should be conducted to determine the average number of masking layers per wafer and standards should be based on these new results.

Agency Response: Increasing emissions due to product complexity was a key consideration in developing the standards. The ARB survey data indicate that companies manufacturing the full range of products are already complying with the regulation. Another company in Tier 1 that already complies with the emission standard makes products that are just as complex as those produced by NEC. Including the number of wafer layers in the regulation would add complexity and make enforcement more difficult. NEC is the only company requesting inclusion of the number of wafer layers in the regulation. Other manufacturers are opposed to basing the standards on wafer layers.

A second survey would not change the determination that the proposed standards are technically feasible. As stated previously, businesses processing nearly half of the wafers already meet the standards.

#### **E. NEC Is Opposed to the Proposed Tier System**

1. Comment: We strongly oppose the tier system. Tier 1 companies will be responsible for achieving 69 percent of the emissions reduction target of 0.18 MMT CO<sub>2</sub>e.

Agency Response: The tier system is based on the size of semiconductor operations, or the volume of wafers processed per year. The reductions are essentially proportionate to the emission levels generated by businesses within each tier. Large operations, accounting for over half of the emissions, have the most stringent emission standard, achieving 61 (not 69) percent of the total reduction. Medium operations, which account for one quarter of emissions, have a less stringent emission standard that achieves 17 percent of the reduction, and small operations have the least stringent standard, accounting for 22 percent of the reduction. Although the stringency of the standards decreases with the size of the operation, some smaller operations in Tiers 2 and 3 must achieve a higher percentage emission reduction than NEC.

#### **F. No Specific Guidance for Air District Permitting**

1. Comment: The regulation does not offer districts guidance on how permit fees will be assessed. Language should be included stating that a single permit shall be used per site for all devices used to reduce GHG emissions.

Agency Response: State law establishes permitting and fee authority (Health and Safety Code section 42300 for permits and section 42311 for fees) for districts. ARB does not have the authority to instruct districts on assessing permit fees. Districts are responsible for determining the fees required to recover the cost of implementation of the regulation.

2. Comment: The regulation also does not require districts to protect confidential business information.

Agency Response: Districts have established protocols on protecting confidential information. SCAQMD adopted Guidelines for Implementing the Public Records Act on May 6, 2005. The Guidelines follow Government Code section 6254.7 relating to exempt records and trade secrets. The entity filing confidential information must meet with the public records staff to identify the information and justify why the information should be protected.

NEC is currently subject to permitting requirements in the Placer County Air Pollution Control District and did not indicate that they have experienced a breach of confidentiality. The Placer County Air Pollution Control District adopted Rule 409 in 1974, amended in 1977, describing

treatment of confidential information. The filing entity must identify the information and justify the validity of trade secret claims.

Most of the operations subject to the proposed regulation are located in the BAAQMD. BAAQMD protocols are described in section 11 of their Administrative Code, Guidelines for Public Access to Records. Section 11.3 contains specific procedures followed for not disclosing trade secrets, again referencing Government Code Section 6254.7. The BAAQMD process is initiated when a request for information is made, giving the affected entity 14 days to identify trade secret information once notified by the district. The requestor is provided the grounds for the trade secret claims and, if the information is still desired, the affected entity has additional time to apply for a judicial determination on whether the information should be disclosed.

#### **G. The Regulation Should be Rewritten to Address NEC Concerns**

1. Comment: The Board should reject the regulation and direct ARB staff to form a joint committee with industry representatives to rewrite the regulation to meet the requirements of AB 32 and address the concerns expressed by NEC.

Agency Response: ARB staff conducted an extensive public process in developing the regulation and believes that the regulation adequately reflects industry considerations. Staff formed a technical working group, which included industry representatives, to help develop the regulation. The draft performance standards and three tier structure were provided to the working group for comment on July 17, 2008. The principal concern expressed by the group was to combine the emissions standards, which had been specified separately for CVD chamber cleaning and etching. The regulation accommodates industry's concerns by establishing a single emissions standard for both processes to provide more compliance flexibility. The group met three times over the course of 2008. Furthermore, ARB staff conducted four public workshops, visited three semiconductor operations, and participated in four meetings with the Semiconductor Industry Association, before preparing the ISOR, demonstrating that AB 32 requirements have been met.

Staff also met with NEC separately in September and October 2008 to further discuss their concerns. Staff subsequently accommodated their concern about the compliance schedule by adding a two year extension for facilities such as NEC that are upgrading their equipment.

## Oral Comment Summary and Agency Response

Set forth below is a summary of oral comments made regarding the specific regulatory action proposed with the agency response to each comment.

### Oral Comments by SCAQMD

1. Comment: The possible increased use of  $\text{NF}_3$ , a highly potent and long-lasting GHG, is not a good option from an environmental tradeoff standpoint.

Agency Response:  $\text{NF}_3$  is one of the regulated gases included in the regulation so its emissions are accounted for in determining whether a semiconductor operation complies with the emission standards. Although it is the second highest volume of gas used, representing 20 percent of total gas usage, it accounts for only five percent of emissions. This is because it is more efficient than other gases used in the semiconductor industry.

2. Comment: Researchers at the University of California San Diego have published a paper showing an exponential rise in the concentration of  $\text{NF}_3$ . In developing this regulation, ARB should consider that production is expected to increase from industries that produce solar panels and flat screens.

Agency Response: The research conclusions are based on 11 air samples of which nine were from California. Six of the nine were collected from northern California between 1998 and 2008. The other three were from southern California and were collected between 1978 and 1991. Modeling results show a trend of  $\text{NF}_3$  concentrations increasing 11 percent per year from 0.02 parts per trillion to 0.454 parts per trillion. These results strengthen the case for documenting  $\text{NF}_3$  production and emissions and suggest that 16 percent of global  $\text{NF}_3$  production is emitted compared to two to three percent quoted by industry. Staff does not dispute the research findings or the need to include  $\text{NF}_3$  in California's regulation. Because of its high GWP value,  $\text{NF}_3$  has a greater impact on the earth's climate per unit mass of emissions than most of the gases it replaces. However, its unit mass is much smaller than other gases because it is largely destroyed in the chamber cleaning process.

Regarding increasing  $\text{NF}_3$  production and emissions, staff concludes from ARB survey data that this trend is unlikely in California. California has no  $\text{NF}_3$  production operations. Furthermore, after accounting for companies that indicated they planned to close their California operations before the regulation was proposed, total  $\text{NF}_3$  use will likely decline. The solitary

company producing solar panels in 2006 does not use NF<sub>3</sub> in its processes.

3. Comment: Researchers at the University of California Irvine published a paper that projects that the impacts of NF<sub>3</sub> could be higher than SF<sub>6</sub> in terms of its impact on climate change.

Agency Response: The researchers estimate NF<sub>3</sub> production for 2008 at 67 MMT CO<sub>2</sub>e per year (±25 percent), based on press releases and industry data, and indicate that the maximum potential release of NF<sub>3</sub> is equivalent to production. The researchers then show SF<sub>6</sub> and other GHG emissions for 2005 at 35 and 42 MMT CO<sub>2</sub>e per year, respectively. These values are then compared to show that the CO<sub>2</sub>e value of NF<sub>3</sub> production is greater than SF<sub>6</sub> or other GHG emissions. Staff believes the comparison should be based on an emissions-to-emissions evaluation.

If 16 percent of NF<sub>3</sub> production is assumed to occur as emissions, as suggested in the University of California San Diego research paper (see response to comment 2 above), then NF<sub>3</sub> emissions would be approximately 11 MMT CO<sub>2</sub>e per year, 70 percent less than SF<sub>6</sub> emissions and 74 percent less than other GHG emissions. ARB's survey shows approximately 20 metric tons of NF<sub>3</sub> use in 2006 with emissions of 0.018 MMT CO<sub>2</sub>e per year in California, a release equivalent to 5 percent of use. Consequently, ARB staff disagrees with the assertion that NF<sub>3</sub> could have a greater climate change impact than SF<sub>6</sub>.

4. Comment: Because of past decisions where shifts from one compound to another produced undesirable results, and based on information available on NF<sub>3</sub>, it might be more prudent to use a pollution prevention approach rather than go back to address its use the next time you look at the Scoping Plan or consider future regulations.

Agency Response: The regulation controls NF<sub>3</sub> and all other GHGs, but allows operators flexibility in meeting the emission standards. A shift from one compound to another is one of many options available. For example, within the alternative chemistries option, gases other than NF<sub>3</sub> may be substituted for other chamber cleaning gases. While NF<sub>3</sub> is a high GWP gas, its more efficient use means CO<sub>2</sub>e emissions are reduced. Staff does not anticipate needing to address this subject in future regulations unless there are other unknown non-semiconductor related applications where NF<sub>3</sub> use does not result in improved efficiencies.

5. Comment: NF<sub>3</sub> use generates HF, a toxic byproduct. The regulation should include language to prevent semiconductor operators from switching to NF<sub>3</sub> and transition existing NF<sub>3</sub> users to move to a gas that would be better for the environment.

Agency Response: Semiconductor operations have control equipment in place to abate HF emissions because  $\text{NF}_3$  and other gases have the potential to emit HF. The ARB survey shows that the highest user of  $\text{NF}_3$  has HF emissions that are 80 percent below the trigger level the districts have for action to mitigate HF toxicity.  $\text{NF}_3$  can be used more efficiently compared to other chamber cleaning gases and control equipment is 99 percent effective in abating HF emissions.

However, if a district determines that HF generation poses a localized risk, the district has authority to require the semiconductor operator to mitigate the risk. In addition, the Occupational Safety and Health Administration has a very stringent standard of three parts per million to ensure worker safety. Staff therefore concludes that HF generation does not pose a significant adverse environmental impact. The BAAQMD, which has most of the semiconductor operations in California, provided written comments in support of the regulation.

6. Comment: The regulation should include language to prevent semiconductor operators from switching to  $\text{NF}_3$  and transition existing  $\text{NF}_3$  users to move to a gas that would be better for the environment.

Agency Response: ARB staff does not believe it is necessary to revise the regulatory language to prevent operators from switching to  $\text{NF}_3$ . ARB staff does not expect a large increase in  $\text{NF}_3$  use because it is an expensive option requiring new tools. The HF generated from  $\text{NF}_3$  use is also effectively treated (e.g., 99 percent reduction) by water scrubbers.

### **Oral Comments by NEC**

1. Comment: NEC feels that the AB 32 requirement to achieve the maximum feasible reductions cost-effectively is not being achieved by the proposed regulation.

Agency Response: ARB staff disagrees with this assertion. In addition to the cost-effectiveness analysis, which produces a cost of \$21 per metric ton of  $\text{CO}_2$  equivalent reduction, ARB staff's cost-effectiveness analysis considered the decline in the return on owner's equity (ROE) caused by the cost of compliance. This analysis, presented in the ISOR, indicated that the average decline was 0.4 percent, with Tier 1 businesses averaging a 0.9 percent decline. These results are well below the threshold value of a 10 percent decline in ROE that has consistently been used by ARB to determine a severe financial impact. Staff based the maximum feasible reduction on what industry has achieved voluntarily.

Twelve out of 28 operations subject to the standards have been in compliance since 2006. Therefore, the emission standards are cost-effective and technologically feasible.

2. Comment: The cost of abatement is very high and is going to adversely affect California's semiconductors.

Agency Response: Staff agrees that compliance using abatement technology is the highest cost option. However, ARB survey results show that some operators have incurred abatement costs and remained competitive. Furthermore, staff used abatement cost information provided by industry in assessing the cost-effectiveness of the regulation. The analysis showed that the cost would average \$21 per metric ton of CO<sub>2</sub>e reduced. The Executive Officer and the Board determined this to be cost-effective. While the cost will impact some California semiconductor operators, the ARB considered this impact on the state's overall economy in the cost effectiveness analysis in the ISOR and found it to be absorbable, while not significantly affecting company profitability.

3. Comment: The complexity of our product and the fact that we're a very large fab means that we're going to put out and use more GHGs.

Agency Response: Emissions are a function of many factors specific to each operation. These include, but are not limited to, the gases and processes used, wafer size and quantities processed, product design, and control technology in place. ARB survey results show that some fabs with high processing volumes achieve relatively low emissions per unit area of wafers processed. These fabs have high use of gases, but use chamber cleaning technology that minimizes emissions. ARB survey results also identified a large complying California fab that makes products as complex as those produced by NEC. Thus, while product complexity may mean higher gas use, emissions can still be low per unit area of wafers processed.

### III. NON SUBSTANTIVE CHANGES MADE TO THE RULEMAKING RECORD

There were date errors in the references for various chapters in the Staff Report (ISOR). ARB staff notes the following corrections to the references by chapter and appendix, and corrections are as follows:

1. Chapter 3 Reference #4, "October 19, 2006" was corrected to "December 30, 2008"; the U.S. EPA, "High Global Warming Potential Gases," document was available as part of the rulemaking record at time of publication.

2. Chapter 3 Reference #7, "September 2008" was corrected to "December 2008"; the 2008 "Chemical Vapor Deposition" document was available as part of the rulemaking record at time of publication.
3. Chapter 7 Reference #11, "December 6, 1996" was corrected to "December 9, 1996"; the California Environmental Protection Agency, Memorandum from Peter M. Rooney, Undersecretary, to Cal/EPA Executive Officers and Directors. Economic Analysis Requirements for the Adoption of Administrative Regulations. Appendix C (Cal/EPA Guidelines for Evaluation Alternatives to Proposed Major Regulations). December 9, 1996. (Cal/EPA, 1996) document was available as part of the rulemaking record at time of publication.
4. Chapter 7 Reference #12, "July 2008" was corrected to "December 2008"; the Hoovers.com. On-line financial database by subscription for selected publicly-owned companies. December 2008. (Dunn and Bradstreet, 2008) document was available as part of the rulemaking record at time of publication.
5. Chapter 7 Reference #13, "November, 2008" was corrected to "December, 2008"; the U.S. Department of Labor, Bureau of Labor Statistics. December 2008. (BLS, 2008) document was available as part of the rulemaking record at time of publication.
6. Appendix C Reference #1, the "6," was deleted in "June 6, 1997."
7. Appendix C Reference #13, "November, 2008 (Dunn and Bradstreet, 2007) was corrected to "December, 2008 (Dunn and Bradstreet).