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40 CFR Part 98
Greenhouse Gas Reporting Program: Final Amendments and Confidentiality Determinations for Electronics Manufacturing; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 98

[EPA–HQ–OAR–2011–0028; FRL–9845–6]

RIN 2060–AR61

Greenhouse Gas Reporting Program: Final Amendments and Confidentiality Determinations for Electronics Manufacturing

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule; Notice of Final Action on Reconsideration.

SUMMARY: The EPA is amending the calculation and monitoring methodologies for electronics manufacturers covered by the Greenhouse Gas Reporting Rule. These changes include revising certain calculation methods and adding a new method, amending data reporting requirements, and clarifying terms and definitions. The EPA is also making confidentiality determinations for new and revised data elements pertaining to electronics manufacturing. This rule also finalizes amendments to the general provisions of the Greenhouse Gas Reporting Rule to remove entries for data elements that are being moved from reporting to recordkeeping.

DATES: This final rule is effective on January 1, 2014. The incorporation by reference of certain publications listed in this rule is approved by the Director of the Federal Register as of January 1, 2014.

ADDRESSES: The EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2011–0028. All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, e.g., confidential business information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at the Air Docket, EPA/DC, EPA West, Room B102, 1301 Constitution Ave. NW., Washington, DC. This Docket Facility is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Air Docket is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT: Carole Cook, Climate Change Division, Office of Atmospheric Programs (MC–6207J), Environmental Protection Agency, 1200 Pennsylvania Ave. NW., Washington, DC 20460; telephone number: (202) 343–9263; fax number: (202) 343–2342; email address: *GHGReportingRule@epa.gov*. For technical information and implementation materials, please go to the Greenhouse Gas Reporting Rule Program Web site at *http://www.epa.gov/ghgreporting/*. To submit a question, select Rule Help Center, followed by ''Contact Us.''

Worldwide Web (WWW). In addition to being available in the docket, an electronic copy of this final rule will also be available through the WWW. Following the Administrator's signature, a copy of this action will be posted on the EPA's Greenhouse Gas Reporting Program Web site at *http://www.epa.gov/ghgreporting/*.

SUPPLEMENTARY INFORMATION: *Regulated Entities.* The Administrator determined that this action is subject to the provisions of Clean Air Act (CAA) section 307(d). These amended regulations may affect owners or operators of certain electronic manufacturing facilities. Regulated categories and entities may include those listed in Table 1 of this preamble:

TABLE 1—EXAMPLES OF AFFECTED ENTITIES BY CATEGORY

Source category	NAICS	Examples of affected facilities
Electronics Manufacturing	334111	Microcomputers manufacturing facilities.
	334413	Semiconductor, photovoltaic (solid-state) device manufacturing facilities.
	334419	Liquid Crystal Display (LCD) unit screens manufacturing facilities.
	334419	Micro-electro-mechanical systems (MEMS) manufacturing facilities.

Table 1 of this preamble is not intended to be exhaustive, but rather provides a guide for readers regarding facilities likely to be affected by this action. Table 1 of this preamble lists the types of facilities of which the EPA is aware may be potentially affected by the reporting requirements. Other types of facilities not listed in the table may also be affected. To determine whether you are affected by this action, you should carefully examine the applicability criteria found in 40 CFR part 98, subpart A and 40 CFR part 98, subpart I. If you have questions regarding the applicability of this action to a particular facility, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Judicial Review. Under CAA section 307(b)(1), judicial review of this final rule is available only by filing a petition for review in the U.S. Court of Appeals for the District of Columbia Circuit (the Court) by January 13, 2014. Under CAA section 307(d)(7)(B), only an objection to this final rule that was raised with reasonable specificity during the period for public comment can be raised during judicial review. Section 307(d)(7)(B) of the CAA also provides a mechanism for the EPA to convene a proceeding for reconsideration, ''[i]f the person raising an objection can demonstrate to EPA that it was impracticable to raise such objection within [the period for public comment] or if the grounds for such objection arose after the period for public comment (but within the time specified for judicial review) and if such objection is of central relevance to the outcome of the rule.'' Any person seeking to make such a demonstration to us should submit a Petition for Reconsideration to the Office of the Administrator, Environmental Protection Agency, Room 3000, Ariel Rios Building, 1200 Pennsylvania Ave. NW., Washington, DC 20460, with a copy to the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section, and the Associate General Counsel for the Air and Radiation Law Office, Office of General Counsel (Mail Code 2344A), Environmental Protection Agency, 1200 Pennsylvania Ave. NW. Washington, DC 20004. Note that under CAA section 307(b)(2), the requirements established

by this final rule may not be challenged separately in any civil or criminal proceedings brought by the EPA to enforce these requirements.

Acronyms and Abbreviations. The following acronyms and abbreviations are used in this document.

ASME American Society of Mechanical Engineers
ASTM American Society of Testing and Materials
BAMM best available monitoring methods
CAA Clean Air Act
CBI confidential business information
CFR Code of Federal Regulations
CO_2 carbon dioxide
CO_2e carbon dioxide equivalent
CVD chemical vapor deposition
DRE destruction or removal efficiency
EIA Economic Impact Analysis
EPA U.S. Environmental Protection Agency
FDL field detection limit
F–GHG fluorinated greenhouse gas
FR Federal Register
FTIR Fourier transform infrared
GHG greenhouse gas
GHGRP Greenhouse gas reporting period
GWP global warming potential
HQ Headquarters
HTF heat transfer fluid
IBM International Business Machines Corporation
IPCC Intergovernmental Panel on Climate Change
ISMI International SEMATECH Manufacturing Initiative
kg kilograms
LCD liquid crystal display
MACT Maximum Achievable Control Technology
MEMS micro-electro-mechanical systems
$mtCO_2e$ metric ton carbon dioxide equivalent
N_2O nitrous oxide
NAICS North American Industrial Classification System
NF_3 nitrogen trifluoride
NTTAA National Technology Transfer and Advancement Act of 1995
OMB Office of Management & Budget
POU point of use
ppbv parts per billion by volume
ppm parts per million
PV photovoltaic
QA/QC quality assurance/quality control
QMS quadrupole mass spectroscopy
R&D research and development
RFA Regulatory Flexibility Act
RICE Reciprocating Internal Combustion Engines
RIN Regulatory Information Number
RSASTP random sampling abatement system testing program
RSD relative standard deviation
SEMATECH Semiconductor Manufacturing Technology
SIA Semiconductor Industry Association
TI Texas Instruments Incorporated
U.S. United States
UMRA Unfunded Mandates Reform Act of 1995
VCS voluntary consensus standard
VOC volatile organic compound
WWW Worldwide Web

I. General Information

A. Organization of This Preamble

The following outline is provided to aid in locating information in this preamble.

I. General Information
A. Organization of this Preamble
B. Background
C. Legal Authority
D. How do these amendments apply to 2013 and 2014 reports?
II. Overview of Final Amendments to the Electronics Manufacturing Source Category and Responses to Major Public Comments
A. Final Amendments to the Electronics Manufacturing Source Category
B. Responses to Major Comments Submitted on the Electronics Manufacturing Source Category
III. Confidentiality Determinations for New and Revised Subpart I Data Elements and Responses to Public Comments
A. Final Confidentiality Determinations for New and Revised Subpart I Data Elements
B. Public Comments on the Proposed Confidentiality Determinations
IV. Statutory and Executive Order Reviews
A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review
B. Paperwork Reduction Act
C. Regulatory Flexibility Act
D. Unfunded Mandates Reform Act
E. Executive Order 13132: Federalism
F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks
H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use
I. National Technology Transfer and Advancement Act
J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations
K. Congressional Review Act

B. Background

The GHG reporting requirements for subpart I were finalized on December 1, 2010 (75 FR 74774, hereafter referred to as ''final subpart I rule''). Following the publication of the final subpart I rule in the **Federal Register**, the Semiconductor Industry Association (hereafter referred to as the ''SIA'' or ''the Petitioner'') submitted on January 31, 2011 an administrative petition titled ''Petition for Reconsideration and Request for Stay Pending Reconsideration of Subpart I of the Final Rule for Mandatory Reporting of Greenhouse Gases'' (hereafter referred to as the ''Petition for Reconsideration,'' available in docket EPA–HQ–OAR–2009–0927), requesting reconsideration of numerous provisions in the final subpart I rule. Since that petition was filed, the EPA has published five actions related to subpart I.

- Additional Sources of Fluorinated GHGs: Extension of Best Available Monitoring Provisions for Electronics Manufacturing (76 FR 36339, published June 22, 2011). Granted the Petition for Reconsideration with respect to the provisions for the use of Best Available Monitoring Methods (BAMM). Extended three of the deadlines in subpart I related to using the BAMM provisions from June 30, 2011 to September 30, 2011.
- Changes to Provisions for Electronics Manufacturing to Provide Flexibility (76 FR 59542, published September 27, 2011). Amended the calculation and monitoring provisions for the largest semiconductor manufacturing facilities to provide flexibility through the end of 2013 and extended two deadlines in the BAMM provisions.
- Proposed Confidentiality Determinations for Subpart I and Proposed Amendments to Subpart I Best Available Monitoring Methods Provisions (77 FR 10434, published February 22, 2012). Re-proposed confidentiality determinations for data elements in subpart I and proposed amendments to the provisions regarding the calculation and reporting of emissions from facilities that use BAMM.
- Revisions to Heat Transfer Fluid Provisions (77 FR 10373, published February 22, 2012). Amended the definition of fluorinated heat transfer fluids (fluorinated HTFs) and the provisions to estimate and report emissions from fluorinated HTFs.
- Final Confidentiality Determinations for Nine Subparts and Amendments to Subparts A and I under the Mandatory Reporting of Greenhouse Gases Rule; Final Rule (77 FR 48072, published August 13, 2012). Final confidentiality determinations for data elements in subpart I and final amendments to the provisions regarding the calculation and reporting of emissions from facilities that use BAMM.

In response to the Petition for Reconsideration, the EPA published a proposal to amend provisions in subpart I related to calculation and monitoring methodologies, data reporting and recordkeeping requirements, clarifying terms and definitions, and confidentiality determinations to provide greater flexibility to facilities. The proposal was published on October 16, 2012 (77 FR 63538). The public

comment period for the proposed rule amendments was initially scheduled to end on December 17, 2012. The EPA received a request to extend the public comment period and published a notice in the **Federal Register** on November 20, 2012 (77 FR 69585) extending the public comment period to January 16, 2013.

In this action, the EPA is finalizing amendments to provisions in the final subpart I that were proposed in the October 16, 2012 notice. Responses to comments submitted on the proposed amendments can be found in Sections II.B and III.B of this preamble and the document, ''Greenhouse Gas Reporting Rule—Technical Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Responses to Public Comments'' (see Docket Id. No. EPA–HQ–OAR–2011–0028).

C. Legal Authority

The EPA is promulgating these rule amendments to Part 98 under its existing CAA authority, specifically authorities provided in CAA section 114.

As stated in the preamble to the 2009 final rule (74 FR 56260, October 30, 2009) and the Response to Comments on the Proposed Rule, Volume 9, Legal Issues, CAA section 114 provides the EPA broad authority to obtain the information in Part 98, including subpart I, because such data would inform and are relevant to the EPA's carrying out a wide variety of CAA provisions. As discussed in the preamble to the initial Part 98 proposal (74 FR 16448, April 10, 2009), CAA section 114(a)(1) authorizes the Administrator to require emissions sources, persons subject to the CAA, manufacturers of control or process equipment, or persons whom the Administrator believes may have necessary information to monitor and report emissions and provide such other information the Administrator requests for the purposes of carrying out any provision of the CAA.

In addition, the EPA has made confidentiality determinations for subpart I data elements that are added or revised by this rule under its authorities provided in sections 114, 301, and 307 of the CAA. As mentioned in the previous paragraph, CAA section 114 provides the EPA authority to obtain the information in Part 98, including those in subpart I. Section 114(c) requires that the EPA make publicly available information obtained under section 114 except for information (excluding emission data) that qualifies for confidential treatment.

The Administrator has determined that this action (finalized amendments and confidentiality determinations) is subject to the provisions of section 307(d) of the CAA.

D. How do these amendments apply to 2013 and 2014 reports?

These final amendments are effective on January 1, 2014. Facilities are required to follow one of the methods in subpart I as amended through this action to estimate emissions beginning in 2014. The first reports of emissions estimated using the new methods will be submitted in early 2015. As a result of these finalized amendments, the EPA does not expect reporters will need to purchase and install any new monitoring equipment to continue to comply with subpart I since reporters will still have the option to use default utilization and by-product formation rates. Additionally, unless reporters choose to estimate F–GHG emissions using the optional stack test method, the EPA does not expect reporters will be required to make any substantial modifications to their recordkeeping procedures. For the reasons discussed here, in addition to the absence of any opposition to the timeline received during the public comment period, the EPA believes that the effective date of January 1, 2014 is reasonable.

For the reports of emissions in calendar year 2013 (reporting year 2013) that are to be submitted in early 2014, reporters must calculate emissions and other relevant data using the requirements under Part 98 that predated today's revisions. Those requirements include the flexibility for the largest semiconductor manufacturing facilities added in the September 27, 2011 rule titled ''Changes to Provisions for Electronics Manufacturing to Provide Flexibility.''

II. Overview of Final Amendments to the Electronics Manufacturing Source Category and Responses to Major Public Comments

The EPA is finalizing amendments to the calculation and monitoring methodologies in the final subpart I rule. In addition, the EPA is finalizing conforming changes to the reporting and recordkeeping requirements of subpart I. Changes include revising certain calculation methods and adding a new method, amending data reporting requirements, and clarifying terms and definitions. The EPA is finalizing these amendments to (1) Modify calculation methods and data requirements to better reflect new industry data and current practice; (2) provide additional calculation methods to allow individual facilities to choose the method best suited for their operations; (3) reduce the burden associated with existing requirements; and (4) address potential disclosure concerns raised by members of the SIA. Amendments being finalized today affect all facilities subject to subpart I that manufacture electronics including those that manufacture semiconductors (including light emitting diodes), micro-electro-mechanical systems (MEMS), liquid crystal displays (LCDs), or photovoltaic (PV) cells. Because the effective date of these final amendments is January 1, 2014, those provisions that apply to reporting year 2013, but not thereafter, will no longer appear in the text of the regulation.

Section II.A describes the final amendments to the subpart I rule, including a detailed summary of the changes in the final amendments since proposal. Section II.B, Response to Major Comments Submitted on the Electronics Manufacturing Source Category, discusses the EPA's responses to major comments on the proposed amendments. For a full description of the rationale for these and any other amendments to the final subpart I rule, please refer to the ''Greenhouse Gas Reporting Rule—Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Response to Public Comment'' in addition to Sections II.A and II.B of this preamble.

A. Final Amendments to the Electronics Manufacturing Source Category

In this rulemaking, the EPA is taking final action on its proposed reconsideration on all issues in the Petition for Reconsideration not already addressed in the final rules published June 22, 2011 (Additional Sources of Fluorinated GHGs: Extension of Best Available Monitoring Provisions for Electronics Manufacturing); September 27, 2011 (Changes to Provisions for Electronics Manufacturing to Provide Flexibility); and August 13, 2012 (Confidentiality Determinations for Subpart I and Amendments to Subpart I Best Available Monitoring Methods Provisions). Those final rules are described in Section I.B of this preamble. Section II.A discusses the final amendments to the subpart I rule in response to the petition. The EPA is completing its response to the Petition for Reconsideration through this rulemaking.

The major changes to the final rule since proposal are the following:

Default Emission Factors:

• Etch emission factors: The proposed etch emission factors and by-product

formation rates for semiconductor manufacturing have been updated since proposal to account for new data submitted in public comments.

• Nitrous oxide (N_2O) emission factors: The proposed revised emission factor for all ''other'' (e.g., non-CVD) N_2O emitting processes is not being adopted in the final rule.

Abatement System Requirements:

• The proposed default abatement system destruction or removal efficiency (DRE) factors have been updated since proposal to account for new data submitted in public comments and for a revised statistical approach to calculating the default DRE factors.

• The certification requirements for abatement systems have been revised to refer to the site maintenance plan for abatement systems.

• The abatement system requirements have been revised to allow the use of either default DREs or site-specific measured DRE values; however, if an abatement system was not specifically designed for F–GHG removal and the reporter elects to account for the effect of that abatement system when using either the emission factors and calculation methods in 40 CFR 98.93(a) and (b) or the stack testing alternative in 40 CFR 98.93(i), site-specific DRE values must be used.

• The calculation of abatement system uptime has been revised so that only a single equation is used to calculate uptime for both input gases and their associated by-product gases for a given input gas and process combination.

Stack Testing Alternative:

• The rule designates a list of five ''expected'' by-product gases (CF_4, CHF_3, CH_3F, C_2F_6, and CH_2F_2) and four ''possible'' by-product gases (C_3F_8, C_4F_6, c-C_4F_8, and C_5F_8) that must be measured in stack testing. These two lists replace the proposed requirement to perform an analysis to identify potential by-products to include in testing. The proposed analysis would have considered for testing the by-products from the applicable gas and process combinations in Tables I–3 to I–7 of subpart I.

• The maximum allowed field detection limits (FDLs) have been increased by a factor of four compared to the proposed FDLs.

• The final rule allows the use of ASTM D6348–03, Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, as an alternative to EPA Method 320.

• The Tier 2a emission factors on Tables I–11 and I–12 for semiconductors have been updated since proposal to account for new data submitted in public comments, and to include weighting by the amount of gas used in each process type (as opposed to not being weighted).

Facility-Wide DRE Calculation:

• Equations I–26, I–27, and I–28 have been revised to calculate only a fab-wide DRE, not a facility-wide DRE, when more than one fab is present.

The following sections of this preamble summarize the final amendments to subpart I.

1. Stack Testing as an Alternative Emission Monitoring Method for Facilities That Manufacture Electronics

The EPA is promulgating amendments to revise subpart I to include a stack testing option for estimating annual F–GHG emissions at 40 CFR 98.93(i). This option applies to all electronic manufacturing facilities, including those making semiconductors, MEMS, LCDs, and PV cells. The stack testing option is not available for estimating N_2O emissions. The finalized amendments to the provisions and emission factors for estimating N_2O emissions are discussed in Section II.A.9 of this preamble.

In this action, we are also finalizing the option to allow all electronics manufacturing facilities to use separate methods (i.e., stack testing or default utilization and by-product formation rates) to estimate emissions from each fab within a single facility. (A facility must use only a single method for each fab.) Additionally, we are also finalizing the requirements for facilities to report GHG emissions on a fab basis but submit reports on a ''facility'' basis, as defined in 40 CFR 98.6. There may be one or more fabs at each facility. A ''fab'' is defined in subpart I as ''the portion of an electronics manufacturing facility located in a separate physical structure that began manufacturing on a certain date.''

Selection of Stack Systems for Testing. Under the final amendments, reporters are required to develop a preliminary estimate of the annual emissions from each ''stack system'' in a fab and are not required to test those stack systems that account for relatively small emissions. A stack system is considered to be one or more stacks that are connected by a common header or manifold, through which a F–GHG-containing gas stream originating from one or more fab processes is, or has the potential to be, released to the atmosphere. For purposes of subpart I, stack systems do not include emergency vents or bypass stacks through which emissions are not usually vented under typical operating conditions.

The reporter must develop a preliminary estimate of F–GHG emissions from each stack system on a metric ton carbon dioxide equivalent ($mtCO_2e$) basis. To develop the preliminary estimate, the reporter must use the gas consumption in the tools associated with the stack system and gas utilization rates and by-product formation rates in Tables I–11 through I–15. Facilities must also include any intermittent low-use F–GHGs in the preliminary estimate. The reporter must also account for the DRE of the ''point of use'' (POU) abatement systems and the uptime of the POU systems (the fraction of time the system is operating within the parameters specified in the facility's site maintenance plan for abatement systems). The gas utilization rates and by-product formation rates in Tables I–13 and I–14 are based on the 2006 Intergovernmental Panel on Climate Change (IPCC) Tier 2a factors [1] for LCD and PV manufacturing, respectively. The factors in Table I–13 for MEMs manufacturing are based on the 2006 IPCC Tier 2a factors for semiconductor manufacturing due to the similarities in the manufacturing processes. The factors in Tables I–11 and I–12 for semiconductor manufacturing facilities were updated from the 2006 IPCC factors based on utilization rate and by-production formation rate data collected by the Petitioner (see ''Technical Support for Modifications to the Fluorinated Greenhouse Gas Emission Estimation Method Option for Semiconductor Facilities under Subpart I,'' Docket ID No. EPA–HQ–OAR–2011–0028) in addition to data submitted to the EPA during the comment period. The default factors for each gas in Tables I–11 and I–12 were also updated by weighting the emission factor data for each gas and process type or subtype based on the gas consumption for that process type or sub-type. The EPA did not update the factors in Tables I–13 through I–15 based on the data collected by the Petitioner or submitted during the comment period because none of the data were for LCD, PV, or MEMS manufacturing. The EPA did not receive additional data on LCD, PV, or MEMs manufacturing processes, therefore, it was not feasible to propose revised factors for these processes. Furthermore, because MEMS are generally

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Hayama, Kanagawa, Japan.

manufactured on older semiconductor manufacturing tools (i.e., 150 mm and 200 mm wafer sizes), we have determined that the 2006 IPCC factors for semiconductor manufacturers remain appropriate.

In the preliminary estimate, reporters are required to use data from the previous reporting year for the total uptime of all abatement systems in each stack system, and either a default DRE or measured site-specific DRE; the reporter must use the measured site-specific DRE if the abatement system was not specifically designed to abate F–GHG. If uptime data from the previous reporting year are not available (either because the fab is new or the facility was not required to report in the previous reporting year), the reporter must use representative operating data from a period of 30 days or more. The reporter must account for any anticipated change in activity for the fab (i.e., an increase or decrease in the annual consumption and emissions of any F–GHG) greater than 10 percent for the current reporting year compared to the previous reporting year. To estimate the expected change in activity, the reporter must use a quantifiable metric (e.g., the ratio of the number tools that are expected to be vented to the stack system in the current year as compared to the previous reporting year), engineering judgment, or other industry standard practice.

The consumption of each F–GHG in each stack system is estimated as the total gas consumption of that F–GHG in the fab, times the ratio of the number of tools using that F–GHG that are feeding to that stack system to the total number of tools in the fab using that F–GHG. The reporter must convert the F–GHG emissions to CO_2e using the global warming potential (GWP) values for F–GHGs in Table A–1 of subpart A of Part 98. For F–GHGs in Tables I–11 through I–15 for which Table A–1 of subpart A of Part 98 does not list a GWP value, reporters must use a default value of 2,000 for the GWP for the purposes of this estimate. Based on this preliminary estimate, the reporter must rank the F–GHG emitting stack systems at the facility from the lowest to highest emitting. The reporter is not required to test emissions from low-emitting stack systems if those F–GHG emitting stack systems meet all of the following three criteria:

(1) The sum of the F–GHG emissions from all combined stack systems in the fab that are not tested is less than 10,000 $mtCO_2e$ per year;

(2) Each of the stack systems that are not tested are within the fab's lowest F–GHG emitting stack systems that together emit 15 percent or less of total CO_2e F–GHG emissions from the fab; and

(3) The F–GHG emissions from each of the stack systems that are not tested can be attributed to only one particular collection of process tools during the test (i.e., the stack cannot be used as a bypass from other tools that are normally vented through a stack system that does not meet these criteria).

For those low-emitting stack systems that are not tested, the reported F–GHG emissions are calculated using the annual gas consumption in the tools vented to those stacks and the gas utilization rates and by-product formation rates in Tables I–11 through I–15 in subpart I, accounting for the DRE and uptime of the POU abatement systems, as discussed above.

Stack testing requirements. For those higher-emitting stack systems in each fab that are not exempt from measurement, the reporter must measure each F–GHG concentration (in parts per billion by volume, or ppbv) and the total stack flow to determine the hourly mass flow rate (kg/hr) of each F–GHG emitted from each applicable stack system. If a stack system has more than one stack from a common header, the reporter is required to measure F–GHG concentration and flow in each stack from that header. The reporter must use EPA Method 320, ASTM D6348–03 or another approved method to measure F–GHG concentration (per the requirements of 40 CFR 98.94(k)), and EPA Methods 1 through 4 at 40 CFR part 60, appendices A–1, A–2, and A–3 to measure other stack gas parameters needed to convert F–GHG concentration to mass emissions for the test period. Reporters must also measure the fab-specific consumption of each F–GHG for the test period.

Reporters are required to measure emissions for all F–GHGs used as input gases and any expected or possible by-product F–GHGs listed in Table I–17 to subpart I. Reporters are not required to measure emissions for any intermittent low-use F–GHGs. Intermittent low-use F–GHGs are defined as F–GHGs that meet all of the following:

(1) The F–GHG is used by the fab but was not used on the day of the actual stack testing;

(2) The emissions of that F–GHG do not constitute more than 5 percent of the total annual F–GHG emissions from the fab on a CO_2e basis;

(3) The sum of all F–GHGs that are considered intermittent low-use F–GHGs does not exceed 10,000 $mtCO_2e$ for that year; and

(4) The F–GHG is not an expected or possible by-product identified in Table I–17 of subpart I.

Reporters must calculate annual emissions of intermittent low-use F–GHGs using the gas consumption and the gas utilization rates and by-product formation rates in Tables I–11 through I–15 in the rule, accounting for the DRE and uptime of the POU systems during the year for which emissions are being estimated.

The testing period must be at least 8 hours for each stack, although reporters may choose to conduct testing over a longer period.

Reporters are not required to measure all stacks simultaneously, but reporters must certify that no significant changes in stack flow configuration occur during and in between tests conducted for any particular fab in a reporting year. Specifically, reporters must certify that no more than 10 percent of the total number of F–GHG emitting process tools have been connected or disconnected from the stack system during testing. Reporters must also certify that no process tools that were in operation at the start of the testing period were moved to a different stack system during testing and that no POU abatement systems have been permanently removed from service during the testing period. Reporters must document and keep records of any changes in the number of tools connected to or disconnected from the stack system and the uptime of each POU abatement system during the testing period for each system.

The tests must be conducted during a period in which the fab is operating at a representative operating level and with the POU abatement systems connected to the stack being tested operating with at least 90 percent average uptime during the 8-hour (or longer) period, or at no less than 90 percent of the uptime measured during the previous reporting year, averaged over all abatement systems connected to the stack being tested. The representative operating level is defined in subpart I as operating the fab, in terms of substrate starts for the period of testing, at no less than 50 percent of installed production capacity or no less than 70 percent of the average production rate for the reporting year, where production rate for the reporting year is represented in average monthly substrate starts. For the purposes of stack testing, the period for determining the representative operating level must be the 30-day period ending on the same date on which testing is concluded.

To convert the measured F–GHG emission rates into fab-specific emission

factors, the reporter must measure the consumption of each F–GHG used in the tools associated with the stack systems being tested, excluding gas consumption allocated to tools venting to low-emitting stack systems that are not tested. Consumption may be measured using gas flow meters, weigh scales, or pressure measurement equipment (with measurements corrected for temperature and non-ideal gas behavior). For gases with low volume consumption for which it is infeasible to measure consumption accurately over the 8-hour testing duration, short-term consumption may be estimated by using one or more of the following:

(1) Drawing from single gas containers in cases where gas is normally drawn from a series of containers supplying a manifold;

(2) Increasing the length of the test period to greater than 8 hours; or

(3) Calculating consumption from long-term consumption (e.g., monthly) that is pro-rated to the test duration.

Stack test methods. The EPA is finalizing the requirement that the F–GHG concentrations in stacks systems be measured using EPA Method 320. We are also allowing the use of ASTM D6348–03 as an alternative to EPA Method 320 with the following additional requirements: (1) The test plan preparation and implementation in the Annexes to ASTM D6348–03, Sections A1 through A8 are mandatory; and (2) In ASTM D6348–03 Annex A5 (Analyte Spiking Technique), the percent recovery (%R) must be determined for each target analyte (Equation A5.5). The reporter must also follow Section 4.1 of ASTM D6348–03 to ensure the F–GHG remains in the gas phase. In order for the test data to be acceptable for a compound, the percent recovery must be between 70 and 130 percent. If the percent recovery does not meet this criterion for a target compound, the test data are not acceptable for that compound and the test must be repeated for that analyte (i.e., the sampling and/or analytical procedure should be adjusted before a retest). The percent recovery value for each compound must be reported in the test report, required under 40 CFR 98.94(j)(4), and all field measurements must be corrected with the calculated percent recovery value for that compound. The use of ASTM D6348–03 was added since proposal, as discussed in section II.B of this preamble.

F–GHGs not detected. We are also finalizing the following provisions to account for different scenarios in which a F–GHG is used, expected to be emitted as a by-product, or possibly emitted as a by-product, but may occur in concentrations that are below the FDL. The FDL of a by-product is the lowest concentration of the by-product that should be detectable through measurements, as defined in Method 320.

- If a F–GHG is consumed during testing, but emissions are not detected, the reporter must use one-half of the FDL for the concentration of that F–GHG in calculations.
- If a F–GHG is consumed during testing and detected intermittently during the test run, the reporter must use the measured concentration for the value of that F–GHG when available and use one-half of the FDL for the value when the F–GHG is not detected.
- If a F–GHG is not consumed during testing but is detected intermittently as a by-product gas, the reporter must use the measured concentration when available and use one-half of the FDL for the value when the F–GHG is not detected.
- If a F–GHG is an expected by-product as listed in Table I–17 to subpart I and is not detected during the test run, use one-half of the FDL for the value of that F–GHG.
- If a F–GHG is a possible by-product as listed in Table I–17 to subpart I and is not detected during the test run, then assume zero emissions for that F–GHG for the tested stack system.
- If a F–GHG is not used, and is not an expected or possible by-product of the stack system and is not detected, then assume zero emissions for that F–GHG for the tested stack system.

Under the stack testing option, reporters are required to achieve FDLs that are less than or equal to the maximum FDLs in Table I–10 of the regulatory textAlso since proposal, the maximum values for FDLs for stack testing have been increased by a factor of four. The rationale for these changes is discussed in Section II.B of this preamble.

Alternative stack test methods. We are finalizing the option for reporters to use an alternative stack test method (other than EPA Method 320 or ASTM D6348–03) to measure the concentration of each F–GHG in each stack provided that the method is validated using EPA Method 301 of 40 CFR part 63, appendix A (hereafter ''EPA Method 301''), and the EPA approves its use.

Under the promulgated approval process in 40 CFR 98.94(k), the reporter is required to notify the Administrator (or authorized representative) of the intent to use an alternative test method. The notification must include a test plan describing the alternative method and procedures, the range of test conditions over which the validation is intended to be applicable, and an alternative means of calculating the fab-level F–GHG emissions if the Administrator denies the use of the results of the alternative method. The reporter must validate the alternative method using EPA Method 301 and submit the results of the Method 301 validation process along with the notification of intention and a rationale for not using the specified method.

The Administrator will review and determine whether the validation of the proposed alternative method is adequate and issue an approval or disapproval of the alternative test plan within 120 days of the reporter submitting the notification and test plan. The reporter is required to respond to any of the Administrator's questions on the test plan before obtaining approval and to take into account the Administrator's comments on the test plan in conducting the test using the alternative method. The reporter must respond to the Administrator's questions or request for additional information on the plan during the 120-day review period and the Administrator's questions or request for additional information will not extend that review period. Therefore, it is the reporter's obligation to respond in a timely manner. If an alternative test plan is not approved within the 120-day period and the reporter still opts to use that method, a reporter must recommence the process to have an alternative test method approved starting with the notification of intent to use an alternative test method.

The reporter must report the results of stack testing using the alternative method and procedure specified in the approved test plan. The report must include all methods, calculations and data used to determine F–GHG emissions. The Administrator will review the results of the test using the alternative methods and procedure and then approve or deny the use of the results of the alternative test method and procedure no later than 120 days after they are submitted to the EPA. During this 120-day period, the reporter is required to respond to any of the Administrator's questions on the test report before obtaining approval of the final test results using the alternative method. If the Administrator finds reasonable grounds to dispute the results obtained by the alternative method, the Administrator may require the use of the method specified in subpart I instead of the alternative method.

Once the Administrator approves the use of the alternative method, that method may be used by any other facility for the same F–GHGs and types

of stack systems, if the approved conditions apply to that facility. In granting approval, the Administrator will limit the range of test conditions and emission characteristics for which that approval is granted and under which the alternative method may be used without seeking further approval. The Administrator will specify those limitations, if any, in the approval of the alternative method.

Accounting for Abatement System Downtime. To account for the effect of POU abatement system downtime in estimating emissions using the stack testing method, reporters must record the abatement system downtime in each fab during testing and for the entire reporting year. Using the downtime measured during testing, reporters are required to correct the measured emission factors to assume no abatement system downtime (i.e., 100 percent abatement system uptime). The downtime measured over the entire reporting year is then used to calculate the excess F–GHG emissions that occur as a result of abatement system downtime events.

The reporter is required to measure the amount of POU abatement system downtime (in minutes) during the emission tests for any tools that are vented to the stacks being tested. For example, if five POU abatement systems are down for times of 10, 15, 25, 30, and 40 minutes during an 8-hour test, the total POU system downtime would be 120 minutes, or 5.0 percent of the total possible abatement system and tool operating time for the five tools (2,400 minutes). Using these data and the average DRE for the POU abatement systems, the emission factor measured during the testing is adjusted to an emission factor representing POU abatement systems with 100 percent uptime (zero percent downtime). The DRE for the abatement systems may be a default DRE or a site-specific measured DRE; however, the reporter must use a site-specific measured DRE if the abatement system is not specifically designed for F–GHG abatement.

The downtime measured over the year is used to determine an average uptime factor that is an aggregate for all abatement systems in the fab, and calculated using Equation I–23 in subpart I. Abatement system downtime is considered any time during which the abatement system was not operating according to the site maintenance plan for abatement systems. The reporter must determine the sum of the downtime for all abatement systems during the year, and divide this sum by the sum of the possible annual operating time for each of the tools connected to those abatement systems in the fab to determine the downtime fraction. The downtime fraction is the decimal fraction of operating time that the abatement systems were not operating according to the site maintenance plan for abatement systems. The average uptime factor used in the emissions calculations is equal to 1 minus the downtime fraction.

The total possible annual tool operating time is calculated by assuming that tools that were installed for the whole of the reporting year were operated for the entire year. The total possible tool operating time is prorated to account for the days in which a tool was not installed; any partial day that a tool was installed is treated as a full day of tool operation. For an abatement system with more than one connected tool, the tool operating time is equivalent to a full year if at least one tool was installed at all times throughout the year. The reporter has the option to account for time that tools are idle and no gas is flowing through the tools to the abatement system.

It is important to note that the calculation of the uptime factor is different when a reporter is using the promulgated stack testing method than when the reporter is using the default gas utilization rate and by-product formation rate method. In the stack testing method, uptime is not determined for each gas and process type combination, as it is under the final revisions to the default emission factor method. Instead, the uptime factor is based on an aggregate for all tools and gases in the fab for which the stack testing method is being used. In contrast, the default gas utilization rates and by-product formation rates are based on ''unabated emissions'' of each gas, and the uptime factor needs to be determined for each gas and process type combination to determine the portion of emissions that have been abated. ''Unabated emissions'' are gas streams containing F–GHG or N_2O which has exited the process, but which has not yet been introduced into an abatement system to reduce the mass of F–GHG or N_2O in the stream. If the emissions from the process are not routed to an abatement system, or are routed to an abatement device that is not in an operation mode, unabated emissions are those F–GHG or N_2O released to the atmosphere.

To calculate an unabated emission factor during periods of downtime in the stack testing method, the reporter must divide the abated emission factor by $(1—d_{if})$, where d_{if} is the average weighted fraction of F–GHG is destroyed or removed in the POU abatement system(s) in the fab. The factor d_{if} is calculated using Equation I–24 in subpart I, based on the gas consumption and destruction and removal efficiency (DRE) for the abatement system(s) for each gas and process type combination.

When calculating annual emissions, the reporter must continue to collect abatement system downtime data and calculate the fraction of abatement system uptime for the fab. Excess emissions from abatement system downtime events are determined based on the actual amount of downtime as a percent of the total annual abatement system operating time for the reporting year. For example, if a fab had 2.0 percent downtime for the year, then the unabated emission factor is applied to 2.0 percent of the gas consumption for the year to calculate the excess emissions. The abated emission factor is applied to the other 98 percent of gas consumption for the fab. The excess emissions and the abated emissions are added together to determine the total annual emission from the fab.

Calculating an average fab-specific emission factor. The reporter must calculate an average fab-specific emission factor using Equation I–19 in subpart I for each input F–GHG and Equation I–20 for each by-product F–GHG, based on the testing results (average kg/hr) and the F–GHG gas consumption (average kg/hr). The fab-specific emission factor for each input F–GHG and each F–GHG formed as a by-product takes into account the mass emission rate, the gas consumption, the abatement system uptime, and the F–GHG destroyed or removed from the abatement systems. The fab-specific emission factor for input gases is in units of kilograms (kg) gas emitted per kg of the same gas consumed (kg/kg).

For gases generated as by-products, the fab-specific emission factor is the mass of the by-product emitted divided by the summed masses of all the F–GHGs consumed, as presented in Equation I–20. This equation applies to those F–GHGs that are emitted as by-products and is not used for gases consumed as input gases.

The reporter must calculate annual emissions for each F–GHG by-product gas as the product of the fab-specific emission factor and the total annual amount of F–GHG consumed, corrected for any POU abatement system downtime as described in this section of the preamble.

In some cases, emissions of a particular F–GHG input gas may exceed consumption of that gas because the F–GHG is generated as a by-product of the

other input gases. This is often the case for CF_4. In these cases, the reporter must use 1.0 as the input F–GHG emission factor and treat the remainder of that F–GHG's emissions as a by-product of the other input gases. The reporter must use Equation I–20 to calculate the emission factor for the by-product emissions. For example, if during the testing, the fab consumed 100 kg of an F–GHG, but the stack testing measured 300 kg of that gas, the reporter must assign 100 kg of that F–GHG as an input gas used in proposed Equation I–19, and 200 kg of that gas as a by-product gas used in proposed Equation I–20. In this instance, the denominator in Equation I–20 includes the consumption of all other F–GHGs, with the exception of the F–GHG being included in the numerator. This treatment of the denominator reflects the fact that we are assuming that the F–GHG in the numerator is formed as a by-product from all other F–GHGs, while the emissions from the actual consumption of that F–GHG as an input are being accounted by Equation I–19. For calculating emissions from an F–GHG with an input emission factor equal to 1.0 and with a by-product emission factor, the input F–GHG emissions are assumed to equal consumption of that F–GHG, and the by-product emissions are determined by multiplying the by-product emission factor by the sum of the consumption of all F–GHGs excluding the by-product F–GHG.

Testing frequency. The EPA is finalizing in 40 CFR 98.94(j)(5)(i) the requirement for annual testing of each stack system and annual calculation of emission factors, excluding those low-emitting stack systems that are exempt from testing. However, to offer flexibility, the EPA is also promulgating in 40 CFR 98.94(j)(5)(ii) an option to allow reduced testing frequency based on variability in measured emission factors. If the reporter meets criteria for low measured variability in emission factors calculated from the test results, then testing frequency may be reduced to every 5 years instead of annually. Under this option, a reporter must conduct a minimum of three emission tests for each non-exempt stack, with at least 2 months between the tests on a single stack system. All tests may be done in one year, or the reporter may use three annual tests for this analysis. If the relative standard deviation (RSD) of the emission factors calculated from each of the three tests, expressed as CO_2e for all F–GHG combined, is less than or equal to 15 percent, and the RSD of the emission factors for each single F–GHG that individually accounts for 5 percent or more of CO_2e emissions is less than 20 percent, the facility may use the averages of the three emission factors for each F–GHG for annual reporting for that year and the next 4 years without testing, unless conditions change that affect the emission factors and trigger retesting, as specified in 40 CFR 98.94(j)(8) and described in this section of the preamble. If the variability among the three tests does not meet these criteria, then the facility must use the emission factors from the most recent testing for reporting for that year and continue the annual testing. Facilities may repeat the RSD analysis each year using the previous three sets of data.

In addition, previously completed tests that were performed and verified according to EPA Method 320, ASTM D6348–03, or an alternative method validated using EPA Method 301 may be applied towards the three tests required under this option, as long as all three tests were completed no earlier than January 1, 2011 and they meet the final rule requirements for stack testing under 40 CFR 98.94(j). We are also allowing reporters to use previously completed tests that include minor deviations from the requirements for stack testing. However, the use of such data must be approved by the Administrator (or an authorized representative) on a case-by-case basis, according to the review procedure specified in 40 CFR 98.94(j)(7). This procedure is similar to that specified for review and approval of an alternative stack testing method in 40 CFR 98.94(k), but it does not require the use of EPA Method 301 to validate the prior test data. The EPA retains the right to not approve the use of data that do not meet the data quality requirements in 40 CFR 98.94(j)(7).

Reporters are required to conduct testing of each stack system that is not a low-emitting stack system, regardless of the results of the most recent stack tests, if certain changes take place in the reporters' annual consumption of F–GHGs or in the equipment and processes at the fab. Testing must be repeated to develop a new fab-specific emission factor if consumption of a specific input gas used during the emissions test changes by more than 10 percent of total annual gas consumption in CO_2e, relative to gas consumption in CO_2e for that gas during the year in which the most recent emissions test was conducted. For example, if use of a single gas goes from 25 percent of CO_2e to more than 35 percent of CO_2e, that would trigger the need for a new test. If there is a change in the reporter's use of an intermittent low-use F–GHG that was not used during the emissions test and not reflected in the fab-specific emission factor, such that it no longer meets the definition of intermittent low-use F–GHG (see ''Stack testing requirements'' in Section II.A.1 of this preamble), the reporter is required to re-test using that gas. Additionally, if there is: (1) A decrease by more than 10 percent in the fraction of tools with abatement systems, compared to the fraction of tools with abatement systems during the most recent emissions test; (2) a change in the wafer or substrate size used by the fab since the most recent emissions test; or (3) a change in a stack system that formerly met the criteria as a low-emitting stack system for not being subject to testing, such that it no longer meets those criteria, then the reporter is also required to re-test.

Finally, if a reporter is using a F–GHG that was not used during the emissions test, the reporter is required to conduct additional stack tests in that year during a period when that gas is being used to determine an emission factor for that gas. If a F–GHG is no longer used or is an intermittent low-use gas, re-testing is not required, and F–GHG emissions must be calculated according to the process for intermittent low-use gases.

As stacks are re-tested, reporters must update the fab-specific emission factors with the new data from those stacks, replacing the data from the earlier testing of the same stack. The reporters are also required to annually review the current data for determining which stacks were exempt from testing to ensure that the low-emitting stacks still qualify for exemption. If a stack no longer meets the criteria for exemption from testing as a low-emitting stack, it must be tested and the fab-specific emission factor must be recalculated including those data.

Finally, if a requirement to re-test stacks is triggered, the reporter must re-evaluate the RSD of the emission factors, including the most recent test results and the previous two test results, to determine if the fab still complies with the provisions that allow the fab to skip testing. If the fab does not meet those provisions, annual testing must resume and three stack tests must be completed and a new RSD analysis must be performed. Even if the fab meets those requirements to skip testing, annual testing still must resume no later than the fifth year after the original RSD analysis that was performed before the retesting requirement was triggered.

2. Revise the Default Gas Utilization Rates and By-Product Formation Rates for the Plasma Etch Process Category for Facilities That Manufacture Semiconductors

The EPA is amending the default plasma etch and chamber cleaning gas utilization rates and by-product formation rates and the requirements in 40 CFR 98.93(a)(2) for estimating F–GHG emissions from plasma etch processes at semiconductor manufacturing facilities. The EPA is not amending the default emission factors for other types of electronics manufacturing facilities.

First, the EPA is providing that all semiconductor manufacturing facilities, regardless of manufacturing capacity, have the option to calculate F–GHG emissions from the plasma etching process type using the appropriate default gas utilization rates and by-product formation rates provided in Tables I–3 and I–4 of subpart I. Under these final amendments, no electronics manufacturing facility has the option to determine and use recipe-specific gas utilization rates and by-product formation rates for the plasma etch process type. The EPA is removing the distinction between large and other semiconductor facilities, such that all semiconductor manufacturing facilities may use the default gas utilization rates and by-product formation rates, independent of facility size.

Second, we are revising the default emission factors for the plasma etch process type in Tables I–3 and I–4 of subpart I. The revised default emission factors are based on an expanded data set provided to the EPA by semiconductor manufacturing facilities after subpart I was originally promulgated in December 2010 in addition to data provided by commenters during the public comment period. The revised emission factors have been updated since proposal to account for the new data that were submitted during the public comment period, as discussed in Section II.B of this preamble. For more information regarding the revised by-product emission factor calculation methodology, please refer to ''Technical Support for Modifications to the Fluorinated Greenhouse Gas Emission Estimation Method Option for Semiconductor Facilities under Subpart I,'' Docket ID No. EPA–HQ–OAR–2011–0028.

Finally, as the EPA proposed, the EPA is combining the semiconductor wafer cleaning process type with the plasma etch process type; the amended rule does not have separate default emission factors for semiconductor wafer cleaning in the revised Table I–3 and I–4 of subpart I.

For the chamber clean process type, semiconductor manufacturing facilities must estimate emissions from chamber clean and plasma etch processes using the following four process types/sub-types: (1) Plasma etch/wafer cleaning process type; and (2) chamber cleaning process type, including (2a) in situ plasma chamber cleaning; (2b) remote plasma chamber cleaning; and (2c) in situ thermal chamber cleaning.

If gas utilization rates and by-product formation rates are not available for a gas/process combination in Tables I–3 or I–4 of subpart I, reporters must assume that the utilization and by-product formation rates are zero (i.e., assume that emissions of a gas equals consumption of that gas). This approach is consistent with the methodology in the current subpart I rule, except that we are removing the option for facilities to develop recipe-specific factors.

All other provisions related to the method using default gas utilization rates and by-product formation rates, such as the wafer size classes used for the default emission factors in Tables I–3 and I–4, remain the same. The only exception is that the default emission factors in Table I–4 that apply to 300 mm wafers also apply to 450 mm wafers. As more data (i.e., utilization and by-product formation rates) become available for the semiconductor manufacturing industry in the future, the EPA will consider adding new default emission factors to Tables I–3 and I–4 for new gas and process type/sub-type combinations, including adding any new default emission factors specifically for semiconductor manufacturing facilities using 450 mm wafers. However, for these final amendments, facilities using wafers greater than 300 mm diameter must use the same default emission factors as those using 300 mm wafers. Section II.A.12 of this preamble describes the process that EPA will follow for updating default emission factors as more information is collected from the electronics manufacturing industry.

3. Removing the Provisions for Using Recipe-Specific Gas Utilization Rates and By-Product Formation Rates for Facilities That Manufacture Electronics

The EPA is removing the provisions to use recipe-specific gas utilization rates and by-product formation rates in 40 CFR 98.93(a)(2)(ii)(A), (a)(3), and (a)(4), as proposed.

Although the EPA has deferred the mandatory use of recipe-specific gas utilization rates and by-product formation rates through the end of 2013 (76 FR 59542, September 27, 2011), as a result of these final amendments, no semiconductor manufacturing facility has the option to use the recipe-specific method or report those data elements after the end of 2013. In addition, we are removing the recipe-specific method as an option for other electronics manufacturing facilities.

No facilities have used the recipe-specific emission factor methods in 40 CFR 98.93(a)(2)(ii)(A), (a)(3), (a)(4), or (a)(6) for reporting emissions for 2011 or 2012. According to information the EPA has received from industry members, no facilities are known to be planning to use the recipe specific methods in 2013 for emissions reported in 2014. All comments received by the EPA supported removing the recipe specific method, and the EPA received no comments asking that this method be retained in Subpart I. However, reporters may still use the recipe-specific methods for estimating 2013 emissions reported in 2014. Following the January 1, 2014 effective date of this rule, reporters are required to select calculation methods to estimate emissions for 2014 reported in 2015, and thereafter, based on the options in these final amendments to subpart I.

Finally, we are revising 40 CFR 98.93(a)(6) to remove the option to develop recipe-specific gas utilization rates and by-product formation rates for F–GHG and process combinations for which no default emission factors are available. We are also revising 40 CFR 98.93(b)(1)(i) and (b)(2)(i) to remove the option to develop facility-specific N_2O emission factors. Under 40 CFR 98.93(a)(6), for gas and process combinations without default factors, facilities must assume that F–GHG emissions equal F–GHG consumption, which is equivalent to treating the utilization and by-product formation rates as both zero. Under the final revisions to 40 CFR 98.93(b), facilities must use default N_2O emission factors for both CVD processes and for the aggregate of all other manufacturing production processes, and do not have the option to develop facility-specific N_2O emission factors. EPA is not revising the current default N_2O emission factors in this final rule. The emission factor for CVD processes is 0.8 and the emission factor for the aggregate of all other manufacturing production processes is 1.0.

4. Applicability and Calculating Annual Manufacturing Capacity for Facilities That Manufacture Electronics

The EPA is revising the calculation to determine annual capacity for

electronics manufacturing facilities, which is used in the calculation to determine whether a facility meets the reporting threshold. First, we are revising Equation I–5 to clarify that reporters must sum the annual manufacturing across each fab to determine the annual manufacturing capacity of the facility. This is a change since proposal to reflect other changes in the rule that calculate emissions per fab. The EPA is replacing the phrase ''maximum designed substrate starts of a facility'' in Equation I–5 with the phrase ''maximum substrate starts of the fab,'' as proposed. Likewise, as proposed, we are replacing the definition in 40 CFR 98.98 of ''maximum designed substrate starts'' with that for ''maximum substrate starts,'' which is defined as ''the maximum quantity of substrates, expressed as surface area, that could be started each month during a reporting year based on the equipment installed in that fab and assuming that the installed equipment were fully utilized. Manufacturing equipment is considered installed when it is on the manufacturing floor and connected to required utilities.''

A reporter must continue to use Equation I–5, with these revisions, to determine the annual manufacturing capacity of the facility to determine if they meet the threshold for reporting under subpart I.

The final rule includes revised requirements, as proposed, in 40 CFR 98.96(a) and (b) to calculate and report the maximum annual capacity and the actual annual production, respectively, for each fab in the facility, and to clarify that the maximum capacity is based on the equipment on-site in the reporting year, assuming it is fully utilized, rather than the design capacity.

The changes do not affect the applicability of subpart I to any facility that is already reporting GHG emissions under subpart I. The mere fact that a facility that is already reporting would not meet the applicability test in 40 CFR 98.91 under the revised subpart I does not relieve its obligation to report. Facilities may cease reporting only if they meet the criteria in 40 CFR 98.2(i).

We are also removing the requirement, as proposed, that semiconductor manufacturing facilities calculate and report their F–GHG emissions based on the annual manufacturing capacity of the facility and the size of wafers that the facility is manufacturing. Subpart I currently distinguishes between ''large'' and ''other'' semiconductor facilities based on the calculated annual manufacturing capacity. Except as provided in the September 27, 2011 final rule titled ''Changes to Provisions for Electronics Manufacturing to Provide Flexibility in 2011 to 2013,'' subpart I requires ''large'' semiconductor facilities (facilities with an annual manufacturing capacity of greater than 10,500 m_2 of substrate) and those facilities that manufacture wafers greater than 300 mm in diameter to calculate emissions using recipe-specific utilization and by-product formation rates. As discussed in Sections II.A.1 through II.A.3 of this preamble, we are revising the calculation methodologies for semiconductor manufacturers. The calculation methods apply to all semiconductor manufacturers and there is no longer a need to distinguish ''large'' facilities based on manufacturing capacity.

5. Integrated Production and R&D Activities for Facilities That Manufacture Electronics

The EPA is finalizing provisions, as proposed, to allow all electronics manufacturing facilities covered by subpart I to report R&D emissions with their total facility emissions and to identify that emissions associated with R&D activities are included in their overall emissions estimates. We are also requiring facilities that report integrated R&D emissions to report an estimate of the range of the percentage of total emissions from their R&D activities as part of their annual report (40 CFR 98.96(x)), and to keep records documenting that determination (40 CFR 98.97(j)).

6. Accuracy and Precision of Monitoring Instrumentation for Facilities That Manufacture Electronics

The EPA is removing the requirements in 40 CFR 98.94(i) that all measuring devices meet an accuracy and precision of 1 percent of full scale or greater. Instead, as proposed, we are requiring electronics manufacturing facilities subject to subpart I to meet the existing General Provision calibration accuracy requirements in subpart A (40 CFR 98.3(i)). The calibration accuracy requirements for gas flow measurement devices are 5 percent, as specified in 40 CFR 98.3(i). Further, other measuring devices (e.g., weigh scales and thermometers) are required to be calibrated to an accuracy based on an applicable operating standard, including, but not limited to, device manufacturer's specifications and industry standards (40 CFR 98.3(i)(1)(i)).

7. Facility-Wide Gas Specific Heel Factor for Facilities That Manufacture Electronics

The EPA is amending, as proposed, the requirements in subpart I to clarify that recalculating the heel factor is only needed when the trigger point for a specific gas and cylinder type is changed, and not as a result of variation in the actual heel remaining in a cylinder. We are amending 40 CFR 98.94(b)(5) to clarify that a gas-specific heel factor must be recalculated when the facility executes a process change to modify the trigger point for a gas and container type that differs by more than 5 percent from the previously used trigger point for that gas and container type.

We are also clarifying, since proposal, that the facility is not required to estimate the fab-specific heel factor for F–GHGs or N_2O that are used in quantities of less than 50 kg in one reporting year and for which emissions are calculated as equal to consumption, or for any intermittent low-use F–GHG.

The EPA is also revising, as proposed, the ''exceptional circumstance'' criteria at 40 CFR 98.94(b)(4) with respect to small containers. Specifically, we are revising the criteria for an ''exceptional circumstance'' in 40 CFR 98.94(b)(4) from 20 percent of the original trigger point for change out to 50 percent for small cylinders. We are defining a small cylinder as a container that contains less than 9.08 kg (20 pounds) of gas. For large containers, the ''exceptional circumstance'' remains as a change out point that differs by 20 percent of the trigger point used to calculate the gas-specific heel factor. The revisions still require facilities to measure the heel in cases where the cylinder change out deviated from the established trigger point. For example, a small 15-pound cylinder with a 2 pound trigger point must still be measured, in lieu of using the established heel factor, if the difference in the change out point is greater than 1 pound. In this example, this 1 pound difference (based on the 50-percent criteria for an exceptional circumstance) represents less than 8 percent of the usable gas in the cylinder.

8. Apportioning Model Verification for Facilities That Manufacture Electronics

The EPA is amending the apportioning model verification requirements. First, the final amendments, as proposed, allow reporters the option to use direct measurements of gas consumption to avoid the need to develop an apportioning model, and to develop an apportioning factor for each process

type, sub-type, stack system, or fab using gas flow meters or weigh scales. The final amendments also retain the option to use an apportioning model and the verification requirements. Reporters opting to use the apportioning model must verify the model by comparing actual gas consumption to modeled gas consumption. The reporter must select for comparison the F–GHG that corresponds to the largest quantity, on a mass basis, of F–GHG used at the fab that has to be apportioned. Reporters may alternatively verify the model for two F–GHGs on an aggregate use basis if one of the gases selected is used in the largest quantity at each fab that is required to be apportioned. In this option, the predicted total mass consumed of the two gases combined must match the actual total mass consumed within the verification percent difference requirements for the apportioning model.

Second, where a facility opts to develop and use an apportioning model, we are revising, as proposed, the verification standard to increase the allowable difference between the actual and modeled gas consumption from a maximum 5 percent difference to a maximum of 20 percent difference.

We are finalizing changes, as proposed, to allow facilities to select a period of the reporting year when the fab is at a ''representative operating level,'' as defined in 40 CFR 98.98, for the model verification, instead of at a minimum percent of design capacity, or instead of at the highest 30-day average utilization. Under these final amendments, the representative period must still be at least 30 days, but we are clarifying that it can be up to the whole calendar reporting year in duration.

9. Calculating N_2O Emissions for Facilities That Manufacture Electronics

The EPA is revising the language for calculating N_2O emissions in 40 CFR 98.93(b) to require reporting at the fab level, as proposed. We are finalizing, as proposed, the requirement that facilities must only use the default N_2O utilization factors in Table I–8 of subpart I, and removing the option to measure and use facility-specific N_2O emission factors. However, the EPA is not revising the default factors of 0.8 for CVD processes and 1.0 for all other N_2O-using manufacturing processes in the current Table I–8 of subpart I. The reasons for not adopting the default N_2O emission factors that were proposed are described in section II.B of this preamble.

The EPA is revising 40 CFR 98.93(b), as proposed, to clarify that facilities must report two N_2O emission values for each fab at a facility: one for the aggregate of all CVD processes and one for the aggregate of all other N_2O using manufacturing processes. We are finalizing similar changes to the reporting requirements in 40 CFR 98.96(c) for consistency and clarification.

10. Abatement System Destruction and Removal Efficiency (DRE) for Facilities That Manufacture Electronics

The EPA is revising provisions for directly measuring abatement system DRE, and the basis for determining average DRE values for groups of similar abatement systems. These amendments apply to all electronics manufacturers. All reporters covered under subpart I still have the option of using either default DRE factors or a measured DRE value to calculate abated emissions.

We are finalizing the option, as proposed, to allow reporters to establish a measured DRE value for gas and process type combinations, rather than for each abatement system or ''class'' of abatement systems. Reporters may measure the DRE for a gas and process type combination in which F–GHG and N_2O are used in tools with abatement systems and for which abated emissions are calculated. Reporters may use a combination of measured and default DRE values; however, if a reporter develops a measured DRE value for abatement systems for a specific gas and process type combination for a fab, the resulting measured DRE must be used for that gas and process type combination and a default DRE factor cannot be used for that fab. In addition, the default DRE values may only be used for abatement systems specifically designed for F–GHG or N_2O abatement. If a reporter elects to claim abatement for a system that is not specifically designed for F–GHG or N_2O abatement, they must use a measured site-specific DRE for that system.

We are also amending subpart I to allow reporters, as proposed, to use methods adapted from the 2009 ISMI Guideline tracer release/FTIR monitoring approach for determining abatement system DRE (hereafter, the ''2009 ISMI Guideline'') [2] and also an alternative method to locate sampling sites. These alternatives are included in Appendix A to subpart I. We are also promulgating, as proposed, provisions that allow facilities to use an adaptation of Section 8.1 of EPA Method 7E at 40 CFR part 60, appendix A–4 as an alternative to determine whether the injected tracer is well mixed in the duct system or is stratified (i.e., poorly mixed), and to adjust the sampling if it is stratified. The concentration of the tracer must be measured at three traverse points at 16.7, 50.0, and 83.3 percent of the diameter of the duct and must be sampled for a minimum of twice the system response time. If the tracer gas concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±5.0 percent of the mean concentration, the gas stream may be considered un-stratified and the facility is allowed collect samples from a single point that most closely matches the mean. If the 5.0 percent criterion is not met, but the concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±10.0 percent of the mean, a facility may take samples from two points and use the average of the two measurements. The two points must be spaced at 16.7, 50.0, or 83.3 percent of the line. If the concentration at each traverse point differs from the mean concentration for all traverse points by more than ±10.0 percent of the mean but less than ±20.0 percent, the facility must take samples from three points at 16.7, 50.0, and 83.3 percent of the measurement line and use the average of the three measurements. If the gas stream is found to be stratified because the ±20.0 percent criterion for a three-point test is not met, the facility must locate and take samples from traverse points for the test in accordance with Sections 11.2 and 11.3 of EPA Method 1 at 40 CFR part 60, appendix A–1. This finalized protocol is an adaptation of the protocol in Section 8.1.2 of EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure), in 40 CFR part 60, Appendix A–4.

In addition, we are also allowing reporters, as proposed, to request approval to use an alternative sampling and analysis method to measure abatement system DRE that is not included in subpart I, provided the reporter follows the process to obtain the Administrator's approval specified in 40 CFR 98.94(k). The approval process is the same process used to obtain the Administrator's approval to use an alternative stack testing method (see ''Alternative stack test methods'' in Section II.A.1 of this preamble).

We are amending the random sampling abatement system testing

[2] Benaway, B., Hall, S., Laush, C., Ridgeway, R., Sherer, M., & Trammell, S. (2009). ''Guideline for Environmental Characterization of Semiconductor Process Equipment—Revision 2'', TT#06124825B–ENG, International SEMATECH Manufacturing Initiative (ISMI), December 2009, Available at: *http://www.sematech.org/docubase/document/4825beng.pdf.*

program (RSASTP), as proposed, to reduce the amount of testing that must be performed by an individual facility. These final amendments require that facilities test 10 percent of systems annually over a 2-year period (20 percent total) to set a baseline DRE for the given gas and process type combination. The systems must be randomly selected. A facility may test 20 percent of abatement systems in the first year. Until the facility measures 20 percent of abatement systems for a gas and process type combination (e.g., for calculating emissions in the first year if they test only 10 percent of systems per year), they must use the default DRE factors to calculate emissions. For every 3-year period after, facilities are required to randomly select and test 15 percent of the systems to validate the site-specific DRE. The reporter may opt to test 15 percent of the systems in the first year of the 3-year period, but must test at least 5 percent of the systems each year until 15 percent are tested.

If testing of a particular randomly selected abatement system is disruptive to production, the reporter may replace that system with another randomly selected system and return the other to the sampling pool for subsequent testing. We are finalizing the requirement that a system cannot be returned to the subsequent testing pool for more than three consecutive selections and must be tested on the third selection. We are also allowing a reporter to specifically include in one of the next two sampling years a system that could not be tested when it was first selected so that the reporter can plan for the testing of that system when it will be less disruptive.

We are finalizing the requirement, as proposed, that the average DRE for each gas and process type combination must be calculated first as the arithmetic mean of the first 2 years of measurements. Beginning in the third year of testing, the average DRE must be the arithmetic mean of all test results for that gas and process type combination, until the facility tests at least 30 percent of all systems for each gas and process combination. After testing at least 30 percent of all systems for a gas and process combination, the facility must use the arithmetic mean of the most recent 30 percent of systems tested as the average DRE in the emissions calculations.

To account for measurements that may be affected by improper maintenance or operation of the abatement systems during a DRE measurement, the measured DRE value must be used as follows: (1) Where the DRE of some abatement units is below the design and default DRE, and the abatement system is installed, operated, and maintained in accordance with the site maintenance plan for abatement systems, the data from the low DRE test must be included in calculating the fab-specific DREs; (2) If proper maintenance and operation procedures have not been not followed, then the facility must implement the appropriate operational change or system maintenance (per the site maintenance plan for abatement systems), and retest that device within the same reporting year. In this case, a reporter is not required to include in the average DRE calculation the DRE result from the device for which proper maintenance and operation procedures were not followed. As an alternative, instead of retesting that device within the reporting year, the reporter may use the measured DRE value in calculating the average DRE for the reporting year, and then include the same device in the next year's abatement system testing in addition to the testing of randomly selected devices for that next reporting year. Regardless of whether or not the reporter uses the low DRE value in calculating the average measured DRE, the reporter must count the period during which the proper maintenance and operation procedures were not being followed toward that abatement system's downtime for the year for the purposes of calculating emissions.

For reporters who do not measure facility-specific DRE values, we are also allowing electronics manufacturing facilities to use a default DRE for abatement systems that are specifically designed for F–GHG or N_2O abatement (as applicable) and that are operated and maintained according to the facility's abatement system site maintenance plan that is based on the abatement system(s) manufacturer's recommendations and specifications for installation, operation, and maintenance. For semiconductor manufacturing facilities, we are revising and expanding the available DRE default values that may be used to calculate emissions. The revised default DREs for semiconductor manufacturing facilities are included in Table I–16. We are not revising or expanding default DRE factors for other electronics manufacturers (MEMS, LCDs, and PV cells); no changes to these DRE factors were proposed. Facilities manufacturing MEMS, LCDs, and PV cells must use the 60 percent default DRE if they do not develop facility-specific DRE values and elect to account for abatement system DRE in their reported emissions.

We are revising the default DRE factors for semiconductors since proposal to reflect the results of the EPA's analysis of DRE test data for specific gas and process type combinations, which includes data that were submitted to the EPA during the comment period. The final default DRE factors also reflect a change since proposal in the statistical method used to calculate the default DRE factors as a result of public comments. The change in the method and EPA's rationale for adopting the different method is discussed in more detail in section II.B.5 of this preamble. The revised default DRE factors for the gas and process type combinations for semiconductor manufacturing are shown in Table I–16 of Subpart I. The EPA will add new or revised default DRE factors when appropriate data become available in the future. See Section II.A.12 of this preamble for the process for updating default emission factors and default DRE factors as more data are collected for the semiconductor manufacturing industry.

In order to ensure that the abatement systems used are performing in a way that meets the default DRE or the measured DRE, we are requiring, as proposed, that facilities certify that abatement systems are properly installed, operated, and maintained according to the site maintenance plan for abatement systems (40 CFR 98.97(d)(9)). The site maintenance plan for abatement systems must define the required operation and maintenance procedures for each type of abatement system used at the facility, and must include corrective action procedures for when an abatement unit is not operating properly. The site maintenance plan must be based on the manufacturer's recommendations and specifications for installation, operation, and maintenance, where available. The site maintenance plan for abatement systems must also include documentation where the operation and maintenance deviate from the manufacturer's specifications, including an explanation of how the deviations have a positive or neutral effect on the performance or destruction or removal efficiency of the abatement system. For example, a reporter may include documentation of more frequent maintenance checks or tighter operating parameters that optimize system performance. The site maintenance plan for abatement systems must be kept as part of the GHG monitoring plan required by 40 CFR 98.3(g)(5).

We are also specifying that if the manufacturer's recommendations and specifications for installation, operation, and maintenance are not available (e.g., for older fabs that want to claim abatement in their reported emissions), then facilities may not use the default DRE factors found in Table I–16 for

those abatement systems, but do have the option to properly measure site-specific DREs following the requirements of 40 CFR 98.94(f)(4). Facilities also have the option to report their annual emissions without accounting for abatement. This is a change since proposal, and the rationale for this change is discussed in more detail in section II.B of this preamble.

Furthermore, we are also requiring that facilities using the default emission factors who elect to claim abatement for reporting purposes and elect to use the default DRE values must also certify that the abatement systems are specifically designed for F–GHG abatement (or N_2O abatement, as appropriate) in addition to the requirement that the manufacturer's recommendations and specifications for installation, operation, and maintenance be incorporated into the site maintenance plan. In response to public comments, we have revised the definition of ''abatement system'' since proposal to be clear that we meant a device or equipment that is designed to destroy or remove F–GHGs (or N_2O, as appropriate) in exhaust streams from one or more electronics manufacturing production processes, or for which a site-specific DRE has been measured according to 40 CFR 98.94(f). We are also revising 40 CFR 98.94(f), in response to comments since proposal, to clarify that if facilities elect to use the stack test alternative in 40 CFR 98.93(i) and elect to account for abatement, they must certify that the system is designed to abate F–GHGs, or they must measure a site-specific DRE according to 40 CFR 98.94(f). We have also included a requirement that facilities using the stack test alternative must certify that that all abatement systems that are designed to abate F–GHGs or for which a site-specific DRE has been measured are fully accounted for when calculating annual emissions and accounting for excess emissions from downtime using the methods in 40 CFR 98.93(i)(3). If an abatement system is not designed to abate F–GHG, then reporters may elect to not account for any incidental F–GHG abatement from that system under the stack testing alternative.

11. Abatement System Uptime for Facilities That Manufacture Electronics

The EPA is revising the methods used to calculate abatement system uptime. For facilities that are using the default gas utilization rates and by-product formation rates, we are amending 40 CFR 98.93(g) to allow reporters to calculate the uptime of all the abatement systems for each combination of input gas or by-product gas and each process type or sub-type combination, using the same process categories in which F–GHG use and emissions are calculated. We are revising Equation I–15 to calculate the average uptime factor for all abatement system connected to process tools for a given input gas and process type or subtype. The same uptime factor will be used for both input gases and the associated by-product gases for that input gas and process combination. However, since proposal we have removed the separate equations for uptime of abatement systems applied to input gases and by-product gases and the final rule has only a single equation for uptime applicable to all gases. The reason for this change since proposal is discussed in more detail in Section II.B of this preamble.

Reporters are required, as proposed, to determine the average abatement system uptime factor for a given gas/process type or sub-type combination by: (1) Calculating the total time that the abatement system connected to process tools in the fab is not operating within site maintenance plan specifications as a fraction of the total time in which the abatement system has at least one associated tool in operation during the reporting year for each gas/process type combination; and (2) by subtracting this fraction from 1.0 to calculate the uptime fraction. For determining the amount of tool operating time, reporters may assume that tools that were installed for the entire reporting year were operated for 525,600 minutes per year. For tools that were installed or uninstalled during the year, reporters must prorate the operating time to account for the days in which the tool was not installed; any partial day that a tool was installed must be treated as a full day (1,440 minutes) of tool operation. If a tool is ''idle'' with no gas flowing through it to the abatement system, the reporter has the option to count only the time that the tool has gas flowing through it for purposes of determining the tool operating time. For an abatement system that has more than one connected tool, the tool operating time must be considered to be equivalent to a full year if at least one tool was installed and operating at all times throughout the year.

12. Triennial Technology Report for Semiconductor Manufacturing

We are requiring certain semiconductor manufacturing facilities, as proposed, to provide a report to the EPA every 3 years, beginning in 2017, that addresses technology and process changes at the facility that could affect GHG emissions. The report must address how technology and processes have changed in the industry over the previous 3 years and the extent to which any of the identified changes are likely to have affected the GHG emissions characteristics (i.e., the identity, amount, frequency, concentration, or other characteristics related to GHG emissions) of semiconductor manufacturing processes in such a way that the default gas utilization rates and by-product formation rates and/or default DRE factors in subpart I may need to be updated or augmented. The EPA plans to have reporters submit this report using the Electronic Greenhouse Gas Reporting Tool (e-GGRT) system.

We are requiring, as proposed, that the first 3-year report be due with the annual GHG emissions report submitted in 2017. Only semiconductor manufacturing facilities subject to subpart I and with emissions from subpart I processes greater than 40,000 $mtCO_2e$ per year CO_2e are required to submit the report. The requirement to submit the first report in 2017 is based on the facility's emissions in 2015 (which would be reported in 2016), and the requirement to submit subsequent reports is based on emissions in the most recently submitted annual GHG report. For example, any facility that reported GHG emissions from the subpart I source category of greater than 40,000 $mtCO_2e$ for reporting year 2015 must submit the 3-year report due in 2017. To reduce burden, we are allowing the option for multiple semiconductor manufacturing facilities (regardless of whether they are owned by the same parent company) to submit a single consolidated 3-year report. Facilities with reported emissions at or below 40,000 $mtCO_2e$ per year may voluntarily prepare and submit a report. Facilities that are not subject to reporting under subpart I based on the applicability criteria in subparts A and I are not required to submit a 3-year report.

The 3-year report must include, as proposed, the following: (1) Whether and how the gases and technologies used in 200 mm and 300 mm wafer semiconductor manufacturing in the United States have changed and whether any of the identified changes are likely to have affected the emissions characteristics of semiconductor manufacturing processes in such a way that the default gas utilization rates and by-product formation rates or default DRE factors may need to be updated; (2) The effect of the implementation of new products, process technologies, and/or finer line width processes in 200 mm and 300 mm technologies, the introduction of new tool platforms and process chambers, and the introduction of new processes on previously tested

platforms or process chambers; (3) The status of implementing 450 mm wafer technology and the potential need to create or update gas utilization rates and by-product formation rates compared to 300 mm technology; and (4) The submission of any gas utilization rates and by-product formation rate or DRE data that have been collected in the previous 3 years that support the changes or continuities in semiconductor manufacturing processes described in the report.

If the report indicates that the emissions characteristics of semiconductor manufacturing processes may have changed (i.e., the identity, amount, frequency, or concentration), the report must include a data gathering and analysis plan describing the testing of tools to determine the potential effect on current gas utilization rates and by-product formation rates and DRE values under the new conditions, and a planned analysis of the effect on overall facility emissions using a representative gas-use profile for a 200 mm, 300 mm, or 450 mm fab (depending on which technology is under consideration). The EPA will review the reports received and determine whether it is necessary to update the default gas utilization rates and by-product formation rates in Tables I–3, I–4, I–11, and I–12, and default DREs in I–16 based on the following: (1) Whether the revised default gas utilization rates and by-product formation rates and DREs would result in a projected shift in emissions of 10 percent or greater for each gas and process type or process subtype; (2) Whether new platforms, process chambers, processes, or facilities that are not captured in current default gas utilization rates and by-product formation rates and DRE values should be included in revised values; and (3) Whether new data are available that would expand the existing data set to include new gases, tools, or processes not included in the existing data set (i.e. gases, tools, or processes for which no data are currently available).

The EPA will review the report(s) within 120 days and notify the facilities that submitted the report(s) whether the Agency determined it was appropriate to update the default emission factors and/or DRE values. If the EPA determines it is necessary to update the default emission factors and/or DRE values, those facilities would then have 180 days following the date they receive notice of the determination to execute the data collection and analysis plan described in the report and submit those data to the EPA. The EPA will then determine whether to issue a proposal to amend the rule to update the default emission factors and/or DRE values using the newly submitted data.

13. Final Amendments to Reporting and Recordkeeping Requirements

In this action, the EPA is finalizing several changes (additions as well as revisions) to the data reporting and recordkeeping requirements in subpart I. Table 2 of this preamble summarizes the changes to the reporting elements, and notes those elements that were changed since proposal.

TABLE 2—CHANGES TO REPORTING REQUIREMENTS

Data element	Change/revision	Original citation	New or revised citation
Annual manufacturing capacity of facility as determined in Equation I–5.	Revised to report manufacturing capacity on a fab basis, rather than facility [1].	98.96(a)	NA.
The diameter of wafers manufactured at the facility.	Revised to report wafer size on a fab basis, rather than facility [1]	98.96(b)	NA.
Annual emissions of each F–GHG emitted from each process type for which your facility is required to calculate emissions as calculated in Equations I–6 and I–7.	Revised to apply only when default gas utilization rate and by-product formation rate procedures in 40 CFR 98.93(a) are used to calculate emissions. Revised so that requirement applies to "fab" instead of facility.	98.96(c)(1)	NA.
Annual emissions of each F–GHG emitted from each individual recipe (including those in a set of similar recipes) or process sub-type.	Removed requirement to report emissions by individual recipe (including those in a set of similar recipes). Revised so that requirement applies to "fab" instead of facility.	98.96(c)(2)	NA.
Emissions of N_2O emitted from each chemical vapor deposition process and from other N_2O using manufacturing processes as calculated in Equation I–10.	Revised to clarify that facilities report N_2O emitted from the aggregate of all chamber cleaning processes and from the aggregate of other N_2O-using manufacturing processes. Revised so that requirement applies to "fab" instead of facility.	98.96(c)(3)	NA.
Annual emissions of each F–GHG emitted from each fab when you use the procedures specified in 40 CFR 98.93(i).	Added reporting requirement in conjunction with the stack testing option.	NA	98.96(c)(5).
Data elements reported when you use factors for F–GHG process utilization and by-product formation rates other than the defaults provided in Tables I–3, I–4, I–5, I–6, and I–7 to this subpart and/or N_2O utilization factors other than the defaults provided in Table I–8 to subpart I.	Removed and reserved all of 98.96(f) because of changes to remove the use of recipe-specific gas utilization rates and by-product formation rates.	98.96(f)	NA.
Annual gas consumption for each F–GHG and N_2O as calculated in Equation I–11 of this subpart, including where your facility used less than 50 kg of a particular F–GHG or N_2O during the reporting year. For all F–GHGs and N_2O used at your facility for which you have not calculated emissions using Equations I–6, I–7, I–8, I–9, and I–10, the chemical name of the GHG used, the annual consumption of the gas, and a brief description of its use.	Changed to recordkeeping requirement. Revised so that requirement applies to "fab" instead of facility. Added applicable equation references for the stack testing option.	98.96(g)	98.97(k).

TABLE 2—CHANGES TO REPORTING REQUIREMENTS—Continued

Data element	Change/revision	Original citation	New or revised citation
All inputs used to calculate gas consumption in Equation I–11 for each F–GHG and N_2O used.	Changed to recordkeeping requirement	98.96(h)	98.97(k)(1).
Disbursements for each F–GHG and N_2O during the reporting year, as calculated using Equation I–12.	Changed to recordkeeping requirement	98.96(i)	98.97(n).
All inputs used to calculate disbursements for each F–GHG and N_2O used in Equation I–12 including all facility-wide gas-specific heel factors used for each F–GHG and N_2O.	Change to recordkeeping requirement	98.96(j)	98.97(n).
Annual amount of each F–GHG consumed for each recipe, process sub-type, or process type, as appropriate, and the annual amount of N_2O consumed for each chemical vapor deposition and other electronics manufacturing production processes, as calculated using Equation I–13.	Changed to recordkeeping requirement. Removed "recipe-specific" requirements. Revised to refer to the annual amount of N_2O consumed for the aggregate of all CVD processes and for the aggregate of all other electronics manufacturing production processes [1].	98.96(k)	98.97(m).
All apportioning factors used to apportion F–GHG and N_2O consumption.	Changed to recordkeeping requirement	98.96(l)	98.97(c)(1).
Identification of the quantifiable metric used in your facility-specific engineering model to apportion gas consumption, and an indication if direct measurements were used in addition to, or instead of, a quantifiable metric.	Corrected citation and revised to indicate whether direct measurements used.	98.96(m)(i)	98.96(m)(1).
Start and end dates selected under 40 CFR 98.94(c)(2)(i).	Corrected citation	98.96(m)(ii)	98.96(m)(2).
Certification that the gases you selected under 40 CFR 98.94(c)(2)(ii) correspond to the largest quantities consumed on a mass basis, at your facility in the reporting year for the plasma etching process type and the chamber cleaning process type.	Corrected citation	98.96(m)(iii)	98.96(m)(3).
The result of the calculation comparing the actual and modeled gas consumption under 40 CFR 98.94(c)(2)(iii).	Corrected citation and revised to refer to modeled gas consumption under 40 CFR 98.94(c)(2)(iii) and (iv), as applicable.	98.96(m)(iv)	98.96(m)(4).
If you are required to apportion F–GHG consumption between fabs, certification that the gases you selected under 40 CFR 98.94(c)(2)(ii) correspond to the largest quantities consumed on a mass basis, of F–GHG used at your facility during the reporting year for which you are required to apportion.	Added requirement	NA	98.96(m)(5).
Fraction of each F–GHG or N_2O fed into recipe, process sub-type, or process type that is fed into tools connected to abatement systems.	Moved to recordkeeping, and removed recipe-specific references.	98.96(n)	98.97(o).
Fraction of each F–GHG or N_2O destroyed or removed in abatement systems connected to process tools where recipe, process sub-type, or process type j is used, as well as all inputs and calculations used to determine the inputs for Equation I–14.	Moved to recordkeeping, removed recipe-specific references, and revised to apply to the stack testing option.	98.96(o)	98.97(p).

TABLE 2—CHANGES TO REPORTING REQUIREMENTS—Continued

Data element	Change/revision	Original citation	New or revised citation
Inventory and description of all abatement systems through which F–GHGs or N_2O flow at your facility, including the number of systems of each manufacturer, model numbers, manufacturer claimed F–GHG and N_2O destruction or removal efficiencies, if any, and records of destruction or removal efficiency measurements over their in-use lives. The inventory of abatement systems must describe the tools with model numbers and the recipe(s), process sub-type, or process type for which these systems treat exhaust.	Revised the inventory to include only those systems for which the facility is claiming F–GHG or N_2O destruction or removal. Revised to report only (1) the number of devices controlling emissions for each process type, for each gas used in that process for which control credit is being taken; and (2) the basis of the DRE being used (default or site specific testing) for each process type and for each gas.		
	Revised to not require reporting the model number of the tools associated with each abatement system, and to remove the recipe-specific references.	98.96(p)	NA.
Certification that each abatement system is installed, maintained, and operated according to manufacturer recommendations and specifications. All inputs to abatement system uptime calculations, the default or measured DRE used for each abatement system, and the description of the calculations and inputs used to calculate class averages for measured DRE values.	The certification is revised to include that all systems are installed, maintained, and operated according to the site operation and maintenance plan for abatement systems, including documentation where the process deviates from the manufacturer's recommendations and specifications, and an explanation of why the deviation does not have a negative effect on system performance [1].	98.96(q)	98.97(d)
	All inputs to abatement system uptime calculations, the default or measured DRE used for each abatement system, and the description of the calculations and inputs used to calculate class averages for measured DRE values moved to recordkeeping in 98.97(d). In place of reporting the information and data on uptime and DRE calculations for abatement systems, the reporter must calculate and report an effective fab-wide DRE, as required in 98.96(r).		
Inputs to the F–HTF mass balance equation, Equation I–16, for each F–HTF.	Changed to recordkeeping	98.96(r)	98.97(r).
An effective fab-wide DRE calculated using Equation I–26, I–27, and I–28, as appropriate.	Added requirement [1]	NA	98.96(r).
Estimates of missing data where missing data procedures were used to estimate inputs into the F–HTF mass balance equation under 40 CFR 98.95(b).	Changed to recordkeeping	98.96(s)	98.97(s).
A brief description of each "best available monitoring method" used according to 40 CFR 98.94(a), the parameter measured or estimated using the method, and the time period during which the "best available monitoring method" was used.	Removed requirement	98.96(t)	NA.
For reporting year 2012 only, the date on which you began monitoring emissions of F–HTF whose vapor pressure falls below 1 mm of Hg absolute at 25 degrees C.	Removed requirement	98.96(v)	NA.
The date of any stack testing conducted during the reporting year, and the identity of the stack tested.	Added requirement in conjunction with stack testing option	NA	98.96(w)(1).
An inventory of all stacks from which process F–GHGs are emitted. For each stack system, indicated whether the stack is among those for which stack testing was performed as per 40 CFR 98.3(i)(3) or not performed per 40 CFR 98.93(i)(2).	Added requirement in conjunction with stack testing option	NA	98.96(w)(2).
If emissions reported under 40 CFR 98.96(c) include emissions from research and development activities, the approximate percentage of total GHG emissions that are attributable to research and development activities.	Added requirement	NA	98.96(x).

TABLE 2—CHANGES TO REPORTING REQUIREMENTS—Continued

Data element	Change/revision	Original citation	New or revised citation
If your semiconductor manufacturing facility emits more than 40,000 $mtCO_2e$, a triennial technology assessment report that includes information such as how gases and technologies have changed, the effect on emissions of the implementation of new process technologies, and default utilization and by-product formation rates collected in the previous 3 years.	Added requirement	NA	98.96(y).

NA—Not applicable.
[1] Data element revised from proposed rule (77 FR 635380, October 16, 2012).

The EPA is amending subpart I such that, with the addition of certain new data elements, several previous data reporting elements are not required to be reported to the EPA and, instead, are to be kept as records, as proposed.[3] These records must be made available to the EPA for review upon request.

The EPA is amending subpart I to add a stack testing option and to revise the method that uses default gas utilization rates and by-product formation rates. The stack testing approach involves the development of fab-specific emission factors in terms of kg of F–GHG emitted per kg of F–GHG consumed based on measured stack emissions. Using this approach, facilities are required to monitor and keep records of the fab-specific emission factor, the amount of each F–GHG consumed, and data on the operating time and performance of abatement systems, but they are not required to report these data. Other data needed to determine the amount of F–GHG used in a process type or sub-type are not reported, but rather kept as records. The EPA has also included additional recordkeeping requirements in 40 CFR 98.97 to verify compliance with the factors that trigger a retest, including the identity and total annual consumption of each gas identified as an intermittent, low-use F–GHG, and the total number of tools at each stack in the fab.

The final amendments to the default gas utilization rate and by-product formation rate approach require facilities to monitor and keep records of the amount of each F–GHG consumed in each process type and sub-type, and data on the operating time and performance of abatement systems, but do not require facilities to report these data.

The final amendments to the reporting requirements move the information on the number and DRE of abatement systems at each facility from the reporting requirements to the recordkeeping requirements as proposed. In order to determine the extent to which GHG emissions from this category are being abated, we are including in 40 CFR 98.96(r) a requirement for reporters to calculate and report effective fab-wide DRE factors for the emissions from the electronics manufacturing processes at each fab. In the October 16, 2012 proposed amendments to subpart I, the EPA proposed to require facilities to report facility-wide DRE factors in order to assist in our verification of reported GHG emissions (77 FR 63569). Following proposal, the EPA determined that because facilities are already collecting information to determine emissions on a fab-level basis using either the methods in 40 CFR 98.93(a), (b), or (i), a fab-wide DRE factor (instead of facility-wide) is more appropriate to ascertain the extent to which GHGs are being abated. The fab-wide DRE factor is calculated as 1 minus the ratio of reported emissions to the emissions that would occur if there were no abatement. The emissions are already reported under subpart A and subpart I.

For calculating the effective fab-wide DRE factors, reporters have two methods for calculating emissions that would occur if there were no abatement. The first method is used to calculate the emissions without abatement in cases where the reporter calculated emissions using default utilization and by-product formation rates. This includes cases in which the reporter calculated emissions under 40 CFR 98.93(a) and also those emissions that were calculated for stack systems that are exempt from testing, under 40 CFR 98.93(i)(3). In this method, emissions without abatement are calculated using the consumption of each F–GHG and N_2O in each process type or sub-type, and the default gas utilization rates and by-product formation rates in Tables I–3 to I–8, and I–11 to I–15 of subpart I. This calculation does not require reporters to collect any additional information because the information on F–GHG and N_2O consumption is already required to perform the calculations needed to estimate emissions using either the revised default emission factor approach or the stack testing option. This reporting requirement, 40 CFR 98.96(r), requires a calculation with these existing data, including the current reported emissions and the emissions that would occur if there were no abatement. The latter must be calculated using the consumption of each F–GHG and N_2O in each process type or sub-type and the appropriate default gas utilization rates and by-product formation rates in Tables I–3 to I–8 and I–11 to I–15 of subpart I.

The second method is used to calculate the emissions without abatement from stack systems in cases where the reporter calculated emissions based on stack testing conducted according to 40 CFR 98.93(i)(4). In this method, reporters must calculate emissions without abatement from the reported GHG emissions using the inverse of the DRE and the fraction of each gas in each process type that is abated. This method uses default values or values that are already measured and used in the equations that a reporter uses to calculate GHG emissions in the stack testing option.

In this notice we are also finalizing changes, as proposed, to Table A–7 of subpart A, General Provisions. Table A–7 lists those data elements for which the reporting date has been deferred to March 31, 2015 for the 2011 to 2013

[3] These reporting elements include data elements that have been designated as ''inputs to emissions equations'' in the August 25, 2011 final rul titled, ''Change to the Reporting Date for Certain Data Elements Required Under the Mandatory Reporting of Greenhouse Gases Rule'' (76 FR 53057), and listed in Table A-7 of subpart A. Consistent with the final amendments to subpart I, we are removing these subpart I inputs to emissions equations data elements from table A-7 so that they are not required to be reported by March 31, 2015. More information on this final change can be found in Section III of this preamble.

reporting years. We are revising Table A–7 for the rows specific to subpart I to remove the references to those data elements described in Table 4 of this preamble that are moved from reporting in 40 CFR 98.96 to recordkeeping under 40 CFR 98.97, or that are removed entirely from subpart I because of the removal of the relevant emission calculation requirement. Since these data elements were originally deferred until 2015 and reporters are no longer required to report these data elements after January 1, 2014, this final rule revises these data elements from reporting requirements to recordkeeping requirements for 2011, 2012, and 2013, as well as 2014 and beyond. Reporters are still required to maintain records of these data elements according to the procedures outlined in 98.97.

14. Changes To Remove BAMM Provisions and Language Specific to Reporting Years 2011, 2012, and 2013

We are removing the provisions in 40 CFR 98.94(a) for best available monitoring methods (BAMM), as proposed. The requirements of 40 CFR 98.94(a)(1) through (a)(3) provide an option for reporters to request and use BAMM for calendar year 2011 reporting for monitoring parameters that cannot be reasonably measured according to the monitoring and quality assurance/quality control (QA/QC) methods provided in subpart I. The provisions require that, starting no later than January 1, 2012, the reporter must discontinue using BAMM and begin following all applicable monitoring and QA/QC requirements of this part, unless the EPA has approved the use of BAMM beyond 2011 under 40 CFR 98.98(a)(4).

As discussed in Section I.D of this preamble, these amendments will become effective on January 1, 2014. Facilities are required to follow one of the new methods to estimate emissions beginning in 2014, submitting the first reports of emissions estimated using the new methods in 2015. The BAMM provisions of 40 CFR 98.94(a) will be outdated on the effective date. The provisions of 40 CFR 98.94(a)(1) to (a)(3) are limited to 2011, and the deadline for requesting an extension under 40 CFR 98.94(a)(4) also occurred in 2011. Therefore, we are removing all the BAMM provisions in the current subpart I, because they will no longer be applicable starting in 2014, which is when this final rule will be effective. We are not promulgating any new BAMM provisions because we expect that all facilities will be in compliance with the monitoring and QA/QC methods required under subpart I for the 2014 calendar year.

We are also removing 40 CFR 98.93(h)(2), as proposed, which provided an option for reporters to calculate and report emissions of fluorinated heat transfer fluids using select time periods in 2012, and the corresponding reporting requirement at 40 CFR 98.96(v). In addition, we are removing language in 40 CFR 98.94(h)(3) that is specific to the monitoring of fluorinated heat transfer fluids in 2012. These provisions will no longer be applicable on the effective date of these final amendments, since both data elements are specific to 2012.

B. Responses to Major Comments Submitted on the Electronics Manufacturing Source Category

This section contains a brief summary of the major comments and responses on the proposed changes to the final subpart I rule. The EPA received comments on the proposed changes from the SIA, five semiconductor manufacturers (GlobalFoundries, IBM, Intel, Samsung, and Texas Instruments), and Environmental Defense Fund (an environmental advocacy group).

A summary of all of the comments and the responses thereto that are not included in this preamble can be found in the document, ''Reporting of Greenhouse Gases—Technical Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Responses to Public Comments'' (see EPA–HQ–OAR–2011–0028).

1. Stack Testing as an Alternative Emission Monitoring Method for Facilities That Manufacture Electronics

Comment: One commenter could not duplicate the EPA's calculation for all of the Tier 2a emission factors in Tables I–11 and I–12 of subpart I that are to be used to screen which stacks are to be tested under the stack testing alternative, and for calculating emissions from certain low-emitting stacks in that alternative. Based on their review of the EPA's explanation of how the factors in Tables I–11 and I–12 of subpart I were derived (see EPA–HQ–OAR–2011–0028–0090), the commenter recommended the following changes for the final amendments to subpart I:

- EPA should continue to use the default factors by process type and process sub-type in Tables I–3 and I–4 of subpart I, or the underlying data, as the starting point for the derivation of the simpler factors in Tables I–11 and I–12 of subpart I. To the extent the factors in Tables I–3 and I–4 are updated between proposal and final rulemaking, those updated factors should be used to update the factors in Tables I–11 and I–12.
- The commenter noted that the EPA used the arithmetic averages of the different process specific factors when deriving the factors in Tables I–11 and I–12 of subpart I. The commenter stated that weighting the individual factors for each process type by the amount of gas used in that process type is technically more appropriate than sample weighting (i.e., taking the arithmetic average of all the data points for that gas and process type). The commenter encouraged the EPA to re-compute the Table I–11 and I–12 factors with gas-use weighting. Where gas use information is not available, the commenter noted that sample weighting of available emission factor data would be acceptable.
- The commenter recommended that the EPA should revise the nitrogen trifluoride (NF_3) emission factors to give proper weighting to the emissions factor for remote clean, which represents the largest use of NF_3.

Response: The EPA agrees with the commenter that the factors in Tables I–11 and I–12 of subpart I should be updated in light of the additional emission factor data received during the public comment period for the proposed amendments to subpart I. The EPA also agrees with the commenter that gas-use weighting is more appropriate than sample-weighted averaging in developing the revised Tier 2a factors. Therefore, the EPA is promulgating revised Tier 2a factors in Tables I–11 and I–12 using gas consumption-weighted averages where consumption data were available (see Docket Id. No. EPA–HQ–OAR–2008–0028–0090) and sample weighted averages where gas use information was not available. The EPA is also updating the NF_3 emission factor to give proper weighting to the emissions factor for remote clean, which, as the commenter notes, represents the largest use of NF_3.

Comment: One commenter noted that some facilities may not be able to comply with the proposed requirements in 40 CFR 98.93(i)(1)(ii) and (iii) which require reporters to use data from the previous reporting year to estimate the consumption of input gas and total uptime of all abatement systems. For example, a new facility or a facility that just crossed the reporting threshold will not have data from a ''prior reporting year'' for estimating gas consumption and abatement system uptime. The commenter recommended that both 40 CFR 98.93(i)(1)(ii) and (iii) be revised to allow a facility, where a previous reporting year's data are not available, to estimate annual gas usage and abatement system uptime based on

representative operating data from a previous period covering 30 days or more.

Response: The EPA agrees with the commenter that instances will occur where there will be no data from a prior reporting year available. As a result, the EPA is including in the final amendments to subpart I, the commenter's suggested changes to 40 CFR 98.93(i)(1)(ii) and (iii) to allow a facility to estimate annual gas usage and abatement system uptime based on representative operating data from a period covering 30 days or more, when data from a prior reporting year are not available, with the exception that the option is only available for a fab that did not report in the previous reporting year. If there is an anticipated change in activity for the fab (i.e., in an increase or decrease in the annual consumption or emissions of any F–GHG) greater than 10 percent for the current reporting year compared to the previous reporting year, reporters are required to identify and account for the change in their preliminary estimate. Reporters must use a quantifiable metric (e.g., the ratio of the number tools that are expected to be vented to the stack system in the current year as compared to the previous reporting year), engineering judgment, or other industry standard practice.

The EPA has determined that this exception is necessary so that any fab that collected and reported data in the previous reporting year is required to estimate consumption and uptime based on the data from the previous reporting year. Recognizing that the previous reporting year may not represent a complete year (i.e., the fab may have started operations during the previous year), partial data from the prior year may be used if the reporter accounts for changes in activity. The EPA established activity changes that are greater than 10 percent for the current reporting year compared to the previous reporting year, because it is the same threshold criterion for conducting a re-test under the stack test method, as discussed in Section II.A.1 of this preamble.

Comment: One commenter requested that the EPA include ASTM D6348–03, ''Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform (FTIR) Spectroscopy,'' in subpart I as an alternative to EPA Method 320. The commenter stated that the ASTM method is more straight-forward than EPA Method 320 and, as such, is easier to understand/implement. The commenter stated that EPA Method 320 requires performing a validation of 12 spiked/unspiked pairs in addition to the three Quality Assurance (QA) spikes whereas ASTM D6348–03 requires only three analyte spikes to demonstrate acceptable performance. The commenter noted that when using the ASTM method one loses the ability to generate compound-specific correction factors should the system not sufficiently recover the analytes. The commenter indicated that using the ASTM method will save time during collection and data processing. The QA spike procedure and recovery requirements for EPA Method 320 and ASTM D6348–03 are essentially the same. In both methods, one cannot spike at more than 10 percent of the extracted flow rate and must demonstrate recoveries within 30 percent of expected amounts, respectively.

The commenter stated that testing companies have collected data using the ASTM method. The commenter noted that although none of these data involved F–GHG measurements at semiconductor facilities, the ASTM method has been successfully used in semiconductor fabs for other determinations (e.g., hazardous air pollutants) and was used in Intel stack testing for F–GHG emissions conducted in 2011 to support rule development. The commenter also noted that several existing EPA regulations list both EPA Method 320 and ASTM D6348–03 as acceptable methods: The Reciprocating Internal Combustion Engines (RICE) Maximum Achievable Control Technology (MACT) (40 CFR part 63 subpart ZZZZ) and the Turbine MACT (40 CFR part 63 subpart YYYY) list both methods.

Response: We agree with the commenter that ASTM D6348–03 is an acceptable method and are including it in this final rule. At proposal the EPA stated that ASTM D6348–03 had been reviewed as a potential alternative to EPA Method 320 (77 FR 63575). In the preamble to the proposed amendments, the EPA stated, ''All data and information EPA has received in support of the stack testing method used EPA Method 320. Since this industry contains specialized gases in low concentrations, EPA would prefer to have supporting data prior to approving another test method. Because of this, we are not proposing this standard as an acceptable alternative for EPA Method 320 in this proposed rule.''

Since this rule was proposed, we have revisited this assessment based on the comments received. We acknowledge that several existing regulations list both EPA Method 320 and ASTM D6348–03 as acceptable methods, as noted by the commenter. We also acknowledge the efficiency of ASTM D6348–03 as compared to EPA Method 320, although it may pose a greater risk for the need to perform a retest, as discussed below in this response. However, ASTM D6348–03 is also ''self-validating,'' as is EPA Method 320, and contains quality assurance procedures that, when adhered to, provide an acceptable level of confidence in the measured concentrations. For these reasons, along with the additional information provided in the comment on testing conducted in semiconductor facilities, we are allowing in the final rule amendments the use of ASTM D6348–03, Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, as an alternative to EPA Method 320 with the following requirements:

(1) The test plan preparation and implementation in the Annexes to ASTM D6348–03, Sections A1 through A8 are mandatory; and

(2) In ASTM D6348–03 Annex A5 (Analyte Spiking Technique), the percent recovery (%R) must be determined for each target analyte (Equation A5.5).

The reporter must also follow Section 4.1 of ASTM D6348–03 to ensure the F–GHG remains in the gas phase. In order for the test data to be acceptable for a compound, the percent recovery must be between 70 and 130 percent. If the percent recovery does not meet this criterion for a target compound, the test data are not acceptable for that compound and the test must be repeated for that analyte (i.e., the sampling and/or analytical procedure should be adjusted before a retest). The percent recovery value for each compound must be reported in the test report, required under 40 CFR 98.94(j)(4), and all field measurements must be corrected with the calculated percent recovery value for that compound by using the following equation:

Reported result = measured concentration in the stack × (100/%R).

As noted by the commenter, the use of ASTM D6348–03 could result in the loss of the ability to generate compound-specific correction factors if the system does not sufficiently recover the analytes (i.e., the percent recovery value is not between 70 and 130 percent). In this case, the testing facility would be required to perform a retest for the target analyte. Therefore, although the use of ASTM D6348–03 provides some efficiency, facilities must assume this risk when using the ASTM method.

Comment: One commenter noted that a facility may choose to report emissions as equal to consumption for a gas if consumption of that gas is less

than 50 kg per year in a fab, if using the default emission factor method, as specified in 40 CFR 98.93(a). The commenter asserted that, under the stack testing alternative, a facility should also not be required to test for a gas that is not one of the listed ''expected by-products'' if consumption of that gas is less than 50 kg per year in a fab. To ensure clarity on this point, the commenter requested that the EPA modify 40 CFR 98.93(a) to state that, if a fab uses less than 50 kg of a F–GHG in one reporting year, the reporter may calculate emissions as equal to the fab's annual consumption for that specific gas as calculated in Equation I–11 of subpart I. If this is done and the stack testing method under 40 CFR 98.94(j) is used, the commenter stated that testing for the gas should not be required unless it is one of the expected by-products.

Response: In the proposed rule, EPA neglected to update 40 CFR 98.93(a) to clarify that the provision allowing fabs to calculate emissions as equal to consumption if their fab consumes less than 50 kg of a F–GHG only applies to facilities using the estimation methods in 40 CFR 98.93(a)(1) and (a)(2). For the stack testing method, our intent at proposal was to minimize the burden by providing reporters a method to calculate emissions of F–GHGs used in small quantities that was similar but not equal to that of the provisions under the default emission factor method for gases consumed in quantities of less than 50 kg. To achieve this burden reduction, we proposed provisions for intermittent low-use gases at 40 CFR 98.93(i)(4)(i). Additionally, we specified under 40 CFR 98.94(j)(1)(ii) of the proposed amendments, ''you must measure for . . . those fluorinated GHGs used as input fluorinated GHG in process tools vented to the stack system, except for any intermittent low-use fluorinated GHG as defined in § 98.98.'' We did not intend for the provisions under 40 CFR 98.93(a) regarding input gases consumed in quantities less than 50 kg per reporting year to apply to fabs using the stack testing method because they would have been duplicative of the provisions for intermittent low-use gases specified at 40 CFR 98.93(i)(4)(i).

To clarify that reporters may only calculate emissions as equal to consumption if their fab consumes less than 50 kg of a F–GHG in one reporting year and they are using default emission factors for that fab, we have moved the provision from 40 CFR 98.93(a) and placed it in 40 CFR 98.93(a)(1) and (a)(2). We have also clarified the provision by specifying that the reporter must also include any by-product emissions of the gas as calculated in 40 CFR 98.93(a).

Additionally, in our review of the emissions estimation requirements for intermittent low-use gases for facilities using the stack testing method in 40 CFR 98.93(i), we have determined that in some cases, a facility may use an intermittent low-use gas that does not have associated default gas utilization and by-product formation rates in Tables I–11 through I–15. For example, if a facility uses C_4F_8O in manufacturing semiconductors on 300 mm wafers, Table I–12 of subpart I does not have applicable default utilization and by-product formation rate factors. For these cases, we have included a provision in 40 CFR 98.93(i)(4) for facilities to calculate emissions of these gases by assuming utilization and by-product formation rates of zero for those gases. Facilities will also account for abatement of these gases, if abatement systems are present on the tools associated with those stacks.

Comment: Two commenters questioned the applicability of the definition of the time interval in Equations I–17 and I–18 at 40 CFR 98.93(i)(3)(ii), which specifies that ''each time interval in the sampling period must be less than or equal to 60 minutes (for example an 8 hour sampling period would consist of at least 8 time intervals).'' One commenter observed that the sum of the average concentrations in Equations I–17 and I–18 are numerically equivalent whether the minimum time interval is one hour or one minute. The commenters requested that the requirement for minimum time intervals (t_m) over the duration of the 8-hour (minimum) stack test either be removed entirely, or be made specific to the use of the FTIR method.

The commenters further explained that when the FTIR method is used, the sampling period time intervals are typically on the order of minutes, and so the requirement for a minimum of a 60 minute time interval is easily achieved. However, in the future GC–MS or similar types of appropriately validated methods may be used that collect composite samples continuously over the 8-hour sampling period. In these situations, the EPA requirement as currently worded would obligate the sampling technician to collect a minimum of 8 one-hour time-integrated samples. The commenters contended that such an obligation would be excessive, and would provide little benefit because the 8-hour composite sample itself provides an appropriate average.

The commenters requested that 40 CFR 98.93(i)(3)(ii) either delete the requirement for a minimum time interval, or make it specific to the FTIR method, by specifying that each time interval in an FTIR sampling period must be less than or equal to 60 minutes (for example an 8-hour sampling period would consist of at least 8 time intervals). Another commenter recommended that the language in the final rule be revised to allow for continuous 8-hour testing rather than 8 individual one-hour runs.

Response: The EPA agrees with comments regarding sampling times when using the stack test option. The EPA recognizes that in typical FTIR sampling, which is the method incorporated into the proposed use of EPA Method 320, the sampling period time intervals are typically on the order of minutes; however, instead of specifying a potentially restrictive sampling period (i.e., a 1 minute basis), the EPA chose to allow facilities and their testing contractors to decide the most appropriate sampling period. Additionally, the EPA's intention was to require facilities to collect concentration measurement data that were representative of the entire 8-hour (or more) sampling period. As a result, the EPA proposed that concentration measurement data be collected, at a minimum, on an hourly basis. The EPA agrees with the commenter that, if a composite sampling method was used to conduct stack testing, either through the use of an approved alternative method or through future rule amendments, the requirement to collect a minimum of 8 one-hour time integrated samples would not apply since the composite sample itself would provide a time integrated sample. As a result, the EPA is incorporating the commenters' suggested revision to 40 CFR 98.93(i)(3)(ii). However, the EPA notes that the GC/MS method is not an approved method in this final rule and thus any reporter preferring to use that method would need to follow the procedures found in 40 CFR 98.94(k).

Comment: Two commenters expressed concern with the requirement to certify that no changes in stack flow configuration occur between tests conducted for any particular fab in a reporting year. The commenters recognized that it is important to ensure that the system is relatively static over the course of a round of testing, but stated that a certification of ''no changes'' goes beyond what is necessary and reasonable. The commenters noted that a fab may readily be able to certify that no significant changes have occurred over the relatively short time

required to complete the consecutive testing of multiple stacks. However, a facility may not be able to certify that no changes occurred during testing because one or more process tools might have been added to or subtracted from a stack system during that time period because, as part of normal operation, a process tool might be disconnected or added during a week of testing, but such an action should not invalidate the test. Such an action would not cause a significant change in emissions, since a single process tool (or small number of them) would represent a small fraction of the total. The commenter stated that, in addition, there is typically a time lag between the time a process tool connection is made and the time the process tool is up to full production and emissions.

The commenters proposed that the certification criterion in 40 CFR 98.94(j)(1)(iv) be modified so that reporters must identify any changes that occurred over the course of testing, including any GHG emitting process tools newly connected to or disconnected from the system. The reporter must also certify that no process tools that were in operation at the start of the test period have been moved to a different stack during the test period and that no point-of-use abatement systems on active process tools have been permanently removed from service during the test period.

Response: The EPA agrees with the commenters' suggestions regarding stack flow configuration certification requirements. Our original intent of requiring reporters to certify that no changes in stack flow configuration occur between tests was to ensure that emission factors developed as a result of testing are representative of normal operations, and to avoid under or over reporting of emissions as a result of reporters directing emissions from one stack to another stack between testing of separate stack systems, or by taking process tools with lower utilization efficiencies offline during testing.

Based on the information provided by the commenters, the EPA agrees that the addition and removal of a limited number of process tools to a stack system is a common occurrence under normal operating conditions. As a result, we are revising the certification requirement under 40 CFR 98.94(j)(1)(iv) to require reporters to certify that no significant changes in stack flow configuration occur between tests conducted for any particular fab in a reporting year. Specifically, reporters must certify that no more than 10 percent of the total number of F–GHG or N_2O emitting process tools are connected or disconnected from a stack system during testing. Although the commenters did not provide a quantitative limit when referring to ''a small fraction of the total,'' we determined that it is necessary to limit the number of tools connected or disconnected to a single stack system during testing to ensure there are no significant changes in emissions. Additionally, we agree with the commenters' suggestion to require reporters to certify that no process tools that were in operation at the start of the test period have been moved to a different stack during the test period, and that no point of use abatement systems have been permanently removed from service during the test period. We also agree with the commenters that any changes during the test period must be identified. Therefore, we are requiring reporters to document and record such changes in the emissions test data and report required under 40 CFR 98.97(i)(3).

Comment: Two commenters requested that the final rule include a specific list of by-products that are to be included in the testing instead of the requirement for a facility-specific analysis of ''expected'' or ''possible'' by products for each series of tests. This approach would eliminate uncertainty for the facility that the analysis was sufficient for purposes of the rule. The commenter noted that the EPA suggested a list of six chemicals that would be treated as potential by-products: CF_4, C_2F_6, CHF_3, C_3F_8, C_4F_6, and C_4F_8 (77 FR 63546). The commenter stated that the latest round of data gathering also found CH_2F_2, CH_3F, and C_5F_8 as by-products in some instances. The commenter recommended that these three gases be added to the list of ''possible'' by-product gases to be tested for under the stack test alternative. The commenter further recommended that the list of ''expected'' by-product gases, that will be assumed to be present at half the FDL even if they are not detected, be limited to the five C1 and C2 compounds (CF_4, C_2F_6, CHF_3, CH_2F_2, and CH_3F) because the four C3, C4 and C5 by-products (C_3F_8, C_4F_6, c-C_4F_8 and C_5F_8) were found in only a handful of tests. The commenter stated that the four ''possible'' by-products would be tested for and, if detected, they would be reported as detected and at half the FDL for any interval in that round of testing where they are not detected. If not detected, they would be reported as zero.

A third commenter supported the EPA's proposal to require that all fabs using the stack testing method test for the most common six by-product gases (CF_4, C_2F_6, C_3F_8, C_4F_6, C_4F_8, and CHF_3). The commenter supported the EPA's rationale that the cost of testing for six, as opposed to two, of these gases is expected to be low, because the tests would be conducted at the same time, with the same equipment and personnel.

Response: The EPA agrees with the commenters' suggestion to designate specific F–GHGs as ''expected'' and ''possible'' by-products. In the final rule, we are adding Table I–17, which includes a list of expected by-products and a list of possible by-products. Facilities are required to test for both expected and possible by-products. If expected by-products are not detected during a round of testing, facilities are required to assume that they are emitted at one-half of the FDL. If possible by-products are not detected during a round of testing, facilities are required to equate their emissions to zero for that round of testing.

This approach simplifies the rule, provides certainty for purposes of implementation, and relieves facilities of the burden of determining which by-products should be tested for or assumed to be emitted if they are not detected. By establishing a comprehensive list of by-products to include in testing, it also avoids routine underestimates of emissions that could result if a facility did not test for a by-product that was in fact emitted.

We agree with the commenter's suggestion to add CHF_3, CH_2F_2, and CH_3F to the list of expected by-products. With these additions, the list of expected by-products includes CF_4, C_2F_6, CHF_3, CH_2F_2, and CH_3F. Based on all the emission factor data available to the EPA, CF_4 was identified as a by-product in 532 instances, C_2F_6 in 589 instances, CHF_3 in 297, CH_2F_2 in 21, and CH_3F in seven instances out of a total of 1,149 data sets.

The EPA also agrees with the commenters' recommendation to include the four C3 to C5 compounds (C_3F_8, C_4F_6, c-C_4F_8 and C_5F_8) in the list of ''possible'' by-products in the final rule. Based on all the emission factor data available to the EPA, C_3F_8 was identified in four instances, C_4F_6 in three, c-C_4F_8 in five, and C_5F_8 in four of 1,149 data sets.

Comment: Three commenters asserted that the maximum FDL values in Table I–10 of the proposed amendments to subpart I have been achieved in very limited circumstances with specifically enhanced FTIR measurement systems. The commenters stated that the FDLs are not achievable with conventional FTIR systems in normal usage. The commenters noted that stack testing at

three fabs was completed in support of the testing alternative and the emissions reports appear in the docket and that the proposed maximum FDLs were not always met. The commenters noted that when the proposed maximum FDLs were met, it was with customized enhanced measurement systems. The commenters stated that these maximum FDLs should be either dropped from the rule or raised substantially. The commenters asserted that if they are not removed or raised, the number of available testing contractors and equipment will be severely limited. If the maximum FDLs are not met during a test and the test results are consequently considered invalid, very expensive efforts and arrangements for data gathering will be wasted. In light of these concerns, the commenters recommended that the maximum FDLs be increased by a factor of five. With that change, the fully fluorinated gases would have a maximum FDL of 25 ppbv, SF6 would have a maximum FDL of 5 ppbv, and other F–GHG would have a maximum FDL of 50 ppbv. These values would be considered maximum allowable FDLs. However, if stack testing at a site achieves lower FDLs, the lower FDLs determined for that stack test would be used for estimating emissions of expected, but not detected gases.

The commenters stated that allowing facilities to use higher FDLs would not affect testing results in a significant way. One commenter provided a comparison of emissions based on stack test results by Intel, International Business Machines (IBM) and Texas Instruments Incorporated (TI) using different FDL assumptions (Docket ID. No EPA–HQ–OAR–2011–0028–0095). The commenter asserted that, based on their analysis, the impact when accounting for five expected C1 and C2 by-products is minor and does not change appreciably for the higher FDLs except in the case of one facility that had very low concentrations in the stacks resulting from the fact that facility's tools are fully abated.

One commenter supported the proposed maximum FDLs, and agreed that FDLs should be lower for F–GHGs with higher GWPs.

Response: The EPA acknowledges the industry commenters' concerns with respect to the proposed maximum FDLs. The FDL is the lowest concentration at which at which an F–GHG can be detected during a specific field measurement. The maximum allowed FDL is the concentration at which an F–GHG should be detectable when the method is conducted properly and the analytical instruments are used correctly and of reasonable quality. Maximum FDLs are specified to ensure that the field measurements of F–GHG emissions are of adequate quality and accuracy, and that the fraction of total emissions that are below the FDL (and which have to be assumed to be one-half the FDL) is minimized. As discussed in the proposed amendments (77 FR 63547), EPA Method 320 requires the specification of maximum FDLs because the FDLs achieved by a method and analytical instruments can have a significant impact on the quality of the measurements. Maximum FDLs are necessary because if the FDL for a F–GHG is too high, it may capture a relatively large fraction of the fab's emissions of that F–GHG may occur at concentrations that are lower than what is detectable by the instrumentation. This results in the uncertainty of the emission estimates being correspondingly high. Due to this fact, the proposed amendments required that facilities must use FDLs that are less than or equal to the maximum FDLs in Table I–10 to reduce the uncertainty associated with the emissions estimates under the stack test method. The maximum FDLs in the proposed amendments were based on FDLs achieved at three different semiconductor facilities and an analysis of the magnitude of the emissions that would occur (in CO_2e) at various possible maximum FDLs (see docket item EPA–HQ–OAR–2011–0028–0085, section 5.1.2). The proposed FDLs were generally, though not always, close to the average FDLs achieved across all three facilities that submitted FDL information to the EPA.

The EPA acknowledges the industry commenters' assertion that two of the three facilities that submitted information on FDLs (see IBM, Intel, and TI test reports in docket EPA–HQ–OAR–2011–0028) used enhanced FTIR technology during stack testing and that not all stack testing contractors have the capability to perform these enhanced FTIR measurements. The EPA re-analyzed the available information to assess the FDL levels that were achievable by the facilities using other accurate and well-maintained FTIR, including a facility that did not use enhanced FTIR. Upon review of the FDLs included in the three test reports, we determined that increasing the proposed FDLs by a factor of four increases the values to a level that should be consistently achievable by testers using FTIR equipment under EPA Method 320, even if the tester does not use enhanced FTIR techniques. At these levels (four times the proposed maximum FDLs), all of the three stack tests that were conducted in support of the proposed amendments comply with the final FDLs for each of the F–GHGs specified in Table I–10. In contrast, only two of the three facilities that submitted data would have been able to achieve FDLs that were equal to or lower than the proposed maximum FDLs. We anticipate that the FTIR equipment and techniques used by these three facilities are representative of what would be used by the field of reporters and represent accurate and well-maintained equipment and techniques in the industry. As a result, the EPA is promulgating revised FDL values in Table I–10 to subpart I that are equivalent to the proposed values multiplied by a factor of four. The EPA determined that it was not necessary to increase the maximum allowed FDLs by a factor of five, as suggested by the industry commenter, to establish levels that could be achieved by testing companies using EPA Method 320 because the analysis of data and information provided to EPA on this topic demonstrated that an increase by a factor of four represents the appropriate FDL values. The final FDLs achieve the necessary balance between achievable FDLs and minimum uncertainty in the emission measurements derived from stack testing.

The EPA appreciates the support of the one commenter for the proposed maximum FDLs. However, as explained earlier in this response, the maximum FDLs were revised since proposal to a level that better reflects the FDLs that can be achieved by testing companies using the methods included in the final rule. The EPA would also like to clarify that the maximum FDLs that were included in the proposed and final rule were based primarily on the technical achievability of those levels. The GWP of the corresponding gases was used only to determine the overall effect on emissions (in CO_2e) of the different maximum FDL, and it was observed that the achieved FDLs were lower for gases with higher GWPs that were also easier to detect (see EPA–HQ–OAQ–2011–0028–0085, section 5.1.2).

Comment: Two commenters supported the proposed provisions to allow facilities subject to Subpart I to use prior stack testing completed in support of rule development to establish initial emissions factors under the stack test alternative, as long as the tests were completed no earlier than the date 3 years before the date of publication of the final rule amendments. The commenters noted that stack testing at three facilities in support of the

proposed rule was completed in 2011. The commenters requested that the EPA clarify that all data collected during the calendar year 2011 regardless of the month that the final rule is published will meet the ''within 3-year'' criterion for pre-rule data collection.

One commenter further explained that for testing conducted prior to the final rule, a fab may not have collected all required data elements and/or may not have collected all data elements in a manner consistent with all criteria in the final rule, and abatement systems may not have been certified in the 2011 testing as specified in the final rule. As a result, the commenter requested that the final rule be explicit that a fab may use prior stack test data to set emissions factors under the stack test alternative if the key substantive requirements were met, any deviations from the final rule are reported to the EPA and the EPA provides concurrence with the use of the data. The commenter stated that in evaluating whether to accept the earlier test results, the EPA should exercise its discretion to allow the use of data recorded during earlier testing, even if the procedures used do not match exactly what appears as a requirement in the final rule.

Response: The EPA agrees with the commenter's suggestions regarding the use of data collected in calendar year 2011 in the stack testing alternative. In the final amendments to subpart I, under 40 CFR 98.94(j)(7), the EPA is clarifying that data collected on or after January 1, 2011 may be used in the relative standard deviation calculation in 40 CFR 98.94(j)(5)(ii) if the previous results were determined using a method meeting the requirements in paragraph 40 CFR 98.94(j)(2). The EPA is also allowing reporters to use data collected on or after January 1, 2011 but before January 1, 2014, using a method that did not meet all the requirements of 40 CFR 98.94(j), on a case-by-case basis, contingent on Administrator (or an authorized representative's) approval. Reporters would describe any deviations from the methods and provisions in the final rule and the EPA would review and approve or disapprove the use of those data in the stack testing alternative, according to a review procedure that is similar to that followed for review and approval of an alternative stack testing method specified in 40 CFR 98.94(k). However, this procedure does not require the use of EPA Method 301 to validate the prior test data. The EPA would retain the right to not approve the use of data that does not meet the data quality requirements in 40 CFR 98.94(j)(7). See 40 CFR 98.94(j)(7) for more details regarding the use of data collected prior to the promulgation of the final amendments in the relative standard deviation calculation.

Comment: One commenter asked the agency to reconsider its proposal to allow facilities to conduct multiple tests in a single year with the aim of demonstrating low variability and becoming exempt from annual testing. The commenter stated that given the magnitude and rate of change in the semiconductor industry, facilities should, at a minimum, be required to do annual tests for a period of 3 years before qualifying for an exemption of up to 5 years. The commenter expressed concern that the measured emission factors could be stable over a one-year period but not over a three-year period.

Response: The EPA agrees with the commenter that it is possible an emission factor determined from three tests in one year could be representative of a fab's emissions over a one-year period, but not over a three-year period. However, the types of factors that could affect the emissions over a three-year period, such that the emission factors developed from conducting three tests in one year are no longer representative, are likely to be the same types of factors that would trigger the requirements to perform a new test, as promulgated at 40 CFR 98.94(j)(8). Therefore, it is unlikely that a reporter could substantially change a facility in such a way that the emissions would change substantially without triggering the requirement to perform a retest.

If a facility is required to perform a re-test, the results of that test will not extend the date of the next scheduled test. If a facility is required to conduct a re-test, the facility must also use the data from the re-test and the two most recent previous stack tests to evaluate whether the facility still meets the criteria to skip annual testing. If the facility no longer meets those criteria, the facility must resume testing regardless of when the facility qualified to skip annual testing. The facility may perform annual testing or may perform multiple tests in a single year to collect sufficient new data to see if they again qualify to skip annual testing. Therefore, the option for facilities to perform multiple emissions tests within the same year would not allow facilities to use data that are not representative of current emissions, provided they adhere to the provisions in 40 CFR 98.94(j)(5).

Comment: One commenter agreed with the list of changes at a fab included in 40 CFR 98.94(j)(8) that trigger the requirement that a stack system be retested. The commenter suggested additional fab changes identified in the context of the triennial technology assessment report required under 40 CFR 98.96(y) that should also trigger retesting (e.g., implementation of new process technologies, introduction of new tool platforms, and introduction of new processes on existing platforms). Another commenter stated that potential new process technologies that would change the nature of the emissions of GHGs from semiconductor manufacturing would trigger one or more of the six triggers for retesting included in 40 CFR 98.94(j)(8). The second commenter predicted that the triggers that would most likely be affected by new process technologies would be the change in the consumption of a F–GHG by more than 10 percent of the total annual F–GHG consumption (in CO_2e), the change in the consumption of an intermittent low-use F–GHG, or a decrease by more than 10 percent in the fraction of process tools with abatement systems.

Response: Based on the comments on the proposal, the EPA has concluded that the re-test triggers that were proposed and promulgated under 40 CFR 98.94(j)(8) are adequate to capture changes in fab emissions as a result of new process technologies, new tool platforms, and new processes on existing platforms. These types of changes are already accounted for by the criteria that that are specified in 40 CFR 98.94(j)(8), and no new criteria have been added in the final rule. However, the EPA has included additional recordkeeping requirements in 40 CFR 98.97 to verify compliance with the factors that would trigger a retest. Specifically, we are revising 40 CFR 98.97(i)(3) to require records of the identity and total annual consumption of each gas identified as an intermittent low use F–GHG, to verify any change in the consumption of an intermittent low-use F–GHG that was not used during the emissions test and not reflected in the fab-specific emission factor, such that it no longer meets the definition of an intermittent low-use F–GHG. We are also adding a new provision at 40 CFR 98.97(i)(9) to require records of the total number of tools at each stack in the fab which, along with the number of abatement systems, is needed to verify if a facility has a decrease by more than 10 percent in the fraction of tools with abatement systems compared to the number during the most recent emissions test.

2. Revisions to the Default Gas Utilization Rates and By-Product Formation Rates for the Plasma Etch Process Category for Facilities That Manufacture Semiconductors

Comment: One commenter provided additional input on the merging of the default gas utilization and by-product formation rates for wafer clean and etch processes. The commenter provided data from industry publications for the total F–GHG usage for these processes. The commenter stated that wafer cleaning is between 0.8 and 2 percent of total 200 mm F–GHG usage. The commenter stated that five gases are used in 200 mm wafer cleaning. The commenter noted that four of the five gases are also used in 200 mm chamber cleaning and etch processes, and one gas is used in etch and wafer cleaning. The commenter asserted that because wafer cleaning is a low percentage of 200 mm F–GHG usage, combining wafer cleaning and etch processes will have a minor impact on the accuracy of the emissions estimates under Subpart I.

Response: The EPA proposed to combine the etch and wafer cleaning categories, which could reduce the apportioning required of a facility and potentially reduce gas apportioning errors if the facility uses the same F–GHGs for wafer cleaning and etch. Facilities using 150 mm and 200 mm wafers typically need to apportion three to five gases between the plasma etch and chamber cleaning process types/subtypes. As noted by the commenter, five gases are typically used in 200 mm wafer cleaning (C_2F_6, CF_4, CHF_3, NF_3, and SF_6) and each of these gases are also used in either the etch and/or chamber cleaning process types.

The effect of gas apportioning errors on GHG emissions accuracy depends upon the difficulty of the gas apportionment by gas and process type/subtype. For example, no apportionment error would be present for gases used only in one process and little apportionment error would result if only small portions of gas use are allocated to processes other than the dominant one. The overall impact of apportioning on the accuracy of the GHG estimate depends on each gas's GWP value and its contribution to the total fab emissions. As noted in the preamble to the proposed amendments to subpart I (77 FR 63552), the gases used for plasma etch and wafer clean have similar gas utilization rates and by-product formation rates. Furthermore, as provided in the ''Technical Support for Modifications to the Fluorinated Greenhouse Gas Emission Estimation Method Option for Semiconductor Facilities under Subpart I'' (see Docket Id. No. EPA–HQ–OAR–2011–0028–0083) and supported in the data provided by commenters, wafer cleaning is expected to represent a small percentage of total gas consumption for facilities manufacturing wafers 200 mm or smaller. Because the gases used in wafer cleaning at 200 mm facilities represent only a small portion of total fab emissions, the EPA does not anticipate that merging the etch and wafer clean subcategories will greatly impact the accuracy of GHG emission estimates. Therefore, the final rule will combine the wafer clean and etch process types for fabs using 150 and 200 mm diameter wafers. The final rule will also combine the wafer clean and etch process types for fabs using 300 and 450 mm diameter wafers.

Comment: Several commenters supported the use of default gas utilization rates and by-product formation rates under subpart I. One commenter claimed that the method allows for the use of emissions factors and abatement efficiency factors that have been derived from extensive testing and provide the basis for high quality emissions estimates without disruptive testing in the fab environment where operating uptime is critical to the productivity of the fab. The commenter stated that much of the data used to derive the factors in the proposed rule came from the efforts of the semiconductor industry in advance of the proposed rule. The commenter noted that SIA and ISMI continued emissions factor data collection activities during settlement discussions to improve the representativeness of the emissions factor database.

The commenter provided 168 additional gas utilization and by-product formation rate data sets, noting that the data were provided by semiconductor process equipment suppliers and device manufacturers for 200 mm and 300 mm plasma etch equipment. The commenter asserted that the 2012 data closed gaps in the emissions factor database and allowed for establishment of default emission factors for every gas used in semiconductor plasma etch processes, as identified in a 2011 ISMI survey. The commenter provided an analysis of the integrated database and the resulting emission factors (see Docket Id. No. EPA–HQ–OAR–2011–0028–0095). The commenter further stated that a minimum of 23 data sets for each gas were used to develop emission factors for each gas that is 1 percent or more of the total F–GHG usage for each wafer size. The commenter stated that the four gases with four or less data sets are either not used for etch or are much less than 0.1 percent of total F–GHG usage for that wafer size.

The commenter also provided a comparison of default emission factors based on the added data to the default emission factors in the 2012 proposed rule (EPA–HQ–OAR–2011–0028–0095). The commenter noted that when a large dataset was previously available to establish the proposed revised default emission factors, the addition of the 2012 data did not appreciably change the proposed revised default factors. The commenter also provided a list of the revised default by-product emission factors for 200 mm and 300 mm etch based on the additional data (EPA–HQ–OAR–2011–0028–0095). The commenter noted that several by-products, namely C_5F_8, CH_3F, and CH_2F_2, that were not detected previously, were observed during this round of testing. The commenter reasoned that this may be the result of data being provided for tool and gas combinations that were not previously tested. The commenter suggested that these new by-products would have no discernible effect on reported emissions because the by-product emission factors are small and the GWPs of these gases are less than 200.

Response: The EPA thanks the commenter for the additional data provided during the public comment period. The EPA incorporated the provided data into the existing etch process type emissions factor database to calculate new and revised gas utilization and by-product formation rates for the final rule. The EPA used the emission factor calculation methodology outlined in the proposed rule to evaluate the new and revised emission factors. Specifically, the EPA:

(1) Used a simple arithmetic averaging method to develop default utilization and by-product emission factors by gas for the etch process type; and

(2) Used the ''all inputs gas'' convention for assigning by-product formation rates (emission factors) for etch gases. This convention assigns by-product emissions to input F–GHGs used in a process by dividing the measured mass emitted of a specific by-product by the total mass of all input F–GHGs for that process and assigning this by-product factor to each input F–GHG used in that process. This is the same approach used in developing the proposed revised emission factors in the 2012 proposed rule.

For semiconductor manufacturing using 200 mm wafers, the data provided by the commenter added one gas utilization rate for semiconductor manufacturing for which no data were

previously available (for C_5F_8 as an input gas) and revised the utilization rates of nine F–GHGs. For semiconductor manufacturing using 300 mm wafers, the new data added two gas utilization rates, for C_3F_8 and CH_3F, and revised the utilization rates of 10 F–GHGs.

The new data also provided 75 revised by-product formation rates, including three new by-products not previously identified (for the by-products C_5F_8, CH_3F, and CH_2F_2).

The EPA's analysis of the new emission factor data for input gases and by-product gases is included in the docket for the final rulemaking in the item entitled ''Technical Support for Final Modifications to the Fluorinated Greenhouse Gas Emission Factors and By-Product Formation Rates for Semiconductor Facilities under Subpart I'' (EPA–HQ–OAR–2011–0028).

Comment: A commenter noted that in the preamble to the proposed rule (77 FR 63551), the EPA asked for an explanation of the zeros in the data previously collected and provided by SIA and used by the EPA to calculate the default emissions factors. The commenter noted that because the data came from a wide range of sources, the commenter cannot be certain of the basis of the zero entries in the data base. The commenter suggested that the zeros most likely mean that a gas was not present above the detection limit achieved during the test, but there is a small chance that the tester did not look for the gas. The commenter stated that in the interest of conservative emissions reporting, they agree that it is appropriate to err on the ''high side'' by determining by-product factors only using the non-zero results. The commenter stated that the default factors would be less if the zeros were included in determining the average emissions factor and that it is likely that the default by-product emissions factors would also be lower if the zeros were included at half the detection limit, using the practice proposed by the EPA for measuring the presence of certain gases when implementing the stack alternative. The commenter stated however, that it is not possible to do so for the default by-product emissions factors based on the data collected by the commenter because the field detection limits (FDLs) for each test were not previously collected. For these reasons, the commenter recommended that the EPA retain the approach used in the proposed rule for determining default by-product emissions factors from the available data.

Response: The EPA agrees with the commenter on the method for averaging the available by-product emission factor data and with the likely basis for the zeros in the data collected. The EPA considered averaging the available emissions data using either the zeros in the available data or half the detection limit for the by-product gas if the data gatherer looked for, but did not detect, by-product emissions. However, because it is not apparent that the basis of the zeros in the data represent instances where a by-product was looked for, but not detected, and because the field detection limits for each test were not previously collected, the EPA agrees with the commenter that the averaging approach used in the proposed amendments to subpart I is appropriate. In determining revised default by-product emission factors for the final rule, the EPA used the simple arithmetic mean of all available non-zero by-product emission factor data for each gas, wafer size, and process-type or subtype using the revised etch emissions database. If additional by-product emission factor data are made available to the EPA in the future, and those data include instances where a by-product was looked for, but not detected, and field detection limits are provided, the EPA may reassess the by-product emission factor calculation methodology.

Comment: One commenter stated that Equation I–15b should be eliminated. The commenter stated that the calculated abatement unit uptime for the process gases for which the abatement system is certified for treatment is the same for by-product treatment. The commenter further noted that where the unit is not effective for one or more of the by-product gases, it will not be certified to treat that gas and the DRE will be zero, and where a unit has a lower uptime for a subset of the certified gases, that lower, gas specific uptime would be applied to applicable by-product gas(es). The commenter stated that companies will have abatement uptime data organized by input gas type, and the uptime for the input gases will match the uptime for the by-product gases. The commenter contended that there is no need to perform a separate calculation of abatement system uptime for by-product gases, and enabling companies to calculate uptime by the combination of input and by-product gas would simplify calculations and recordkeeping while not reducing the accuracy of the uptime data.

Response: The EPA agrees with the commenter that only a single uptime equation is needed and has removed Equation I–15b from the final rule, and modified Equation I–15a (Equation I–15 in the final rule) so that it is applicable to both abatement systems treating input gases and by-product gases.

In developing the proposed rule amendments, the EPA developed separate equations under the assumption that the population of abatement systems treating a particular input gas could be different from the population of abatement systems treating a by-product gas because not all input gas and process combinations create the same by-product gases. However, the uptime calculated by Equations I–15a and I–15b is used in Equations I–8 and I–9, respectively, and in those latter two equations, emissions are tied to the consumption of the same input gas, Cij. Therefore, uptime only needs to be calculated for the abatement systems receiving the input gas, Cij, and separate uptime does not need to be calculated for the by-product gas. As the commenter correctly notes, where an abatement system is not certified for the treatment of a particular by-product gas from an input gas, the DRE for that gas will be zero, and the uptime of the system will be irrelevant.

The EPA has also made the other conforming changes in other sections of the final rule to remove the references to Equation I–15b as noted by the commenter.

3. Apportioning Model Verification for Facilities that Manufacture Electronics

Comment: One commenter noted that in the proposed amendments at 40 CFR 98.94(c)(2)(iv), the period of representative gas consumption used to verify the apportioning model when using the stack method would be required to end exactly on the day that stack testing is completed. The commenter noted that most gas use accounting is managed on a monthly basis, so it would not be practical to end the period on the same day that testing is completed. The commenter suggested that the rule should allow the apportioning model to be validated over a period that ends between the first and last day of the accounting month(s) in which the stack testing takes place because this would simplify the data collection for locations without significantly affecting the accuracy of the gas use estimates used in the verification. The commenter noted that 40 CFR 98.94(c)(2)(i), which is referenced by 40 CFR 98.94(c)(2)(iv), allows the representative period to be '' . . . at least 30 days but not more than the reporting year.'' Enabling locations to use an end date within the accounting month, instead of tying it to the last day of stack testing, would simplify the data collection without

introducing error, particularly if the verification period is more than 90 days. The gas usage accounting systems at some semiconductor facilities are based on accounting months (e.g., 13–4 week months) rather than calendar months. The commenter asked that 40 CFR 98.94(c)(2)(iv) be revised to allow that the time period specified in 40 CFR 98.94(c)(2)(i) ends on a day between the first and last day of the accounting month for the period that includes the last day the facility performs stack testing, or that is a defined period ending on the last day of sampling event.

Response: The EPA agrees with the commenter that it is reasonable that the period selected for apportioning model verification, when a facility is using the stack testing method, should be allowed to coincide with the accounting period used at the fab for normally tracking gas consumption, and should not be tied to the day on which testing is completed. The EPA's proposal was intended to ensure that the representative period selected to validate the apportioning model coincided with the period during which the stack testing was being performed to ensure that gas consumption during stack testing was being estimated as accurately as possible. The commenter's suggested change to 40 CFR 98.94(c)(2)(iv) would achieve the same objective and would also be consistent with the facility's normal accounting periods for gas usage.

4. Calculating N_2O Emissions for Facilities That Manufacture Electronics

Table I–8 of subpart I provides two default N_2O emission factors. One factor is for CVD processes using N_2O, and the other is for the aggregate of all other N_2O-using electronics manufacturing processes. The EPA proposed to revise the default N_2O emission factor in Table I–8 of subpart I for the aggregate of the ''other'' (non-CVD) N_2O-using manufacturing processes (77 FR 63560). The current default emission factor is 1.0 kg of N_2O emitted per kg of N_2O consumed. The proposed emission factor was 1.14 kg of N_2O emitted per kg of N_2O consumed, and represented an average of the stack emission factors for N_2O (total N_2O emissions/total N_2O consumption) measured in nine tests at three fabs. (See EPA–HQ–OAR–2011–0028–0084, section 5, for a summary of the data used to develop the proposed default emission factor.) The EPA did not propose to revise the N_2O emission factor for CVD processes. The EPA specifically sought comment on the existing data and analysis supporting the proposed emission factor, and requested additional data and analysis. The preamble noted that the average N_2O emissions from the stack testing appeared to be greater than the N_2O consumption and, as a result, the emission factor is greater than 1.0. The preamble also noted that the proposed emission factor was based on emissions associated with total N_2O consumption, rather than just emissions and consumption data associated with non-CVD applications (which were not available to the EPA). Thus, the EPA noted at proposal that when these data were applied only to non-CVD N_2O consumption, they may not have fully compensated for the unknown N_2O source that resulted in an emission factor greater than 1.0, and that EPA did not have an explanation for the apparent creation of N_2O. The preamble requested comment on the existing data and analysis supporting the proposed revised default emission factor, and noted that the EPA would consider new information and data submitted by commenters in developing the final default emission factor.

Comment: No commenters offered an explanation for the apparent creation of N_2O reflected by the average N_2O emission factor greater than 1.0, nor did any commenters provide any additional N_2O emission factor data.

Two commenters recommended that the N_2O process categories should be aligned with the F–GHG categories to ensure consistency and reduce the potential for confusion. The commenters suggested that the use of the term CVD (chemical vapor deposition) in the current rule does not align with the established process categories of chamber clean and/or plasma etch/wafer cleaning. The commenters proposed that the EPA replace the terms ''chemical vapor deposition'' or ''CVD'' where they appear in Section 98.93(b)(1) and Table I–8 with the following phrase: ''processes associated with the chamber clean process type.'' The commenters noted that N_2O is sometimes used in the deposition processes associated with the in-situ, remote, and thermal chamber cleaning tools and recipes, and suggested that the application of N_2O in these circumstances is very similar and the utilization rates are consistent. The commenters suggested that the EPA should continue to categorize those N_2O-using processes that do not fall into the processes associated with the chamber clean process type as ''other manufacturing processes.''

Response: The EPA did not receive any new N_2O emission factor data that can be used to resolve the uncertainties associated with the data used to develop the proposed emission factor for the other N_2O-using manufacturing processes of 1.14 kg of N_2O emitted per kg of N_2O consumed. As stated above, at proposal the EPA had data from nine tests of N_2O emission rates from three fabs owned by two companies. Six measurements were from one fab, two measurements were from a second fab, and one measurement was from a third fab. The second and third fab were owned by the same company. In four of the nine measurements, N_2O emissions were greater than N_2O consumption, and the emission factors were highly variable both within and across fabs, ranging from 0.34 to 1.89 kg emitted per kg consumed. The EPA could not explain the cause of the emission factors that are greater than 1.0. Given the highly variable nature of the measured emission factor data, the small number of tests, and the lack of information on the specific processes represented by those data, the EPA is not confident that those data accurately represent emissions from non-CVD processes used in electronics manufacturing. Therefore, the EPA is not finalizing the proposed change to the emission factor that was based on those data. The N_2O emission factors will remain as they are in the current Table I–8 of subpart I. The emission factor for CVD will remain at 0.8 and for all other N_2O using processes at 1.0 kg of N_2O emitted per kg of N_2O consumed. The EPA does not have, at this time, a sufficient amount of data to support any changes to these emission factors.

The EPA is also not accepting the suggestion at this time to revise the N_2O categories in Table I–8 of subpart I to include CVD and chamber clean under a single category of ''processes associated with the chamber clean process type.'' The EPA does not have data at this time to demonstrate that the utilization rates in the deposition processes associated with the in-situ, remote, and thermal cleaning process types are similar to those in the CVD process type and should, therefore, be combined into a single category.

The EPA will continue to work with industry to understand these N_2O-emitting processes and to gather additional data and information for potential future revisions. One potential avenue for gathering information and data will be through the triennial technology assessment report specified in 40 CFR 98.96(y), although the EPA may accept new data at any time they are available.

5. Abatement System Destruction and Removal Efficiency (DRE) for Facilities That Manufacture Electronics

Comment: One commenter suggested revising the definition of abatement system to clarify which abatement systems are covered under the requirements in Subpart I as follows: ''Abatement system means a device or equipment that is designed to destroy or remove F–GHGs and N_2O in waste exhaust streams from one or more electronics manufacturing production processes.''

The commenter explained that there are abatement units installed in fabs for purposes other than GHG abatement, including but not limited to solids removal, pyrophoric destruction, and volatile organic compound (VOC) emissions control. The commenter noted that under the current rule language, it appears that if any of the regulated GHGs are exhausted to these units, one is technically required to manage them under the requirements of Subpart I. These types of units are not designed for F–GHG treatment and any treatment which does occur is incidental and would not be capable of being certified under the rule requirements. The commenter stated that inclusion of the ''designed to'' phrase clarifies that only systems designed to treat F-gas emissions are covered by the requirements of the regulation.

Response: The EPA agrees with the commenter and has revised the definition of abatement system as suggested by the commenter. However, in response to other comments, the EPA has also revised the definition to include abatement systems for which the F–GHG or N_2O DRE has been measured according to 40 CFR 98.94(f). The EPA recognizes that some systems that were not specifically designed for F–GHG or N_2O abatement may still achieve substantial F–GHG or N_2O abatement for certain gases and some facilities may wish to account for this abatement in calculating emissions.

The EPA notes that only data from abatement systems that were specifically designed to abate F–GHG or N_2O emissions were used to develop the final default DREs. As a result, those default DREs will be applied only to those systems specifically designed to abate F–GHGS or N_2O, as appropriate, under the requirements of subpart I.

To account for abatement systems that may have been installed to abate other gases, such as volatile organic compounds or hazardous air pollutants, but achieve some level of F–GHG abatement, the final rule will also allow facilities to account for the DRE of systems if a site-specific DRE has been measured as specified in 40 CFR 98.94(f).

Because the final rule allows facilities to account for the DRE of systems that are specifically designed for F–GHG or N_2O abatement, and for those for which a site-specific DRE has been measured, including those that were not designed for F–GHG or N_2O abatement, the definition of abatement system in the final rule has been modified to account for both situations.

In each situation, facilities will be required to certify these systems according to the applicable requirements of 40 CFR 98.94(f), include these systems in the abatement system inventory included in the annual report (40 CFR 98.96(q)), and meet the recordkeeping requirements of 40 CFR 98.97 for abatement systems.

Comment: One commenter noted that the abatement system count in a particular gas and process type will change over time. The commenter asserted that a change in the number of systems may lead to uncertainty in the number of abatement systems that should be included in the random sampling abatement system testing program specified in 40 CFR 98.94(f)(4)(ii)(A). In the proposed rule amendments, the facility must test 20 percent of systems in a given gas and process combination in the first 2 years (a minimum of 10 percent per year until reaching a minimum of 20 percent), and at least 15 percent in each following 3-year period (a minimum of five percent per year until reaching at least 15 percent). The commenter requested that the final rule clarify the number that should be used as the basis for the percentages and suggested that it should be based on the number present at the time the testing begins for the given period of the testing. The commenter explained that if five percent are tested a year and units are added or removed between that year and the next, that round of testing still counts as five percent.

Response: The EPA agrees with the commenter that the final rule should clarify the number of abatement systems to be tested on a yearly basis, because the abatement system count for a particular gas and process type could change over time. The final rule specifies that reporters determine the number of abatement systems to be tested based on the average number present over the period required to test the minimum percent of systems for a gas and process type. For example, if a facility completes testing of the minimum 15 percent in a single year instead of three years, then the number tested would be based on the systems present in that year. If testing were completed over 3 years, the number tested would be determined based on the average number in that three year period. If a facility adds abatement systems during that time, they may need to increase the number tested in the second or third year to meet the minimum for the 3-year average. If a facility tested the minimum of 15 percent in 1 year, and then added systems in years 2 and 3, the higher number of systems would be accounted for in the number to be tested in the next 3-year period.

We are not adopting the commenter's suggestion that reporters should determine the number of abatement systems to be tested for the 3-year period based only on the count at the beginning of testing. Allowing a facility to use only the number of abatement systems at the beginning of the period may result in a non-representative site-specific DRE for a particular gas and process type/sub-type combination, especially if a facility began a program of adding substantial numbers of abatement systems after the first year of the RSASTP. Facilities that have not completed testing when abatement systems are added must include those abatement systems in determining the number to be tested. For example, if a facility installs abatement systems in years 2 or 3, and is still testing DRE in those years, then the number of systems tested must be adjusted to reflect the increased number of systems. However, if testing of 15 percent of systems is already completed for that 3-year period, the facility does not need to resume testing to account for the change in percentages. If a facility has completed testing for that period and then installs abatement systems for a gas and process combination that was not included in the testing, the facility would have the option of testing the DRE for that newly abated gas and process combination, or using the default DRE until that gas and process combination is included in the next round of testing.

Comment: One commenter requested that the EPA add a sentence to the end of 40 CFR 98.94(f)(4)(iii) to clarify that all DRE test data collected in 2011, or later, will qualify for use in determining site specific DREs for the locations where the testing occurred.

Response: The EPA agrees with the commenter regarding the use of data collected in calendar year 2011. In the final rule under 40 CFR 98.94(f)(4)(iii), the EPA is clarifying that data collected on or after January 1, 2011 may be used

in the average DRE calculation if the previous results were obtained following the requirements in 40 CFR 98.94(f)(4)(i).

Comment: One commenter suggested changes to the provisions under 40 CFR 98.94(f)(4)(v) regarding the use of a DRE value below the manufacturer-claimed DRE measured when the abatement system is not installed, operated, or maintained in accordance with the site maintenance plan. The commenter proposed two options:

(1) Include the measured DRE for the unit in the calculation of the site-specific DRE for the gas and process combination. The measured DRE for that unit must be included in the site-specific DRE average until corrective action is completed and the abatement system is retested. Corrective action must be completed in a reasonable time, but retesting can be deferred to the next testing period. Any affected abatement units that are being re-tested must be in addition to the randomly selected minimum sample for that testing period, or

(2) Exclude the measured DRE for that unit in the site-specific DRE average until corrective action is completed and the abatement system is retested. However, in that instance the abatement system will be treated as down for purposes of calculating abatement system uptime until the retest is completed.

The commenter claimed that allowing inclusion of the lower DRE in the site-specific average would enable a facility to choose whether it wants to accept a lower DRE for its site-specific value for a given gas (even though a low DRE value will have an inordinate impact on the site-specific DRE because the average is based on measurements from 35 percent of the units), or whether the facility wants to manage its uptime number for different units. The commenter stated that the benefit of choosing the lower DRE is being able to maintain a consistent uptime across all the gases, simplifying management of the calculations.

Response: The EPA agrees with the commenter that facilities should have the flexibility to either include or exclude DRE data from a system that is operating outside the established parameters for that system and not meeting the definition of ''operational mode'' in 40 CFR 98.98. However, the EPA disagrees with the commenter's implication that the facility can treat that system as meeting the definition of operational mode, even if it is not, for the purposes of calculating uptime. If a facility has abatement systems that are operating outside the established parameters and not meeting the definition of ''operational mode'', the facility must treat that system as being ''down'' for purposes of calculating uptime and emissions, even if the facility is using the lower measured DRE in calculating an average measured DRE. This approach would allow a facility to use a lower DRE value and avoid the expense of immediately repeating a system's DRE measurement, but it would also recognize that facilities should not treat an abatement system as meeting the definition of ''operational mode'' when it is operating outside established parameters and could have variable and unpredictable performance. Therefore, in both situations suggested by the commenter, the final rule requires that the facility treat the system as being down for purposes of calculating uptime until the system operation is restored to the established parameters and it is meeting the definition of operational mode.

The EPA also agrees with the commenter that some facilities may complete the testing needed to establish measured average DRE values in the first or second year of each three year period, and would not be required to perform any additional DRE testing until the start of the next three-year period. The final rule has been revised since proposal to allow a facility to postpone retesting of the affected unit with low DRE until the next required testing period, instead of the next reporting year.

Comment: One commenter (an industry organization) stated that it and its member companies have worked at considerable expense to generate an extensive DRE test database, in support of this rule, so that accurate default DREs could be incorporated into the rule. The commenter noted that the additional data they collected increased the number of fabs contributing data and the representativeness of the data across the installed base of systems inventoried, compared to the data available to develop the default DREs that were in the proposed amendments.

The commenter provided a summary of the member companies' abatement system inventory and the number of individual abatement devices that have been tested in support of the alternative default DRE calculations proposed by the commenter. The commenter contended that the EPA should not utilize any data from devices that were not designed to abate F–GHG or N_2O in the EPA assessment of abatement device performance and the determination of default DREs for the final rule.

The commenter further explained that the testing represented a substantial fraction of the installed base of devices at the companies responding to a 2011 survey of industry association member companies. The survey referenced by the commenter included results from five companies representing nine facilities and approximately 50 percent of the estimated number of abatement systems in U.S. fabs, based on a 2010 ISMI survey.[4] The commenter noted that although the testing is predominantly of one manufacturer's devices (i.e., greater than 95 percent of DRE measurements), this is representative because the U.S. industry's installed base is predominantly that same manufacturer's devices. The commenter explained that in a statistical sense, the sample of devices tested exceeds the usual 10 percent threshold at which a sample is deemed ''large'' and brings into play the ''finite sample correction'' for variance, meaning that the sample is more than a statistical representation and has begun to enumerate the population.

The commenter stated that the revised default DREs in the proposed rule were based primarily on the results of testing carried out by SIA members and their contractors. The information was provided to the EPA and used to develop the revised defaults in the proposed rule amendments. The commenter noted that since that initial submittal, SIA members have carried out additional testing and collected additional test results. The supplemental data reflect an additional 208 tests of POU abatement device performance, including 143 new tests of etch gas abatement and 65 new tests of NF_3 abatement in chamber cleaning. The complete data set with the initial data and the additional data represents three companies and nine different fabs, similar to the previously submitted data. The commenter provided the additional data, as well as a detailed analysis, as attachments to their comment letter, which are available in the docket (docket item EPA–HQ–OAR–2011–0028–0095).

The commenter also noted that they were not able to use the EPA data collection template for new DRE test results because much of the data gathering had either been completed or was underway before the template was provided in the docket to the proposed rule. The commenter stated that they had already begun using an alternative template based on the data template SIA

[4] The survey results were reported on page 2 of EPA–HQ–OAR–2011–0028–0045, SIA Briefing Paper on abatement Issues: Destruction Removal Efficiency (DRE), January 10, 2012. Submitted as part of settlement documents for *SIA* v. *EPA* (D.C. cir. No. 1024).

used to provide data to the EPA previously. The commenter provided the DRE data in an attachment to their comment letter and claimed that the information in the attachment was sufficient to assess the applicability and usefulness of the data while avoiding the confidentiality issues inherent in the template the EPA provided.

Response: The EPA thanks the commenter for the additional DRE data and appreciates the effort expended to generate the DRE test database. We acknowledge the similarities between the EPA data request sheet and the SIA template and have accepted the data provided as meeting the EPA's information needs. We have evaluated the additional data provided and have incorporated the data into the existing abatement device inventory to develop the default DRE factors in Table I–16 of the final rule. The default DRE factors in the final rule are based on an analysis of the average DREs from 343 performance tests, including 11 data points from the EPA's DRE dataset from the Technical Support Document for Process Emissions from Electronics Manufacture (Revised November 2010), 125 tests provided to the EPA from SIA after the finalization of the December 2010 subpart I rule, and the 207 tests provided to the EPA by SIA during the public comment period for this rulemaking.

EPA agrees with the commenter that data collected from abatement devices that are not designed to abate F–GHGs should not be included in the DRE testing database, and the EPA has not considered these data in the development of the default DREs in the final rule. The EPA agrees with the commenter that it is inappropriate to include devices that only incidentally abate F–GHGs and N_2O in the calculation of default DREs, as these devices are unlikely to have the same emissions reductions as systems specifically designed to abate F–GHGs. For the same reason, we have revised 40 CFR 98.94(f)(3) such that facilities may take credit for abatement using the default DREs only if they can certify that the abatement systems were specifically designed to abate F–GHGs or N_2O and have a site maintenance plan that includes the manufacturer's recommendations and specifications for installation, operation, and maintenance for each abatement system. However, the final rule also allows facilities to use measured site-specific DREs to account for emission reductions from systems that were not specifically designed to abate F–GHGs or N_2O.

The EPA remains interested in obtaining more information about whether the abatement system data are fully representative of the abatement system technologies currently installed in the U.S. industry. As discussed in the next response to comment, the EPA generally agrees with the commenter's conclusion that the data provided are representative of the facilities required to report under subpart I. The EPA intends to collect and review additional data to improve the DRE database in the future. The EPA's analysis of the DRE data provided by the commenter and the method used to calculate the default DREs in the final rule are discussed in the response to the next comment.

Comment: Several commenters disagreed with the EPA's method for calculating the default DRE factors that were included in the proposed rule. The EPA calculated the proposed default DRE factors as the arithmetic mean DRE value for a gas and process combination, minus two standard deviations of the population.[5]

Several commenters proposed an alternative method for calculating default DRE factors. The commenters claimed that the suggested approach is conservative, mirrors the approach SIA used in the facility level error analysis for emissions factors (see docket item EPA–HQ–OAR–2011–0028–0074, section 3.4.1), and recognizes that the number of individual devices in a typical fab is an important determinant of variability. The commenter provided data from an industry association survey on the number of abatement systems used at each fab for each gas and process type. The commenter's approach attempted to estimate the lowest average DRE value that any fab could be expected to achieve (''lowest fab-average''). Specifically, it placed the default DRE at the bottom of the distribution of fab averages, by discounting two standard deviations below the observed fab-average DRE. It is important to note the standard deviation used by the commenter is one that described the combined variation of fab-averages and the variation of devices, unlike the EPA method that used only the standard deviation of individual device performance (i.e., the population of all devices).

The commenters stated that fab-level averages should be the basis of emissions reporting because no fab has just one POU device, and site-specific DREs developed under the rule would be applied as fab-averages. They stated that discounting the default to the lowest expected fab-average would still fully protect against the risk of under-estimating emissions in reporting due to a default DRE that is too high. The commenters suggested that the majority of fabs would have a higher average and would still have an incentive and mechanism to obtain site-specific DREs.

The commenters asserted that their approach uses a well-accepted statistical methodology called Components of Variance Analysis to model the variance in the DRE data and separately identify the variation in the average DRE among fabs versus the variation in DRE among individual devices in a fab. The variance components method applies a random effects model to the data for the purpose of identifying the sources of variance in a sample and making inferences regarding the size (magnitude) of each source of variance. A random effects model is used because it is unknown in advance whether a particular fab or device is above or below the average for fabs or for devices within the fab. The commenter provided references for background information on the components of variance analysis.

The commenter provided a detailed description of their approach and a summary of default DREs calculated using their approach and compared to the EPA's proposed default values.[6] The commenter contended that for each gas and process combination, the alternative defaults were conservative representations of the average performance of abatement devices in the test data because, by design, they targeted the fab with the lowest average DRE.

The commenter urged the EPA to reconsider its method for discounting the available data to develop default DRE values. The commenter recommended that the EPA adopt their procedure documented in their comment letter and establish revised default DREs comparable to their developed alternative DREs for the following reasons:

(1) The EPA method of default DRE calculation in the proposed rule was overly conservative because it discounted for the entire variability of individual device performance that resulted from the varied operating conditions existing in a semiconductor manufacturing fab. The commenter claimed their method is designed to discount to a similar degree, but only for the variability that exists in fab-average DREs.

(2) In determining the average DRE for a fab, the individual device variability is attenuated by the large number of

[5] p. 3 of Technical Support for Accounting for Destruction or Removal Efficiency for Electronics Manufacturing Facilities under Subpart I, EPA–HQ–OAR–2011–0028–0082.

[6] See EPA–HQ–OAR–2011–0028–0095.

abatement devices in service in each fab. As with the variability in the emissions factors, considering the large number of individual devices in an abated fab brings the overall fab average DRE much closer to the overall average of the entire database.

(3) For all of the gas/process type combinations, the alternative default DREs developed using the commenters' recommended approach are less than the average DREs observed in the majority of the fabs that provided testing, demonstrating sufficient conservatism to prevent an under-estimation of emissions when the alternative default DREs are used in reporting. While they are higher than the default DREs in the proposed rule, the commenters stated they are designed to represent the fab with the lowest average DRE. They stated that very few fabs would have lower average DREs and, due to the expense of testing, fabs would not obtain site-specific DREs in all cases where their actual DREs are higher. The commenter asserted that by using their default DREs, reported GHG emissions would not be understated.

Response: The EPA agrees with the commenters' proposed ''Components of Variance Analysis'' averaging method for developing the default DREs in Table I–16 of the proposed rule. The EPA acknowledges that the averaging method used in the proposed rule may result in a lower default DRE than may be present at fabs using many individual abatement devices. This approach was used in the development of the proposed rule based on the limitations in the information available at the time of the proposed rulemaking. About 95 percent of the data available for the proposed DRE values came from systems from a single manufacturer, and the EPA was concerned that the data might not be representative of the performance of other device manufacturers. However, for the 2011 data reporting year, 50 facilities reported GHG emissions to the EPA under subpart I. Of those 50 facilities, 17 reported having abatements systems and the vast majority of those 17 reported abatement systems from the same manufacturer. Only four facilities with abatement systems had no systems from the manufacturer that represented greater than 95 percent of the DRE test data points. Therefore, the EPA generally agrees with the commenter's conclusion that the data provided are representative of the facilities required to report under subpart I that have abatement systems. In addition, as noted in comments earlier in this section, the EPA received additional data during the public comment period that was incorporated into the DRE database. The expanded data provide average DREs from 343 performance tests. This more robust dataset provides greater confidence for the establishment of default DREs for specific gas and process types/subtypes.

The EPA agrees that the approach recommended by the commenters is a valid statistical method that will account for the variance in the average DRE from each fab in addition to the variance in the average DRE from individual devices in each fab. The EPA also agrees with the commenter that this approach is more appropriate for the final rule than the approach used at proposal because the survey data provided by the commenter and the results of the 2011 GHGRP reporting year have demonstrated that the large majority of abatement systems in use are from the same manufacturer for which the majority of the data were collected. Therefore, the EPA's concerns with the representativeness of the DRE data documented at proposal have been largely addressed by the data received in the public comments and by the results of the 2011 annual GHG reports. The EPA remains interested in working with industry stakeholders to develop a more robust DRE dataset that includes all abatement system manufacturers.

The approach recommended by commenters takes the average minus two times the standard deviation of the average observed DRE (See Docket Id. No. EPA–HQ–OAR–2011–0028–0095). The standard deviation used is one that describes the variation of fab-averages. The method first discounts the observed average for the standard deviation among fabs, and places the default at the bottom of the statistical distribution for the lowest fab-average, then accounts for the effect of individual device performance. As noted by the commenter, using the recommended approach, the calculated DREs represent the fab with the lowest average DRE, which still results in a conservative estimate. The EPA agrees that this approach is appropriate and has adopted the method to determine the default DREs for each gas and process type/subtype in the final rule. In cases where no new data were received (e.g., for N_2O using processes and other F–GHGs not listed), we have retained the default DRE in the current subpart I of 60 percent, as described in Table 3 to the preamble to the proposed amendments (see 77 FR 63563). The following table shows the sample size, mean, standard deviation, and the calculated default DRE for each gas and process type using the final expanded dataset.

TABLE 3—SUMMARY OF CALCULATED DEFAULT DRE WHERE ADDITIONAL DATA WERE PROVIDED

Gas/process type	Number of data points available	Mean	Standard deviations		Calculated DRE (using components of variance analysis)
			Fabs	Devices	
	Etch				
CF_4	66	83.56	0.0	18.31	75.4
CH_3F	4	99.24	0.0	0.93	98.4
CHF_3	43	99.10	0.69	1.14	97.4
CH_2F_2	30	98.74	0.62	1.59	96.8
C_2F_6	5	98.84	1.85	0.50	95.1
C_4F_6	9	98.55	0.0	2.54	96.3
C_4F_8	24	98.50	0.75	1.69	96.4
C_5F_8	1	96.59	n/a	n/a	96.6
SF_6	20	98.69	0.66	1.01	97.2
NF_3	31	98.51	0.0	4.20	96.3
	Chamber Clean				

TABLE 3—SUMMARY OF CALCULATED DEFAULT DRE WHERE ADDITIONAL DATA WERE PROVIDED—Continued

Gas/process type	Number of data points available	Mean	Standard deviations		Calculated DRE (using components of variance analysis)
			Fabs	Devices	
NF_3 (All sub-types combined)	110	93.32	1.83	9.38	87.8

However, as described in the response to another comment in this section of the preamble, the EPA is including in the final rule a single combined default DRE value for all carbon-based F–GHG used in the etch process, other than CF_4, instead of individual DRE values.

The EPA also notes that the final rule provides provisions for gathering additional DRE performance data in future years for updating and revising the default DREs (see 40 CFR 98.96(y)). The EPA would consider additional data that is representative of other abatement system designs and manufacturers for update of the default DREs, when those data become available.

The final rule also provides for facilities who do not wish to use the default DREs for reporting purposes by including the option to perform site-specific DRE testing. We have revised the final rule to clarify that facilities have the option to develop site specific DREs for specific gas and process combinations on a fab-basis, while also using default DREs for other gas and process combinations. These final rule options allow flexibility and reduce burden for facilities who wish to reflect the emission reductions from abatement systems for reporting purposes.

Comment: One commenter asked that EPA revisit the conclusion that a lack of DRE data for C_3F_8 and C_5F_8 requires that they be subject to default DRE factors of 60 percent. The current data set includes one DRE value for C_5F_8 and no DRE values for C_3F_8. The commenter noted that the chemistry of C_3F_8 is very similar to C_2F_6 because both are fully fluorinated molecules, although C_3F_8 will be more amenable to abatement because of weaker molecular bonds associated with its additional carbon atom when compared to C_2F_6. Because of the similarity, the commenter stated the C_2F_6 DRE data should be recognized as applicable to C_3F_8.

The commenter made a similar argument for C_5F_8, and compared it to C_4F_8 with an average DRE of 98.5 percent, and also noted the one DRE measurement for C_5F_8 of 96.6 percent.

Response: The EPA agrees with the commenter that for these two compounds, the availability of DRE data for similar compounds justifies the use of a higher default DRE than the 60 percent included in the current rule and in the proposed amendments. The C_3F_8 and C_5F_8 compounds are more amenable to combustion than the C_2F_6 and C_4F_8, respectively, because of the presence of the additional carbon atom in the case of C_3F_8, and the presence of an additional carbon and the C=C double bond in the case of C_5F_8. Therefore, the same default DREs for C_2F_6 and C_4F_8 can be applied to C_3F_8 and C_5F_8, respectively (See Table 4 of this preamble).

Comment: One commenter asked that the EPA consider a single shared DRE value for the carbon-based etch gases (besides CF_4) to simplify calculations. The commenter noted that based on the commenter's method of calculating the default DREs, a single default of 97 percent would be appropriate. The commenter noted that in the proposed amendments, the EPA proposed a single default of 98 percent in proposed Table I–16 of subpart I for the gases for which the EPA had DRE data (CHF_3, CH_2F_2, C_4F_8, and C_4F_6).

Response: In the proposed rule, the EPA included NF_3 and SF_6 among the etch gases CHF_3, CH_2F_2, C_4F_8, and C_4F_6 and assigned a DRE of 98 percent due to similarities in the calculated DREs for each gas. As discussed in this section, the EPA has incorporated the additional DRE data submitted during the public comment period into the existing dataset to calculate default DREs for the individual compounds. The EPA recognizes that the calculated DREs for the carbon-based etch gases (other than CF_4) are grouped in the range of 95 to 98 percent, using the most recent data and methodology discussed earlier in this section. The EPA agrees with the commenter that it would simplify calculations to group together the carbon-based etch gases (other than CF_4) and assign a single default DRE to theses etch gases.

For the combined carbon-based etch gases, the default DRE for combined gases is calculated similarly to the default DRE for individual gases, with the exception that a fixed number of DRE counts, fab counts, and abatement systems per fab are assumed for each gas so that the variance components for fabs and devices are the same for each gas. This approach is used in lieu of the raw DRE average for each gas (and the associated number of data DRE values, fabs, and abatement systems) because the raw averages for each gas include variations between fabs, and are therefore less precise. For example, even if a high raw average is observed for an individual gas, this may be caused by the fact that a disproportionate number of the observations are coming from a fab which has ''above average'' DRE.

The EPA calculated the variance components (σ(Fabs) and σ(Devices)) for the carbon-based etch gases using statistical software. The results are shown in Table 4 below. The variance components only describe the variability between fabs and between devices (any difference between gases is already accounted for by the gas effect, which is assumed to be fixed). Therefore, these values do not change for each gas. The default DREs are averaged over all the carbon-based etch gases (other than CF_4) to produce a group-average DRE of 96.7 percent, which the EPA has rounded to a value of 97 percent in Table I–16 in the final rule. This default value will also apply to C_3F_8 and C_5F_8, as discussed in the response to the previous comment, even though there were no DRE data for C_3F_8 and only one DRE data point for C_5F_8.

TABLE 4—COMBINED ETCH DRE FOR NON-CF_4 CARBON-BASED F–GHG

Input gas	DRE fixed effect	DRE count	Fabs	σ(Fabs)	σ(Devices)	N	Default DRE	Group-average DRE
C_2F_6	98.6	116	5	0.631	1.523	5	96.76	
C_4F_6	98.6	116	5	0.631	1.523	5	96.74	
C_4F_8	98.7	116	5	0.631	1.523	5	96.80	
C_5F_8	96.8	116	5	0.631	1.523	5	94.97	96.71
CH_2F_2	98.9	116	5	0.631	1.523	5	97.00	
CH_3F	99.2	116	5	0.631	1.523	5	97.33	
CHF_3	99.2	116	5	0.631	1.523	5	97.35	

Comment: Several commenters expressed concern regarding the certification requirements for abatement systems under proposed 40 CFR 98.94(f) and 40 CFR 98.96(q).

In regards to the requirement that reporters who wish to account for abatement must certify and document/verify that the abatement devices were installed, operated, and maintained in accordance with manufacturer recommendations and specifications, one commenter stated that manufacturer's specifications may no longer be available. The comment explained that even when they are available, the specifications can be general and do not specifically call out how to manage and maintain the abatement devices. Typically, this requires the fab to create a site-specific maintenance plan, which will be based on a combination of available manufacturer's updated specifications and/or the fab-specific procedures developed through subsequent operating and maintenance experience. Material changes to the manufacturer's specification requirements for their abatement systems may be necessary to address process or equipment specific requirements in an operating fab.

The commenter noted that for existing older abatement systems, it is not always possible to determine that they were installed in accordance with manufacturer specifications at the time of their original installation, which in many cases preceded this rule. Records of the manufacturer's intent and installation requirements may not have existed and, if they did exist, they were not kept. Importantly, process tool(s) and gases/liquid precursors may have changed since the initial installation. It is critical that abatement systems be operated and maintained properly in the periods when emissions are being reported and that the current infrastructure and system configuration are appropriate for the abatement application. It is not germane whether the abatement systems were installed in a particular way in the past, as some of the systems at specific fabs have been in operation for up to a decade.

The commenter further explained that some process types may require parameters outside of the manufacturer's specification requirements to address complications introduced by specific material types, reaction products, or to meet specific safety requirements. ''Tuning'' of operating parameters and/or maintenance schedules different from the abatement system manufacturer's recommendations are required to optimize system operation in these cases. The commenter noted that examples of maintenance plan adjustments beyond the original manufacturer's recommendations to maximize the DRE for CF_4 abatement were discussed in docket EPA–HQ–OAR–2011–0028–0046 item 4a.[7]

The commenter contended that the purpose of the site maintenance plan is to ensure that the abatement devices are operated and maintained correctly. The commenter stated that the plan should be a dynamic document that incorporates improvements in how the abatement devices are serviced and maintained, including corrective actions that are taken when the causes of abatement system failure or outage are determined. In addition, proper set-up of abatement device in GHG abatement mode after maintenance will be addressed. The commenter reasoned that, by their nature, these plans may depart from the original manufacturer's specifications.

Response: The EPA agrees with the commenter that there are scenarios in which a facility may not be able to rely on manufacturer's specifications (e.g., if they are unavailable), or where the facility may have a need to adopt fab-specific procedures to optimize system performance. As such, we have revised 40 CFR 98.94(f)(1) and 40 CFR 98.96(q) to specify that facilities must certify and document that the abatement systems are properly installed, operated, and maintained according to the site maintenance plan for abatement systems that is developed and maintained in records as specified in 40 CFR 98.97(d).

However, the EPA also recognizes that manufacturers specifications are still important to ensuring the proper installation and operation of abatement systems and the reference to manufacturers specifications has been retained in 40 CFR 98.97(d)(9). As noted in docket item EPA–HQ–OAR–2011–0028–0046, item 4, cited by the commenter and incorporated into the ''Technical Support for Accounting for Destruction or Removal Efficiency for Electronics Manufacturing Facilities under Subpart I'' (see Docket ID. No. EPA–HQ–OAR–2011–0028–0082), during the review of DRE test data for the revision of the default DRE, the EPA and SIA noted that some low CF_4 and NF_3 DREs in the test data resulted from variation in flows through the abatement system and from operating and maintaining the abatement systems outside of the manufacturer specifications. Specifically, low CF_4 DREs associated with etch processes were found to be the result of systems operating outside the manufacturers' recommended set points for flow rate and/or pressure that should have been verified during abatement installation. The document cited by the commenter reported that once the abatement systems were returned to the manufacturer's specifications, the DRE also returned to higher levels comparable to those of other systems. Because the high variability in the available DRE data was directly associated with operating outside of the manufacturer's specifications, the EPA proposed a requirement for facilities to develop, follow, and keep on-site maintenance plans for abatement systems that are built on the manufacturer's recommended installation, operation, and maintenance program, and that must include a defined preventive maintenance process and checklist and a corrective action

[7] Questions Generated from SIA/EPA Conference Calls and Outstanding Questions from Work Plan appendices, March 29, 2012.

process to follow whenever an abatement system fails to operate properly.

Therefore, the EPA has determined that although a certification may rely on the implementation of site maintenance plans for abatement systems, it is also necessary to ensure that facilities rely on manufacturer's recommendations and specifications to the extent possible, particularly when using the default DRE values. Therefore, if the facility uses the emissions estimation methods in 40 CFR 98.93(a), (b), and (i) and uses the default DRE values when claiming abatement for reporting purposes, the final site maintenance plan requirements in 40 CFR 98.97(d)(9) for abatement systems must be based on the manufacturer's recommendations and specifications for installation, operation, and maintenance. If the facility is using properly measured site-specific DRE values, the final site maintenance plan must include the manufacturer's recommendations and specifications for installation, operation, and maintenance, where available. For a facility to use the default DREs, the EPA needs assurance that the abatement system is installed, operated, and maintained in accordance with the manufacturer's specifications. Otherwise, the EPA would be unable to verify that the default DREs are met without further validation testing. The site maintenance plan for abatement systems must also include documentation where the operation and maintenance deviates from the manufacturer's specifications, including an explanation of how the deviations do not negatively affect the performance or destruction or removal efficiency of the abatement system. For example, the site maintenance plan may include documentation where the process optimizes system performance (e.g., more frequent maintenance checks or tighter operating parameters). Finally, facilities who elect to claim abatement for reporting purposes and want to use the default DRE factors must also certify that the abatement systems are specifically designed for F–GHG abatement (or N_2O abatement, as appropriate). (This certification is not needed for facilities using a measured site-specific DRE value.) The facility must also have a site maintenance plan that is based on the manufacturer's recommendations and specifications for each abatement system These are minimal requirements that are necessary to verify that abatement systems are operating consistently at or above the default DRE. We note that the commenter provided several additional recommendations for changes to the proposed provisions for certifications regarding abatement systems and the use of default and site-specific DRE values. Those comments and our responses can be found in ''Reporting of Greenhouse Gases—Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Response to Public Comment'' (see EPA–HQ–OAR–2011–0028).

Comment: One commenter stated that the proposed rule requires a facility using the stack testing alternative to make assumptions for abatement system DREs in order to adjust annual emissions calculations for abatement downtime and does not allow one to assume a DRE of zero, as would be an option under the emission factor method. The commenter stated that this is a logical approach for a stack test method; however, other portions of the rule require that a DRE assumption of zero be used if a facility cannot meet certain requirements for certifying the design and installation of an abatement device. The commenter concluded that the net result is that, as the rule was proposed, a facility that is unable to meet these certification requirements (for example, one with older abatement equipment where such certification may be difficult to obtain) is effectively disqualified from using the stack test method as they may not assume zero efficiency, yet cannot meet the requirements to assume something other than zero. The commenter recommended revising the DRE certification requirements such that the use of default DRE factors is dependent upon certifying and documenting that the systems are installed, operated, and maintained according to the site maintenance plan, and not according to manufacturers specifications. The commenter stated that this is consistent with the way in which other pollution control devices are handled in many facility air permits.

Response: In stack testing, the measured emissions used to calculate fab-specific emission factors will reflect the effect of all abatement systems, including those not specifically designed for F–GHG abatement that still achieve some incidental F–GHG abatement. However, the EPA recognizes that facilities using the stack testing method may not be able to certify that the abatement systems are specifically designed to abate F–GHGs, although those systems may achieve incidental control of F–GHGs that could have an effect on emissions. As discussed earlier in this section, we have revised the definition of ''abatement system'' to clarify that the abatement system requirements of subpart I only apply to abatement systems that are designed to abate F–GHGs (and/or N_2O, but N_2O is not included in the stack testing alternative), or for which the DRE has been measured according to 40 CFR 98.94. Facilities using the stack testing alternative would, in their emissions calculations, account for the effect of abatement systems that are specifically designed for F–GHG abatement and for systems for which the facility measured the site-specific DRE according to 40 CFR 98.94. In the case of abatement systems that are not specifically designed to abate F–GHG, the reporter may elect to not include the effect of those systems in their emissions calculations. In all cases where the reporter is accounting for the effect of the abatement systems, the reporter must also comply with the other monitoring and quality assurance requirements for abatement systems in subpart I. In all other cases, the reporters would assume that the DRE is zero for abatement systems that are not designed for abatement of F–GHG and would not account for the downtime of those systems.

In order to ensure that the abatement systems, as defined in 40 CFR 98.98 and included in the emission calculations, are operated properly and consistently following the initial stack test, the EPA is requiring that facilities must certify that the abatement system is operated and maintained in accordance with the site maintenance plan for abatement systems in 40 CFR 98.97(d). Facilities who elect to use the stack testing alternative in 40 CFR 98.93(i) and who elect to use the default DREs must base the site maintenance plan on the abatement system manufacturer's recommendations and specifications. If manufacturer's recommendations and specifications are unavailable, the facility using the stack test method must use a site-specific DRE, which can be developed concurrently. Facilities using the stack testing method and the default DREs must also certify that the abatement systems are designed to abate F–GHGs.

Finally, the EPA also needs to ensure that facilities using the stack test alternative account for the abatement systems that are present when calculating their facility annual emissions. We have revised the final rule to clarify that facilities using the stack test alternative must certify that all abatement systems that are designed to abate F–GHGs, or for which the DRE has been measured, are fully accounted for when calculating annual emissions and accounting for excess emissions from

downtime (i.e., facilities are accounting for the uptime and DREs of these systems, either using the default DREs or site-specific DRES, in Equations I–21 through I–24). Facilities would only apply the default DREs to account for abatement from those systems that meet the certification requirements and are specifically designed to abate F–GHGs. They would use a site-specific DRE for systems for which the facility had measured a site-specific DRE. If they elect to account for abatement from systems that are not specifically designed to abate F–GHGs, they would use a site-specific DRE for these systems. These requirements are necessary to ensure that the calculated emission factors are representative and accurately reflect abatement.

6. Abatement System Uptime for Facilities That Manufacture Electronics

Comment: One commenter proposed revisions to the definition of uptime such that uptime is defined as ''the ratio of the total time during which the abatement system is in an operational mode and operating in accordance with the site abatement system maintenance plan, to the total time during which production process tool(s) connected to that abatement system are normally in operation.''

Response: The EPA is not revising the definition of ''uptime'' as suggested by the commenter. The EPA previously defined ''operational mode'' as ''the time in which an abatement system is properly installed, maintained, and operated according to manufacturers' specifications as required in 40 CFR 98.93(f)(1). This includes being properly operated within the range of parameters as specified in the operations manual provided by the system manufacturer.'' Consistent with the changes to the abatement system certification requirements in the final rule, the EPA has revised the definition of ''operational mode'' to reflect that the abatement system is properly installed, maintained, and operated according to the site maintenance plan for abatement systems. Therefore, the revisions to the definition of ''uptime'' as requested by the commenter are not necessary, as an abatement system in operational mode must be operated within the parameters of the site maintenance plan.

7. Triennial Technology Report for Semiconductor Manufacturing

Comment: Several commenters expressed concern with an option for the triennial technology report on which the EPA requested comment, specifically the option to require additional information beyond that proposed in 40 CFR 98.96(y). The preamble to the proposed amendments requested comment on requiring that the reports include an analysis of the effect of the introduction of new processes on existing tools, where a new process could be defined as one that used a markedly different gas mixture than the mixture used by previous processes applied to achieve the same end (i.e., etch the same film or feature), or that included a change in the radio frequency (RF) power and gas flow rate (see 77 FR 63566). Commenters stated that these suggested requirements appear to resurrect the recipe testing requirements established in the original subpart I regulation published in December of 2010 and which were specifically called out as unworkable in SIA's petition for reconsideration. One commenter stated that, as described in the petition for reconsideration, the recipe testing requirements created unacceptable intellectual property risk, potential national security concerns, significant disruption of fab operations, and unreasonable and excessive economic impact. The commenters cited as examples the impacts (cost and business disruption) of process emissions factor testing that were experienced during the additional emissions factor testing work that was completed in support of the default factors that are in Subpart I. The commenters reported that in one fab, testing required two weeks of time and cost over $25,000 (not including lost production and fab staff support time) just to measure 12 emissions factors for 5 tools. The ISMI technology transfer report ''2010 ISMI Analysis of the Impact of Final Mandatory Reporting Rule Subpart I on U.S. Semiconductor Facilities'' issued January 31, 2011 provides additional description of the impact of recipe level testing.

The commenter further explained that the cost to test all new and revised process recipes is very large. On average, each large facility introduces 40 new etch processes per year and changes 56 etch recipes per year; for 29 large facilities the testing cost per year equates to $17 million or $51 million for three years. This assumes $35,000 for testing/week and six recipes tested/week, according to the commenter.

The commenter noted that the cost for tool downtime for the testing over the three years would be an additional $6.9 million. (This assumes 11 hours of downtime for an 8 hour test and 3 hours for tool requalification; $1.5 million per/year for etch tool downtime.) Total cost for testing of tools is on the order of $58 million.

The commenter asserted that the cost of any testing of POU abatement devices for DRE changes would be additional. Costs for large leading-edge technology fabs would be significantly higher than the industry average numbers by a factor of 10 or more.

The commenter stated that in the economic impact assessment for the proposed amendments (EPA–HQ–OAR–2011–0028–0081), the EPA does not include the cost for preparing the triennial report, ''. . . given that the EPA does not expect this requirement to significantly affect the compliance costs either on a per facility or a national basis . . .'' The commenter estimated that preparing a triennial report, as proposed in the preamble to the revised subpart I, would require the effort of several full time employees. The commenter stated that their intent with regards to preparing the triennial report and developing a company or industry plan to perform testing to assess the impact of new (meaning significantly different from existing) processes, equipment, and technologies on default emissions factors and default DRES, is to enable the industry to pool its resources to most efficiently measure, collect, and report the data needed to assess these changes. The commenter further added that the adoption and propagation of distinctly new processes, equipment, and technologies into high-volume manufacturing occurs slowly, allowing a reasoned, considered plan to be developed to assess the impact. Additionally, the commenter claimed that their statistical assessment of the emissions factor data for current manufacturing processes and equipment indicate that the magnitude of the emissions factor is primarily dependent on the wafer size and the gas type, suggesting that significant changes are unlikely to occur frequently because these two variables are not changed frequently.

The commenter concluded that the level of information requested and the cost associated with measuring and collecting data according to the expanded scope of triennial reporting requirements described in the preamble are excessive and the final rule should not include more than what is included in the proposed 40 CFR 98.96(y).

Response: Except for a minor technical correction, EPA is finalizing the requirements for the triennial technology report as proposed at 40 CFR 98.96(y). Facilities are not required to implement recipe-specific testing in the first phase of the triennial technology review, as some commenters inferred from the request for comment in the preamble to the proposed amendments.

Nevertheless, EPA encourages, but does not require, facilities to acquire measurements of gas utilization rates, by-product formation rates, and DREs that reflect the impact of technology changes for the triennial report, because such measurements would be useful for informing future changes to the rule.

To the extent that facilities acquire these measurements, either because they perform the measurements themselves or because they receive them from tool manufacturers, 40 CFR 98.96(y)(2)(iv) requires facilities to submit them as part of the triennial report. That provision states facilities must ''provide any utilization and by-product formation rates and/or destruction or removal efficiency data that have been collected in the previous 3 years that support the changes in semiconductor manufacturing processes described in the report.'' This requirement refers to all the rate or DRE measurements collected in the previous 3 years that reflect the impact of any technology changes during that time. Submission of specific selections or subsets of those measurements would not meet this requirement because such selections or subsets may not be representative. We anticipate that the types of information submitted would include information similar to that submitted to inform the default emission factors and default DREs in today's rule.

In the proposal, we also requested comment on whether triennial reports should include gas utilization rates and by-product formation rates measured ''for all new tools acquired by the facility over the previous 3 years as well as gas utilization rates and by-product formation rates measured for new processes run on existing tools'' (77 FR 63566). For these measurements, testing data for new tool models is often available from the manufacturer or from performance tests as new tool models are installed. The EPA anticipates that this information could be used to inform future changes to the rule and could be supplied through the triennial report. While the EPA is not requiring that this information be included in the triennial report, the agency encourages reporters to include this information on a voluntary basis where practical.

The final rule does not require the triennial report to consider process or technology changes at the recipe-specific level, nor does it require facilities to collect any recipe-specific data. However, the report should address whether, over time, the facility has incrementally implemented process or technology changes that have now cumulatively resulted in a wide-spread effect on emission factors or DRE factors. The report would not need to consider each incremental change separately. For example, the report does not need to consider differences in flow rates among individual recipes and their effect on the emission rates of individual gases. However, if the industry implements or adopts a technology change that substantially affects the average flow rate for a given process type such that the current default emission factors may no longer be representative, the cause and potential impact of that change in flow rate should be addressed in the triennial technology review report (though not detailed at the recipe-level). See Section II.A.12 of this preamble for additional discussion of the contents of the triennial report. The EPA agrees with the commenter that the triennial technology review should avoid the burden and potential disclosure concern associated with the provisions for reporting of recipe-specific information that appear in the December 2010 promulgated rule and that are removed from this amended rule.

We note that commenters provided additional input regarding the triennial technology report. Those comments and our responses can be found in ''Reporting of Greenhouse Gases—Technical Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Response to Public Comment'' (see EPA–HQ–OAR–2011–0028).

8. Final Amendments to Reporting and Recordkeeping

Comment: One commenter noted that a facility may have multiple fabs, which each process different wafer sizes. The commenter recommended that the language in 40 CFR 98.96(a) and (b) apply to fabs rather than facilities. The commenter noted that the wafer size and capacity could then be reported for each fab, rather than trying to report for the entire facility.

Response: The EPA appreciates the input provided by the commenter regarding facility and fab level reporting requirements. The EPA agrees with the commenter that the language in 40 CFR 98.96(a) and (b) should apply to fabs rather than facilities. As a result, the EPA is promulgating the final amendments to subpart I with the proposed modifications to 40 CFR 98.96(a) and (b).

Comment: One commenter asserted that the facility-wide DRE reporting requirement under 40 CFR 98.96(r) using Equations I–26, I–27, and I–28, should not apply to the stack test alternative. The commenter noted that the derivation of a facility-wide DRE is unnecessarily complicated, subject to error, and provides no material benefit to the reporting of emissions under the stack test option. According to the commenter, the EPA's proposed requirement to use these equations entails an artificial determination of how much of a facility's emissions are coming from the process tools versus the abatement systems, and as such is complicated, somewhat arbitrary, and potentially subject to errors. The commenter stated that the requirement to determine an effective, facility-wide or fab-wide DRE using equations I–26 and I–28 for facilities that choose the stack testing method (40 CFR 98.93(i)) is not logical and should be removed from the rule.

The commenter explained that one of the benefits of the stack testing method is that it eliminates the need to test individual abatement units, which is costly. The stack test data combines the impact of the gas utilization factors in the equipment and the abatement system DREs into a single emissions factor for the facility. Whether a fab chooses to generate and use site-specific DREs or use the default DRES, the DREs will only be used to adjust fab emissions for abatement system downtime; adjustments which are expected to have a small influence on the total site emissions. The proposal to calculate an effective DRE for the facility would require using complicated calculations and apportioning gas use to abatement units.

The commenter also stated that attempting to compute a combined DRE for a multi-fab facility that uses the emissions factor method at one or more fabs and the stack testing method at the other(s) also seems to be unnecessary. The commenter proposed revisions that they claimed simplified the reporting of a facility-wide DRE value by calculating only a fab-level DRE instead of a facility-wide DRE.

The commenter suggested as an alternative that the EPA use a modification to proposed Equation I–24 of subpart I because Equation I–24 calculates the average weighted fraction of F–GHG input gas i destroyed or removed in abatement systems. The commenter stated that the EPA should modify equation I–24, adding the multiplication of both the numerator and denominator terms by the GWP for each gas. The commenter stated this would provide an estimate of the site-wide DRE based on the removal of CO_2e emissions that will have as much meaning as a fab-wide DRE calculated using equations I–26 and I–28, while requiring much less work on the part of the fab.

Response: The EPA disagrees with the commenter that the facility-wide DRE calculated by Equations I–26, I–27, and I–28 in proposed 40 CFR 98.96(r) is not relevant for facilities using the stack testing alternative. As explained in the preamble to the proposed amendments (77 FR 63569), the EPA included a requirement that facilities report a facility-wide DRE factor to assist in our verification of reported GHG emissions. In the amendments to subpart I, we proposed to move the information on the number and DRE of abatement systems at each facility from the reporting requirements to the recordkeeping requirements, and these changes are being made in the final rule. In order to determine the extent to which GHG emissions from this category are being abated, we proposed to require facilities to report a facility-wide DRE. The EPA's intent of requiring a facility-wide DRE is also to gain an understanding of the extent to which a fab or facility's emissions are abated in the absence of facilities reporting information that may raise potential disclosure concerns, such as actual DRE values for gases and process types. This information can also be used to help verify reported emissions. This rationale is equally valid for facilities using the default emission factor method in 40 CFR 98.93(a)

Contrary to the reporters interpretation, the facility-wide DRE is calculated using inputs, emissions, and other data already collected and calculated to report annual F–GHG and N_2O emissions and does not require the collection of new data. The terms used in the equations to calculate the facility-wide DRE for a facility using the stack testing alternative are already calculated by the facility to report emissions. Reporters using the stack testing alternative would not have to measure the DRE of abatement systems unless they were doing so to determine the DRE of systems that were not specifically designed to abate F–GHG. Otherwise they could use default DREs for systems that were specifically designed for F–GHG abatement. Similarly, facilities would not have to separately apportion gas usage to tools with abatement systems in Equation I–28 because that is already done to calculate emissions as part of other equations in the stack testing alternative. First, the commenter states that DREs are only used under the stack test option to adjust fab emissions for abatement system downtime, and that downtime is expected to have a small influence on the total site emissions. While we agree that the inclusion of an adjustment for abatement system downtime may have a small influence on the total site emissions as calculated, the argument made by the commenter does not provide justification for removing the requirement for a facility to report a fab-wide DRE. Even when the uptime for a fab is relatively high, the fact remains that the fab is abated and no other reporting requirement provides the EPA with an estimate of the extent of the abatement.

Second, the commenter states that using Equations I–26 and I–28 for the stack test alternative is unnecessary and the commenter proposes using a modification of Equation I–24 that incorporates multiplication by GWP values. We disagree that the use of Equations I–26 and I–28 is unnecessary for fabs electing to use the stack test option. First, Equation I–28 is necessary to account for the fact that a fab may not be fully abated and a portion of the input gas consumed in the fab is used by tools that are unabated. The result of Equation I–24 does not account for apportionment between abated and unabated tools. Apportionment is accounted for in Equation I–28 by the ''a_{if}'' and ''a_f'' terms, just as in Equation I–21 and I–22. Reporting the result of Equation I–24, regardless of any accounting for GWPs, would result in an artificially high fab-wide DRE because Equation I–24 does not account for the portion of gases consumed by tools that are not abated. Equation I–26 is also necessary because reporters are not allowed to calculate N_2O emissions using the stack test method. As a result, Equation I–26 incorporates the abatement of N_2O emissions into the effective fab-wide DRE calculation.

Finally, we disagree that the equations under 40 CFR 98.96(r) are unnecessarily complicated. Although the equations may appear complicated, the equations, in fact, use many of the same data operations already performed to calculate emissions under either the default emission factor approach or the stack testing alternative. For example, the summation of F–GHGs and N_2O contained in the numerator of Equation I–26 is easily calculated from the emissions already reported under 40 CFR 98.96(c). The first term in Equation I–28 is the same as the second term in Equation I–21, except that the value ''$(1–UT_f)$'' has been replaced with ''GWP_i'' for the input gas. The case is the same for the second term in Equation I–28; it is identical to the second term in Equation I–22, except again the value ''$(1–UT_f)$'' has been replaced with ''GWP_k'' for the by-product gas. Therefore, due to the similarity of terms, we believe that Equation I–28 is no more burdensome or complicated than Equation I–21 or I–22.

We agree with the commenter that facilities should be required to report a fab-wide DRE instead of a combined DRE for a multi-fab facility. Reporting a fab-wide DRE, instead of a facility-wide DRE, will provide the EPA with a more detailed assessment of the extent to which GHG emissions are being abated. The fab-wide DRE will also simplify the calculation requirements for reporters because they will not have to use an extra equation to combine the DREs when a facility uses the emission factor method and the stack testing alternative in different fabs at the same facility.

In light of the commenter's suggestion, we are finalizing the requirement for reporters to provide effective DRE on a fab basis, instead of a facility basis. We disagree, however, with the commenter's assertion that a facility that chooses the stack test option to calculate emissions from a fab should not be required to report an effective fab-wide DRE, and as such, we are requiring all facilities to report an effective fab-wide DRE, regardless of their emission calculation methodology.

9. Technical Corrections in Response to Public Comments

The final rule includes numerous minor technical changes as a result of addressing major public comments. These changes are summarized in the document, ''Reporting of Greenhouse Gases—Technical Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Response to Public Comment'' (see EPA–HQ–OAR–2011–0028).

III. Confidentiality Determinations for New and Revised Subpart I Data Elements and Responses to Public Comments

A. Final Confidentiality Determinations for New and Revised Subpart I Data Elements

In this action, we have added or revised 25 new data reporting requirements in subpart I. We have assigned each of these new or revised data elements in subpart I, a direct emitter subpart, to one of the direct emitter data categories created in the 2011 Final CBI Rule.[8] The 25 new or revised data elements are assigned to one of the 10 data categories listed in

[8] The 2011 Final CBI Rule created 11 direct emitter date categories, including the 10 data categories listed in Table 5 of this preamble and an inputs to emissions equations data category. However, EPA has not made final confidentiality determinations for any data element assigned to the inputs to emissions equations data category either in the 2011 Final CBI Rule or any other rulemaking.

Table 5 of this preamble. Please see the memorandum titled ''Final Data Category Assignments for Subpart I 2012 Amendments'' in Docket EPA–HQ–OAR–2011–0028 for a list of the 25 new or revised data elements in this subpart and their final category assignments.

TABLE 5—SUMMARY OF FINAL CONFIDENTIALITY DETERMINATIONS FOR DIRECT EMITTER DATA CATEGORIES

[Based on May 26, 2011 final CBI rule]

Data category	Confidentiality determination for data elements in each category		
	Emission data [a]	Data that are not emission data and not CBI	Data that are not emission data but are CBI [b]
Facility and Unit Identifier Information	X		
Emissions	X		
Calculation Methodology and Methodological Tier	X		
Data Elements Reported for Periods of Missing Data that are Not Inputs to Emission Equations	X		
Unit/Process ''Static'' Characteristics that are Not Inputs to Emission Equations		X [c]	X [c]
Unit/Process Operating Characteristics that are Not Inputs to Emission Equations		X [c]	X [c]
Test and Calibration Methods		X	
Production/Throughput Data that are Not Inputs to Emission Equations			X
Raw Materials Consumed that are Not Inputs to Emission Equations			X
Process-Specific and Vendor Data Submitted in BAMM Extension Requests			X

[a] Under CAA section 114(c), ''emission data'' are not entitled to confidential treatment. The term ''emission data'' is defined at 40 CFR 2.301(a)(2)(i).

[b] Section 114(c) of the CAA affords confidential treatment to data (except emission data) that are considered CBI.

[c] In the 2011 Final CBI Rule, this data category contains both data elements determined to be CBI and those determined not to be CBI. See discussion in Section III.A of this preamble for more details.

As shown in Table 5 of this preamble, the EPA made categorical confidentiality determinations for data elements assigned to eight direct emitter data categories. For two data categories, ''Unit/Process 'Static' Characteristics That are Not Inputs to Emission Equations'' and ''Unit/Process Operating Characteristics That are Not Inputs to Emission Equations,'' the EPA determined in the 2011 Final CBI Rule that the data elements assigned to those categories are not emission data but did not make categorical CBI determinations. Rather, the EPA made CBI determinations for individual data elements assigned to these two data categories.

We have followed the same approach in this final rule. Specifically, we have assigned each of the 25 new or revised data elements in the final subpart I amendments to the appropriate direct emitter data category. For the 13 data elements assigned to categories with categorical confidentiality determinations, we have applied the categorical determinations made in the 2011 Final CBI Rule to the assigned data elements. For the 12 data elements assigned to the ''Unit/Process 'Static' Characteristics That are Not Inputs to Emission Equations'' and the ''Unit/Process Operating Characteristics That are Not Inputs to Emission Equations'' data categories, consistent with our approach towards data elements previously assigned to these data categories, we are finalizing that these data elements are not emission data. All 25 new and revised subpart I data elements in the final subpart I amendments are listed in the memorandum titled ''Final Data Category Assignments for Subpart I 2012 Amendments'' in Docket EPA–HQ–OAR–2011–0028.

B. Public Comments on the Proposed Confidentiality Determinations

The EPA is finalizing all confidentiality determinations as they were proposed. Please refer to the preamble to the proposed rule (77 FR 63570) for additional information regarding the proposed confidentiality determinations.

The EPA received several comments questioning the proposed determination that several new or revised data elements should be treated as confidential, or that the confidentiality should be determined on a case-by-case basis.

Comment: One commenter questioned the determination that the confidentiality of the identification of the quantifiable metric used in the fab-specific engineering model to apportion gas consumption for each fab should be determined on a case-by-case basis. The commenter asserted that EPA has not provided any justification for how release of this data would cause competitive harm and that it should not be treated as confidential.

Response: The EPA made a final confidentiality determination for the identification of the quantifiable metric used in the facility-specific engineering model to apportion gas consumption (40 CFR 98.96(m)(i)) in an earlier **Federal Register** notice (77 FR 48072, August 13, 2012), after a notice and period for public comment (77 FR 10434, February 22, 2012). In that final notice (77 FR 48072, August 13, 2012), the EPA decided to evaluate the confidentiality status of that data element on a case-by-case basis, in accordance with existing confidentiality regulations in 40 CFR part 2, subpart B.

The EPA re-proposed the confidentiality determination for this data element due to the proposed revision to this data element. The proposed changes to this data element, which we are finalizing today, reflect that the apportioning model is now fab-specific instead of facility-specific because the amendments now require gas use to be apportioned on a fab basis (instead of a facility basis) and a facility may have separate models for each fab. As mentioned above, we have determined that the confidentiality status of the identification of the quantifiable metric used in the facility-specific engineering model to apportion gas consumption should be determined on a case-by-case basis. The change in the basis of the quantifiable metric (i.e., from a facility to fab basis) does not fundamentally change the nature of the information being reported; for example, each fab at a facility may use the same metric, and as a result the fab-based and

facility-based quantifiable metrics may be the same. Because the commenter did not offer any compelling reasons why the EPA should now change course due to the change in the basis of the quantifiable metric, the EPA will continue to evaluate claims by facilities that this data element should be protected as CBI on a case-by-case basis.

Comment: One commenter expressed concern with EPA's proposed determinations to treat the inventory of abatement systems under 40 CFR 98.96(p) as confidential business information. The commenter asserted that that if the EPA ''has better evidence that *actual* harm could occur from the release of the inventory information in certain circumstances than the current justification provided at 77 FR 10,440, row 3, no categorical determination should be made.'' (Emphasis added.) Instead, the commenter asserted, ''the confidentiality of the inventory should require specific demonstration by the company/facility involved that there is an actual threat of competitive harm and reverse-engineering.'' (Emphasis added.)

Response: The EPA originally proposed to treat the inventory of abatement systems data element in 40 CFR 98.96(p) as confidential business information in a February 22, 2012 notice of proposed rulemaking (77 FR 10434) followed by a period for public comment. That original determination was finalized as proposed in an August 13, 2012 rulemaking (77 FR 48072). As discussed in the proposal for this action (77 FR 63538, October 16, 2012), the EPA re-proposed the confidentiality determination for this data element in conjunction with edits that were proposed to the data element itself. We are finalizing the changes to this data element as proposed to clarify that the number of abatement systems and the basis of the destruction or removal efficiency should be reported on a process sub-type or process type basis. Please see Table 2 of this preamble for a detailed description of the changes being made to the inventory of abatement systems data element. We are also moving the following reporting requirements to recordkeeping: (1) The number of abatement systems of each manufacturer, and model number, and the manufacturer's claimed F–GHG and N_2O destruction or removal efficiency, if any; (2) records of destruction or removal efficiency measurements over the in-use life of each abatement system; and (3) a description of the tool, with the process type or sub-type, for which the abatement system treats exhaust.

Facilities must still report an inventory, and more specifically, the number of abatement systems at their facility. As a result, a competitor may be able to gain insight into the number of tools at the facility, as described above. For the same reasons stated in the prior confidentiality determination described above, we believe that confidentiality determination for this data element, as revised, should remain as CBI. The change in the basis of the number of abatement systems does not affect the rationales we previously set forth supporting a CBI determination for this data element, nor did the commenter offer any specific reasons why we should now change course due to the change to the basis of the number of abatement systems reported. The EPA also notes that the commenter's assertion that a company/facility should be required to demonstrate an ''actual threat of competitive harm'' for a data element to be determined to be CBI is inconsistent with 40 CFR 2.208, which states that the business must demonstrate that ''disclosure of the information is likely to cause substantial harm to the business's competitive position.'' The EPA will continue to treat this data element as confidential business information.

Comment: One commenter expressed concern with EPA's proposed determination to treat five of the six data elements specified in 40 CFR 98.96(y) for the Triennial Technology Assessment as confidential. These data elements include all of the items to be included in the Triennial Technology Assessment Report, with the exception of emissions data that might be provided under 98.96(y)(2)(iv). The commenter asked EPA to reconsider the treatment for these other data elements as confidential and asserted that the public has a compelling need for access because public stakeholders outside the semiconductor industry will be unable to evaluate both industry claims regarding technology evolution and EPA's judgment regarding whether and when it is appropriate to update the Subpart I default values. The commenter asked that EPA not make a categorical determination on these five data elements, but instead, evaluate confidentiality claims on a case-by-case basis.

Other commenters supported the EPA's determination that these five data elements should be treated as confidential. The commenters noted that in these reporting requirements, EPA is requesting detailed information on process characteristics, equipment types and equipment performance parameters that are likely to represent sensitive intellectual property for semiconductor manufacturers and their equipment suppliers.

Response: The EPA appreciates the input provided by the commenters regarding the CBI determinations related to the Triennial Technology Assessment Report. In the preamble to the proposed amendments to subpart I, we indicated that we were proposing five data elements under 40 CFR 98.96(y) as CBI because the data elements are likely to reveal information regarding process-specific data or new technologies or advances in production processes that could be used by a competitor. The information required by these five data elements is not emission data and is likely to reveal potentially sensitive information about individual facilities because it is likely to include information about recent process technology developed and adopted by the facilities, including proprietary process technology that would not be revealed otherwise. The commenter questioning these determinations did not provide additional information that would alter the EPA's decision.

The EPA recognizes the first commenter's concern that without access to the detailed information provided in those data elements, public stakeholders may be unable to evaluate industry claims regarding technology evolution and EPA's judgment regarding whether it is appropriate to update the Subpart I default emission factors and DRE values. However, the EPA has had to reach a balance between public access to data and the protection of confidential business information. Over time and based on careful consideration and analysis, EPA may be able to aggregate sensitive information on an industry-wide basis that would allow stakeholders to evaluate industry claims and EPA decisions regarding the effects of new technology on GHG emissions. In addition, annual emissions data submitted as part of regular annual reporting to the GHGRP and measurements of emission factors and DRE values submitted as part of the triennial technology reviews would not be considered CBI and could also be analyzed by stakeholders to evaluate industry claims and EPA judgments on changes in technology that affect emissions.

For comments and responses regarding confidentiality determinations for other new and revised subpart I data elements, please refer to the document titled ''Reporting of Greenhouse Gases—Technical Revisions to the Electronics Manufacturing Category of the Greenhouse Gas Reporting Rule: EPA's Response to Public Comment'' in Docket EPA–HQ–OAR–2011–0028.

IV. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

This action is not a ''significant regulatory action'' under the terms of Executive Order 12866 (58 FR 51735, October 4, 1993) and is therefore not subject to review under Executive Orders 12866 and 13563 (76 FR 3821, January 21, 2011).

The EPA prepared an analysis of the potential costs associated with this final action. This analysis is contained in the Economics Impact Analysis (EIA), ''Final Amendments and Confidentiality Determinations for Subpart I EIA.'' A copy of the analysis is available in the docket for this action and the analysis is briefly summarized here. Overall, the EPA has concluded that the costs of the changes will significantly reduce subpart I compliance costs. Specifically, the proposed changes will reduce nationwide compliance costs in the first year by 37 percent ($2.7 million to $1.7 million) and by 73 percent in the second year ($6.4 million to $1.7 million). The confidentiality determinations for new and revised data elements do not increase the compliance costs of the final rule.

B. Paperwork Reduction Act

This action does not impose any new information collection burden. As previously mentioned, this action finalizes amended reporting methodologies in subpart I, confidentiality determinations for reported data elements, and amendments to subpart A to reflect changes to the reporting requirements in subpart I. However, the Office of Management and Budget (OMB) has previously approved the information collection requirements contained in subpart I, under 40 CFR part 98, under the provisions of the *Paperwork Reduction Act,* 44 U.S.C. 3501 *et seq.,* and has assigned OMB control number 2060–0650 for subpart I. The OMB control numbers for the EPA's regulations in 40 CFR are listed at 40 CFR part 9.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this rule on small entities, ''small entity'' is defined as: (1) A small business as defined by the Small Business Administration's regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; or (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The small entities directly regulated by this final rule are facilities included in NAICS codes for Semiconductor and Related Device Manufacturing (334413) and Other Computer Peripheral Equipment Manufacturing (334119).

After considering the economic impacts of today's final rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. In determining whether a rule has a significant economic impact on a substantial number of small entities, the impact of concern is any significant adverse economic impact on small entities, since the primary purpose of the regulatory flexibility analyses is to identify and address regulatory alternatives ''which minimize any significant economic impact of the rule on small entities.'' 5 U.S.C. 603 and 604. Thus, an agency may certify that a rule will not have a significant economic impact on a substantial number of small entities if the rule relieves regulatory burden, or otherwise has a positive economic effect on small entities subject to the rule.

This action (1) amends monitoring and calculation methodologies in subpart I; (2) assigns subpart I data reporting elements into CBI data categories; and (3) amends subpart A to reflect final changes to the reporting requirements in subpart I. In this final rule, the EPA is taking several steps to reduce the impact of Part 98 on small entities. For example, the EPA is removing the recipe-specific reporting requirements for subpart I, which the Petitioner identified by the Petitioner as economically and technically burdensome. In addition, the EPA has provided a number of flexibilities in this final rule, which allow reporters to choose the methodologies that are least burdensome for their facility. Additional information can be found in the docket (see file ''Economic Impact Analysis for the Mandatory Reporting of Greenhouse Gas Emissions F-Gases: Subpart I *Final Report,*'' August 2012). We have therefore concluded that this final rule will relieve regulatory burden for all affected small entities.

D. Unfunded Mandates Reform Act

This rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and tribal governments, in the aggregate, or the private sector in any one year. This action (1) Amends monitoring and calculation methodologies in subpart I; (2) assigns subpart I data reporting elements into CBI data categories; and (3) amends subpart A to reflect proposed changes to the reporting requirements in subpart I. In some cases, the EPA has increased flexibility in the selection of methods used for calculating and reporting GHGs. This action also revises specific provisions to provide clarity on what is to be reported. These revisions do not add additional burden on reporters but offer flexibility. As part of the process of finalization of the subpart I rule, the EPA undertook specific steps to evaluate the effect of those final rules on small entities. Based on the final amendments to subpart I provisions, burden will stay the same or decrease, therefore the EPA's determination finding of no significant economic impact on a substantial number of small entities has not changed. Thus, this action is not subject to the requirements of sections 202 or 205 of the Unfunded Mandates Reform Act (UMRA).

This rule is also not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments. No small government entities are engaged in the electronics manufacturing processes that are subject to reporting under subpart I and which would be affected by these final rule amendments.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132.

This action, which amends calculation and reporting methodologies in subpart I, applies to only certain electronics manufacturers. No State or local government facilities are known to be engaged in the activities that are affected by the provisions in this final rule. This action also does not limit the

power of states or localities to collect GHG data and/or regulate GHG emissions. Thus, Executive Order 13132 does not apply to this action. For a more detailed discussion about how Part 98 relates to existing state programs, please see Section II of the preamble to the final rule, Mandatory Reporting of Greenhouse Gases (74 FR 56266, October 30, 2009).

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications, as specified in Executive Order 13175 (65 FR 67249, November 9, 2000). This action (1) Amends monitoring and calculation methodologies in subpart I; (2) assigns subpart I data reporting elements into CBI data categories; and (3) amends subpart A to reflect changes to the reporting requirements in subpart I. No tribal facilities are known to be engaged in the activities affected by this action. Thus, Executive Order 13175 does not apply to this action. For a summary of the EPA's consultations with tribal governments and representatives, see Section VIII.F of the preamble to the final rule, Mandatory Reporting of Greenhouse Gases (74 FR 56371, October 30, 2009).

G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

The EPA interprets Executive Order 13045 (62 FR 19885, April 23, 1997) as applying to only those regulatory actions that concern health or safety risks, such that the analysis required under section 5–501 of the Executive Order has the potential to influence the regulation. This action (1) Amends monitoring and calculation methodologies in subpart I; (2) assigns subpart I data reporting elements into CBI data categories; and (3) amends subpart A to reflect changes to the reporting requirements in subpart I. This action is not subject to Executive Order 13045 because it does not establish an environmental standard intended to mitigate health or safety risks.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

This action is not subject to Executive Order 13211 (66 FR 28355, May 22, 2001) because it is not a significant regulatory action under Executive Order 12866.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104–113 (15 U.S.C. 272 note) directs the EPA to use voluntary consensus standards (VCS) in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by VCS bodies. The NTTAA directs the EPA to provide Congress, through OMB, explanations when the agency decides not to use available and applicable VCS.

This action, which amends monitoring and calculation methodologies in subpart I, involves technical standards. The EPA is including a stack testing option that involves using the following EPA reference methods:

- Method 1 or 1A at 40 CFR part 60, appendix A–1, to select sampling port locations and the number of traverse points in the exhaust stacks.
- Method 2, 2A, 2C, 2D, 2F, or 2G at 40 CFR part 60, appendix A–1 and A–2, to determine gas velocity and volumetric flow rate in the exhaust stacks.
- Method 3, 3A, or 3B at 40 CFR part 60, appendix A–2, to determine the gas molecular weight of the exhaust using the same sampling site and at the same time as the F–GHG sampling is performed.
- Method 4 at 40 CFR part 60, appendix A–3, to measure gas moisture content in the exhaust stacks.
- Method 301 at 40 CFR part 63, appendix A, to perform field validations of alternative methods of measuring F–GHG emissions and abatement system DRE.
- Method 320 at 40 CFR part 63, appendix A, to measure the concentration of F–GHG in the stack exhaust.

Consistent with the NTTAA, the EPA conducted searches to identify VCS in addition to these EPA methods. The EPA conducted searches for VCS from at least three different voluntary consensus standards bodies, including the following: American Society of Testing and Materials (ASTM), American Society of Mechanical Engineers (ASME), and International SEMATECH Manufacturing Initiative (ISMI). No applicable VCS were identified for EPA Methods 1A, 2A, 2D, 2F, or 2G. The method ASME PTC 19.10–1981, Flue and Exhaust Gas Analyses, is not cited in this final rule for its manual method for measuring the oxygen, carbon dioxide and carbon monoxide content of the exhaust gas. ASME PTC 19.10–1981 is an acceptable alternative to EPA Methods 3A and 3B for the manual procedures only, and not the instrumental procedures. The VCS ASTM D6348–03, Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform (FTIR) Spectroscopy, has been reviewed by the EPA as a potential alternative to EPA Method 320; and, in light of public comments received on the proposed rule, we acknowledge that several existing regulations list both EPA Method 320 and ASTM D6348–03 as acceptable methods. We also acknowledge the efficiency of ASTM D6348–03 as compared to EPA Method 320. For these reasons, we are allowing, in the final amendments, the use of ASTM D6348–03 with the requirements described in Section II.A.1 of this preamble and 40 CFR 98.94(j) of the final rule.

This rule revises the current subpart I provisions for determining abatement system DRE to incorporate language based on methods adapted from the ISMI 2009 Guideline for Environmental Characterization of Semiconductor Process Equipment—Revision 2. We are incorporating applicable portions of the ISMI 2009 Guideline into the rule in Appendix A to Subpart I. The EPA is not incorporating by reference the entire ISMI 2009 Guideline because the ISMI 2009 Guidelines have not been subject to the same level of peer review and validation as other alternative standards (e.g., ASTM or ASME standards). Therefore, we are incorporating only those portions of the 2009 ISMI Guideline that the EPA has determined are needed to provide flexibility and reduce burden in subpart I.

The EPA identified no other VCS that were potentially applicable for subpart I in lieu of EPA reference methods. Therefore, the EPA is not adopting other standards for this purpose. For the methods required or referenced by the final rule, a source may apply to the EPA for permission to use alternative test methods or alternative monitoring requirements in place of any required testing methods, performance specifications or procedures, as specified in proposed 40 CFR part 98, subpart I.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629, February 16, 1994) establishes federal

executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

The EPA has determined that this final rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it does not affect the level of protection provided to human health or the environment. This action addresses only reporting and recordkeeping procedures.

K. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 et seq., as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. The EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States. A major rule cannot take effect until 60 days after it is published in the **Federal Register**. This action is not a ''major rule'' as defined by 5 U.S.C. 804(2). This rule will be effective on January 1, 2014.

List of Subjects 40 CFR Part 98

Environmental protection, Administrative practice and procedure, Greenhouse gases, Incorporation by reference, Reporting and recordkeeping requirements.

Dated: August 16, 2013.

Gina McCarthy,

Administrator.

For the reasons set out in the preamble, title 40, chapter I, of the Code of Federal Regulations is amended as follows:

PART 98—MANDATORY GREENHOUSE GAS REPORTING

■ 1. The authority citation for part 98 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

Subpart A—[Amended]

■ 2. Section 98.7 is amended by:

■ a. Revising paragraphs (e)(30), (m)(3), and (n)(1); and

■ b. Removing and reserving paragraph (n)(2).

The revisions read as follows:

§ 98.7 What standardized methods are incorporated by reference into this part?

* * * * *

(e) * * *

(30) ASTM D6348–03 Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, IBR approved for § 98.54(b), Table I–9 to subpart I of this part, § 98.224(b), and § 98.414(n).

* * * * *

(m) * * *

(3) Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing, Version 1, EPA–430–R–10–003, March 2010 (EPA 430–R–10–003), *http://www.epa.gov/semiconductor-pfc/documents/dre_protocol.pdf,* IBR approved for § 98.94(f)(4)(i), § 98.94(g)(3), § 98.97(d)(4), § 98.98, Appendix A to subpart I of this part, § 98.124(e)(2), and § 98.414(n)(1).

* * * * *

(n) * * *

(1) Guideline for Environmental Characterization of Semiconductor Process Equipment, International SEMATECH Manufacturing Initiative Technology Transfer #06124825A–ENG, December 22, 2006 (International SEMATECH #06124825A–ENG), IBR approved for § 98.96(y)(3)(i).

* * * * *

Table A–7 to subpart A [Amended]

■ 3. Table A–7 to subpart A of part 98 is amended by removing the entries for subpart I ''98.96(f)(1),'' ''98.96(g),'' ''98.96(h),'' ''98.96(i),'' ''98.96(j),'' ''98.96(k),'' ''98.96(l),'' ''98.96(n),'' ''98.96(o),'' ''98.96(q)(2),'' ''98.96(q)(3),'' ''98.96(q)(5)(iv),'' and ''98.96(r)'', ''98.96(s)''.

Subpart I—[Amended]

■ 4. Section 98.91 is amended by revising the definitions of ''C_i'' in Equation I–3 of paragraph (a)(3) and ''W_x'' in Equation I–5 of paragraph (b).

The revisions read as follows:

§ 98.91 Reporting threshold.

(a) * * *

(3) * * *

C_i = Annual fluorinated GHG (input gas i) purchases or consumption (kg). Only gases that are used in PV manufacturing processes listed at § 98.90(a)(1) through (a)(4) that have listed GWP values in Table A–1 to subpart A of this part must be considered for threshold applicability purposes.

* * * * *

(b) * * *

W_X = Maximum substrate starts of fab f in month x (m^2 per month).

* * * * *

■ 5. Section 98.92 is amended by:

■ a. Revising paragraphs (a) introductory text and (a)(1);

■ b. Removing and reserving paragraphs (a)(2) and (a)(3); and

■ c. Revising paragraph (a)(6).

The revisions read as follows:

§ 98.92 GHGs to report.

(a) You must report emissions of fluorinated GHGs (as defined in § 98.6), N_2O, and fluorinated heat transfer fluids (as defined in § 98.98). The fluorinated GHGs and fluorinated heat transfer fluids that are emitted from electronics manufacturing production processes include, but are not limited to, those listed in Table I–2 to this subpart. You must individually report, as appropriate:

(1) Fluorinated GHGs emitted.

* * * * *

(6) All fluorinated GHGs and N_2O consumed.

* * * * *

■ 6. Section 98.93 is amended by:

■ a. Revising paragraphs (a) and (b);

■ b. Revising paragraph (c) introductory text and the definitions of ''C_i'', ''I_{Bi}''; ''I_{Ei}'', ''A_i'', and ''D_i'' in Equation I–11 of paragraph (c);

■ c. Revising paragraph (d) introductory text and the definitions of ''D_i'', ''h_{iI}'', ''F_{iI}'', ''X_i'', and ''M'' in Equation I–12 of paragraph (d);

■ d. Revising paragraph (e) introductory text and the definitions of ''$C_{i,j}$'', ''$f_{i,j}$'', ''C_i'', and ''j'' in Equation I–13 of paragraph (e);

■ e. Removing and reserving paragraph (f);

■ f. Revising paragraph (g);

■ g. Revising paragraph (h) introductory text and the definitions of ''EHi'', ''I_{iB}'', ''P_i'', ''N_i'', ''R_i'', ''I_{iE}'', and ''D_i'' in Equation I–16 of introductory paragraph (h);

■ h. Removing and reserving paragraph (h)(2); and

■ i. Adding paragraph (i).

The revisions and addition read as follows:

§ 98.93 Calculating GHG emissions.

(a) You must calculate total annual emissions of each fluorinated GHG emitted by electronics manufacturing production processes from each fab (as defined in § 98.98) at your facility,

including each input gas and each by-product gas. You must use either default gas utilization rates and by-product formations rates according to the procedures in paragraph (a)(1), (a)(2), or (a)(6) of this section, as appropriate, or the stack test method according to paragraph (i) of this section, to calculate emissions of each input gas and each by-product gas.

(1) If you manufacture semiconductors, you must adhere to the procedures in paragraphs (a)(2)(i) through (iii) of this section. You must calculate annual emissions of each input gas and of each by-product gas using Equations I–6 and I–7, respectively. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in Equation I–11 of this subpart, plus any by-product emissions of that gas calculated under this paragraph (a).

$$\mathrm{Pr}\,ocesstypeE_i = \sum_{j=1}^{N} E_{ij} \qquad \text{(Eq. I-6)}$$

Where:

$ProcesstypeE_i$ = Annual emissions of input gas i from the process type on a fab basis (metric tons).

E_{ij} = Annual emissions of input gas i from process sub-type or process type j as calculated in Equation I–8 of this subpart (metric tons).

N = The total number of process sub-types j that depends on the electronics manufacturing fab and emission calculation methodology. If E_{ij} is calculated for a process type j in Equation I–8 of this subpart, N = 1.

i = Input gas.

j = Process sub-type or process type.

$$\mathrm{Pr}\,ocesstypeBE_k = \sum_{j=1}^{N}\sum_{i} BE_{ijk} \qquad \text{(Eq. I-7)}$$

Where:

$ProcesstypeBE_k$ = Annual emissions of by-product gas k from the processes type on a fab basis (metric tons).

BE_{ijk} = Annual emissions of by-product gas k formed from input gas i used for process sub-type or process type j as calculated in Equation I–9 of this subpart (metric tons).

N = The total number of process sub-types j that depends on the electronics manufacturing fab and emission calculation methodology. If BE_{ijk} is calculated for a process type j in Equation I–9 of this subpart, N = 1.

i = Input gas.

j = Process sub-type, or process type.

k = By-product gas.

(i) You must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching/wafer cleaning process type using default utilization and by-product formation rates as shown in Table I–3 or I–4 of this subpart, and by using Equations I–8 and I–9 of this subpart.

$$E_{ij} = C_{ij} * \left(1 - U_{ij}\right) * \left(1 - \left[(a]_{ij} * d_{ij} * UT_{ij}\right)\right) * 0.001 \qquad \text{(Eq. I-8)}$$

Where:

E_{ij} = Annual emissions of input gas i from process sub-type or process type j, on a fab basis (metric tons).

C_{ij} = Amount of input gas i consumed for process sub-type or process type j, as calculated in Equation I–13 of this subpart, on a fab basis (kg).

U_{ij} = Process utilization rate for input gas i for process sub-type or process type j (expressed as a decimal fraction).

a_{ij} = Fraction of input gas i used in process sub-type or process type j with abatement systems, on a fab basis (expressed as a decimal fraction).

d_{ij} = Fraction of input gas i destroyed or removed in abatement systems connected to process tools where process sub-type, or process type j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

UT_{ij} = The average uptime factor of all abatement systems connected to process tools in the fab using input gas i in process sub-type or process type j, as calculated in Equation I–15 of this subpart, on a fab basis (expressed as a decimal fraction).

0.001 = Conversion factor from kg to metric tons.

i = Input gas.

j = Process sub-type or process type.

$$\cancel{BE_{ijk} = B_{ijk} * C_{ij} * (1 - a_{ij} * d_{jk}) * 0.001}$$

$$BE_{ijk} = B_{ijk} * C_{ij} * \left(1 - \left(a_{ij} * d_{jk} * UT_{ijk}\right)\right) * 0.001 \qquad \text{(Eq. I-9)}$$

Where:

BE_{ijk} = Annual emissions of by-product gas k formed from input gas i from process sub-type or process type j, on a fab basis (metric tons).

B_{ijk} = By-product formation rate of gas k created as a by-product per amount of input gas i (kg) consumed by process sub-type or process type j (kg).

C_{ij} = Amount of input gas i consumed for process sub-type, or process type j, as calculated in Equation I–13 of this subpart, on a fab basis (kg).

a_{ij} = Fraction of input gas i used for process sub-type, or process type j with abatement systems, on a fab basis (expressed as a decimal fraction).

d_{jk} = Fraction of by-product gas k destroyed or removed in abatement systems connected to process tools where process

sub-type, or process type j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

UT_{ijk} = The average uptime factor of all abatement systems connected to process tools in the fab emitting by-product gas k, formed from input gas i in process sub-type or process type j, on a fab basis (expressed as a decimal fraction). For this equation, UT_{ijk} is assumed to be equal to UT_{ij} as calculated in Equation I–15 of this subpart.

0.001 = Conversion factor from kg to metric tons.

i = Input gas.

j = Process sub-type or process type.

k = By-product gas.

(ii) You must calculate annual fab-level emissions of each fluorinated GHG used for each of the process sub-types associated with the chamber cleaning process type, including in-situ plasma chamber clean, remote plasma chamber clean, and in-situ thermal chamber clean, using default utilization and by-product formation rates as shown in Table I–3 or I–4 of this subpart, and by using Equations I–8 and I–9 of this subpart.

(iii) If default values are not available for a particular input gas and process type or sub-type combination in Tables I–3 or I–4, you must follow the procedures in paragraph (a)(6) of this section.

(2) If you manufacture MEMS, LCDs, or PVs, you must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching and chamber cleaning process types using default utilization and by-product formation rates as shown in Table I–5, I–6, or I–7 of this subpart, as appropriate, and by using Equations I–8 and I–9 of this subpart. If default values are not available for a particular input gas and process type or sub-type combination in Tables I–5, I–6, or I–7, you must follow the procedures in paragraph (a)(6) of this section. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in Equation I–11 of this subpart, plus any by-product emissions of that gas calculated under this paragraph (a).

(3) [Reserved]

(4) [Reserved]

(5) [Reserved]

(6) If you are required, or elect, to perform calculations using default emission factors for gas utilization and by-product formation rates according to the procedures in paragraphs (a)(1) or (a)(2) of this section, and default values are not available for a particular input gas and process type or sub-type combination in Tables I–3, I–4, I–5, I–6, or I–7, you must use the utilization and by-product formation rates of zero and use Equations I–8 and I–9 of this subpart.

(b) You must calculate annual fab-level N_2O emissions from all chemical vapor deposition processes and from the aggregate of all other electronics manufacturing production processes using Equation I–10 of this subpart and the methods in paragraphs (b)(1) and (2) of this section. If your fab uses less than 50 kg of N_2O in one reporting year, you may calculate fab emissions as equal to your fab's annual consumption for N_2O as calculated in Equation I–11 of this subpart.

$$E(N_2O)_j = C_{N_2O,j} * \left(1 - U_{N_2O,j}\right) * \left(1 - \left(a_{N_2O,j} * d_{N_2O,j} * UT_{N2O}\right)\right) * 0.001 \qquad \text{(Eq. I-10)}$$

Where:

$E(N_2O)_j$ = Annual emissions of N_2O for N_2O-using process j, on a fab basis (metric tons).

$C_{N2O,j}$ = Amount of N_2O consumed for N_2O-using process j, as calculated in Equation I–13 of this subpart and apportioned to N_2O process j, on a fab basis (kg).

$U_{N2O,j}$ = Process utilization factor for N_2O-using process j (expressed as a decimal fraction) from Table I–8 of this subpart.

$a_{N2O,j}$ = Fraction of N_2O used in N_2O-using process j with abatement systems, on a fab basis (expressed as a decimal fraction).

$d_{N2O,j}$ = Fraction of N_2O for N_2O-using process j destroyed or removed in abatement systems connected to process tools where process j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

UT_{N2O} = The average uptime factor of all the abatement systems connected to process tools in the fab that use N_2O, as calculated in Equation I–15 of this subpart, on a fab basis (expressed as a decimal fraction). For purposes of calculating the abatement system uptime for N_2O using process tools, in Equation I–15 of this subpart, the only input gas i is N_2O, j is the N_2O using process, and p is the N_2O abatement system connected to the N_2O using tool.

0.001 = Conversion factor from kg to metric tons.

j = Type of N_2O-using process, either chemical vapor deposition or all other N_2O-using manufacturing processes.

(1) You must use the factor for N_2O utilization for chemical vapor deposition processes as shown in Table I–8 to this subpart.

(2) You must use the factor for N_2O utilization for all other manufacturing production processes other than chemical vapor deposition as shown in Table I–8 to this subpart.

(c) You must calculate total annual input gas i consumption on a fab basis for each fluorinated GHG and N_2O using Equation I–11 of this subpart. Where a gas supply system serves more than one fab, Equation I–11 is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c).

* * * * *

C_i = Annual consumption of input gas i, on a fab basis (kg per year).

I_{Bi} = Inventory of input gas i stored in containers at the beginning of the reporting year, including heels, on a fab basis (kg). For containers in service at the beginning of a reporting year, account for the quantity in these containers as if they were full.

I_{Ei} = Inventory of input gas i stored in containers at the end of the reporting year, including heels, on a fab basis (kg). For containers in service at the end of a reporting year, account for the quantity in these containers as if they were full.

A_i = Acquisitions of input gas i during the year through purchases or other transactions, including heels in containers returned to the electronics manufacturing facility, on a fab basis (kg).

D_i = Disbursements of input gas i through sales or other transactions during the year, including heels in containers returned by the electronics manufacturing facility to the chemical supplier, as calculated using Equation I–12 of this subpart, on a fab basis (kg).

* * * * *

(d) You must calculate disbursements of input gas i using fab-wide gas-specific heel factors, as determined in § 98.94(b), and by using Equation I–12 of this subpart. Where a gas supply system serves more than one fab, Equation I–12 is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c).

* * * * *

Di = Disbursements of input gas i through sales or other transactions during the

reporting year on a fab basis, including heels in containers returned by the electronics manufacturing fab to the gas distributor (kg).

h_{il} = Fab-wide gas-specific heel factor for input gas i and container size and type l (expressed as a decimal fraction), as determined in § 98.94(b). If your fab uses less than 50 kg of a fluorinated GHG or N_2O in one reporting year, you may assume that any hil for that fluorinated GHG or N_2O is equal to zero.

* * * * *

F_{il} = Full capacity of containers of size and type l containing input gas i, on a fab basis (kg).

Xi = Disbursements under exceptional circumstances of input gas i through sales or other transactions during the year, on a fab basis (kg). These include returns of containers whose contents have been weighed due to an exceptional circumstance as specified in § 98.94(b)(4).

* * * * *

M = The total number of different sized container types on a fab basis. If only one size and container type is used for an input gas i, M=1.

(e) You must calculate the amount of input gas i consumed, on a fab basis, for each process sub-type or process type j, using Equation I–13 of this subpart. Where a gas supply system serves more than one fab, Equation I–13 is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c). If you elect to calculate emissions using the stack test method in paragraph (i) of this section, you must calculate the amount of input gas i consumed on the applicable basis by using an appropriate apportioning factor. For example, when calculating fab-level emissions of each fluorinated GHG consumed using Equation I–21 of this section, you must substitute the term fij with the appropriate apportioning factor to calculate the total consumption of each fluorinated GHG in tools that are vented to stack systems that are tested.

* * * * *

$C_{i,j}$ = The annual amount of input gas i consumed, on a fab basis, for process sub-type or process type j (kg).

$f_{i,j}$ = Process sub-type-specific or process type-specific j, input gas i apportioning factor (expressed as a decimal fraction), as determined in accordance with § 98.94(c).

C_i = Annual consumption of input gas i, on a fab basis, as calculated using Equation I–11 of this subpart (kg).

* * * * *

j = Process sub-type or process type.

* * * * *

(g) If you report controlled emissions pursuant to § 98.94(f), you must calculate the uptime of all the abatement systems for each combination of input gas or by-product gas, and process sub-type or process type, by using Equation I–15 of this subpart.

$$UT_{ij} = 1 - \sum_{p} \frac{Td_{ijp}}{\sum_p UT_{ijp}} \qquad \text{(Eq. I-15)}$$

Where:

UT_{ij} = The average uptime factor of all abatement systems connected to process tools in the fab using input gas i in process sub-type or process type j (expressed as a decimal fraction).

Td_{ijp} = The total time, in minutes, that abatement system p, connected to process tool(s) in the fab using input gas i in process sub-type or process type j, is not in operational mode, as defined in § 98.98, when at least one of the tools connected to abatement system p is in operation.

UT_{ijp} = Total time, in minutes per year, in which abatement system p has at least one associated tool in operation. For determining the amount of tool operating time, you may assume that tools that were installed for the whole of the year were operated for 525,600 minutes per year. For tools that were installed or uninstalled during the year, you must prorate the operating time to account for the days in which the tool was not installed; treat any partial day that a tool was installed as a full day (1,440 minutes) of tool operation. For an abatement system that has more than one connected tool, the tool operating time is 525,600 minutes per year if at least one tool was installed at all times throughout the year. If you have tools that are idle with no gas flow through the tool for part of the year, you may calculate total tool time using the actual time that gas is flowing through the tool.

i = Input gas.

j = Process sub-type or process type.

p = Abatement system.

(h) If you use fluorinated heat transfer fluids, you must calculate the annual emissions of fluorinated heat transfer fluids on a fab basis using the mass balance approach described in Equation I–16 of this subpart.

* * * * *

EH_i = Emissions of fluorinated heat transfer fluid i, on a fab basis (metric tons/year).

* * * * *

I_{iB} = Inventory of fluorinated heat transfer fluid i, on a fab basis, in containers other than equipment at the beginning of the reporting year (in stock or storage) (l). The inventory at the beginning of the reporting year must be the same as the inventory at the end of the previous reporting year.

P_i = Acquisitions of fluorinated heat transfer fluid i, on a fab basis, during the reporting year (l), including amounts purchased from chemical suppliers, amounts purchased from equipment suppliers with or inside of equipment, and amounts returned to the facility after off-site recycling.

N_i = Total nameplate capacity (full and proper charge) of equipment that uses fluorinated heat transfer fluid i and that is newly installed in the fab during the reporting year (l).

R_i = Total nameplate capacity (full and proper charge) of equipment that uses fluorinated heat transfer fluid i and that is removed from service in the fab during the reporting year (l).

I_{iE} = Inventory of fluorinated heat transfer fluid i, on a fab basis, in containers other than equipment at the end of the reporting year (in stock or storage) (l). The inventory at the beginning of the reporting year must be the same as the inventory at the end of the previous reporting year.

D_i = Disbursements of fluorinated heat transfer fluid i, on a fab basis, during the reporting year, including amounts returned to chemical suppliers, sold with or inside of equipment, and sent off-site for verifiable recycling or destruction (l). Disbursements should include only amounts that are properly stored and transported so as to prevent emissions in transit.

* * * * *

(i) *Stack Test Method.* As an alternative to the default emission factor method in paragraph (a) of this section, you may calculate fab-level fluorinated GHG emissions using fab-specific emission factors developed from stack testing. To use the method in this paragraph, you must first make a preliminary estimate of the fluorinated GHG emissions from each stack system in the fab under paragraph (i)(1) of this section. You must then compare the preliminary estimate for each stack system to the criteria in paragraph (i)(2) of this section to determine whether the

stack system meets the criteria for using the stack test method described in paragraph (i)(3) of this section or whether the stack system meets the criteria for using the method described in paragraph (i)(4) of this section to estimate emissions from the stack systems that are not tested.

(1) *Preliminary estimate of emissions by stack system in the fab.* You must calculate a preliminary estimate of the total annual emissions, on a metric ton CO_2e basis, of all fluorinated GHG from each stack system in the fab using default utilization and by-product formation rates as shown in Table I–11, I–12, I–13, I–14, or I–15 of this subpart, as applicable, and by using Equations I–8 and I–9 of this subpart. You must include any intermittent low-use fluorinated GHGs, as defined in § 98.98 of this subpart, in any preliminary estimates. When using Equations I–8 and I–9 of this subpart for the purposes of this paragraph (i)(1), you must also adhere to the procedures in paragraphs (i)(1)(i) to (iv) of this section to calculate preliminary estimates.

(i) When you are calculating preliminary estimates for the purpose of this paragraph (i)(1), you must consider the subscript ''j'' in Equations I–8 and I–9, and I–13 of this subpart to mean ''stack system'' instead of ''process sub-type or process type.'' For the value of a_{ij}, the fraction of input gas i that is used in tools with abatement systems, for use in Equations I–8 and I–9, you may use the ratio of the number of tools using input gas i that have abatement systems that are vented to the stack system for which you are calculating the preliminary estimate to the total number of tools using input gas i that are vented to that stack system, expressed as a decimal fraction. In calculating the preliminary estimates, you must account for the effect of any fluorinated GHG abatement system meeting the definition of abatement system in § 98.98. You may use this approach to determining a_{ij} only for this preliminary estimate.

(ii) You must use representative data from the previous reporting year to estimate the consumption of input gas i as calculated in Equation I–13 of this subpart and the fraction of input gas i destroyed in abatement systems for each stack system as calculated by Equation I–24 of this subpart. If you were not required to submit an annual report under subpart I for the previous reporting year and data from the previous reporting year are not available, you may estimate the consumption of input gas i and the fraction of input gas i destroyed in abatement systems based on representative operating data from a period of at least 30 days in the current reporting year. When calculating the consumption of input gas i using Equation I–13 of this subpart, the term ''f_{ij}'' is replaced with the ratio of the number of tools using input gas i that are vented to the stack system for which you are calculating the preliminary estimate to the total number of tools in the fab using input gas i, expressed as a decimal fraction. You may use this approach to determining f_{ij} only for this preliminary estimate.

(iii) You must use representative data from the previous reporting year to estimate the total uptime of all abatement systems for the stack system as calculated by Equation I–23 of this subpart, instead of using Equation I–15 of this subpart to calculate the average uptime factor. If you were not required to submit an annual report under subpart I for the previous reporting year and data from the previous reporting year are not available, you may estimate the total uptime of all abatement systems for the stack system based on representative operating data from a period of at least 30 days in the current reporting year.

(iv) If you anticipate an increase or decrease in annual consumption or emissions of any fluorinated GHG, or the number of tools connected to abatement systems greater than 10 percent for the current reporting year compared to the previous reporting year, you must account for the anticipated change in your preliminary estimate. You may account for such a change using a quantifiable metric (e.g., the ratio of the number tools that are expected to be vented to the stack system in the current year as compared to the previous reporting year, ratio of the expected number of wafer starts in the current reporting year as compared to the previous reporting year), engineering judgment, or other industry standard practice.

(2) *Method selection for stack systems in the fab.* If the calculations under paragraph (i)(1) of this section, as well as any subsequent annual measurements and calculations under this subpart, indicate that the stack system meets the criteria in paragraph (i)(2)(i) through (iii) of this section, then you may comply with either paragraph (i)(3) of this section (stack test method) or paragraph (i)(4) of this section (method to estimate emissions from the stack systems that are not tested). If the stack system does not meet all three criteria in paragraph (i)(2)(i) through (iii) of this section, then you must comply with the stack test method specified in paragraph (i)(3) of this section. For those fluorinated GHGs in Tables I–11, I–12, I–13, I–14, and I–15 of this subpart for which Table A–1 to subpart A of this part does not define a GWP value, you must use a value of 2,000 for the GWP in calculating metric ton CO_2e for that fluorinated GHG for use in paragraphs (i)(2)(i) through (iii) of this section.

(i) The sum of annual emissions of fluorinated GHGs from all of the combined stack systems that are not tested in the fab must be less than 10,000 metric ton CO_2e per year.

(ii) When all stack systems in the fab are ordered from lowest to highest emitting in metric ton CO_2e of fluorinated GHG per year, each of the stack systems that is not tested must be within the set of the fab's lowest emitting fluorinated GHG stack systems that together emit 15 percent or less of total CO_2e fluorinated GHG emissions from the fab.

(iii) Fluorinated GHG emissions from each of the stack systems that is not tested can only be attributed to particular process tools during the test (that is, the stack system that is not tested cannot be used as an alternative emission point or bypass stack system from other process tools not attributed to the untested stack system).

(3) *Stack system stack test method.* For each stack system in the fab for which testing is required, measure the emissions of each fluorinated GHG from the stack system by conducting an emission test. In addition, measure the fab-specific consumption of each fluorinated GHG by the tools that are vented to the stack systems tested. Measure emissions and consumption of each fluorinated GHG as specified in § 98.94(j). Develop fab-specific emission factors and calculate fab-level fluorinated GHG emissions using the procedures specified in paragraph (i)(3)(i) through (viii) of this section. All emissions test data and procedures used in developing emission factors must be documented and recorded according to § 98.97.

(i) You must measure, and, if applicable, apportion the fab-specific fluorinated GHG consumption of the tools that are vented to the stack systems that are tested during the emission test as specified in § 98.94(j)(3). Calculate the consumption for each fluorinated GHG for the test period.

(ii) You must calculate the emissions of each fluorinated GHG consumed as an input gas using Equation I–17 of this subpart and each fluorinated GHG formed as a by-product gas using Equation I–18 of this subpart and the procedures specified in paragraphs (i)(3)(ii)(A) through (E) of this section. If

a stack system is comprised of multiple stacks, you must sum the emissions from each stack in the stack system when using Equation I–17 or Equation I–18 of this subpart.

$$E_{is} = MW_i * Q_j * \frac{1}{SV} * \frac{1}{10^3} * \sum_{s=1}^{N} \frac{X_{ism}}{10^9} * \Delta t_m \quad \text{(Eq. I-17)}$$

Where:

E_{is} = Total fluorinated GHG input gas i, emitted from stack system s, during the sampling period (kg).

X_{ism} = Average concentration of fluorinated GHG input gas i in stack system s, during the time interval m (ppbv).

MW_i = Molecular weight of fluorinated GHG input gas i (g/g-mole).

Q_s = Flow rate of the stack system s, during the sampling period (m^3/min).

SV = Standard molar volume of gas (0.0240 m^3/g-mole at 68 °F and 1 atm).

Δt_m = Length of time interval m (minutes). Each time interval in the FTIR sampling period must be less than or equal to 60 minutes (for example an 8 hour sampling period would consist of at least 8 time intervals).

$1/10^3$ = Conversion factor (1 kilogram/1,000 grams).

i = Fluorinated GHG input gas.

s = Stack system.

N = Total number of time intervals m in sampling period.

m = Time interval.

$$E_{ks} = MW_k * Q_s * \frac{1}{SV} * \frac{1}{10^3} * \sum_{m=1}^{N} \frac{X_{ksm}}{10^9} * \Delta t_m \quad \text{(Eq. I-18)}$$

Where:

E_{ks} = Total fluorinated GHG by-product gas k, emitted from stack system s, during the sampling period (kg).

X_{ks} = Average concentration of fluorinated GHG by-product gas k in stack system s, during the time interval m (ppbv).

MW_k = Molecular weight of the fluorinated GHG by-product gas k (g/g-mole).

Q_s = Flow rate of the stack system s, during the sampling period (m^3/min).

SV = Standard molar volume of gas (0.0240 m^3/g-mole at 68 °F and 1 atm).

Δt_m = Length of time interval m (minutes). Each time interval in the FTIR sampling period must be less than or equal to 60 minutes (for example an 8 hour sampling period would consist of at least 8 time intervals).

$1/10^3$ = Conversion factor (1 kilogram/1,000 grams).

k = Fluorinated GHG by-product gas.

s = Stack system.

N = Total number of time intervals m in sampling period.

m = Time interval.

(A) If a fluorinated GHG is consumed during the sampling period, but emissions are not detected, use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of ''X_{ism}'' in Equation I–17.

(B) If a fluorinated GHG is consumed during the sampling period and detected intermittently during the sampling period, use the detected concentration for the value of ''X_{ism}'' in Equation I–17 when available and use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of ''X_{ism}'' when the fluorinated GHG is not detected.

(C) If an expected or possible by-product, as listed in Table I–17 of this subpart, is detected intermittently during the sampling period, use the measured concentration for ''X_{ksm}'' in Equation I–18 when available and use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of ''X_{ksm}'' when the fluorinated GHG is not detected.

(D) If a fluorinated GHG is not consumed during the sampling period and is an expected by-product gas as listed in Table I–17 of this subpart and is not detected during the sampling period, use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of ''X_{ksm}'' in Equation I–18.

(E) If a fluorinated GHG is not consumed during the sampling period and is a possible by-product gas as listed in Table I–17 of this subpart, and is not detected during the sampling period, then assume zero emissions for that fluorinated GHG for the tested stack system.

(iii) You must calculate a fab-specific emission factor for each fluorinated GHG input gas consumed (in kg of fluorinated GHG emitted per kg of input gas i consumed) in the tools that vent to stack systems that are tested, as applicable, using Equation I–19 of this subpart. If the emissions of input gas i exceed the consumption of input gas i during the sampling period, then equate ''E_{is}'' to the consumption of input gas i and treat the difference between the emissions and consumption of input gas i as a by-product of the other input gases, using Equation I–20 of this subpart.

$$EF_{if} = \frac{\sum_s (E_{is})}{Activity_{if} * \left(UT_f + \left(\frac{1 - UT_f}{1 - (a_{if} * d_{if})} \right) \right)} \quad \text{(Eq. I-19)}$$

Where:

EF_{if} = Emission factor for fluorinated GHG input gas i, from fab f, representing 100 percent abatement system uptime (kg emitted/kg input gas consumed).

E_{is} = Mass emission of fluorinated GHG input gas i from stack system s, during the sampling period (kg emitted).

$Activity_{if}$ = Consumption of fluorinated GHG input gas i, for fab f, in the tools vented to the stack systems being tested, during the sampling period, as determined following the procedures specified in § 98.94(j)(3) (kg consumed).

UT_f = The total uptime of all abatement systems for fab f, during the sampling period, as calculated in Equation I–23 of this subpart (expressed as decimal fraction). If the stack system does not have abatement systems on the tools vented to the stack system, the value of this parameter is zero.
a_{if} = Fraction of fluorinated GHG input gas i used in fab f in tools with abatement systems (expressed as a decimal fraction).
d_{if} = Fraction of fluorinated GHG input gas i destroyed or removed in abatement systems connected to process tools in fab f, as calculated in Equation I–24 of this subpart (expressed as decimal fraction). If the stack system does not have abatement systems on the tools vented to the stack system, the value of this parameter is zero.
f = Fab.
i = Fluorinated GHG input gas.
s = Stack system.

(iv) You must calculate a fab-specific emission factor for each fluorinated GHG formed as a by-product (in kg of fluorinated GHG per kg of total fluorinated GHG consumed) in the tools vented to stack systems that are tested, as applicable, using Equation I–20 of this subpart. When calculating the by-product emission factor for an input gas for which emissions exceeded its consumption, exclude the consumption of that input gas from the term ''$\Sigma(Activity_{if})$.''

$$EF_{kf} = \frac{\sum_s (E_{ks})}{\sum_i (Activity_{if}) * \left(UT_f + \left(\frac{1 - UT_f}{1 - (a_f * d_{kf})} \right) \right)} \quad \text{(Eq. I-20)}$$

Where:
EF_{kf} = Emission factor for fluorinated GHG by-product gas k, from fab f, representing 100 percent abatement system uptime (kg emitted/kg of all input gases consumed in tools vented to stack systems that are tested).
E_{ks} = Mass emission of fluorinated GHG by-product gas k, emitted from stack system s, during the sampling period (kg emitted).
$Activity_{if}$ = Consumption of fluorinated GHG input gas i for fab f in tools vented to stack systems that are tested, during the sampling period as determined following the procedures specified in § 98.94(j)(3) (kg consumed).
UT_f = The total uptime of all abatement systems for fab f, during the sampling period, as calculated in Equation I–23 of this subpart (expressed as decimal fraction).
a_f = Fraction of all fluorinated input gases used in fab f in tools with abatement systems (expressed as a decimal fraction).
d_{kf} = Fraction of fluorinated GHG by-product gas k destroyed or removed in abatement systems connected to process tools in fab f, as calculated in Equation I–24 of this subpart (expressed as decimal fraction).
f = Fab.
i = Fluorinated GHG input gas.
k = Fluorinated GHG by-product gas.
s = Stack system.

(v) You must calculate annual fab-level emissions of each fluorinated GHG consumed using Equation I–21 of this section.

$$E_{if} = EF_{if} * C_{if} * UT_f + \frac{EF_{if}}{\left(1 - (a_{if} * d_{if})\right)} * C_{if} * \left(1 - UT_f\right) \quad \text{(Eq. I-21)}$$

Where:
E_{if} = Annual emissions of fluorinated GHG input gas i (kg/year) from the stack systems that are tested for fab f.
EF_{if} = Emission factor for fluorinated GHG input gas i emitted from fab f, as calculated in Equation I–19 of this subpart (kg emitted/kg input gas consumed).
C_{if} = Total consumption of fluorinated GHG input gas i in tools that are vented to stack systems that are tested, for fab f, for the reporting year, as calculated using Equation I–13 of this subpart (kg/year).
UT_f = The total uptime of all abatement systems for fab f, during the reporting year, as calculated using Equation I–23 of this subpart (expressed as a decimal fraction).
a_{if} = Fraction of fluorinated GHG input gas i used in fab f in tools with abatement systems (expressed as a decimal fraction).
d_{if} = Fraction of fluorinated GHG input gas i destroyed or removed in abatement systems connected to process tools in fab f that are included in the stack testing option, as calculated in Equation I–24 of this subpart (expressed as decimal fraction).
f = Fab.
i = Fluorinated GHG input gas.

(vi) You must calculate annual fab-level emissions of each fluorinated GHG by-product formed using Equation I–22 of this section.

$$E_{kf} = EF_{kf} * \sum_i C_{if} * UT_f + \frac{EF_{kf}}{\left(1 - (a_f * d_{kf})\right)} * \sum_i C_{if} * \left(1 - UT_f\right) \quad \text{(Eq. I-22)}$$

Where:
Ek_f = Annual emissions of fluorinated GHG by-product k (kg/year) from the stack systems that are tested for fab f.
EF_{kf} = Emission factor for fluorinated GHG by-product k, emitted from fab f, as calculated in Equation I–20 of this subpart (kg emitted/kg of all fluorinated input gases consumed).
C_{if} = Total consumption of fluorinated GHG input gas i in tools that are vented to stack systems that are tested, for fab f, for the reporting year, as calculated using Equation I–13 of this subpart.
UT_f = The total uptime of all abatement systems for fab f, during the reporting year as calculated using Equation I–23 of this subpart (expressed as a decimal fraction).
a_f = Fraction of fluorinated input gases used in fab f in tools with abatement systems (expressed as a decimal fraction).
dk_f = Fraction of fluorinated GHG by-product k destroyed or removed in abatement systems connected to process tools in fab

f that are included in the stack testing option, as calculated in Equation I–24 of this subpart (expressed as decimal fraction).
f = Fab.
i = Fluorinated GHG input gas.
k = Fluorinated GHG by-product

(vii) When using the stack testing method described in this paragraph (i), you must calculate abatement system uptime on a fab basis using Equation I–23 of this subpart. When calculating abatement system uptime for use in Equation I–19 and I–20 of this subpart, you must evaluate the variables ''Td_{pf}'' and ''UT_{pf}'' for the sampling period instead of the reporting year.

$$UT_f = 1 - \sum_p \frac{Td_{pf}}{\sum_p UT_{pf}} \qquad \text{(Eq. I-23)}$$

Where:
UT_f = The average uptime factor for all abatement systems in fab f (expressed as a decimal fraction).
Td_{pf} = The total time, in minutes, that abatement system p, connected to process tool(s) in fab f, is not in operational mode as defined in § 98.98.
UT_{pf} = Total time, in minutes per year, in which the tool(s) connected at any point during the year to abatement system p, in fab f could be in operation. For determining the amount of tool operating time, you may assume that tools that were installed for the whole of the year were operated for 525,600 minutes per year. For tools that were installed or uninstalled during the year, you must prorate the operating time to account for the days in which the tool was not installed; treat any partial day that a tool was installed as a full day (1,440 minutes) of tool operation. For an abatement system that has more than one connected tool, the tool operating time is 525,600 minutes per year if there was at least one tool installed at all times throughout the year. If you have tools that are idle with no gas flow through the tool, you may calculate total tool time using the actual time that gas is flowing through the tool.
f = Fab.
p = Abatement system.

(viii) When using the stack testing option described in this paragraph (i), you must calculate the weighted-average fraction of fluorinated input gas i destroyed or removed in abatement systems for each fab f, as applicable, by using Equation I–24 of this subpart.

$$d_{if} = \frac{\sum_j C_{ijf} * DRE_{ij}}{\sum_j C_{ijf}} \qquad \text{(Eq. I-24)}$$

Where:
d_{if} = The average weighted fraction of fluorinated GHG input gas i destroyed or removed in abatement systems in fab f (expressed as a decimal fraction).
C_{ijf} = The amount of fluorinated GHG input gas i consumed for process type j fed into abatement systems in fab f as calculated using Equation I–13 of this subpart (kg).
DRE_{ij} = Destruction or removal efficiency for fluorinated GHG input gas i in abatement systems connected to process tools where process type j is used (expressed as a decimal fraction) determined according to § 98.94(f).
f = fab.
i = Fluorinated GHG input gas.
j = Process type.

(4) *Method to calculate emissions from stack systems that are not tested.* You must calculate annual fab-level emissions of each fluorinated GHG input gas and by-product gas for those fluorinated GHG listed in paragraphs (i)(4)(i) and (ii) of this section using default utilization and by-product formation rates as shown in Tables I–11, I–12, I–13, I–14, or I–15 of this subpart, as applicable, and by using Equations I–8, I–9, and I–13 of this subpart. When using Equations I–8, I–9, and I–13 of this subpart to fulfill the requirements of this paragraph, you must use, in place of the term C_{ij} in each equation, the total consumption of each fluorinated GHG meeting the criteria in paragraph (i)(4)(i) of this section or that is used in tools vented to the stack systems that meet the criteria in paragraph (i)(4)(ii) of this section. You must use, in place of the term a_{ij}, the fraction of fluorinated GHG meeting the criteria in paragraph (i)(4)(i) of this section used in tools with abatement systems or that is used in tools with abatement systems that are vented to the stack systems that meet the criteria in paragraph (i)(4)(ii) of this section. You also must use the results of Equation I–24 of this subpart in place of the terms d_{ij} in Equation I–8 of this subpart and d_{jk} in Equation I–9 of this subpart, and use the results of Equation I–23 of this subpart in place of the results of Equation I–15 of this subpart for the term UT_{ij}.

(i) Calculate emissions from consumption of each intermittent low-use fluorinated GHG as defined in § 98.98 of this subpart using the default utilization and by-product formation rates and equations specified in paragraph (i)(4) of this section. If a fluorinated GHG was not being used during the stack testing and does not meet the definition of intermittent low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use at a magnitude that would allow you to determine an emission factor for that gas according to the procedures specified in paragraph (i)(3) of this section.

(ii) Calculate emissions from consumption of each fluorinated GHG used in tools vented to stack systems that meet the criteria specified in paragraphs (i)(2)(i) through (i)(2)(iii) of this section, and were not tested according to the procedures in paragraph (i)(3) of this section. Calculate emissions using the default utilization and by-product formation rates and equations specified in paragraph (i)(4) of this section. If you are using a fluorinated GHG not listed in Tables I–11, I–12, I–13, I–14, or I–15 of this subpart, then you must assume utilization and by-product formation rates of zero for that fluorinated GHG.

(5) To determine the total emissions of each fluorinated GHG from each fab under this stack testing option, you must sum the emissions of each fluorinated GHG determined from the procedures in paragraph (i)(3) of this section with the emissions of the same fluorinated GHG determined from the procedures in paragraph (i)(4) of this section. Sum the total emissions of each fluorinated GHG from all fabs at your facility to determine the facility-level emissions of each fluorinated GHG.

■ 7. Section 98.94 is amended by:

■ a. Removing and reserving paragraph (a);
■ b. Revising paragraph (b), paragraph (c) introductory text, and paragraph (c)(2);
■ c. Adding paragraph (c)(3);
■ d. Removing and reserving paragraphs (d) and (e);
■ e. Revising paragraph (f);
■ f. Removing and reserving paragraphs (g)(1) and (2);
■ g. Revising paragraphs (g)(3) and (4);
■ h. Revising paragraphs (h) introductory text, (h)(3), and (i); and
■ i. Adding paragraphs (j) and (k).

The revisions and additions read as follows:

§ 98.94 Monitoring and QA/QC requirements.

* * * * *

(b) For purposes of Equation I–12 of this subpart, you must estimate fab-wide gas-specific heel factors for each container type for each gas used, according to the procedures in paragraphs (b)(1) through (b)(5) of this section. This paragraph (b) does not apply to fluorinated GHGs or N_2O that your fab uses in quantities of less than 50 kg in one reporting year and for which you calculate emissions as equal to consumption under § 98.93(a)(1), (a)(2), or (b), or for any intermittent low-use fluorinated GHG for which you calculate emissions according to § 98.93(i)(4)(i).

(1) Base your fab-wide gas-specific heel factors on the trigger point for change out of a container for each container size and type for each gas used. Fab-wide gas-specific heel factors must be expressed as the ratio of the trigger point for change out, in terms of mass, to the initial mass in the container, as determined by paragraphs (b)(2) and (3) of this section.

(2) The trigger points for change out you use to calculate fab-wide gas-specific heel factors in paragraph (b)(1) of this section must be determined by monitoring the mass or the pressure of your containers. If you monitor the pressure, convert the pressure to mass using the ideal gas law, as displayed in Equation I–25 of this subpart, with the appropriate Z value selected based upon the properties of the gas.

$$pV = ZnRT \qquad \text{(Eq. I-25)}$$

Where:

p = Absolute pressure of the gas (Pa).
V = Volume of the gas container (m^3).
Z = Compressibility factor.
n = Amount of substance of the gas (moles).
R = Gas constant (8.314 Joule/Kelvin mole).
T = Absolute temperature (K).

(3) The initial mass you use to calculate a fab-wide gas-specific heel factor in paragraph (b)(1) of this section may be based on the weight of the gas provided to you in gas supplier documents; however, you remain responsible for the accuracy of these masses and weights under this subpart.

(4) If a container is changed in an exceptional circumstance, as specified in paragraphs (b)(4)(i) and (ii) of this section, you must weigh that container or measure the pressure of that container with a pressure gauge, in place of using a heel factor to determine the residual weight of gas. When using mass-based trigger points for change out, you must determine if an exceptional circumstance has occurred based on the net weight of gas in the container, excluding the tare weight of the container.

(i) For containers with a maximum storage capacity of less than 9.08 kg (20 lbs) of gas, an exceptional circumstance is a change out point that differs by more than 50 percent from the trigger point for change out used to calculate your fab-wide gas-specific heel factor for that gas and container type.

(ii) For all other containers, an exceptional circumstance is a change out point that differs by more than 20 percent from the trigger point for change out used to calculate your fab-wide gas-specific heel factor for that gas and container type.

(5) You must re-calculate a fab-wide gas-specific heel factor if you execute a process change to modify the trigger point for change out for a gas and container type that differs by more than 5 percent from the previously used trigger point for change out for that gas and container type.

(c) You must develop apportioning factors for fluorinated GHG and N_2O consumption (including the fraction of gas consumed by process tools connected to abatement systems as in Equations I–8, I–9, I–10, I–19, I–20, I–21, and I–22 of this subpart), to use in the equations of this subpart for each input gas i, process sub-type, process type, stack system, and fab as appropriate, using a fab-specific engineering model that is documented in your site GHG Monitoring Plan as required under § 98.3(g)(5). This model must be based on a quantifiable metric, such as wafer passes or wafer starts, or direct measurement of input gas consumption as specified in paragraph (c)(3) of this section. To verify your model, you must demonstrate its precision and accuracy by adhering to the requirements in paragraphs (c)(1) and (2) of this section.

* * * * *

(2) You must demonstrate the accuracy of your fab-specific model by comparing the actual amount of input gas i consumed and the modeled amount of input gas i consumed in the fab, as follows:

(i) You must analyze actual and modeled gas consumption for a period when the fab is at a representative operating level (as defined in § 98.98) lasting at least 30 days but no more than the reporting year.

(ii) You must compare the actual gas consumed to the modeled gas consumed for one fluorinated GHG reported under this subpart for the fab. You must certify that the fluorinated GHG selected for comparison corresponds to the largest quantity, on a mass basis, of fluorinated GHG consumed at the fab during the reporting year for which you are required to apportion following the procedures specified in § 98.93(a), (b), or (i). You may compare the actual gas consumed to the modeled gas consumed for two fluorinated GHGs and demonstrate conformance according to paragraph (c)(2)(iii) of this section on an aggregate use basis for both fluorinated GHGs if one of the fluorinated GHGs selected for comparison corresponds to the largest quantity, on a mass basis, of fluorinated GHGs used at each fab that requires apportionment during the reporting year.

(iii) You must demonstrate that the comparison performed for the largest quantity of gas(es), on a mass basis, consumed in the fab in paragraph (c)(2)(ii) of this section, does not result in a difference between the actual and modeled gas consumption that exceeds 20 percent relative to actual gas consumption, reported to two significant figures using standard rounding conventions.

(iv) If you are required to apportion gas consumption and you use the procedures in § 98.93(i) to calculate annual emissions from a fab, you must verify your apportioning factors using the procedures in paragraphs (c)(2)(ii) and (iii) of this section such that the time period specified in paragraph (c)(2)(i) of this section and the last day you perform the sampling events specified under § 98.93(i)(3) occur in the same accounting month.

(v) If your facility has multiple fabs with a single centralized fluorinated-GHG supply system, you must verify that your apportioning model can apportion fluorinated GHG consumption among the fabs by adhering to the procedures in paragraphs (c)(2)(ii) through (c)(2)(iv) of this section.

(3) As an alternative to developing apportioning factors for fluorinated GHG and N_2O consumption using a fab-specific engineering model, you may

develop apportioning factors through the use of direct measurement using gas flow meters and weigh scales to measure process sub-type, process type, stack system, or fab-specific input gas consumption. You may use a combination of apportioning factors developed using a fab-specific engineering model and apportioning factors developed through the use of direct measurement, provided this is documented in your site GHG Monitoring Plan as required under 98.3(g)(5).

* * * * *

(f) If your fab employs abatement systems and you elect to reflect emission reductions due to these systems, or if your fab employs abatement systems designed for fluorinated GHG abatement and you elect to calculate fluorinated GHG emissions using the stack test method under 98.93(i), you must comply with the requirements of paragraphs (f)(1) through (f)(3) of this section. If you use an average of properly measured destruction or removal efficiencies for a gas and process sub-type or process type combination, as applicable, in your emission calculations under § 98.93(a), (b), and/or (i), you must also adhere to procedures in paragraph (f)(4) of this section.

(1) You must certify and document that the abatement systems are properly installed, operated, and maintained according to the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9).

(2) You must calculate and document the uptime of abatement systems using Equation I–15 or I–23 of this subpart, as applicable.

(3) If you use default destruction and removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i), you must certify and document that the abatement systems at your facility for which you use default destruction or removal efficiency values are specifically designed for fluorinated GHG or N_2O abatement, as applicable. If you elect to calculate fluorinated GHG emissions using the stack test method under § 98.93(i), you must also certify that you have included and accounted for all abatement systems designed for fluorinated GHG abatement and any respective downtime in your emissions calculations under § 98.93(i)(3).

(4) If you do not use the default destruction or removal efficiency values in Table I–16 of this subpart to calculate and report controlled emissions, including situations in which your fab employs abatement systems not specifically designed for fluorinated GHG or N_2O abatement and you elect to reflect emission reduction due to these systems, you must use an average of properly measured destruction or removal efficiencies for each gas and process sub-type or process type combination, as applicable, determined in accordance with procedures in paragraphs (f)(4)(i) through (vi) of this section. You must not use a default value from Table I–16 of this subpart for any abatement system not specifically designed for fluorinated GHG and N_2O abatement, or for any gas and process type combination for which you have measured the destruction or removal efficiency according to the requirements of paragraphs (f)(4)(i) through (vi) of this section.

(i) A properly measured destruction or removal efficiency value must be determined in accordance with EPA 430–R–10–003 (incorporated by reference, see § 98.7), or according to an alternative method approved by the Administrator (or authorized representative) as specified in paragraph (k) of this section. If you are measuring destruction or removal efficiency according to EPA 430–R–10–003 (incorporated by reference, see § 98.7), you may follow the alternative procedures specified in Appendix A to this subpart.

(ii) You must select and properly measure the destruction or removal efficiency for a random sample of abatement systems to include in a random sampling abatement system testing program in accordance with procedures in paragraphs (f)(4)(ii)(A) and (B) of this section.

(A) For the first 2 years for which your fab is required to report emissions of fluorinated GHG and N_2O, for each abatement system gas and process sub-type or process type combination, as applicable, a random sample of a minimum of 10 percent of installed abatement systems must be tested annually for a total of a minimum of 20 percent, or a minimum of 20 percent may be tested in the first year. For every 3-year period following the initial 2-year period, a random sample of at least 15 percent of installed abatement systems must be tested for each gas and process sub-type or process type combination; you may test 15-percent in the first year of the 3-year period, but you must test at least 5 percent each year until 15 percent are tested. For each 3-year period, you must determine the number of abatement systems to be tested based on the average number of abatement systems in service over the 3-year period. If the required percent of the total number of abatement systems to be tested for each gas and process sub-type or process type combination does not equate to a whole number, the number of systems to be tested must be determined by rounding up to the nearest integer. Except as provided in paragraph (f)(4)(v) of this section, you may not retest an abatement system for any gas and process sub-type or process type combination, as applicable, until all of the abatement systems for that gas and process sub-type or process type combination have been tested.

(B) If testing of a randomly selected abatement system would be disruptive to production, you may replace that system with another randomly selected system for testing and return the system to the sampling pool for subsequent testing. Any one abatement system must not be replaced by another randomly selected system for more than three consecutive selections. When you have to replace a system in one year, you may select that specific system to be tested in one of the next two sampling years so that you may plan testing of that abatement system to avoid disrupting production.

(iii) If you elect to take credit for abatement system destruction or removal efficiency before completing testing on 20 percent of the abatement systems for that gas and process sub-type or process type combination, as applicable, you must use default destruction or removal efficiencies for a gas and process type combination. You must not use a default value from Table I–16 of this subpart for any abatement system not specifically designed for fluorinated GHG and N_2O abatement, and must not take credit for abatement system destruction or removal efficiency before completing testing on 20 percent of the abatement systems for that gas and process sub-type or process type combination, as applicable. Following testing on 20 percent of abatement systems for that gas and process sub-type or process type combination, you must calculate the average destruction or removal efficiency as the arithmetic mean of all test results for that gas and process sub-type or process type combination, until you have tested at least 30 percent of all abatement systems for each gas and process sub-type or process type combination. After testing at least 30 percent of all systems for a gas and process sub-type or process type combination, you must use the arithmetic mean of the most recent 30 percent of systems tested as the average destruction or removal efficiency. You may include results of testing conducted on or after January 1, 2011 for use in determining the site-specific destruction or removal efficiency for a given gas and

process sub-type or process type combination if the testing was conducted in accordance with the requirements of paragraph (f)(4)(i) of this section.

(iv) If a measured destruction or removal efficiency is below the manufacturer-claimed fluorinated GHG or N_2O destruction or removal efficiency for any abatement system specifically designed for fluorinated GHG or N_2O abatement and the abatement system is installed, operated, and maintained in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9), the measured destruction or removal efficiency must be included in the calculation of the destruction or removal efficiency value for that gas and process sub-type or process type.

(v) If a measured destruction or removal efficiency is below the manufacturer-claimed fluorinated GHG or N_2O destruction or removal efficiency for any abatement system specifically designed for fluorinated GHG or N_2O abatement and the abatement system is not installed, operated, or maintained in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9), you must implement corrective action and perform a retest to replace the measured value within the reporting year. In lieu of retesting within the reporting year, you may use the measured value in calculating the average destruction or removal efficiency for the reporting year, implement corrective action, and then include the same system in the next abatement system testing period in addition to the testing of randomly selected systems for that next testing period. Regardless of whether you use the lower measured destruction or removal efficiency and when you perform the retest of the abatement system, you must count the time that the abatement system is not operated and maintained according to the site maintenance plan for abatement systems as not being in operational mode for purposes of calculating abatement system uptime.

(vi) If your fab uses redundant abatement systems, you may account for the total abatement system uptime (that is, the time that at least one abatement system is in operational mode) calculated for a specific exhaust stream during the reporting year.

(g) * * *

(3) Follow the QA/QC procedures in accordance with those in EPA 430–R–10–003 (incorporated by reference, see § 98.7), or the applicable QA/QC procedures specified in an alternative method approved by the Administrator (or authorized representative) according to paragraph (k) of this section, when calculating abatement systems destruction or removal efficiencies. If you are measuring destruction or removal efficiency according to EPA 430–R–10–003 (incorporated by reference, see § 98.7), and you elect to follow the alternative procedures specified in Appendix A to this subpart according to paragraph (f)(4)(i) of this section, you must follow any additional QA/QC procedures specified in Appendix A to this subpart.

(4) As part of normal operations for each fab, the inventory of gas stored in containers at the beginning of the reporting year must be the same as the inventory of gas stored in containers at the end of the previous reporting year. You must maintain records documenting the year end and year beginning inventories under § 98.97(a).

(h) You must adhere to the QA/QC procedures of this paragraph (h) when calculating annual gas consumption for each fluorinated GHG and N_2O used at each fab and emissions from the use of each fluorinated heat transfer fluid on a fab basis.

* * * * *

(3) Ensure that the inventory at the beginning of one reporting year is identical to the inventory at the end of the previous reporting year. You must maintain records documenting the year end and year beginning inventories under § 98.97(a) and (r).

* * * * *

(i) All flow meters, weigh scales, pressure gauges, and thermometers used to measure quantities that are monitored under this section or used in calculations under § 98.93 must meet the calibration and accuracy requirements specified in § 98.3(i).

(j) *Stack test methodology*. For each fab for which you calculate annual emissions for any fluorinated GHG emitted from your facility using the stack test method according to the procedure specified in § 98.93(i)(3), you must adhere to the requirements in paragraphs (j)(1) through (8) of this section. You may request approval to use an alternative stack test method and procedure according to paragraph (k) of this section.

(1) *Stack system testing*. Conduct an emissions test for each applicable stack system according to the procedures in paragraphs (j)(1)(i) through (iv) of this section.

(i) You must conduct an emission test during which the fab is operating at a representative operating level, as defined in § 98.98, and with the abatement systems connected to the stack system being tested operating with at least 90 percent uptime, averaged over all abatement systems, during the 8-hour (or longer) period for each stack system, or at no less than 90 percent of the abatement system uptime rate measured over the previous reporting year, averaged over all abatement systems.

(ii) You must measure for the expected and possible by-products identified in Table I–17 of this subpart and those fluorinated GHGs used as input fluorinated GHG in process tools vented to the stack system, except for any intermittent low-use fluorinated GHG as defined in § 98.98. You must calculate annual emissions of intermittent low-use fluorinated GHGs by adhering to the procedures in § 98.93(i)(4)(i).

(iii) If a fluorinated GHG being consumed in the reporting year was not being consumed during the stack testing and does not meet the definition of intermittent low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use at a magnitude that would allow you to determine an emission factor for that gas. If a fluorinated GHG consumed in the reporting year was not being consumed during the stack testing and is no longer in use by your fab (e.g., use of the gas has become obsolete or has been discontinued), then you must calculate annual emissions for that fluorinated GHG according to the procedure specified in § 98.93(i)(4).

(iv) Although all applicable stack systems are not required to be tested simultaneously, you must certify that no significant changes in stack flow configuration occur between tests conducted for any particular fab in a reporting year. You must certify that no more than 10 percent of the total number of fluorinated GHG emitting process tools are connected or disconnected from a stack system during testing. You must also certify that no process tools that were in operation at the start of the test period have been moved to a different stack system during the test period (i.e., during or in between testing of individual stack systems) and that no point-of-use abatement systems have been permanently removed from service during the test period. You must document any changes in stack flow configuration in the emissions test data and report required to be kept as records under § 98.97(i)(4).

(2) *Test methods and procedures*. You must adhere to the applicable test

methods and procedures specified in Table I–9 to this subpart, or adhere to an alternative method approved by the Administrator (or authorized representative) according to paragraph (k) of this section. If you select Method 320 of 40 CFR part 63, Appendix A to measure the concentration of each fluorinated GHG in the stack system, you must complete a method validation according to Section 13 of Method 320 of 40 CFR part 63, Appendix A for each FTIR system (hardware and software) and each tester (testing company). Method 320 validation is necessary when any change occurs in instrumentation, tester (i.e., testing company), or stack condition (e.g., acid gas vs. base). Measurement of new compounds require validation for those compounds according to Section 13 of Method 320 of 40 CFR part 63, Appendix A. The field detection limits achieved under your test methods and procedures must fall at or below the maximum field detection limits specified in Table I–10 to this subpart.

(3) *Fab-specific fluorinated GHG consumption measurements.* You must determine the amount of each fluorinated GHG consumed by each fab during the sampling period for all process tools connected to the stack systems tested under § 98.93(i)(3), according to the procedures in paragraphs (j)(3)(i) and (ii) of this section. This determination must include apportioning gas consumption between stack systems that are being tested and those that are not tested under § 98.93(i)(2).

(i) Measure fluorinated GHG consumption using gas flow meters, scales, or pressure measurements. Measure the mass or pressure, as applicable, at the beginning and end of the sampling period and when containers are changed out. If you elect to measure gas consumption using pressure (i.e., because the gas is stored in a location above its critical temperature) you must estimate consumption as specified in paragraphs (j)(3)(i)(A) and (B) of this section.

(A) For each fluorinated GHG, you must either measure the temperature of the fluorinated GHG container(s) when the sampling periods begin and end and when containers are changed out, or measure the temperature of the fluorinated GHG container(s) every hour for the duration of the sampling period. Temperature measurements of the immediate vicinity of the containers (e.g., in the same room, near the containers) shall be considered temperature measurements of the containers.

(B) Convert the sampling period-beginning, sampling period-ending, and container change-out pressures to masses using Equation I–25 of this subpart, with the appropriate Z value selected based upon the properties of the gas (e.g., the Z value yielded by the Redlich, Kwong, Soave equation of state with appropriate values for that gas). Apply the temperatures measured at or nearest to the beginning and end of the sampling period and to the time(s) when containers are changed out, as applicable. For each gas, the consumption during the sampling period is the difference between the masses of the containers of that gas at the beginning and at the end of the sampling period, summed across containers, including containers that are changed out.

(ii) For each fluorinated GHG gas for which consumption is too low to be accurately measured during the sampling period using gas flow meters, scales, or pressure measurements as specified in paragraph (j)(3)(i) of this section, you must follow at least one of the procedures listed in paragraph (j)(3)(ii)(A) through (C) of this section to obtain a consumption measurement.

(A) Draw the gas from a single gas container if it is normally supplied from multiple containers connected by a shared manifold.

(B) Calculate consumption from pro-rated long-term consumption data (for example, calculate and use hourly consumption rates from monthly consumption data).

(C) Increase the duration of the sampling period for consumption measurement beyond the minimum duration specified in Table I–9 of this subpart.

(4) *Emission test results.* The results of an emission test must include the analysis of samples, number of test runs, the average emission factor for each fluorinated GHG measured, the analytical method used, calculation of emissions, the fluorinated GHGs consumed during the sampling period, an identification of the stack systems tested, and the fluorinated GHGs that were included in the test. The emissions test report must contain all information and data used to derive the fab-specific emission factor.

(5) *Emissions testing frequency.* You must conduct emissions testing to develop fab-specific emission factors on a frequency according to the procedures in paragraph (j)(5)(i) or (ii) of this section.

(i) *Annual testing.* You must conduct an annual emissions test for each stack system for which emissions testing is required under § 98.93(i)(3), unless you meet the criteria in paragraph (j)(5)(ii) of this section to skip annual testing. Each set of emissions testing for a stack system must be separated by a period of at least 2 months.

(ii) *Criteria to test less frequently.* After the first 3 years of annual testing, you may calculate the relative standard deviation of the emission factors for each fluorinated GHG included in the test and use that analysis to determine the frequency of any future testing. As an alternative, you may conduct all three tests in less than 3 calendar years for purposes of this paragraph (j)(5)(ii), but this does not relieve you of the obligation to conduct subsequent annual testing if you do not meet the criteria to test less frequently. If the criteria specified in paragraphs (j)(5)(ii)(A) and (B) of this section are met, you may use the arithmetic average of the three emission factors for each fluorinated GHG and fluorinated GHG by-product for the current year and the next 4 years with no further testing unless your fab operations are changed in way that triggers the re-test criteria in paragraph (j)(8) of this section. In the fifth year following the last stack test included in the previous average, you must test each of the stack systems for which testing is required and repeat the relative standard deviation analysis using the results of the most recent three tests (i.e., the new test and the two previous tests conducted prior to the 4 year period). If the criteria specified in paragraphs (j)(5)(ii)(A) and (B) of this section are not met, you must use the emission factors developed from the most recent testing and continue annual testing. You may conduct more than one test in the same year, but each set of emissions testing for a stack system must be separated by a period of at least 2 months. You may repeat the relative standard deviation analysis using the most recent three tests, including those tests conducted prior to the 4 year period, to determine if you are exempt from testing for the next 4 years.

(A) The relative standard deviation of the total CO_2e emission factors calculated from each of the three tests (expressed as the total CO_2e fluorinated GHG emissions of the fab divided by the total CO_2e fluorinated GHG use of the fab) is less than or equal to 15 percent.

(B) The relative standard deviation for all single fluorinated GHGs that individually accounted for 5 percent or more of CO_2e emissions were less than 20 percent.

(C) For those fluorinated GHG that do not have GWP values listed in Table A–1 to subpart A of this part, you must use a GWP value of 2,000 in calculating

CO_2e in paragraphs (j)(5)(ii)(A) and (B) of this section.

(6) *Subsequent measurements.* You must make an annual determination of each stack system's exemption status under § 98.93(i)(2) by March 31 each year. If a stack system that was previously not required to be tested per § 98.93(i)(2), no longer meets the criteria in § 98.93(i)(2), you must conduct the emissions testing for the stack system during the current reporting and develop the fab-specific emission factor from the emissions testing.

(7) *Previous measurements.* You may include the results of emissions testing conducted on or after January 1, 2011 for use in the relative standard deviation calculation in paragraph (j)(5)(ii) of this section if the previous results were determined using a method meeting the requirements in paragraph (j)(2) of this section. You may request approval to use results of emissions testing conducted between January 1, 2011 and January 1, 2014 using a method that deviated from the requirements in paragraph (j)(2) of this section by adhering to the requirements in paragraphs (j)(7)(i) through (j)(7)(iv) of this section.

(i) Notify the Administrator (or an authorized representative) of your intention to use the results of the previous emissions testing. You must include in the notification the data and results you intend to use for meeting either reporting or recordkeeping requirements, a description of the method, and any deviations from the requirements in paragraph (j)(2) of this section. Your description must include an explanation of how any deviations do not affect the quality of the data collected.

(ii) The Administrator will review the information submitted under paragraph (j)(7)(i) and determine whether the results of the previous emissions testing are adequate and issue an approval or disapproval of the use of the results within 120 days of the date on which you submit the notification specified in paragraph (j)(7)(i) of this section.

(iii) If the Administrator finds reasonable grounds to disapprove the results of the previous emissions testing, the Administrator may request that you provide additional information to support the use of the results of the previous emissions testing. Failure to respond to any request made by the Administrator does not affect the 120 day deadline specified in paragraph (j)(7)(ii) of this section.

(iv) Neither the approval process nor the failure to obtain approval for the use of results from previous emissions testing shall abrogate your responsibility to comply with the requirements of this subpart.

(8) *Scenarios that require a stack system to be re-tested.* By March 31 of each reporting year, you must evaluate and determine whether any changes to your fab operations meet the criteria specified in paragraphs (j)(8)(i) through (vi) of this section. If any of the scenarios specified in paragraph (j)(8)(i) through (vi) of this section occur, you must perform a re-test of any applicable stack system, irrespective of whether you have met the criteria for less frequent testing in paragraph (j)(5)(ii) of this section, before the end of the year in which the evaluation was completed. You must adhere to the methods and procedures specified in § 98.93(i)(3) for performing a stack system emissions test and calculating emissions. If you meet the criteria for less frequent testing in paragraph (j)(5)(ii), and you are required to perform a re-test as specified in paragraph (j)(8)(i) through (vi) of this section, the requirement to perform a re-test does not extend the date of the next scheduled test that was established prior to meeting the requirement to perform a re-test. If the criteria specified in paragraph (j)(5)(ii) of this section are not met using the results from the re-test and the two most recent stack tests, you must use the emission factors developed from the most recent testing to calculate emissions and resume annual testing. You may resume testing less frequently according to your original schedule if the criteria specified in paragraph (j)(5)(ii) of this section are met using the most recent three tests.

(i) Annual consumption of a fluorinated GHG used during the most recent emissions test (expressed in CO_2e) changes by more than 10 percent of the total annual fluorinated GHG consumption, relative to gas consumption in CO_2e for that gas during the year of the most recent emissions test (for example, if the use of a single gas goes from 25 percent of CO_2e to greater than 35 percent of CO_2e, this change would trigger a re-test). For those fluorinated GHGs that do not have GWP values listed in Table A–1 to subpart A of this part, you must use a GWP value of 2,000 in calculating CO_2e for purposes of this paragraph.

(ii) A change in the consumption of an intermittent low-use fluorinated GHG (as defined in § 98.98) that was not used during the emissions test and not reflected in the fab-specific emission factor, such that it no longer meets the definition of an intermittent low-use fluorinated GHG.

(iii) A decrease by more than 10 percent in the fraction of tools with abatement systems, compared to the number during the most recent emissions test.

(iv) A change in the wafer size manufactured by the fab since the most recent emissions test.

(v) A stack system that formerly met the criteria specified under § 98.93(i)(2) for not being subject to testing no longer meets those criteria.

(vi) If a fluorinated GHG being consumed in the reporting year was not being consumed during the stack test and does not meet the definition of intermittent, low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use as required in paragraph (j)(1)(iii) of this section.

(k) You may request approval to use an alternative stack test method and procedure or to use an alternative method to determine abatement system destruction or removal efficiency by adhering to the requirements in paragraphs (k)(1) through (6) of this section. An alternative method is any method of sampling and analyzing for a fluorinated GHG or N_2O, or the determination of parameters other than concentration, for example, flow measurements, that is not a method specified in this subpart and that has been demonstrated to the Administrator's satisfaction, using Method 301 in appendix A of part 63, to produce results adequate for the Administrator's determination that it may be used in place of a method specified elsewhere in this subpart.

(1) You may use an alternative method from that specified in this subpart provided that you:

(i) Notify the Administrator (or an authorized representative) of your intention to use an alternative method. You must include in the notification a site-specific test plan describing the alternative method and procedures (the alternative test plan), the range of test conditions over which the validation is intended to be applicable, and an alternative means of calculating the fab-level fluorinated GHG or N_2O emissions or determining the abatement system destruction or removal efficiency if the Administrator denies the use of the results of the alternative method under paragraph (k)(2) or (3) of this section.

(ii) Use Method 301 in appendix A of part 63 of this chapter to validate the alternative method. This may include the use of only portions of specific procedures of Method 301 if use of such procedures are sufficient to validate the alternative method; and

(iii) Submit the results of the Method 301 validation process along with the notification of intention and the

rationale for not using the specified method.

(2) The Administrator will determine whether the validation of the proposed alternative method is adequate and issue an approval or disapproval of the alternative test plan within 120 days of the date on which you submit the notification and alternative test plan specified in paragraph (k)(1) of this section. If the Administrator approves the alternative test plan, you are authorized to use the alternative method(s) in place of the methods described in paragraph (f)(4)(i) of this section for measuring destruction or removal efficiency or paragraph (j) of this section for conducting the stack test, as applicable, taking into account the Administrator's comments on the alternative test plan. Notwithstanding the requirement in the preceding sentence, you may at any time prior to the Administrator's approval or disapproval proceed to conduct the stack test using the methods specified in paragraph (j) of this section or the destruction or removal efficiency determination specified in (f)(4)(i) of this section if you use a method specified in this subpart instead of the requested alternative. If an alternative test plan is not approved and you still want to use an alternative method, you must recommence the process to have an alternative test method approved starting with the notification of intent to use an alternative test method specified in paragraph (k)(1)(i) of this section.

(3) You must report the results of stack testing or destruction or removal efficiency determination using the alternative method and procedure specified in the approved alternative test plan. You must include in your report for an alternative stack test method and for an alternative abatement system destruction or removal efficiency determination the information specified in paragraph (j)(4) of this section, including all methods, calculations and data used to determine the fluorinated GHG emission factor or the abatement system destruction or removal efficiency. The Administrator will review the results of the test using the alternative methods and procedure and then approve or deny the use of the results of the alternative test method and procedure no later than 120 days after they are submitted to EPA.

(4) If the Administrator finds reasonable grounds to dispute the results obtained by an alternative method for the purposes of determining fluorinated GHG emissions or destruction or removal efficiency of an abatement system, the Administrator may require the use of another method specified in this subpart.

(5) Once the Administrator has approved the use of the alternative method for the purposes of determining fluorinated GHG emissions for specific fluorinated GHGs and types of stack systems or abatement system destruction or removal efficiency, that method may be used at any other facility for the same fluorinated GHGs and types of stack systems, or fluorinated GHGs and abatement systems, if the approved conditions apply to that facility. In granting approval, the Administrator may limit the range of test conditions and emission characteristics for which that approval is granted and under which the alternative method may be used without seeking approval under paragraphs (k)(1) through (4) of this section. The Administrator will specify those limitations, if any, in the approval of the alternative method.

(6) Neither the validation and approval process nor the failure to validate or obtain approval of an alternative method shall abrogate your responsibility to comply with the requirements of this subpart.

■ 8. Section 98.96 is amended by:
■ a. Revising paragraphs (a) and (b);
■ b. Revising paragraphs (c) introductory text and (c)(1) through (3);
■ c. Adding paragraph (c)(5);
■ d. Removing and reserving paragraphs (f) through (l);
■ e. Revising paragraph (m) introductory text;
■ f. Redesignating paragraphs (m)(i) through (m)(iv) as paragraphs (m)(1) through (m)(4), and revising newly redesignated paragraphs (m)(1), (3), and (4);
■ g. Adding paragraph (m)(5);
■ h. Removing and reserving paragraphs (n) and (o);
■ i. Revising paragraphs (p) through (s);
■ j. Removing and reserving paragraphs (t) through (v); and
■ k. Adding paragraphs (w), (x), and (y).

The revisions and additions read as follows:

§ 98.96 Data reporting requirements.

* * * * *

(a) Annual manufacturing capacity of each fab at your facility used to determine the annual manufacturing capacity of your facility in Equation I–5 of this subpart.

(b) For facilities that manufacture semiconductors, the diameter of wafers manufactured at each fab at your facility (mm).

(c) Annual emissions, on a fab basis as described in paragraph (c)(1) through (5) of this section.

(1) When you use the procedures specified in § 98.93(a) of this subpart, each fluorinated GHG emitted from each process type for which your fab is required to calculate emissions as calculated in Equations I–6 and I–7 of this subpart.

(2) Each fluorinated GHG emitted from each process type or process sub-type as calculated in Equations I–8 and I–9 of this subpart, as applicable.

(3) N_2O emitted from all chemical vapor deposition processes and N_2O emitted from the aggregate of other N_2O-using manufacturing processes as calculated in Equation I–10 of this subpart.

* * * * *

(5) When you use the procedures specified in § 98.93(i) of this subpart, annual emissions of each fluorinated GHG, on a fab basis.

* * * * *

(m) For the fab-specific apportioning model used to apportion fluorinated GHG and N_2O consumption under § 98.94(c), the following information to determine it is verified in accordance with procedures in § 98.94(c)(1) and (2):

(1) Identification of the quantifiable metric used in your fab-specific engineering model to apportion gas consumption for each fab, and/or an indication if direct measurements were used in addition to, or instead of, a quantifiable metric.

* * * * *

(3) Certification that the gas(es) you selected under § 98.94(c)(2)(ii) for each fab corresponds to the largest quantity(ies) consumed, on a mass basis, of fluorinated GHG used at your fab during the reporting year for which you are required to apportion.

(4) The result of the calculation comparing the actual and modeled gas consumption under § 98.94(c)(2)(iii) and (iv), as applicable.

(5) If you are required to apportion fluorinated GHG consumption between fabs as required by § 98.94(c)(2)(v), certification that the gas(es) you selected under § 98.94(c)(2)(ii) corresponds to the largest quantity(ies) consumed on a mass basis, of fluorinated GHG used at your facility during the reporting year for which you are required to apportion.

* * * * *

(p) Inventory and description of all abatement systems through which fluorinated GHGs or N_2O flow at your facility and for which you are claiming destruction or removal efficiency, including:

(1) The number of abatement systems controlling emissions for each process sub-type, or process type, as applicable,

for each gas used in the process sub-type or process type.

(2) The basis of the destruction or removal efficiency being used (default or site specific measurement according to § 98.94(f)(4)(i)) for each process sub-type or process type and for each gas.

(q) For all abatement systems through which fluorinated GHGs or N_2O flow at your facility, for which you are reporting controlled emissions, the following:

(1) Certification that all abatement systems at the facility have been installed, maintained, and operated in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9).

(2) If you use default destruction or removal efficiency values in your emissions calculations under § 98.93(a), (b), or (i), certification that the site maintenance plan for abatement systems for which emissions are being reported contains manufacturer's recommendations and specifications for installation, operation, and maintenance for each abatement system.

(3) If you use default destruction or removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i), certification that the abatement systems for which emissions are being reported were specifically designed for fluorinated GHG or N_2O abatement, as applicable. You must support this certification by providing abatement system supplier documentation stating that the system was designed for fluorinated GHG or N_2O abatement, as applicable.

(4) For all stack systems for which you calculate fluorinated GHG emissions according to the procedures specified in § 98.93(i)(3), certification that you have included and accounted for all abatement systems and any respective downtime in your emissions calculations under § 98.93(i)(3).

(r) You must report an effective fab-wide destruction or removal efficiency value for each fab at your facility calculated using Equation I–26, I–27, and I–28 of this subpart, as appropriate.

$$DRE_{FAB} = 1 - \left[\frac{\sum_i FGHG_i * GWP_i + \sum_j N_2O_j * GWP_{N2O}}{UAFGHG + SFGHG + \sum_j C_{N2O,j} * (1 - U_{N2O,j}) * GWP_{N2O}} \right] \quad \text{(Eq. I-26)}$$

Where:

DRE_{FAB} = Fab-wide effective destruction or removal efficiency value, expressed as a decimal fraction.

$FGHG_i$ = Total emissions of each fluorinated GHG i emitted from electronics manufacturing processes in the fab, calculated according to the procedures in § 98.93.

N_2O_j = Emissions of N_2O from each N_2O-emitting electronics manufacturing process j in the fab, expressed in metric ton CO_2 equivalents, calculated according to the procedures in § 98.93.

UAFGHG = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO_2 equivalents as calculated in Equation I–27 of this subpart.

SFGHG = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO_2 equivalents, as calculated in Equation I–28 of this subpart.

$C_{N_2O,j}$ = Consumption of N_2O in each N_2O emitting process j, expressed in metric ton CO_2 equivalents.

$1-U_{N_2O,j}$ = N_2O emission factor for each N_2O emitting process j from Table I–8 of this subpart.

GWP_i = GWP of emitted fluorinated GHG i from Table A–1 of this part. For those fluorinated GHGs for which Table A–1 to subpart A of this part does not define a GWP value, use a GWP value of 2,000 for purposes of this equation.

GWP_{N_2O} = GWP of N_2O from Table A–1 of this part.

i = Fluorinated GHG.

j = Process Type.

(1) Use Equation I–27 of this subpart to calculate total unabated emissions, in metric tons CO_2e, of all fluorinated GHG emitted from electronics manufacturing processes whose emissions of fluorinated GHG you calculated according to the default utilization and by-product formation rate procedures in § 98.93(a) or § 98.93(i)(4). For each fluorinated GHG i in process j, use the same consumption (C_{ij}), emission factors ($1 - U_{ij}$), and by-product formation rates (B_{ijk}) to calculate unabated emissions as you used to calculate emissions in § 98.93(a) or § 98.93(i)(4).

$$UAFGHG = \sum_i \sum_j C_{ij} * (1 - U_{ij}) * GWP_i + \sum_i \sum_j C_{ij} * B_{ijk} * GWP_k \quad \text{(Eq. I-27)}$$

Where:

UAFGHG = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO_2e for which you calculated total emission according to the procedures in § 98.93(a) or § 98.93(i)(4).

C_{ij} = Total consumption of fluorinated GHG i, apportioned to process j, expressed in metric ton CO_2e, which you used to calculate total emissions according to the procedures in § 98.93(a) or § 98.93(i)(4).

U_{ij} = Process utilization rate for fluorinated GHG i, process type j, which you used to calculate total emissions according to the procedures in § 98.93(a) or § 98.93(i)(4).

GWP_i = GWP of emitted fluorinated GHG i from Table A–1 of this part. For those fluorinated GHGs for which Table A–1 to subpart A of this part does not define a GWP value, use a GWP value of 2,000 for purposes of this equation.

GWP_k = GWP of emitted fluorinated GHG by-product k, from Table A–1 of this part. For those fluorinated GHGs for which Table A–1 to subpart A of this part does not define a GWP value, use a GWP value of 2,000 for purposes of this equation.

B_{ijk} = By-product formation rate of fluorinated GHG k created as a by-product per amount of fluorinated GHG input gas i (kg) consumed by process type j (kg).

i = Fluorinated GHG.

j = Process Type.

k = Fluorinated GHG by-product.

(2) Use Equation I–28 to calculate total unabated emissions, in metric ton CO_2e, of all fluorinated GHG emitted from electronics manufacturing processes whose emissions of fluorinated GHG you calculated according to the stack testing procedures in § 98.93(i)(3). For each set of processes, use the same input gas

consumption (C_{if}), input gas emission factors (EF_{if}), by-product gas emission factors (EF_{kf}), fractions of tools abated (a_{if} and a_f), and destruction efficiencies (d_{if} and d_{kf}) to calculate unabated emissions as you used to calculate emissions.

$$SFGHG = \sum_i \left[\frac{EF_{if}}{\left(1-\left(a_{if} * d_{if}\right)\right)} * C_{if} * GWP_i \right] + \sum_k \left[\frac{EF_{kf}}{\left(1-\left(a_f * d_{kf}\right)\right)} * \sum_i C_{if} * GWP_k \right] \quad \text{Eq. I-28)}$$

Where:

SFGHG = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO_2e for which you calculated total emission according to the procedures in § 98.93(i)(3).

EF_{if} = Emission factor for fluorinated GHG input gas i, emitted from fab f, as calculated in Equation I–19 of this subpart (kg emitted/kg input gas consumed).

a_{if} = Fraction of fluorinated GHG input gas i used in fab f in tools with abatement systems (expressed as a decimal fraction).

d_{if} = Fraction of fluorinated GHG i destroyed or removed in abatement systems connected to process tools in fab f, which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

C_{if} = Total consumption of fluorinated GHG input gas i, of tools vented to stack systems that are tested, for fab f, for the reporting year, expressed in metric ton CO_2e, which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

EF_{kf} = Emission factor for fluorinated GHG by-product gas k, emitted from fab f, as calculated in Equation I–20 of this subpart (kg emitted/kg of all input gases consumed in tools vented to stack systems that are tested).

a_f = Fraction of input gases used in fab f in tools with abatement systems (expressed as a decimal fraction).

d_{kf} = Fraction of fluorinated GHG by-product k destroyed or removed in abatement systems connected to process tools in fab f, which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

GWP_i = GWP of emitted fluorinated GHG i from Table A–1 of this part. For those fluorinated GHGs for which Table A–1 of subpart A to this part does not define a GWP value, use a GWP value of 2,000 for purposes of this equation.

GWP_k = GWP of emitted fluorinated GHG by-product k, from Table A–1 of this part. For those fluorinated GHGs for which Table A–1 to subpart A of this part does not define a GWP value, use a GWP value of 2,000 for purposes of this equation.

i = Fluorinated GHG.

k = Fluorinated GHG by-product.

(s) Where missing data procedures were used to estimate inputs into the fluorinated heat transfer fluid mass balance equation under § 98.95(b), the number of times missing data procedures were followed in the reporting year and the method used to estimate the missing data.

* * * * *

(w) If you elect to calculate fab-level emissions of fluorinated GHG using the stack test methods specified in § 98.93(i), you must report the following in paragraphs (w)(1) and (2) for each stack system, in addition to the relevant data in paragraphs (a) through (v) of this section:

(1) The date of any stack testing conducted during the reporting year, and the identity of the stack system tested.

(2) An inventory of all stack systems from which process fluorinated GHG are emitted. For each stack system, indicate whether the stack system is among those for which stack testing was performed as per § 98.93(i)(3) or not performed as per § 98.93(i)(2).

(x) If the emissions you report under paragraph (c) of this section include emissions from research and development activities, as defined in § 98.6, report the approximate percentage of total GHG emissions, on a metric ton CO_2e basis, that are attributable to research and development activities, using the following ranges: less than 5 percent, 5 percent to less than 10 percent, 10 percent to less than 25 percent, 25 percent to less than 50 percent, 50 percent and higher. For those fluorinated GHG that do not have GWP values listed in Table A–1 of subpart A of this part, you must use a GWP value of 2,000 in calculating CO_2e for purposes of this paragraph.

(y) If your semiconductor manufacturing facility emits more than 40,000 metric ton CO_2e of GHG emissions, based on your most recently submitted annual report (beginning with the 2015 reporting year) as required in paragraph (c) of this section, from the electronics manufacturing processes subject to reporting under this subpart, you must prepare and submit a triennial (every 3 years) technology assessment report to the Administrator (or an authorized representative) that meets the requirements specified in paragraphs (y)(1) through (6) of this section. Any other semiconductor manufacturing facility may voluntarily submit this report to the Administrator.

(1) The first report must be submitted with the annual GHG emissions report that is due no later than March 31, 2017, and subsequent reports must be delivered every 3 years no later than March 31 of the year in which it is due.

(2) The report must include the information described in paragraphs (y)(2)(i) through (v) of this section.

(i) It must describe how the gases and technologies used in semiconductor manufacturing using 200 mm and 300 mm wafers in the United States have changed in the past 3 years and whether any of the identified changes are likely to have affected the emissions characteristics of semiconductor manufacturing processes in such a way that the default utilization and by-product formation rates or default destruction or removal efficiency factors of this subpart may need to be updated.

(ii) It must describe the effect on emissions of the implementation of new process technologies and/or finer line width processes in 200 mm and 300 mm technologies, the introduction of new tool platforms, and the introduction of new processes on previously tested platforms.

(iii) It must describe the status of implementing 450 mm wafer technology and the potential need to create or update default emission factors compared to 300 mm technology.

(iv) It must provide any utilization and by-product formation rates and/or destruction or removal efficiency data that have been collected in the previous 3 years that support the changes in semiconductor manufacturing processes described in the report.

(v) It must describe the use of a new gas, use of an existing gas in a new process type or sub-type, or a fundamental change in process technology.

(3) If, on the basis of the information reported in paragraph (y)(2) of this section, the report indicates that GHG emissions from semiconductor manufacturing may have changed from those represented by the default utilization and by-product formation

rates in Tables I–3 or I–4, or the default destruction or removal efficiency values in Table I–16 of this subpart, the report must lay out a data gathering and analysis plan focused on the areas of potential change. The plan must describe the elements in paragraphs (y)(3)(i) and (ii).

(i) The testing of tools to determine the potential effect on current utilization and by-product formation rates and destruction or removal efficiency values under the new conditions. You must follow the QA/QC procedures in the International SEMATECH #60124825A–ENG (incorporated by reference, see § 98.7) when measuring and calculating process sub-type and process type fluorinated GHG and N_2O utilization and by-product formation rates.

(ii) A planned analysis of the effect on overall facility emissions using a representative gas-use profile for a 200 mm, 300 mm, or 450 mm fab (depending on which technology is under consideration).

(4) Multiple semiconductor manufacturing facilities may submit a single consolidated 3-year report as long as the facility identifying information in § 98.3(c)(1) and the certification statement in § 98.3(c)(9) is provided for each facility for which the consolidated report is submitted.

(5) The Administrator will review the report received and determine whether it is necessary to update the default utilization rates and by-product formation rates in Tables I–3, I–4, I–11, and I–12 of this subpart and default destruction or removal efficiency values in Table I–16 of this subpart based on the following:

(i) Whether the revised default utilization and by-product formation rates and destruction or removal efficiency values will result in a projected shift in emissions of 10 percent or greater.

(ii) Whether new platforms, processes, or facilities that are not captured in current default utilization and by-product formation rates and destruction or removal efficiency values should be included in revised values.

(iii) Whether new data are available that could expand the existing data set to include new gases, tools, or processes not included in the existing data set (i.e. gases, tools, or processes for which no data are currently available).

(6) The Administrator will review the reports within 120 days and will notify you of a determination whether it is necessary to update any default utilization and by-product formation rates and/or destruction or removal efficiency values. If the Administrator determines it is necessary to update default utilization and by-product formation rates and/or destruction or removal efficiency values, you will then have 180 days from the date you receive notice of the determination to execute the data collection and analysis plan described in the report and submit those data to the Administrator.

■ 9. Section 98.97 is amended by:

■ a. Removing and reserving paragraph (b);

■ b. Revising paragraph (c);

■ c. Revising paragraphs (d) introductory text, (d)(1), and (4), and add paragraphs (d)(5) through (9); and

■ d. Adding paragraphs (i) through (s).

The revisions and additions read as follows:

§ 98.97 Records that must be retained.

* * * * *

(c) Documentation for the fab-specific engineering model used to apportion fluorinated GHG and N_2O consumption. This documentation must be part of your site GHG Monitoring Plan as required under § 98.3(g)(5). At a minimum, you must retain the following:

(1) A clear, detailed description of the fab-specific model, including how it was developed; the quantifiable metric used in the model; all sources of information, equations, and formulas, each with clear definitions of terms and variables; all apportioning factors used to apportion fluorinated GHG and N_2O; and a clear record of any changes made to the model while it was used to apportion fluorinated GHG and N_2O consumption across process sub-types, process types, tools with and without abatement systems, stack systems, and/or fabs.

(2) Sample calculations used for developing the gas apportioning factors (f_{ij}) for the two fluorinated GHGs used at your facility in the largest quantities, on a mass basis, during the reporting year.

(3) If you develop apportioning factors through the use of direct measurement according to § 98.94(c)(3), calculations and data used to develop each gas apportioning factor.

(4) Calculations and data used to determine and document that the fab was operating at representative operating levels, as defined in § 98.98, during the apportioning model verification specified in § 98.94(c).

(d) For all abatement systems through which fluorinated GHGs or N_2O flow at your facility, and for which you are reporting controlled emissions, the following in paragraphs (d)(1) to (9) of this section:

(1) Records of the information in paragraphs (d)(1)(i) though (iv) of this section:

(i) Documentation to certify that each abatement system or group of abatement systems is installed, maintained, and operated in accordance with the site maintenance plan for abatement systems that is specified in paragraph (d)(9) of this section.

(ii) Documentation from the abatement system supplier describing the abatement system's designed purpose and emission control capabilities for fluorinated GHG and N_2O for which the systems or group of systems is certified to abate, where available.

(iii) If you use default destruction or removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i), certification that the abatement systems for which emissions are being reported were specifically designed for fluorinated GHG and N_2O abatement, as required under § 98.94(f)(3), and certification that the site maintenance plan includes manufacturer's recommendations and specifications for installation, operation, and maintenance for all applicable abatement systems.

(iv) Certification that you have included and accounted for all abatement systems and any respective downtime in your emissions calculations under § 98.93(i)(3), as required under § 98.94(f)(3).

* * * * *

(4) Where properly measured site-specific destruction or removal efficiencies are used to report emissions, the information in paragraphs (d)(4)(i) though (vi) of this section:

(i) Dated certification by the technician who made the measurement that the destruction or removal efficiency is calculated in accordance with methods in EPA 430–R–10–003 (incorporated by reference, see § 98.7) and, if applicable Appendix A of this subpart, or an alternative method approved by the Administrator as specified in § 98.94(k), complete documentation of the results of any initial and subsequent tests, the final report as specified in EPA 430–R–10–003 (incorporated by reference, see § 98.7) and, if applicable, the records and documentation specified in Appendix A of this subpart including the information required in paragraph (b)(7) of Appendix A of this subpart, or a final report as specified in an alternative method approved by the Administrator as specified in § 98.94(k).

(ii) The average destruction or removal efficiency of the abatement

systems operating during the reporting year for each process type and gas combination.

(iii) A description of the calculation used to determine the average destruction or removal efficiency for each process type and gas combination, including all inputs to the calculation.

(iv) The records of destruction or removal efficiency measurements for abatement systems for all tests that have been used to determine the site-specific destruction or removal efficiencies currently being used.

(v) A description of the method used for randomly selecting abatement systems for testing.

(vi) The total number of systems for which destruction or removal efficiency was properly measured for each process type and gas combination for the reporting year.

(5) In addition to the inventory specified in § 98.96(p), the information in paragraphs (d)(5)(i) though (iii) of this section:

(i) The number of abatement systems of each manufacturer, and model numbers, and the manufacturer's claimed fluorinated GHG and N_2O destruction or removal efficiency, if any.

(ii) Records of destruction or removal efficiency measurements over the in-use life of each abatement system.

(iii) A description of the tool, with the process type or sub-type, for which the abatement system treats exhaust.

(6) Records of all inputs and results of calculations made accounting for the uptime of abatement systems used during the reporting year, in accordance with Equations I–15 or I–23 of this subpart, as applicable. The inputs should include an indication of whether each value for destruction or removal efficiency is a default value or a measured site-specific value.

(7) Records of all inputs and results of calculations made to determine the average weighted fraction of each gas destroyed or removed in the abatement systems for each stack system using Equation I–24 of this subpart, if applicable. The inputs should include an indication of whether each value for destruction or removal efficiency is a default value or a measured site-specific value.

(8) Records of all inputs and the results of the calculation of the facility-wide emission destruction or removal efficiency factor calculated according to Equations I–26, I–27, and I–28 of this subpart.

(9) A site maintenance plan for abatement systems, which must be maintained on-site at the facility as part of the facility's GHG Monitoring Plan as described in § 98.3(g)(5), and be developed and implemented according to paragraphs (d)(9)(i) through (iii) of this section.

(i) The site maintenance plan for abatement systems must be based on the abatement system manufacturer's recommendations and specifications for installation, operation, and maintenance if you use default destruction and removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i). If the manufacturer's recommendations and specifications for installation, operation, and maintenance are not available, you cannot use default destruction and removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i). If you use an average of properly measured destruction or removal efficiencies determined in accordance with the procedures in § 98.94(f)(4)(i) through (vi), the site maintenance plan for abatement systems must be based on the abatement system manufacturer's recommendations and specifications for installation, operation, and maintenance, where available. If you deviate from the manufacturer's recommendations and specifications, you must include documentation that demonstrates how the deviations do not negatively affect the performance or destruction or removal efficiency of the abatement systems.

(ii) The site maintenance plan for abatement systems must include a defined preventative maintenance process and checklist.

(iii) The site maintenance plan for abatement systems must include a corrective action process that you must follow whenever an abatement system is found to be not operating properly.

* * * * *

(i) Retain the following records for each fab for which you elect to calculate fab-level emissions of fluorinated GHG using the procedures specified in § 98.93(i)(3) or (4).

(1) Document all stack systems with emissions of fluorinated GHG that are less than 10,000 metric tons of CO_2e per year and all stack systems with emissions of 10,000 metric tons CO_2e per year or more. Include the data and calculation used to develop the preliminary estimate of emissions for each stack system.

(2) For each stack system, identify the method used to calculate annual emissions; either § 98.93(i)(3) or (4).

(3) The identity and total annual consumption of each gas identified as an intermittent low use fluorinated GHG as specified in § 98.93(i)(4)(i) and defined in § 98.98.

(4) The emissions test data and reports (see § 98.94(j)(4)) and the calculations used to determine the fab-specific emission factor, including the actual fab-specific emission factor, the average hourly emission rate of each fluorinated GHG from the stack system during the test and the stack system activity rate during the test. The report must also contain any changes in the stack system configuration during or between tests in a reporting year.

(5) The fab-specific emission factor and the calculations and data used to determine the fab-specific emission factor for each fluorinated GHG and by-product, as calculated using Equations I–19 and I–20 of § 98.93(i)(3).

(6) Calculations and data used to determine annual emissions of each fluorinated GHG for each fab.

(7) Calculations and data used to determine and document that the fab was operating at representative operating levels, as defined in § 98.98, during the stack testing period.

(8) A copy of the certification that no significant changes in stack system flow configuration occurred between tests conducted for any particular fab in a reporting year, as required by § 98.94(j)(1)(iv) and any calculations and data supporting the certification.

(9) The number of tools vented to each stack system in the fab.

(j) If you report the approximate percentage of total GHG emissions from research and development activities under § 98.96(x), documentation for the determination of the percentage of total emissions of each fluorinated GHG and/or N_2O attributable to research and development activities, as defined in § 98.6.

(k) Annual gas consumption for each fluorinated GHG and N_2O as calculated in Equation I–11 of this subpart, including where your fab used less than 50 kg of a particular fluorinated GHG or N_2O used at your facility for which you have not calculated emissions using Equations I–6, I–7, I–8, I–9, I–10, I–21, or I–22 of this subpart, the chemical name of the GHG used, the annual consumption of the gas, and a brief description of its use.

(l) All inputs used to calculate gas consumption in Equation I–11 of this subpart, for each fluorinated GHG and N_2O used.

(m) Annual amount of each fluorinated GHG consumed for process sub-type, process type, stack system, or fab, as appropriate, and the annual amount of N_2O consumed for the aggregate of all chemical vapor deposition processes and for the aggregate of all other electronics manufacturing production processes, as calculated using Equation I–13 of this subpart.

(n) Disbursements for each fluorinated GHG and N_2O during the reporting year, as calculated using Equation I–12 of this subpart and all inputs used to calculate disbursements for each fluorinated GHG and N_2O used in Equation I–12 of this subpart, including all fab-wide gas-specific heel factors used for each fluorinated GHG and N_2O. If your fab used less than 50 kg of a particular fluorinated GHG during the reporting year, fab-wide gas-specific heel factors do not need to be reported for those gases.

(o) Fraction of each fluorinated GHG or N_2O fed into a process sub-type, process type, stack system, or fab that is fed into tools connected to abatement systems.

(p) Fraction of each fluorinated GHG or N_2O destroyed or removed in abatement systems connected to process tools where process sub-type, process type j is used, or to process tools vented to stack system j or fab f.

(q) All inputs and results of calculations made accounting for the uptime of abatement systems used during the reporting year, or during an emissions sampling period, in accordance with Equations I–15 and/or I–23 of this subpart, as applicable.

(r) For fluorinated heat transfer fluid emissions, inputs to the fluorinated heat transfer fluid mass balance equation, Equation I–16 of this subpart, for each fluorinated heat transfer fluid used.

(s) Where missing data procedures were used to estimate inputs into the fluorinated heat transfer fluid mass balance equation under § 98.95(b), the estimates of those data.

■ 10. Section 98.98 is amended by:
■ a. Revising the definitions of ''Abatement system'' and ''By-product formation'';
■ b. Removing the definition of ''Class'';
■ c. Adding a definition for ''Fab'' and ''Fully fluorinated GHGs'';
■ d. Revising the definition of ''Gas utilization'';
■ e. Removing the definition of ''Individual recipe'';
■ f. Adding definitions for ''Input gas'' and ''Intermittent low-use fluorinated GHG'';
■ g. Removing the term ''Maximum designed substrate starts'';
■ h. Adding the term ''Maximum substrate starts'';
■ i. Revising the definitions of ''Operational mode,'' ''Process types,'' ''Properly measured destruction or removal efficiency'' and ''Redundant abatement systems'';
■ j. Adding a definition for ''Representative operating levels'';
■ k. Removing the definitions of ''Similar, with respect to recipes'';
■ l. Adding a definition for ''Stack system'';
■ m. Revising the definitions of ''Trigger point for change out,''
■ n. Adding a definition for ''Unabated emissions''; and
■ o. Revising the definitions of ''Uptime'' and ''Wafer passes.''

The revisions read as follows:

§ 98.98 Definitions.

* * * * *

Abatement system means a device or equipment that is designed to destroy or remove fluorinated GHGs or N_2O in exhaust streams from one or more electronics manufacturing production processes, or for which the destruction or removal efficiency for a fluorinated GHG or N_2O has been properly measured according to the procedures under § 98.94(f)(4), even if that abatement system is not designed to destroy or remove fluorinated GHGs or N_2O. The device or equipment is only an abatement system for the individual fluorinated GHGs or N_2O that it is designed to destroy or remove or for the individual fluorinated GHGs or N_2O for which destruction or removal efficiencies were properly measured according to the procedures under § 98.94(f)(4).

* * * * *

By-product formation means the creation of fluorinated GHGs during electronics manufacturing production processes or the creation of fluorinated GHGs by an abatement system. Where the procedures in § 98.93(a) are used to calculate annual emissions, by-product formation is the ratio of the mass of the by-product formed to the mass flow of the input gas. Where the procedures in § 98.93(i) are used to calculate annual emissions, by-product formation is the ratio of the mass of the by-product formed to the total mass flow of all fluorinated GHG input gases.

* * * * *

Fab means the portion of an electronics manufacturing facility located in a separate physical structure that began manufacturing on a certain date.

* * * * *

Fully fluorinated GHGs means fluorinated GHGs that contain only single bonds and in which all available valence locations are filled by fluorine atoms. This includes, but is not limited to, saturated perfluorocarbons, SF_6, NF_3, SF_5CF_3, C_4F_8O, fully fluorinated linear, branched, and cyclic alkanes, fully fluorinated ethers, fully fluorinated tertiary amines, fully fluorinated aminoethers, and perfluoropolyethers.

Gas utilization means the fraction of input N_2O or fluorinated GHG converted to other substances during the etching, deposition, and/or wafer and chamber cleaning processes. Gas utilization is expressed as a rate or factor for specific electronics manufacturing process sub-types or process types.

* * * * *

Input gas means a fluorinated GHG or N_2O used in one of the processes described in § 98.90(a)(1) through (4)

Intermittent low-use fluorinated GHG, for the purposes of determining fluorinated GHG emissions using the stack testing method, means a fluorinated GHG that meets all of the following:

(1) The fluorinated GHG is used by the fab but is not used during the period of stack testing for the fab/stack system.

(2) The emissions of the fluorinated GHG, estimated using the methods in § 98.93(i)(4) do not constitute more than 5 percent of the total fluorinated GHG emissions from the fab on a CO_2e basis.

(3) The sum of the emissions of all fluorinated GHGs that are considered intermittent low use gases does not exceed 10,000 metric tons CO_2e for the fab for that year, as calculated using the procedures specified in § 98.93(i)(1) of this subpart.

(4) The fluorinated GHG is not an expected or possible by-product identified in Table I–17 of this subpart.

Maximum substrate starts means for the purposes of Equation I–5 of this subpart, the maximum quantity of substrates, expressed as surface area, that could be started each month during a reporting year based on the equipment installed in that facility and assuming that the installed equipment were fully utilized. Manufacturing equipment is considered installed when it is on the manufacturing floor and connected to required utilities.

* * * * *

Operational mode means the time in which an abatement system is properly installed, maintained, and operated according to the site maintenance plan for abatement systems as required in § 98.94(f)(1) and defined in § 98.97(d)(9). This includes being properly operated within the range of parameters as specified in the site maintenance plan for abatement systems.

* * * * *

Process types are broad groups of manufacturing steps used at a facility associated with substrate (e.g., wafer) processing during device manufacture for which fluorinated GHG emissions and fluorinated GHG consumption is calculated and reported. The process types are Plasma etching/Wafer Cleaning and Chamber cleaning.

Properly measured destruction or removal efficiency means destruction or removal efficiencies measured in accordance with EPA 430–R–10–003 (incorporated by reference, see § 98.7), and, if applicable, Appendix A to this subpart, or by an alternative method approved by the Administrator as specified in § 98.94(k).

* * * * *

Redundant abatement systems means a system that is specifically designed, installed and operated for the purpose of destroying fluorinated GHGs and N_2O gases, or for which the destruction or removal efficiency for a fluorinated GHG or N_2O has been properly measured according to the procedures under § 98.94(f)(4), and that is used as a backup to the main fluorinated GHGs and N_2O abatement system during those times when the main system is not functioning or operating in accordance with design and operating specifications.

* * * * *

Representative operating levels means (for purposes of verification of the apportionment model or for determining the appropriate conditions for stack testing) operating the fab, in terms of substrate starts for the period of testing or monitoring, at no less than 50 percent of installed production capacity or no less than 70 percent of the average production rate for the reporting year, where production rate for the reporting year is represented in average monthly substrate starts. For the purposes of stack testing, the period for determining the representative operating level must be the period ending on the same date on which testing is concluded.

Stack system means one or more stacks that are connected by a common header or manifold, through which a fluorinated GHG-containing gas stream originating from one or more fab processes is, or has the potential to be, released to the atmosphere. For purposes of this subpart, stack systems do not include emergency vents or bypass stacks through which emissions are not usually vented under typical operating conditions.

Trigger point for change out means the residual weight or pressure of a gas container type that a facility uses as an indicator that operators need to change out that gas container with a full container. The trigger point is not the actual residual weight or pressure of the gas remaining in the cylinder that has been replaced.

Unabated emissions means a gas stream containing fluorinated GHG or N_2O that has exited the process, but which has not yet been introduced into an abatement system to reduce the mass of fluorinated GHG or N_2O in the stream. If the emissions from the process are not routed to an abatement system, or are routed to an abatement device that is not in an operational mode, unabated emissions are those fluorinated GHG or N_2O released to the atmosphere.

Uptime means the ratio of the total time during which the abatement system is in an operational mode, to the total time during which production process tool(s) connected to that abatement system are normally in operation.

* * * * *

Wafer passes is a count of the number of times a wafer substrate is processed in a specific process sub-type, or type. The total number of wafer passes over a reporting year is the number of wafer passes per tool multiplied by the number of operational process tools in use during the reporting year.

* * * * *

■ 11. Table I–1 to subpart I of Part 98 is amended by revising the Note to read as follows:

Table I–1 to Subpart I of Part 98—Default Emission Factors for Threshold Applicability Determination

* * * * *

Notes: NA denotes not applicable based on currently available information.

■ 12. Table I–3 to subpart I of Part 98 is revised to read as follows:

Table I–3 to Subpart I of Part 98—Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for Semiconductor Manufacturing for 150mm and 200 mm Wafer Sizes

Process Type/ Sub-Type	Process Gas i												
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_2HF_5	CH_3F	C_3F_8	C_4F_8	NF_3	SF_6	C_4F_6	C_5F_8	C_4F_8O
ETCHING/ WAFER CLEANING													
$1-U_i$	0.81	0.72	0.50	0.13	0.064	0.51	NA	0.14	0.19	0.55	0.17	0.072	NA
BCF_4	NA	0.10	0.085	0.079	0.077	NA	NA	0.11	0.0040	0.13	0.13	NA	NA
BC_2F_6	0.046	NA	0.030	0.025	0.024	NA	NA	0.037	0.025	0.11	0.11	0.014	NA
BC_4F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_4F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_5F_8	0.0012	NA	0.0012	NA	NA	NA	NA	0.0086	NA	NA	NA	NA	NA
$BCHF_3$	0.10	0.047	NA	0.049	NA	0.0034	NA	0.040	NA	0.0012	0.066	0.0039	NA
CHAMBER CLEANING													
In situ plasma cleaning													
$1-U_i$	0.92	0.55	NA	NA	NA	NA	0.40	0.10	0.18	NA	NA	NA	0.14
BCF_4	NA	0.21	NA	NA	NA	NA	0.20	0.11	0.050	NA	NA	NA	0.13
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.045
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Remote plasma cleaning													
$1-U_i$	NA	NA	NA	NA	NA	NA	NA	NA	0.018	NA	NA	NA	NA
BCF_4	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA	NA	NA
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
In situ thermal cleaning													
$1-U_i$	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCF_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 13. Table I–4 to subpart I of Part 98 is revised to read as follows:

Table I–4 to Subpart I of Part 98–Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for Semiconductor Manufacturing for 300 mm and 450 mm Wafer Size

Process Type/Sub-Type	Process Gas i											
	CF_4	C_2F_6	CHF_3	CH_2F_2	CH_3F	C_3F_8	C_4F_8	NF_3	SF_6	C_4F_6	C_5F_8	C_4F_8O
	ETCHING/WAFER CLEANING											
$1-U_i$	0.65	0.80	0.42	0.21	0.33	0.30	0.18	0.15	0.32	0.15	0.10	NA
BCF_4	NA	0.21	0.095	0.049	0.045	0.21	0.045	0.046	0.040	0.059	0.11	NA
BC_2F_6	0.079	NA	0.064	0.052	0.00087	0.18	0.031	0.045	0.044	0.074	0.083	NA
BC_4F_6	NA	NA	0.00010	NA	NA	NA	0.018	NA	NA	NA	NA	NA
BC_4F_8	0.00063	NA	0.00080	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00012	NA
$BCHF_3$	0.011	NA	NA	0.050	0.0057	0.012	0.027	0.025	0.0037	0.019	0.0069	NA
BCH_2F_2	NA	NA	0.0036	NA	0.0023	NA	0.0015	0.00086	0.000029	0.000030	NA	NA
BCH_3F	0.0080	NA	0.0080	0.0080	NA	0.00073	NA	0.0080	NA	NA	NA	NA
	CHAMBER CLEANING											
	In situ plasma cleaning											
$1-U_i$	NA	NA	NA	NA	NA	NA	NA	0.23	NA	NA	NA	NA
BCF_4	NA	NA	NA	NA	NA	NA	NA	0.037	NA	NA	NA	NA
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Remote plasma cleaning											
$1-U_i$	NA	NA	NA	NA	NA	0.063	NA	0.018	NA	NA	NA	NA
BCF_4	NA	NA	NA	NA	NA	NA	NA	0.075	NA	NA	NA	NA
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Process Type/Sub-Type	Process Gas i											
	CF_4	C_2F_6	CHF_3	CH_2F_2	CH_3F	C_3F_8	C_4F_8	NF_3	SF_6	C_4F_6	C_5F_8	C_4F_8O
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	In situ thermal cleaning											
$1\text{-}U_i$	NA	NA	NA	NA	NA	NA	NA	0.28	NA	NA	NA	NA
BCF_4	NA	NA	NA	NA	NA	NA	NA	0.010	NA	NA	NA	NA
BC_2F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 14. Table I–5 to subpart I of Part 98 is amended by revising the heading and entries for ''CVD 1–U_i,'' ''CVD BCF_4,'' and ''CVD BC_3F_8;'' and by revising the Note to read as follows:

Table I–5 to Subpart I of Part 98—Default Emission Factors (1–U_{ij}) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for MEMS Manufacturing

Process type factors	Process gas i											
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6	C_4F_{6a}	C_5F_{8a}	$C_4F_8O_a$
* * * * * * *												
CVD Chamber Cleaning 1–U_i	0.9	0.6	NA	NA	0.4	0.1	0.02	0.2	NA	NA	0.1	0.1
CVD Chamber Cleaning BCF_4	NA	0.1	NA	NA	0.1	0.1	[2]0.02	[2]0.1	NA	NA	0.1	0.1
CVD Chamber Cleaning BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.4

Notes: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[1] Estimate includes multi-gas etch processes.

[2] Estimate reflects presence of low-k, carbide and multi-gas etch processes that may contain a C-containing fluorinated GHG additive.

■ 15. Table I–6 to subpart I of Part 98 is amended by revising the heading, entries for ''CVD 1–U_i'' and by the Note to read as follows:

Table I–6 to Subpart I of Part 98—Default Emission Factors (1–U_{ij}) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for LCD Manufacturing

Process type factors	Process Gas i								
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6
* * * * * * *									
CVD Chamber Cleaning 1–U_i	NA	NA	NA	NA	NA	NA	0.03	0.3	0.9

Notes: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 16. Table I–7 to subpart I of part 98 is amended by revising the heading, entries for ''CVD 1–U_i'' and ''CVD BCF_4'' and the Note to read as follows:

Table I–7 to Subpart I of Part 98—Default Emission Factors (1–U_{ij}) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for PV Manufacturing

Process type factors	Process Gas i								
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6
* * * * * * *									
CVD Chamber Cleaning 1–U_i	NA	0.6	NA	NA	0.1	0.1	NA	0.3	0.4
CVD Chamber Cleaning BCF_4	NA	0.2	NA	NA	0.2	0.1	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 17. Subpart I is amended by adding Table I–9 to subpart I to read as follows:

Table I-9 to Subpart I of Part 98—Methods and Procedures for Conducting Emissions Tests for Stack Systems

For each stack system for which you use the "stack test method" to calculate annual emissions...	You must...	Using...
For each fluorinated GHG	Measure the concentration in the stack system.	Method 320 at 40 CFR part 63, appendix A or ASTM D6348-03[a] (incorporated by reference, see § 98.7). Conduct the test run for a minimum of 8 hours for each stack system.
	Select sampling port locations and the number of traverse points.	Method 1 or 1A at 40 CFR part 60, appendix A-1.
	Determine gas velocity and volumetric flow rate.	Method 2, 2A, 2C, 2D, 2F, or 2G at 40 CFR part 60, appendix A-1 and A-2.
	Determine gas molecular weight.	Method 3, 3A, or 3B at 40 CFR part 60, appendix A-2 using the same sampling site and time as fluorinated GHG sampling.
	Measure gas moisture content.	Method 4 at 40 CFR part 60, appendix A-3, or using FTIR[b].

[a] Reporters may use ASTM D6348-03 (incorporated by reference, see § 98.7) as an alternative to Method 320 at 40 CFR part 63, appendix A, with the following additional requirements: (1) The test plan preparation and implementation in the Annexes to ASTM D6348-03, Sections A1 through A8 are mandatory; and (2) In ASTM D6348-03 Annex A5 (Analyte Spiking Technique), the percent recovery (%R) must be determined for each target analyte (Equation A5.5). The reporter must also follow Section 4.1 of ASTM D6348-03 to ensure F-GHG remain in the gas phase. In order for the test data to be acceptable for a compound, the percent recovery must be between 70 and 130 percent. If the percent recovery does not meet this criterion for a target compound, the test data are not acceptable for that compound and the test must be repeated for that analyte (i.e., the sampling and/or analytical procedure should be adjusted before a retest). The percent recovery value for each compound must be reported in the test report, required under 40 CFR 98.94(j)(4), and all field measurements must be corrected with the calculated percent recovery value for that compound by using the following equation: Reported Result = Measured Concentration in the stack x (100/% R).

[b] Extractive FTIR is an acceptable method, in lieu of Method 4 at 40 CFR part 60 appendix A, of determining the volumetric concentrations of moisture in semiconductor stack gas streams. The spectral calibrations employed should bracket the anticipated range of optical depths (H_2O concentration in parts per million multiplied by FTIR sample cell path length) measured in the field for moisture saturated (relative humidity approximately 100 percent) air streams at temperatures characterized via Method 2 at 40 CFR part 60 appendix A, within the stack. The HITRAN molecular spectroscopic database is an

example of a widely used international standard of IR absorption parameters that provide accurate H_2O FTIR calibrations at atmospheric conditions. Field measurements should be verified to be in line with moisture saturated wet scrubber exhaust concentrations at measured temperatures. Field measurements at saturated conditions should be verified to be consistent with published water vapor pressure curves at the current stack temperatures (Perry, R.H. and D.W. Green. Perry's Chemical Engineer's Handbook (8th Edition). McGraw-Hill Publishing Company, Inc. New York, New York. 2008). For unsaturated conditions, field measurements should be verified using a single point verification of the FTIR moisture reading using Method 4 at 40 CFR part 60 appendix A, or a NIST traceable hygrometer accurate to +/- 2 percent relative humidity. The FTIR moisture reading shall agree within 10 percent of the moisture measurement obtained using Method 4 at 40 CFR part 60 appendix A or a NIST traceable hygrometer.

■ 18. Subpart I is amended by adding Table I–10 to subpart I to read as follows:

TABLE I–10 TO SUBPART I OF PART 98—MAXIMUM FIELD DETECTION LIMITS APPLICABLE TO FLUORINATED GHG CONCENTRATION MEASUREMENTS FOR STACK SYSTEMS

Fluorinated GHG Analyte	Maximum field detection limit (ppbv)
CF_4	20
C_2F_6	20
C_3F_8	20
C_4F_6	20
C_5F_8	20
c–C_4F_8	20
CH_2F_2	40
CH_3F	40
CHF_3	20
NF_3	20
SF_6	4
Other fully fluorinated GHGs	20
Other fluorinated GHGs	40

ppbv—Parts per billion by volume.

■ 19. Subpart I is amended by adding Table I–11 to subpart I to read as follows:

Table I–11 to Subpart I of Part 98–Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for Semiconductor Manufacturing for use with the Stack Test Method (150 mm and 200 mm wafers)

All Processes	Process Gas i													
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_2HF_5	CH_3F	C_3F_8	C_4F_8	NF_3	NF_3 Remote	SF_6	C_4F_6	C_5F_8	C_4F_8O
$1-U_i$	0.85	0.56	0.50	0.13	0.064	0.51	0.40	0.13	0.16	0.018	0.55	0.17	0.072	0.14
BCF_4	NA	0.19	0.085	0.079	0.077	NA	0.20	0.11	0.045	0.015	0.13	0.13	NA	0.13
BC_2F_6	0.046	NA	0.030	0.025	0.024	0.0034	NA	0.037	0.025	NA	0.11	0.11	0.014	0.045
BC_4F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_4F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_5F_8	0.0012	NA	0.0012	NA	NA	NA	NA	0.0086	NA	NA	NA	NA	NA	NA
$BCHF_3$	0.10	0.047	NA	0.049	NA	NA	NA	0.040	NA	NA	0.0012	0.066	0.0039	NA

Notes: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 20. Subpart I is amended by adding Table I–12 to subpart I to read as follows:

Table I–12 to Subpart I of Part 98–Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for Semiconductor Manufacturing for use with the Stack Test Method (300 mm and 450 mm Wafer Sizes)

All Processes	Process Gas i												
	CF_4	C_2F_6	CHF_3	CH_2F_2	CH_3F	C_3F_8	C_4F_8	NF_3	NF_3 Remote	SF_6	C_4F_6	C_5F_8	C_4F_8O
$1-U_i$	0.65	0.80	0.42	0.21	0.33	0.20	0.18	0.20	0.018	0.32	0.15	0.10	NA
BCF_4	NA	0.21	0.095	0.049	0.045	0.21	0.045	0.040	0.075	0.040	0.059	0.11	NA
BC_2F_6	0.079	NA	0.064	0.052	0.00087	0.18	0.031	0.045	NA	0.044	0.074	0.083	NA
BC_4F_6	NA	NA	0.00010	NA	NA	NA	0.018	NA	NA	NA	NA	NA	NA
BC_4F_8	0.00063	NA	0.00080	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00012	NA
BCH_2F_2	NA	NA	0.0036	NA	0.0023	NA	0.0015	0.00086	NA	0.000029	0.000030	NA	NA
BCH_3F	0.0080	NA	0.0080	0.0080	NA	0.00073	NA	0.0080	NA	NA	NA	NA	NA
$BCHF_3$	0.011	NA	NA	0.050	0.0057	0.012	0.027	0.025	NA	0.0037	0.019	0.0069	NA

Notes: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 21. Subpart I is amended by adding Table I–13 to subpart I to read as follows:

Table I–13 to Subpart I of Part 98—Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for LCD Manufacturing for use with the Stack Test Method

Process Gas (i)	Process Gas i								
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6
$1–U_i$	0.6	NA	0.2	NA	NA	0.1	0.03	0.3	0.6
BCF_4	NA	NA	0.07	NA	NA	0.009	NA	NA	NA
$BCHF_3$	NA	NA	NA	NA	NA	0.02	NA	NA	NA
BC_2F_6	NA	NA	0.05	NA	NA	NA	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 22. Subpart I is amended by adding Table I–14 to subpart I to read as follows:

Table I–14 to Subpart I of Part 98—Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for PV Manufacturing for use with the Stack Test Method

Process Gas (i)	Process Gas i								
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6
$1–U_i$	0.7	0.6	0.4	NA	0.4	0.2	NA	0.2	0.4
BCF_4	NA	0.2	NA	NA	0.2	0.1	NA	0.05	NA
BC_2F_6	NA	NA	NA	NA	NA	0.1	NA	NA	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

■ 23. Subpart I is amended by adding Table I–15 to subpart I to read as follows:

Table I–15 to Subpart I of Part 98–Default Emission Factors ($1–U_{ij}$) for Gas Utilization Rates (U_{ij}) and By-Product Formation Rates (B_{ijk}) for MEMS Manufacturing for use with the Stack Test Method

All Processes	Process Gas i											
	CF_4	C_2F_6	CHF_3	CH_2F_2	C_3F_8	c-C_4F_8	NF_3 Remote	NF_3	SF_6	C_4F_6	C_5F_8	C_4F_8O
$1-U_i$	0.9	0.6	0.4	0.1	0.4	0.1	0.2	0.2	0.2	0.1	0.1	0.1
BCF_4	NA	0.2	0.07	0.08	0.1	0.1	[a]0.02	0.09	NA	0.3	0.1	0.1
BC_2F_6	NA	NA	NA	NA	NA	[a]0.04	NA	NA	NA	0.2	0.04	NA
BC_3F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[a] Estimate reflects presence of low-k, carbide and multi-gas etch processes that may contain a C-containing fluorinated GHG additive.

■ 24. Subpart I is amended by adding Table I–16 to read as follows:

TABLE I–16 TO SUBPART I OF PART 98—DEFAULT EMISSION DESTRUCTION OR REMOVAL EFFICIENCY (DRE) FACTORS FOR ELECTRONICS MANUFACTURING

Manufacturing type/process type/gas	Default DRE (percent)
MEMS, LCDs, and PV Manufacturing	60
Semiconductor Manufacturing:	
Plasma Etch/Wafer Clean Process Type:	
CF_4	75
CH_3F	97
CHF_3	97
CH_2F_2	97
C_2F_6	97
C_3F_8	97
C_4F_6	97
C_4F_8	97
C_5F_8	97
SF_6	97
NF_3	96
All other carbon-based plasma etch/wafer clean fluorinated GHG	60
Chamber Clean Process Type:	
NF_3	88
All other chamber clean fluorinated GHG	60
N_2O Processes:	
CVD and all other N_2O-using processes	60

■ 25. Subpart I is amended by adding Table I–17 to subpart I to read as follows:

TABLE I–17 TO SUBPART I OF PART 98—EXPECTED AND POSSIBLE BY-PRODUCTS FOR ELECTRONICS MANUFACTURING

For each stack system for which you use the "stack test method" to calculate annual emissions, you must measure the following:	If emissions are detected intermittently, use the following procedures:	If emissions are not detected, use the following procedures:
Expected By-products: CF_4, C_2F_6, CHF_3, CH_2F_2, CH_3F	Use the measured concentration for "X_{ksm}" in Equation I–18 when available and use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of "X_{ksm}" when the fluorinated GHG is not detected.	Use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of "X_{ksm}" in Equation I–18.
Possible By-products: C_3F_8, C_4F_6, c-C_4F_8, C_5F_8	Use the measured concentration for "X_{ksm}" in Equation I–18 when available and use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of "X_{ksm}" when the fluorinated GHG is not detected.	Assume zero emissions for that fluorinated GHG for the tested stack system.

■ 26. Subpart I is amended by adding Appendix A to Subpart I of Part 98 to read as follows:

Appendix A to Subpart I of Part 98—Alternative Procedures for Measuring Point-of-Use Abatement Device Destruction or Removal Efficiency

If you are measuring destruction or removal efficiency of a point-of-use abatement device according to EPA 430–R–10–003 (incorporated by reference, see § 98.7) as specified in § 98.94(f)(4), you may follow the alternative procedures specified in paragraphs (a) through (c) of this appendix.

(a) In place of the Quadrupole Mass Spectrometry protocol requirements specified in section 2.2.4 of EPA 430–R–10–003 (incorporated by reference, see § 98.7), you must conduct mass spectrometry testing in accordance with the provisions in paragraph (a)(1) through (a)(15) of this appendix.

(1) *Detection limits.* The mass spectrometer chosen for this application must have the necessary sensitivity to detect the selected effluent species at or below the maximum field detection limits specified in Table 3 of section 2.2.7 of EPA 430–R–10–003 (incorporated by reference, see § 98.7).

(2) *Sampling location.* The sample at the inlet of the point-of-use abatement device must be taken downstream of the process tool and pump package. The sample exhaust must be vented back into the corrosive house ventilation system at a point downstream of the sample inlet location.

(3) *Sampling conditions.* For etch processes, destruction or removal efficiencies must be determined while etching a substrate (product, dummy, or test). For chemical vapor deposition processes, destruction or removal efficiencies must be determined during a chamber clean after deposition (destruction or removal efficiencies must not be determined in a clean chamber). All sampling must be performed non-intrusively during wafer processing. Samples must be drawn through the mass spectrometer source

by an external sample pump. Because of the volatility, vapor pressure, stability and inertness of CF_4, C_2F_6, C_3F_8, CHF_3, NF_3, and SF_6, the sample lines do not need to be heated.

(4) Mass spectrometer parameters. The specific mass spectrometer operating conditions such as electron energy, secondary electron multiplier voltage, emission current, and ion focusing voltage must be selected according to the specifications provided by the mass spectrometer manufacturer, the mass spectrometer system manual, basic mass spectrometer textbook, or other such sources. The mass spectrometer responses to each of the target analytes must all be calibrated under the same mass spectrometer operating conditions.

(5) *Flow rates.* A sample flow rate of 0.5–1.5 standard liters per minute (slm) must be drawn from the process tool exhaust stream under study.

(6) *Sample frequency.* The mass spectrometer sampling frequency for etch processes must be in the range of 0.5 to 1 cycles per second, and for chemical vapor deposition processes must be in the range of 0.25 to 0.5 cycles per second. As an alternative you may use the sampling frequencies specified in section 2.2.4 of EPA 430–R–10–003 (incorporated by reference, see § 98.7).

(7) *Dynamic dilution calibration parameters.* The quadrupole mass spectrometer must be calibrated for both mass location and response to analytes. A dynamic dilution calibration system may be used to perform both types of mass spectrometer system calibrations using two mass flow controllers. Use one mass flow controller to regulate the flow rate of the standard component used to calibrate the system and the second mass flow controller to regulate the amount of diluent gas used to mix with the standard to generate the calibration curve for each compound of interest. The mass flow controller must be calibrated using the single component gas being used with them, for example, nitrogen (N_2) for the diluent. A mass flow controller used with calibration mixtures must be calibrated with the calibration mixture balance gas (for example, N_2 or He) if the analyte components are 2 percent or less of the volume of the sample. All calibration mixtures must be National Institute of Standards and Technology Traceable gases or equivalent. They must be calibrated over their range of use and must be operated in their experimentally determined dynamic linear range. If compressed gas standards cannot be brought into the fab, metered gas flows of target compounds into the process chamber, under no thermal or plasma conditions and with no wafer(s) present, and with no process emissions from other tools contributing to the sample location, must then be performed throughout the appropriate concentration ranges to derive calibration curves for the subsequent destruction or removal efficiency tests.

(8) *Mass location calibration.* A mixture containing 1 percent He, Ar, Kr, and Xe in a balance gas of nitrogen must be used to assure the alignment of the quadrupole mass filter (see EPA Method 205 at 40 CFR part 51, appendix M as reference). The mass spectrometer must be chosen so that the mass range is sufficient to detect the predominant peaks of the components under study.

(9) *Quadrupole mass spectrometer response calibration.* A calibration curve must be generated for each compound of interest.

(10) *Calibration frequency.* The mass spectrometer must be calibrated at the start of testing a given process. The calibration must be checked at the end of testing.

(11) *Calibration range.* The mass spectrometer must be calibrated over the expected concentration range of analytes using a minimum of five concentrations including a zero. The zero point is defined as diluent containing no added analyte.

(12) *Operating procedures.* You must follow the operating procedures specified in paragraphs (a)(12)(i) through (v) of this appendix.

(i) You must perform a qualitative mass calibration by running a standard (or by flowing chamber gases under non-process conditions) containing stable components such as Ar, Kr, and Xe that provide predominant signals at m/e values distributed throughout the mass range to be used. You must adjust the quadrupole mass filter as needed to align with the inert gas fragments.

(ii) You must quantitatively calibrate the quadrupole mass spectrometer for each analyte of interest. The analyte concentrations during calibration must include the expected concentrations in the process effluent. The calibration must be performed under the same operating conditions, such as inlet pressure, as when sampling process exhaust. If the calibration inlet pressure differs from the sampling inlet pressure then the relationship between inlet pressure and quadrupole mass spectrometer signal response must be empirically determined and applied to correct for any differences between calibration and process emissions monitoring data.

(iii) To determine the response time of the instrument to changes in a process, a process gas such as C_2F_6 must be turned on at the process tool for a fixed period of time (for example, 20 seconds), after which the gas is shut off. The sample flow rate through the system must be adjusted so that the signal increases to a constant concentration within a few seconds and decreases to background levels also within a few seconds.

(iv) You must sample the process effluent through the quadrupole mass spectrometer and acquire data for the required amount of time to track the process, as determined in paragraph (a)(12)(iii) of this appendix. You must set the sample frequency to monitor the changes in the process as specified in paragraph (a)(6) of this appendix. You must repeat this for at least five substrates on the same process and calculate the average and standard deviation of the analyte concentration.

(v) You must repeat the quantitative calibration at the conclusion of sampling to identify any drifts in quadrupole mass spectrometer sensitivity. If drift is observed, you must use an internal standard to correct for changes in sensitivity.

(13) *Sample analysis.* To determine the concentration of a specific component in the sample, you must divide the ion intensity of the sample response by the calibrated response factor for each component.

(14) *Deconvolution of interfering peaks.* The effects of interfering peaks must be deconvoluted from the mass spectra for each target analyte.

(15) *Calculations.* Plot ion intensity versus analyte concentration for a given compound obtained when calibrating the analytical system. Determine the slope and intercept for each calibrated species to obtain response factors with which to calculate concentrations in the sample. For an acceptable calibration, the R^2 value of the calibration curve must be at least 0.98.

(b) In place of the Fourier Transform Infrared Spectroscopy protocol requirements specified in section 2.2.4 of EPA 430–R–10–003 (incorporated by reference, see § 98.7), you may conduct Fourier Transform Infrared Spectroscopy testing in accordance with the provisions in paragraph (b)(1) through (17) of this appendix, including the laboratory study phase described in paragraphs (b)(1) through (7), and the field study phase described in paragraphs (b)(8) through (17) of this appendix.

(1) *Conformance with provisions associated with the Calibration Transfer Standard.* This procedure calls for the use of a calibration transfer standard in a number of instances. The use of a calibration transfer standard is necessary to validate optical pathlength and detector response for spectrometers where cell temperature, cell pressure, and cell optical pathlength are potentially variable. For fixed pathlength spectrometers capable of controlling cell temperature and pressure to within +/− 10 percent of a desired set point, the use of a calibration transfer standard, as described in paragraphs (b)(2) to (17) this appendix is not required.

(2) *Defining spectroscopic conditions.* Define a set of spectroscopic conditions under which the field studies and subsequent field applications are to be carried out. These include the minimum instrumental line-width, spectrometer wave number range, sample gas temperature, sample gas pressure, absorption pathlength, maximum sampling system volume (including the absorption cell), minimum sample flow rate, and maximum allowable time between consecutive infrared analyses of the effluent.

(3) *Criteria for reference spectral libraries.* On the basis of previous emissions test results and/or process knowledge (including the documentation of results of any initial and subsequent tests, and the final reports required in § 98.97(d)(4)(i)), estimate the maximum concentrations of all of the analytes in the effluent and their minimum concentrations of interest (those concentrations below which the measurement of the compounds is of no importance to the analysis). Values between the maximum expected concentration and the minimum concentration of interest are referred to below as the ''expected concentration range.'' A minimum of three reference spectra is sufficient for a small expected concentration range (e.g., a

difference of 30 percent of the range between the low and high ends of the range), but a minimum of four spectra are needed where the range is greater, especially for concentration ranges that may differ by orders of magnitude. If the measurement method is not linear then multiple linear ranges may be necessary. If this approach is adopted, then linear range must be demonstrated to pass the required quality control. When the set of spectra is ordered according to absorbance, the absorbance levels of adjacent reference spectra should not differ by more than a factor of six. Reference spectra for each analyte should be available at absorbance levels that bracket the analyte's expected concentration range; minimally, the spectrum whose absorbance exceeds each analyte's expected maximum concentration or is within 30 percent of it must be available. The reference spectra must be collected at or near the same temperature and pressure at which the sample is to be analyzed under. The gas sample pressure and temperature must be continuously monitored during field testing and you must correct for differences in temperature and pressure between the sample and reference spectra. Differences between the sample and reference spectra conditions must not exceed 50 percent for pressure and 40 °C for temperature.

(4) *Spectra without reference libraries.* If reference spectral libraries meeting the criteria in paragraph (b)(3) of this appendix do not exist for all the analytes and interferants or cannot be accurately generated from existing libraries exhibiting lower minimum instrumental line-width values than those proposed for the testing, prepare the required spectra according to the procedures specified in paragraphs (b)(4)(i) and (ii) of this appendix.

(i) Reference spectra at the same absorbance level (to within 10 percent) of independently prepared samples must be recorded. The reference samples must be prepared from neat forms of the analyte or from gas standards of the highest quality commonly available from commercial sources. Either barometric or volumetric methods may be used to dilute the reference samples to the required concentrations, and the equipment used must be independently calibrated to ensure suitable accuracy. Dynamic and static reference sample preparation methods are acceptable, but dynamic preparations must be used for reactive analytes. Any well characterized absorption pathlength may be employed in recording reference spectra, but the temperature and pressure of the reference samples should match as closely as possible those of the proposed spectroscopic conditions.

(ii) If a mercury cadmium telluride or other potentially non-linear detector (i.e., a detector whose response vs. total infrared power is not a linear function over the range of responses employed) is used for recording the reference spectra, you must correct for the effects of this type of response on the resulting concentration values. As needed, spectra of a calibration transfer standard must be recorded with the laboratory spectrometer system to verify the absorption pathlength and other aspects of the system performance. All reference spectral data must be recorded in interferometric form and stored digitally.

(5) *Sampling system preparation.* Construct a sampling system suitable for delivering the proposed sample flow rate from the effluent source to the infrared absorption cell. For the compounds of interest, the surfaces of the system exposed to the effluent stream may need to be stainless steel or Teflon; because of the potential for generation of inorganic automated gases, glass surfaces within the sampling system and absorption cell may need to be Teflon-coated. The sampling system should be able to deliver a volume of sample that results in a necessary response time.

(6) *Preliminary analytical routines.* For the proposed absorption pathlength to be used in actual emissions testing, you must prepare an analysis method containing of all the effluent compounds at their expected maximum concentrations plus the field calibration transfer standard compound at 20 percent of its full concentration as needed.

(7) *Documentation.* The laboratory techniques used to generate reference spectra and to convert sample spectral information to compound concentrations must be documented. The required level of detail for the documentation is that which allows an independent analyst to reproduce the results from the documentation and the stored interferometric data.

(8) *Spectroscopic system performance.* The performance of the proposed spectroscopic system, sampling system, and analytical method must be rigorously examined during and after a field study. Several iterations of the analysis method may need to be applied depending on observed concentrations, absorbance intensities, and interferences. During the field study, all the sampling and analytical procedures envisioned for future field applications must be documented. Additional procedures not required during routine field applications, notably dynamic spiking studies of the analyte gases, may be performed during the field study. These additional procedures need to be performed only once if the results are acceptable and if the effluent sources in future field applications prove suitably similar to those chosen for the field study. If changes in the effluent sources in future applications are noted and require substantial changes to the analytical equipment and/or conditions, a separate field study must be performed for the new set of effluent source conditions. All data recorded during the study must be retained and documented, and all spectral information must be permanently stored in interferometric form.

(9) *System installation.* The spectroscopic and sampling sub-systems must be assembled and installed according to the manufacturers' recommendations. For the field study, the length of the sample lines used must not be less than the maximum length envisioned for future field applications. The system must be given sufficient time to stabilize before testing begins.

(10) *Pre-Test calibration.* Record a suitable background spectrum using pure nitrogen gas; alternatively, if the analytes of interest are in a sample matrix consistent with ambient air, it is beneficial to use an ambient air background to control interferences from water and carbon dioxide. For variable pathlength Fourier Transform Infrared Spectrometers, introduce a sample of the calibration transfer standard gas directly into the absorption cell at the expected sample pressure and record its absorbance spectrum (the ''initial field calibration transfer standard spectrum''). Compare it to the laboratory calibration transfer standard spectra to determine the effective absorption pathlength. If possible, record spectra of field calibration gas standards (single component standards of the analyte compounds) and determine their concentrations using the reference spectra and analytical routines developed in paragraphs (b)(2) through (7) of this appendix; these spectra may be used instead of the reference spectra in actual concentration and uncertainty calculations.

(11) *Deriving the calibration transfer standard gas from tool chamber gases.* The calibration transfer standard gas may be derived by flowing appropriate semiconductor tool chamber gases under non-process conditions (no thermal or plasma conditions and with no wafer(s) present) if compressed gas standards cannot be brought on-site.

(12) *Reactivity and response time checks.* While sampling ambient air and continuously recording absorbance spectra, suddenly replace the ambient air flow with calibration transfer standard gas introduced as close as possible to the probe tip. Examine the subsequent spectra to determine whether the flow rate and sample volume allow the system to respond quickly enough to changes in the sampled gas. Should a corrosive or reactive gas be of interest in the sample matrix it would be beneficial to determine the reactivity in a similar fashion, if practical. Examine the subsequent spectra to ensure that the reactivities of the analytes with the exposed surfaces of the sampling system do not limit the time response of the analytical system. If a pressure correction routine is not automated, monitor the absorption cell temperature and pressure; verify that the (absolute) pressure remains within 2 percent of the pressure specified in the proposed system conditions.

(13) *Analyte spiking.* Analyte spiking must be performed. While sampling actual source effluent, introduce a known flow rate of calibration transfer standard gas into the sample stream as close as possible to the probe tip or between the probe and extraction line. Measure and monitor the total sample flow rate, and adjust the spike flow rate until it represents 10 percent to 20 percent of the total flow rate. After waiting until at least four absorption cell volumes have been sampled, record four spectra of the spiked effluent, terminate the calibration transfer standard spike flow, pause until at least four cell volumes are sampled, and then record four (unspiked) spectra. Repeat this process until 12 spiked and 12 unspiked spectra have been obtained. If a pressure correction routine is not automated, monitor the absorption cell temperature and pressure; verify that the pressure remains within 2

percent of the pressure specified in the proposed system conditions. Calculate the expected calibration transfer standard compound concentrations in the spectra and compare them to the values observed in the spectrum. This procedure is best performed using a spectroscopic tracer to calculate dilution (as opposed to measured flow rates) of the injected calibration transfer standard (or analyte). The spectroscopic tracer should be a component not in the gas matrix that is easily detectable and maintains a linear absorbance over a large concentration range. Repeat this spiking process with all effluent compounds that are potentially reactive with either the sampling system components or with other effluent compounds. The gas spike is delivered by a mass flow controller, and the expected concentration of analyte of interest (AOITheoretical) is calculated as follows:

$$AOI_{Theoretical} = \left(\frac{Tracer_{sample}}{Tracer_{cylinder}}\right)\left(AOI_{cylinder}\right) + \left[1 - \left(\frac{Tracer_{sample}}{Tracer_{cylinder}}\right)\right]\left(AOI_{native}\right)$$

Where:

AOITheoretical = Theoretical analyte of interest concentration (parts per million (ppm)).

Tracersample = Tracer concentration (ppm) as seen by the Fourier Transform Infrared Spectrometer during spiking.

Tracercylinder = The concentration (ppm) of tracer recorded during direct injection of the cylinder to the Fourier Transform Infrared Spectrometer cell.

AOIcylinder = The supplier-certified concentration (ppm) of the analyte of interest gas standard.

AOInative = The native AOI concentration (ppm) of the effluent during stable conditions.

(14) *Post-test calibration.* At the end of a sampling run and at the end of the field study, record the spectrum of the calibration transfer standard gas. The resulting ''final field calibration transfer standard spectrum'' must be compared to the initial field calibration transfer standard spectrum to verify suitable stability of the spectroscopic system throughout the course of the field study.

(15) *Amendment of analytical routines.* The presence of unanticipated interferant compounds and/or the observation of compounds at concentrations outside their expected concentration ranges may necessitate the repetition of portions of the procedures in paragraphs (b)(2) through (14) of this appendix. Such amendments are allowable before final analysis of the data, but must be represented in the documentation required in paragraph (b)(16) of this appendix.

(16) *Documentation.* The sampling and spiking techniques used to generate the field study spectra and to convert sample spectral information to concentrations must be documented at a level of detail that allows an independent analyst to reproduce the results from the documentation and the stored interferometric data.

(17) *Method application.* When the required laboratory and field studies have been completed and if the results indicate a suitable degree of accuracy, the methods developed may be applied to practical field measurement tasks. During field applications, the procedures demonstrated in the field study specified in paragraphs (b)(8) through (16) of this appendix must be adhered to as closely as possible, with the following exceptions specified in paragraphs (b)(17)(i) through (iii) of this appendix:

(i) The sampling lines employed should be as short as practically possible and not longer than those used in the field study.

(ii) Analyte spiking and reactivity checks are required after the installation of or major repair to the sampling system or major change in sample matrix. In these cases, perform three spiked/unspiked samples with calibration transfer standard or a surrogate analyte on a daily basis if time permits and gas standards are easy to obtain and get on-site.

(iii) Sampling and other operational data must be recorded and documented as during the field study, but only the interferometric data needed to sufficiently reproduce actual test and spiking data must be stored permanently. The format of this data does not need to be interferograms but may be absorbance spectra or single beams.

(c) When using the flow and dilution measurement protocol specified in section 2.2.6 of EPA 430–R–10–003 (incorporated by reference, see § 98.7), you may determine point-of-use abatement device total volume flow with the modifications specified in paragraphs (c)(1) through (3) of this appendix.

(1) You may introduce the non-reactive, non-native gas used for determining total volume flow and dilution across the point-of-use abatement device at a location in the exhaust of the point-of-use abatement device. For abatement systems operating in a mode where specific F–GHG are not readily abated, you may introduce the non-reactive, non-native gas used for determining total volume flow and dilution across the point-of-use abatement device prior to the point-of-use abatement system; in this case, the tracer must be more difficult to destroy than the target compounds being measured based on the thermal stability of the tracer and target.

(2) You may select a location for downstream non-reactive, non-native gas analysis that complies with the requirements in this paragraph (c)(2) of this appendix. The sampling location should be traversed with the sampling probe measuring the non-reactive, non-native gas concentrations to ensure homogeneity of the non-reactive gas and point-of-use abatement device effluent (i.e., stratification test). To test for stratification, measure the non-reactive, non-native gas concentrations at three points on a line passing through the centroidal area. Space the three points at 16.7, 50.0, and 83.3 percent of the measurement line. Sample for a minimum of twice the system response time, determined according to paragraph (c)(3) of this appendix, at each traverse point. Calculate the individual point and mean non-reactive, non-native gas concentrations. If the non-reactive, non-native gas concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±5.0 percent of the mean concentration, the gas stream is considered unstratified and you may collect samples from a single point that most closely matches the mean. If the 5.0 percent criterion is not met, but the concentration at each traverse point differs from the mean concentration for all traverse points by no more than ±10.0 percent of the mean, you may take samples from two points and use the average of the two measurements. Space the two points at 16.7, 50.0, or 83.3 percent of the measurement line. If the concentration at each traverse point differs from the mean concentration for all traverse points by more than ±10.0 percent of the mean but less than 20.0 percent, take samples from three points at 16.7, 50.0, and 83.3 percent of the measurement line and use the average of the three measurements. If the gas stream is found to be stratified because the 20.0 percent criterion for a 3-point test is not met, locate and sample the non-reactive, non-

native gas from traverse points for the test in accordance with Sections 11.2 and 11.3 of EPA Method 1 in 40 CFR part 60, Appendix A–1. A minimum of 40 non-reactive gas concentration measurements will be collected at three to five different injected non-reactive gas flow rates for determination of point-of-use abatement device effluent flow. The total volume flow of the point-of-use abatement device exhaust will be calculated consistent with the EPA 430–R–10–003 (incorporated by reference, see § 98.7) Equations 1 through 7.

(3) You must determine the measurement system response time according to paragraphs (c)(3)(i) through (iii) of this appendix.

(i) Before sampling begins, introduce ambient air at the probe upstream of all sample condition components in system calibration mode. Record the time it takes for the measured concentration of a selected compound (for example, carbon dioxide) to reach steady state.

(ii) Introduce nitrogen in the system calibration mode and record the time required for the concentration of the selected compound to reach steady state.

(iii) Observe the time required to achieve 95 percent of a stable response for both nitrogen and ambient air. The longer interval is the measurement system response time.

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