EPA Flexible Permit Implementation Review: Intel Permit Review Report

Source: Intel Corporation - Aloha, Oregon Semiconductor Fabrication Plant

Permitting Authority: Oregon Department of Environmental Quality (ODEQ)

Flexible Permit: Title V permit issued in October 1995 and expired in October 1999 (Oregon Permit No. 34-2681); the flexible permit was the first developed as part of EPA's Pollution Prevention in Permitting Project (P4), and it was the first title V permit issued in Oregon.

1. BACKGROUND

General Questions for Permitting Authority

1.1 Agency name

Oregon Department of Environmental Quality (ODEQ)

1.2 Number of major sources (title V)

As of May 2001, Oregon has approximately 125 title V sources; approximately 950 sources require some form of air permit in Oregon.

1.3 Number of permit actions per year

1.3.a Minor NSR

1.3.b Major NSR

1.3.c Operating permits

- **Title V issuance**
- **Title V revisions**

1.3.d Other permits

ODEQ representatives reported that the Department writes approximately 50 to 60 (title V only) minor NSR permit per year. ODEQ writes approximately 4 to 8 major NSR permits per year. ODEQ issues approximately 5 to 8 new title V permits per year. ODEQ writes approximately 55 to 70 permit revisions a year. ODEQ writes approximately 950 other permits not including major/minor NSR, operating permits, or title V permits per year.

1.4 Number of permit writers

1.4.a Workload (permit actions per year per permit writer)

ODEQ employees approximately 35 permit writers. Currently, there is a permitting backlog for both title V renewals and non-title V permitting.

1.5 Minor NSR provisions (summary of requirements, citation(s))

(For title V sources:[1]) *Applicability*: New construction, modifications, or pollution control equipment replacements, *if:* the source's maximum capacity to emit is increased on an hourly basis at full production, including air pollution control equipment, or the performance of any pollution control equipment used to comply with a ODEQ requirement is degraded causing an increase of the amount of any air pollutant emitted or which results in the emission of any air pollutant not previously emitted.

Application Requirements:

- a description of the constructed or modified source;
- a description of the production processes and a related flow chart for the constructed or modified source;
- a plot plan showing location/height of the construction/modification;
- type/quantity of fuels used;
- change in the amount, quantities emitted, nature and duration of regulated air pollutant emissions;
- estimated air pollution control equipment efficiency ;
- Land Use Compatibility Statement;
- corrections and revisions to insure compliance with applicable rules, orders and statues;
- sufficient information to determine applicable emissions limitations and requirements for hazardous air pollutant sources.

Approval: (1) If the construction/modification does not increase emissions above the facility-wide PSEL; or does not increase the amount of any air pollutant emitted by any individual stationary source above the significant emission rate, excluding emissions decreases; does not establish a federally enforceable limit on potential to emit; or does not establish a new applicable requirement and construction is in accordance with all rules and statutes, ODEQ has up to 60 days following the receipt of the required information to approve the construction/modification. In addition, if the Department does not respond within this time period, the source can proceed with the construction/modification. (2) If construction/modification will increase emissions above the facility-wide PSEL, increase the amount of any air pollutant emitted by any individual stationary source above the significant emission rate, excluding emissions decreases; or establish a federally enforceable limit on PTE, or a new applicable requirement the source must proceed with a minor or major permit modification, as applicable by rule.

Off-permit changes do not require ODEQ approval (see OAR 340-218-0140). Off-permit changes mean changes to a source that:

- are not addressed or prohibited by the permit;
- are not title I modifications;
- are not subject to any requirements under title IV of the Federal Clean Air Act;
- meet all applicable requirements; and
- may result in emissions of regulated air pollutants subject to an applicable requirement, but not otherwise regulated under the permit or may result in insignificant changes as defined in OAR 340-200-0020.

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[1]ODEQ has two sets of rules that apply to businesses that are proposing construction changes at their facility. One set applies to businesses subject to the Oregon title V Operating Permit program, and the other set applies to all other businesses.

Off-permit changes can be made at any time. Owners or operators must contemporaneously submit written notice to the Department and the EPA, except for changes that qualify as insignificant under OAR 340-200-0020.

Other Requirements:

- Emissions Standards: *Highest and best practicable treatment and control* is to be provided in every case to maintain overall air quality at the highest possible levels. A source is deemed in compliance with this rule if it is in compliance with all other applicable emissions standards and requirements in the air program. *Typically Achievable Control Technology (TACT)* is required for a new or modified emissions unit if the unit, for the pollutants to be emitted, is not subject to Major NSR, New Source Performance Standards (NSPS), standards for VOC sources, rules for areas with unique air quality needs, etc.

- Notice of Completion. Within 30 days, or other period specified in the title V permit, after the owner/operator has constructed/modified a stationary source or control equipment, that owner/operator shall so report in writing the date of completion.

1.6 Public participation provisions (summary of requirements, citation(s))

For new construction/modifications that will increase emissions above the facility-wide PSEL, increase the amount of any air pollutant emitted by any individual stationary source above the significant emission rate, excluding emissions decreases; or establish a federally enforceable limit on PTE, or a new applicable requirement, public notice shall allow at least 30 days for written comment. If ODEQ receives written requests from 10 persons for a public hearing, ODEQ is to provide such a hearing before taking final action on the application. ODEQ is to give notice of the hearing at least 30 days in advance of the hearing.

Significant title V permit modifications, and construction/operation modifications when there is an increase of emissions above the PSEL require at least a 30-day public notice and comment period, and a public hearing if requested by 10 or more persons. ODEQ is to provide at least 30 days notice of public hearings.

1.7 Reporting and feedback mechanisms (summary of requirements)

Records of required monitoring information are to include: date, place (as defined in the permit), and time of sampling or measurements; date analyses performed; company/entity performing the analysis; analytical techniques used; results of the analyses; operating conditions as existed at the time of sampling or measurement; and records of quality assurance for continuous monitoring systems.

Reporting requirements include: semi-annual report, including the semi-annual compliance certification; the annual report, consisting of the annual reporting requirements as specified in the permit; emission fee report; emission statement, if applicable; excess emissions upset lot; annual certification that the risk management plan is being properly implemented; and the semi-annual compliance certification; prompt reporting of deviations that do not cause excess emissions, including those attributable to upset conditions; any required source test report within 30 days after the source test.

1.8 Requirements and/or ability to be more stringent than EPA rules.

ODEQ has a number of rules that are more stringent than EPA rules. Presently to promulgate a new rule that is more stringent than EPA, ODEQ must have a demonstrable need to justify the stringency.

1.9 Status of initial title V issuance (i.e., number issued, renewed, in process)

ODEQ permitted approximately 150 sources in the initial title V permit process (the number of title V sources is now down to about 125). Of the sources originally identified for title V permitting, one permit remains to be issued. Approximately 25-30 permits come up for renewal annually.

1.10 Number of flexible permits written and public reaction to them

All air operating permits in Oregon utilize emissions caps, referred to as Plant-Site Emissions Limits (PSELs). Oregon's PSEL approach was instituted in 1981. Another flexible permit has been drafted in Oregon for IDT Corporation. It utilizes flexibility provisions pioneered in the Intel title V permit.

1.11 Air quality status of area where flexible pilot permit was issued

When the permit was issued (1995), the Portland area was designated as a marginal non-attainment area for ozone. But for the prior three years (1992-1994), Portland had been in compliance with the 1-hour National Ambient Air Quality Standard for ozone (0.125 parts per million). The facility was also located in a non-attainment area for carbon monoxide (CO).

1.12 Number of inspections that have occurred re: flexible permit

ODEQ representatives indicated that inspections of Intel's Aloha facility were conducted at least annually throughout the permit term by ODEQ. This includes inspections conducted on 4/24/96, 10/2/96, and 9/21/98.

1.13 Authority to impose P2 requirements and/or additional safeguards suggested by WPN3 (e.g., monitoring, notices, up-front magnitude limits)

During the title V permit development process, the permit development team needed to determine whether a pollution prevention permit condition (condition 16) could be made federally enforceable. It was determined that ODEQ did have authority to create and enforce the P2 permit conditions.

1.14 Agency's overall orientation to P2 (e.g., how is P2 considered in permit writing?)

ODEQ representatives indicated that the agency is generally supportive of efforts to encourage pollution prevention among sources in the state. Oregon's Green Permits Program was developed to reward firms that demonstrate and commit to achieving superior environmental performance.

1.15 Time required to issue flexible permit

The total permit development process spanned just under two years. The table below summarizes the chronology of the title V permit development process.

Table 1.15 **Chronology of Intel Aloha Title V Permit Development**

November 1993	First workgroup meeting of the P4 pilot project team. Goals and procedures defined.
November 1993 - September 1994	Workgroup and subcommittees met several times in person and through conference calls to define potential approach.
September 1994	Senior managers meeting.

December 1994	EPA approves rule change to ODEQ State Implementation Plan (SIP).
December 1994	Intel submits permit application.
January 1995	ODEQ conducts meeting with Oregon environmental organizations.
June 1995	Oregon issues draft title V permit.
July 1995	Public comment period and public hearing held.
July 1995	Proposed permit sent to EPA for approval.
October 1995	Permit issued.

ODEQ indicated that several factors impacted the permit development time:
(1) The Intel Aloha permit was the first title V permit developed in Oregon, and permit development coincided with the state's title V program development. This meant that no permit development procedures had been previously established and nothing was routine since all aspects of title V permitting were new.
(2) Submittal of the permit application had to be coordinated with EPA approval of revisions to Oregon's State Implementation Plan (SIP), which occurred in December 1994. These revisions were otherwise occurring to key applicable requirements affecting the design, but not the authority to design, Intel's flexible permit.
(3) The permit was the first developed under the Pollution Prevention in Permitting Program (P4), and required assessment by multiple regulatory authorities of the legality of various innovative provisions, including whether P2 conditions could be federally enforceable.
(4) The permit required a source-specific RACT determination.

1.16 Time required to issue conventional title V permits (on average)

The time required to issue conventional title V permits in Oregon varies significantly according to the complexity of the source and the need for source-specific provision (e.g., source-specific RACT determination).

1.17 History of any deviations, violations and/or enforcement actions over the period before the effective date of the flexible permit

Prior to issuance of the flexible permit, facility inspections had been conducted on 9/21/95, 9/7/94, and 9/21/93. Intel was found to be in compliance with all existing conditions.

1.18 Compare characteristics of flexible permits vs. traditional permits.

1.18.a Considering all the different types of sources for which you issue Title V permits, what are some examples of good candidates for flexible permits?

1.18.b What are some examples of sources that are not good candidates?

1.18.c Keeping in mind these two different groups of sources (one that contains good P4 candidates and the other that contains sources that are not good P4 candidates) consider the following characteristics. Which characteristics are similar between the two groups of sources? Which are different?

1.18.d Have you ever turned down a facility that asked for a flexible permit? If so, what reasons did you have for making this decision? What facility characteristics were important in making this decision?

Discussions with ODEQ representatives revealed that a good compliance history is one of the primary characteristics that should be considered when determining the appropriateness of a source for a flexible permit. ODEQ representatives indicated that they want to feel confident that a source has:

(1) the ability to track and respond to requirements;
(2) trained, competent environmental staffing; and
(3) a technical capacity to track and manage emissions.

Screening flexible permit candidates for these characteristics is important because if a source makes a mistake with regard to applicability determination or compliance, they will have already constructed or made the change and triggered potential environmental impacts and compliance violation penalties.

ODEQ representatives expressed that they did not believe that ODEQ sacrificed any practical enforceability with Intel's permit. Their primary concern was that advance approval of certain changes shifts the timing of ODEQ compliance verification and enforcement to after the changes have already been made. ODEQ manages for any potential risk associated with the delay in their ability to detect non-compliance by pre-screening flexible permit candidates and by designing their permit to only allow pre-approval actions to occur when defined "pre-approval" criteria are met.

Questions Specific to the Pilot Source

1.19 Source description, types of operations, and applicable requirements

Description/Operations: The original buildings at the Intel-Aloha campus were constructed in 1976 through 1978. Additional buildings have been built on the campus more recently. The facility is engaged in Semiconductor Manufacturing (Primary SIC: 3674), with a broad spectrum of semiconductor manufacturing operations. Production steps traditionally include: application of photoresist, UV light exposure, developing, etch, deionized water rinse, doping, and acid/solvent rinse steps. Operations are divided into three emissions units, grouped with respect to common applicable requirements. VOC generating processes located throughout the campus are grouped under Emission Unit 1 (EU1). Approximately 20-30% of the plant site VOCs come from Isopropyl alcohol used in cleaning and cleanroom wipedown operations. The remainder come from fab manufacturing steps, predominantly photoresist operations.

Intel normally operates the production lines continuously. Chemicals applied at the production lines have uniform solvent content (percent VOC) that does not fluctuate during the continuous weekly operations. (See *Oregon Title-V Operating Permit Application Review Report*, pages 3-4 for a detailed description of Intel's operating scenario)

Intel-Aloha's title V permit, issued October 1995, replaced an existing Air Contaminant Discharge Permit (ACDP) which was issued on 4/19/93 and was originally scheduled to expire on 11/01/96. Intel-Aloha's title V permit expired October 1999, and the facility subsequently became a minor source for purposes of title V applicability, due to emissions decreases that had taken place during the title V permit term.

Applicable Requirements (at time of permit issuance):

- Intel was a major source of VOCs, and minor source of CO and HAPs.
- Intel was not subject to federal New Source Performance Standards (NSPS) or NESHAP.
- Plant-Site Emissions Limit (PSEL): PSELs are to be incorporated into all Oregon title V

permits as a means of managing airshed capacity. PSELs are designed to assure reasonable further progress toward attaining compliance with ambient air standards, assure compliance with ambient air standards and PSD increments are maintained, and to establish the baseline for tracking consumption of PSD increments. (See OAR 340-222, pages 1-6)

- Source-specific RACT: Oregon SIP VOC rules include several RACT standards applicable to specific categorical sources residing inside the designated nonattainment area, and a provision which requires other non-categorical "affected sources" to comply with the case by case (source specific) RACT standards established by ODEQ. It was determined, during the course of title V permit preparation, that Intel would be considered an "affected source" and thus require a RACT determination. This was the first control technology guideline developed for the semiconductor industry. (See *Oregon Title-V Operating Permit Application Review Report*, pages 19-28, for a complete description of RACT development; also see Intel title V Permit, page 10, for RACT permit conditions.)

1.20 Actual and allowable source emissions (tpy) for every year since flexible permit issuance

TABLE 1.20 **Intel Aloha Facility Actual and Allowable Source Emissions**

Year	*VOC PSEL 190 tpy*	*Organic HAPs PSEL 10 tpy*	*Inorganic HAPs PSEL 10tpy*
1995	***82.5***	***8.6***	
1996	***49.5***	***7.0***	***3.3***
1997	***73.1***	***6.0***	***3.8***
1998	***62.0***	***7.6***	***3.3***
1999	***55.6***	***8.2***	***3.1***

Note: In 1996, the annual VOC PSEL was voluntarily reduced by Intel from 190 tons/year to 160 tons/year.

1.21 Amount and nature of fugitive emissions

Fugitive VOC emissions occur from the use of isopropyl alcohol during the manual equipment wipedowns and floor cleaning in the fab clean rooms. Fugitive emissions account for 20-30% of Intel's total VOC emissions. These emissions are included in the facility's VOC emissions tracking through the chemical mass balance calculations.

1.22 Source flexibility needs

1.22.a Characterization of pre-flexible permit regulatory concerns

1.22.b Type and number of source changes potentially subject to air permitting

1.22.c Which changes incur an opportunity cost of being 'late to market' due to permitting "delays," and the potential extent of that cost

1.22.d Why conventional permitting process may not be sufficient for certain types of changes

Intel articulated its need for operational flexibility in several ways. First, they point to their need to plan for change in a way that enables them to meet highly aggressive product development schedules in a highly competitive market. With new generations of computer chips being introduced every 12 to 24 months, even short delays can result in significant missed market opportunities. Each new product cycle is supported by a major fab revamp (re-tooling), which is very time sensitive (e.g., to

meet product release schedules from computer and electronics manufacturers) and involves highly sequenced steps. Intel reported that the Aloha facility experienced three major fab revamps during the permit term. Second, Intel points to an important need to make rapid (and sometimes iterative) process and equipment adjustments in existing production processes to improve product yield, lower costs, reduce chemical usage, and otherwise improve operations. Many of these minor changes involve changing chemical use in tool and process chemical formulations, adjusting gas flow rates, moving or adding tools (e.g., photolithography equipment, plasma etchers, liquid acid baths), or substituting chemicals. (*See questions in Section 4 for information on the type and number of changes potentially subject to air permitting*.)

Intel's primary concern has been to ensure that regulatory uncertainty and time delays related to production are minimized, and eliminated where possible. Intel indicated that shutdowns and delays can cost the firm several millions of dollars over relatively few days. To establish the basis for operating in a more flexible permitting environment, Intel elected to maintain a reduced level of HAP emissions (to create synthetic minor status with regard to title V HAPs applicability) and to meet RACT on all production-related changes.

In Oregon, physical or operational changes that increase a source's maximum capacity to emit, and/or the construction or modification of air pollution control equipment, trigger the Notice of Construction approval process (there is no *de minimis* in Oregon). "Construction" cannot occur until approval is received from ODEQ (or for 60 days if ODEQ does not issue a response). The type of change Intel typically makes would trigger the "minor NSR" approval process in which ODEQ has up to 60 days to approve the change. Intel believed that many/most of their fab revamps and ongoing operational changes could trigger Notice of Construction approval thereby requiring building a minimum 60 day delay for planning purposes into their implementation process. In certain instances, Intel could run the regulatory approval process in parallel with the other aspects of the operational change process (e.g., ordering equipment) and, therefore, the "delay" would not affect actual implementation time (when there is sufficient lead time to plan the change). However, Intel is "at risk" whenever it takes action or expends funds (such as ordering equipment that routinely costs over $1 million per tool) prior to receiving regulatory approval.

In practice, ODEQ indicated that they have rarely required formal notification of construction approval if the change in capacity to emit did not exceed one ton per year (they have, in effect, had a defacto one ton/year *de minimis* level), unless the capacity to emit of the change would threaten the PSEL. However, both Intel and ODEQ indicated that discussions are typically needed with the source to determine its obligations to file or not.

The advent of title V federal operating permits, however, brought the combined need to address changes under both ODEQ's minor NSR rule and their regulations to implement title V. For title V, this can take up to 90 days, although "construction" can commence in advance of the modification so this does not add a delay, but does add some risk. However, Intel believed in commencing operation only after receiving all the necessary regulatory authorizations to minimize business risk.

The flexible title V permit containing advance approvals for the vast majority of process and production changes provided Intel and ODEQ certainty with respect to the regulatory applicability of these changes. The permit, in effect, assumes all changes are subject to construction permitting,

then advance approves the changes. The permit does so by establishing the monitoring, measurement, and reporting procedures to support compliance assurance/practical enforceability, and constraining Intel's activities consistent with local airshed requirements. Thus, under the permit, Intel did not operate "at risk" with respect to the advance-approved changes (lowering the risk of their investment activity while holding return constant).

1.23 What has been the frequency of required NSR permits over the period before the effective date of the flexible permit?

Intel did not apply for any major NSR permits prior to the P4 permit. Prior permits for the facility were issued in 1986 and 1993 under the existing state air operating permit program.

1.24 Flexible permit's inspection history

Inspections were conducted at least annually throughout the permit term by ODEQ. No emissions exceedances or violations were reported by ODEQ.

1.25 Source's history of P2 commitment

Intel exhibited a strong commitment to pollution prevention (P2) prior to the P4 permit. This commitment has been communicated by top executive management in the form of a corporate Environmental, Health and Safety Policy, as well as an air emissions policy that designates P2 as the preferred approach to reducing emissions. Intel had an established P2 program that focused (1) on incorporating P2 into process design (design for environment), and (2) on reducing emissions from existing processes. Between 1991 and 1995 (year of title V permit issuance), Intel's Aloha facility P2 program generated significant reductions in VOC emissions (from approximately 90 tons/billion production units to less than 20 tons/billion production units). During this period prior to 1995, Intel operated its P2 activities in a largely uninhibited change environment due to the state's de facto *de minimis* approach. This history of P2 commitment was an important factor in the selection of Intel for inclusion in the P4 pilot initiative.

2. FLEXIBLE PERMIT DESIGN FEATURES

2.1 What flexible permit tools contained within this permit accomplish advance approvals (ROPs, PTE limits, PALs, clean buildings, category of changes, etc.)?[2]

PSEL:

The title V permit retained Intel's original yearly Plant-Site Emissions Limits (PSELs) required by Oregon's SIP. PSELs are pollutant-specific, plant-wide annual caps on actual emissions. Oregon's rules also require a short-term PSEL, set at a level compatible with business operations (and at a level that ensures NAAQS compliance). Intel's annual PSEL for VOCs was set at 190 tons/year, and the weekly PSEL at 8 tons per week. Its annual CO PSEL was set at 32 tons/year. The annual VOC PSEL addressed major NSR applicability, as it served as the baseline from which the Significant Emissions Rate (SER) was measured for modifications. If Intel exceeded its PSEL, it would then have been subject to a major NSR modification.

[2]Terms used in this document are defined in draft White Paper Number Three.

RACT Standard:
A source-specific RACT standard was developed for Intel's wafer manufacturing processes (which were responsible for the majority of Intel's VOC emissions). The RACT standard did not specify how Intel was to meet the standard: Intel could choose to use pollution prevention measures, add-on control technology, or some combination. However, pollution prevention was often more attractive to Intel because minor review permitting and a title V permit modification would be required if Intel chose to comply with the RACT standard by altering or adding to its existing control technology.

Advance Approvals:
The permit advance approves a defined category of physical and process changes that would increase the maximum capacity of a stationary source to emit VOC. The design of the permit assures that the advance-approved changes will comply with all substantive and procedural applicable requirements, including public review requirements. Advance-approved changes were categorically limited to installing new VOC emitting activities and to making physical changes or changes in the method of operation of existing VOC emitting activities at the plant's three existing stationary sources (i.e., buildings).

For advance approvals to apply to changes, Intel needed to ensure compliance with all requirements, as reflected in the permit. This included compliance with the source-specific RACT standard and specified monitoring and record-keeping requirements. Intel was required to go through conventional case-by-case minor NSR and title V modifications for changes that triggered any new applicable requirements (i.e., beyond those addressed by the permit).

To access the flexibility made possible by the advance-approved permit conditions, Intel had to offset any emissions increases associated with the minor NSR-triggering modification through *pollution prevention*, to maintain compliance with the short term PSEL. This approach was taken because a state minor NSR permit action and a title V permit modification would be triggered if Intel modified its existing control technology, or used a different control technology beyond that specified in the permit. (Intel chose not to specify any alternative control technology in the permit, believing it could achieve emissions reduction through pollution prevention). Intel could use pollution prevention to decrease its emissions by making process changes (including input substitution) that enable a product unit to be made with less VOC input, resulting in fewer per unit emissions.

P2 Program:
The permit contained a provision for Intel to develop and implement a pollution prevention program, reflecting Intel's ongoing commitment to pollution prevention. The permit specified minimum elements for the program, including the formulation of performance goals and objectives to comply with the emissions limits through pollution prevention, and data collection to demonstrate the effectiveness of the pollution prevention measures. The permit also specified requirements for monitoring and reporting requirements for the program. This included requirements for an annual P2 progress report, and a final report (at the end of the permit term) summarizing all P2 activities taken and evaluating overall program effectiveness.

2.1.a Describe the information and level of detail provided in the application to support these flexible permit provisions.

ODEQ and Intel representatives indicated that the title V permit application, in conjunction with

information provided during the permit development meetings, contained significant detail regarding the facility and planned operations.

2.1.b Describe the types of information needed in or required by the permit to support the ongoing implementation of the flexible permit provisions.

The sections below summarize the recordkeeping and reporting requirements contained in Intel's title V permit.

Recordkeeping

- General record of required monitoring (date/place/time of testing, techniques used, results, existing operating conditions, etc.) (*See permit page 19*)

- Specific records of required monitoring (complaint log; operations/maintenance records; inspection & survey records; quantities and types of fuels used on a monthly basis; weekly production in total cm^2 of wafer start; records of chemicals used by type, quantity, and VOC/HAP contents; bi-monthly records of waste shipment and analysis results; continuous monitoring charts, if any; records of all calculated PSEL and RACT emissions; and records resulting from monitoring related to P2 and pre-approval conditions. (*See permit pages 19-20*)

Reporting

At the end of each 6-month reporting period, Intel was to inspect and determine the maximum capacity to emit of each stationary source at EU1, and then combine the maximum capacity to emit of all stationary sources at EU1 and compare the sum to the sum determined as of the end of the previous six month period. If the current maximum capacity of EU1 was greater than the maximum capacity of EU1 as of the end of the previous six month period, Intel was to submit a Notice of Completion, which had to include:

- a summary description of the new/modified activities that caused the increase in EU1 maximum capacity;
- the date of completion and date of new/modified activities commenced;
- the net increase in capacity of EU1 due to the new/modified activities; and
- a brief summary describing how the increases in the capacity of EU1 had been offset by the P2 program, such that the weekly VOC PSEL for EU1 was not exceeded.

Intel was to submit to ODEQ semi-annual monitoring reports by July 30 of each year and Annual monitoring reports by February 15 of each year, each containing:

- emissions fee report;
- emissions statement;
- excess emissions upset log; and
- second semi-annual compliance certification.

Other Reporting: (*See permit page 21*)

- Bi-monthly VOC emissions based on actual solvent monitoring;
- Bi-monthly VOC emissions based on emission factor (EF) and production as determined from the 2 month sum of weekly emissions;
- Bi-monthly EF's (lbs VOC/cm^2 wafer) used for each bi-monthly monitoring period;

- A summary of maximum weekly VOC emissions noted during each (2 month) monitoring period;
- All exceedances of the weekly PSEL;
- A summary of maximum weekly RACT emissions noted during each (2 month) monitoring period, once the RACT standard process became effective;
- All exceedances of the source-specific RACT standard;
- All exceedances of the RACT Free Board Ratio limit;
- A summary of the rolling HAP emissions;
- Excess Emissions: Intel was to immediately (no more than 1 hour after the beginning of the excess emissions period) notify ODEQ by telephone or in person of any excess emissions, other than advance-approved startup, shutdown, or scheduled maintenance. If startups, shutdowns, or scheduled maintenance would result in excess emissions, Intel was to submit startup, shutdown, or scheduled maintenance procedures used to minimize excess emissions to ODEQ for prior authorization;
- Permit Deviations: Intel was to promptly report any deviations from permit requirements that do not cause excess emissions, including those attributable to upset conditions, the probable cause of such deviations, and any corrective actions or preventative measures taken.

P2 Program Reporting:

- Each March 15 following program approval, Intel was to prepare a detailed progress report on an annual basis describing accomplishments made under the approved program;
- The final report prepared on March 15 of the last year of the permit was to include a summary of the activities taken during the permit term, and a self evaluation of the overall effectiveness of the program; and
- Each April 15 following program approval, Intel was to submit to ODEQ an annual executive summary, or the final executive summary in the last year of the term, describing the over-all efforts and definitive results.

2.1.c How were any18-month "commencement of construction" requirements met?

Not applicable.

2.1.d What were the processes, if any, for extending any BACT determinations (i.e., keeping them contemporaneous)?

The source-specific RACT developed for Intel also met all Oregon's control technology requirements for this source category.

2.2 If the flexible permit contains a PAL, how was the PAL baseline set?

Oregon's Plant-Site Emissions Limit (PSEL) is a limit already contained in the Oregon SIP that is intended to function somewhat like a Plantwide Applicability Limit (PAL) emissions cap. The ODEQ title V Permit Application Review Report provides significant detail regarding the approach used to determine the PSEL baselines for Intel's Aloha facility (*see pages 12-18*). Since Oregon's PSEL requirement predates Intel's flexible title V permit, several of Intel's PSEL baselines were first set in 1978.

VOC (EU1) PSELs:

ODEQ incorporated the annual VOC PSEL of 190 tons/year contained in the SIP for Intel in the title

V permit for Emissions Unit 1 (EU1), which covers the semiconductor manufacturing processes. This baseline is equal to the source's 1978 maximum actual capacity to emit VOCs, and was included in Intel's first Air Contaminant Discharge Permit. During the permit term, the annual VOC PSEL was lowered to 160 tons/year, when Intel donated 30 tons/year of capacity to emit back to the state to support efforts to bring the Portland, OR/Vancouver, WA airshed into attainment status for ozone. Under Oregon rules, the approach for determining PSEL baselines differs from the approach typically used to set PAL baselines. Whereas PAL baselines are typically set based on an average of the actual facility emissions for the previous two years plus 39 tons/year (i.e., an increment just under the SER of 40 tons/year that would trigger major NSR), Oregon's PSEL is based on the Baseline Emission Rate which equals the actual emissions attributed to a facility for a 12-month period during the PSEL baseline years of 1977 and 1978 (the Baseline Emission Rate for new facilities that did not exist in 1977 or 1978 equals zero). The allowable PSEL equals the Baseline Emission Rate adjusted for rule limitations and may include an increase of up to one ton less than the SER.

The 8.0 tons/week short term VOC PSEL was extrapolated from the emission monitoring conducted from 6/28/92 to 8/29/92 (ACDP data) and a maximum weekly production rate. The 8.0 tons/week PSEL was retained in the title V permit.

Boiler (EU2 and EU3) PSELs:
PSELs are established for PM_{10}, SO_2, NO_x, CO, and VOC for EU2 and EU3 (boilers). The EU2 and EU3 PSELs are a product of the natural gas usage (based on rated capacity of the boilers) and the AP42 emission factors for boilers, in which gas usage is the limiting factor. In the permit, Intel forfeited EU2 boilers' capacity to burn oil, committing all boilers to burning natural gas only.

2.3 How was the PAL monitoring, recordkeeping, and reporting approach justified?

2.3.a What is the rationale for the monitoring approach and averaging time?

2.3.b What data conversions are required?

2.3.c What is the averaging time for each emissions cap and/or the duration of the cap?

2.3.d What is the rationale supporting the use of any longer (e.g., longer than one month) duration?

VOC PSELs:
The PSEL for VOC emissions is expressed as an annual limit, tons per year (TPY), and weekly limit. Given the nature and complexity of Intel's manufacturing operations, with a large number of relatively minor emissions sources (e.g., tools, solvent baths), ODEQ and Intel opted for a chemical mass balance approach to monitoring emissions from Intel's Aloha facility. The use of this simple "IN-OUT" material balance monitoring approach was justified by Intel and ODEQ as being the most accurate emissions calculation method given Intel's operations. The approach assumes all VOC contained in raw materials used (with the exception of the amount of solvent collected via a waste solvent recovery system from the tools and a small amount of solvent recovered by carbon absorption) is emitted. All VOC materials are distributed via a closed system from the subfab directly to tools in the processing "clean rooms". Monitoring the quantity of each VOC containing material delivered to the subfab for use in the fab provides an accurate accounting of VOC usage. Monitoring usage on a monthly basis provides the information necessary for calculating the annual emissions. ODEQ representatives indicated that Intel had demonstrated proficiency in using the chemical mass balance emissions monitoring approach prior to submitting the title V permit

application. Intel also demonstrated to ODEQ that the facility had an effective chemical management system that enables accurate and consistent tracking of chemical usage, which is necessary for chemical mass balance calculations.

Each fab produces a limited number of end-products; the type of product and processes used do not vary widely from day to day. Instead continuous improvements in the tools used (or the number of tools/steps included in the fabrication) occur over time; these changes may result in decreases or increases in VOC emissions over time. The EPA Review Team concluded that monitoring and reporting the bimonthly usage of VOC materials provides an acceptable monitoring of trends in emissions increases or decreases as a result of process changes. Monitoring bimonthly emissions also allows on-going tracking of performance with respect to the annual limit. However, no resolution of actual emissions beyond the bi-monthly level is possible due to the bi-monthly availability of waste shipment data that is used to subtract the quantity of VOCs in waste shipments from the total VOCs used in chemical inputs to calculate VOC air emissions. The bimonthly emissions data in conjunction with production activity data (i.e., total surface area of wafers processed, square centimeters[cm^2]) provides the information necessary to calculate an overall emission factor (EF) for the fab on an on-going basis. The bimonthly EF will reflect emissions changes resulting from process changes over time. Using the most recent bimonthly EF in conjunction with weekly production activity provides total weekly VOC emissions (tons/wk) which reflect weekly variations in production activity and provides the information necessary to determine compliance with the weekly PSEL (tons/wk). This technique provides for considerable flexibility in that it is not dependent on the type or amount of any particular changes.

In practice, the chemical mass balance approach was conservative (i.e., worst-case scenario) in its estimate of VOC emissions. Intel and ODEQ assumed that all VOCs used, and not accounted for in spent solvent waste shipments or in recovery by VOC pollution control devices, are released to air. Subsequent testing has led Intel to believe that the resulting air emissions estimates are likely to have over-estimated VOC air emissions by as much as 10 percent to 15 percent, by not accounting for VOCs discharged in Intel's wastewater stream.

Under the title V permit, Intel's short term VOC PSEL was set at a weekly limit (8.0 tons/week). ODEQ justified a weekly limit based on the nature of Intel's operations, pursuant to OAR 340-28-1020(2). According to ODEQ and Intel, "Intel normally operates their production lines continuously. Chemicals applied at the production lines have uniform solvent content (percent VOC) that does not fluctuate during the continuous weekly operations. The level of VOC emission would be proportional to the production rate. The weekly emissions closely reflect the sum of their daily emissions which are evenly distributed." (*ODEQ Application Review Report, pages 12-13*) The weekly averaging time for VOC emissions was also consistent with the modeling period used by the state in the attainment plan for the ozone non-attainment area. The weekly averaging time is also consistent with EPA policy, as outlined in the EPA Office of Air Quality Planning and Standards' (OAQPS) January 20, 1984 Memorandum titled "Averaging Times for Compliance With VOC Emissions Limits - SIP Revision Policy". This memorandum stipulates that VOC emission averaging periods must not exceed 30 days.

Criteria Pollutants (Boilers) PSELs:
The Intel Aloha facility also has PSELs (annual limit and monthly limit) for the PM_{10}, SO_2, NO_x, and

CO emissions from 18 boilers, the only sources of these emissions at the site. All boilers use only natural gas as fuel. The short term (monthly) PSEL for the EU2/EU3 boilers is based on the maximum (rated) hourly capacity multiplied by 24 hours/day and 31 days/month; the short term PSEL in the permit can be expressed in either monthly or daily form, and the calculations would actually represent the same limit. It would theoretically not be possible for boilers to operate beyond their maximum capacity, unless physical modifications are made to the boilers. The natural gas usage is the only varying parameter used in determining compliance under the PSEL. The boiler emissions are calculated based on natural gas usage and the appropriate emission factors. Monthly natural gas usage is obtained from the natural gas supplier's monthly billing. Therefore, the monthly PSEL was determined to be the most compatible averaging time for determining emissions from boiler operations and compliance with the PSELs. Annual emissions are determined by multiplying annual fuel usage by appropriate emission factors from AP42, except for Emission Unit 3 (EU3) boiler's NOx and CO emission factors which are based on manufacturer's data and verified by source test. The monthly emissions are also determined by multiplying monthly fuel usage by appropriate emission factors. ODEQ and Intel reported that, in practice, all boilers are operated well below their maximum capacity.

2.4 Where applicable, describe the following aspects of the permit that are used for purposes of tracking emissions under a PAL or an emissions cap:

2.4.a Details regarding source emission factors and processes for changing emission factors.

2.4.b Tracking emissions from startups, shutdowns, and malfunctions of monitoring, control, and/or process equipment.

2.4.c Requirements for tracking emissions from insignificant emissions units.

2.4.d Requirements for quantifying fugitive emissions

The permit calls for the bi-monthly emission factor (EF) (lbs VOC/cm^2 wafer) to be updated every two months, to reflect the most recent process changes. The permit identifies the following equation for calculating the bi-monthly EF in permit condition 24.f.:

$$EF = (a - b - c) / \Sigma_{bi} (e),$$

where a = quantity of VOC used; b = quantity of hazardous and nonhazardous VOC waste shipped off site and representative VOC content; c = quantity (Q1) of VOCs controlled by PCD1 plus quantity (Q2) of VOCs recovered by PCD26; and e = the total "cm^2" of wafer processed.

VOC and HAP emissions associated with startups, shutdowns, and malfunctions were included in the chemical mass balance calculations.

Once during each permit term, Intel was to estimate the emissions from the activities included under the aggregate insignificant emissions limits. Once during each semi-annual reporting period, Intel was to inspect and make a determination that the activities included under the aggregate insignificant emissions limits have not been modified in such a manner that would increase the emissions above the aggregate insignificant emissions limit. Intel was required to maintain a log for recording the results of the inspections. (See permit pages 13-14.)

Fugitive emissions were not quantified separately, although they were included in the chemical usage

numbers used to conduct the chemical mass balance calculations.

Additional Permitting Authority Inquiries

2.5 How did the source articulate its need for flexibility?
See question 1.22.

2.6 What were your key rule interpretations or determinations?
One key determination was associated with the Intel P4 permit. It involved defining "emission unit" to allow for inclusion of more than one stationary source (e.g., building), provided that the stationary sources grouped under the emissions unit have the same applicable requirements. This determination in turn enabled a building-wide RACT determination and an advance approval for a wide category of change to be within the building-based emissions unit (EU).

2.7 Was there a need for follow-up rulemaking?
No follow-up rulemaking was necessary for the permit. Although not required, ODEQ chose to incorporate the revised definition of "emission unit" into its SIP.

2.8 Might you include additional flexible approaches for this source in the future?
The synthetic minor ACDP that ODEQ issued Intel's Aloha facility (to replace the title V permit that expired in October 1999) contains many of the flexibility provisions contained in the title V permit (e.g., advance-approved change provisions). No additional flexibility provisions (that were not contained in the prior title V permit) are included in the ACDP permit or are envisioned for the future as of April 2001.

3. PUBLIC PARTICIPATION AND PUBLIC PERCEPTION

3.1 Were comments received from the public? Please provide a summary of any comments and of your response(s) to them.

3.1.a In what venues/times were public comments received? (formal permit process, public information sessions not required by the permit process, permit implementation, etc.)

3.1.b How many public meetings/information sessions were requested and subsequently held?

In January 1995, ODEQ held a meeting for public interest groups in the Northwest to discuss the initial draft permit. Representatives from two local non-governmental organizations attended the briefing. ODEQ reported that no comments were submitted to the agency at this time.

ODEQ and Intel reported that no public comments were received during the permit development process. The permit went through the standard title V public comment process. A public comment period was held in July 1995 on the draft permit, and no written comments were received. Although not required because no requests were received, a public hearing was also held in July 1995. One consultant, who was interested to learn about flexible permitting, attended the hearing but gave no comments. The public comment period and hearing were publicized by ODEQ using the agency's

standard public notification operating procedures.

3.2 Was there a discussion in notices, meetings and/or public comments of the source's need for flexibility, possible environmental benefit, and/or administrative burden from getting additional permit(s) or permit revisions?

According to ODEQ representatives, there were no notable discussions in the public notices or meetings.

3.3 Were there any environmental justice issues? If so, how were they addressed?

No environmental justice issues were identified. The Intel facility is located in a lower middle-class to middle-class area. There is no record of public complaints related to the facility, and there has been little, if any, public interest in environmental permitting at the facility.

3.4 Were there any CBI issues? If so, how where they addressed?

No formal confidential business information (CBI) protections were instituted for information submitted to regulatory agencies. Through the permit design, however, Intel was able to protect some chemical use information from competitors by accepting more stringent caps on classes of HAPs. In exchange for not publicly reporting emissions of individual HAPs (and thereby disclosing the names of chemicals used), Intel agreed to report total organic HAPs and total inorganic HAPs and to apply the 10 tons/year minor source limit to total HAP emissions in each category, rather than to each individual HAP. This also meant that total HAP emissions were capped at 20 tons/year instead of the statutory 25 tons/year HAP limit. It should be noted that information on the emissions levels of specific HAPs were maintained on-site at Intel, and were available to on-site review by EPA and ODEQ inspectors. While Intel submitted annual P2 progress report executive summaries to ODEQ (available for public access in Intel's file at ODEQ), the specifics of individual P2 projects were deemed proprietary and were maintained on-site by Intel and available for on-site inspection by EPA and ODEQ.

3.5 What was the ongoing level/adequacy of information flow to the public?

3.5.a What was the amount and type of information available during the title V permit development and public notice/comment period?

3.5.b What input was obtained back from the public beyond initial comments?

3.5.c What level of detail of source activity was provided to the permitting authority, and/or the public for flexible permit changes that took place during the permit term (e.g., logs and other records)?

- **What required information was submitted directly to the permitting authority?**
- **What and how much information submitted by the source was claimed as CBI?**
- **What additional information was available to the public only through FOIA requests?**

3.5.d What was the timing of the availability of relevant information to the public during permit implementation and development?

3.5.e What was the level of interest in annual P2 reports provided?

3.5.f Were advance notices circulated or made publicly available?

The draft title V permit and ODEQ Review Report were made available for public review during the

comment period. The public also had access to the Intel facility's historical file at ODEQ that included information associated with the implementation of previous ACDP permits (e.g., correspondence between ODEQ and Intel, inspection reports). ODEQ also held a non-requested public hearing, as well as a non-requested briefing for environmental organizations as part of the draft permit development and review process. No input was obtained back from the public during the comment period or during the term of permit implementation.

During the permit term, Intel submitted all required reports to ODEQ, including semi-annual and annual emissions monitoring reports (see question 2.1.b above for required reports). All reports submitted to ODEQ by Intel are available to the public in ODEQ's files at their Northwest Regional Office. All confidential business information (required by the permit, but not required for submittal to ODEQ) was maintained on-site at Intel and available to inspectors upon request.

Under the permit conditions, Intel was not required to report to ODEQ, EPA, or the public about specific equipment and process changes unless (1) they triggered applicable requirements that were not advance-approved in the permit, or (2) the advance-approved changes in the current six month period resulted in a net increase in the maximum capacity to emit of any stationary source compared to that calculated at the end of the previous six month period (otherwise Intel would have netted out of construction permitting, causing no case-by-case actions to be needed). If this occurred (it did once, in 1997), then Intel was required to submit a Notice of Completion (see permit conditions 17.h.ii. and 25.c.). This notice included a description of all changes during the period that resulted in the increased capacity to emit. Intel does maintain internal documentation of process and equipment changes through its strategy paper process, and Intel also maintains an inspection log documenting the semi-annual capacity to emit assessment. Advance notices were not required by the permit for changes that fit the category of advance-approved changes in the permit.

Intel was also required to submit to ODEQ an executive summary of its annual P2 progress report. This report summarized Intel's P2 activities undertaken under the permit during the prior period and presented the associated emissions reduction results. Detailed information about Intel's P2 projects were not required to be made publicly available, but were available on-site for review by agency inspectors. See question 7.4 below for a discussion of the level of interest in Intel's required P2 reports.

3.6 Based on document/record review, compare conventional regulatory permitting versus flexible permits in terms of:.

3.6.a How provisions are described to the public

3.6.b Number of comments received

3.6.c Number of complaints received

3.6.d Level of ongoing public interest

3.6.e Amount of information (if any) not available to the public (e.g., logs) and how this may or may not contribute to the public's understanding of the permit

3.6.f Amount of P2 information made available

The public participation process associated with the initial permit development was similar to that undertaken for most title V permits. There was a public comment period, during which the draft permit was available for comment, and a public hearing was held. The public hearing was convened by ODEQ without being called for by public petition since the agency believed that the innovative

nature of the permit warranted more proactive steps to engage public input. The process for the Intel permit also involved special meetings held earlier in the process to solicit input from national and local environmental organizations.

The number of public comments (none) and complaints (none) was consistent with historical patterns for that Intel facility and location. Depending on the company's environmental performance and its location in Oregon's Northwest region, other high-tech facilities have experienced higher levels of public involvement or complaints. An official at ODEQ attributed the absence of public interest and complaints at Intel's Aloha facility, in part, to the facility's historical, strong environmental performance (e.g., compliance, emissions and odor performance, proactiveness related to community relations).

Some differences between the amount and type of information available to the public under Intel's title V permit and what might have been available under a conventional title V permit are listed below:

- The P4 permit provided a 5-year advance look at Intel's expected change scenario for the Aloha facility. Under a conventional permit, the facility's change plans (associated with minor construction changes) would only be discernable by the public after the fact through a review of ODEQ's case-by-case approval actions. The information provided by Intel during the initial flexible permit application process was deemed equivalent by ODEQ to that information which would have been provided under conventional case-by-case permitting actions for purposes of making advance approval construction permitting determinations.
- Under the P4 permit, Intel was required to report to ODEQ regarding operational and equipment changes made when the facility's overall maximum capacity to emit increased during the six-month period in which the change occurred when compared with the previous six-month period (see question 2.1b for a discussion of the reporting requirement). For periods in which the facility's maximum capacity to emit remained the same or was reduced (e.g., due to P2 activities), ODEQ did not require Intel to submit notices of advance-approved changes made, even if some of the advance-approved changes would have triggered a case-by-case Notice of Construction permit application under a conventional permitting scenario. Notices of such changes (occurring in six-month periods without an increase in maximum capacity to emit) would, therefore, not be available for public review in ODEQ's files, unless the changes were considered to be P2 changes and were captured in the annual summary report of facility P2 activities that Intel was required to submit to ODEQ.
- Under a conventional title V or construction permit, P2 information is typically not documented and made publicly available.

4. IMPLEMENTATION OF FLEXIBLE PERMIT PROVISIONS (ON-SITE VERIFICATION)

Utilization

4.1 What was the source's overall flexibility provision utilization throughout the permit term?

4.1.a How often were the flexible approaches used?

- **Describe the nature of the changes that occurred at the facility under the**

flexibility provisions.

- **Identify which changes took advantage of which flexibility provisions (e.g., new unit A was added pursuant to advance approval and within a PAL emissions limit).**

Drawing on a variety of data sources documenting operational changes at Intel and discussions regarding the applicability "triggers" of Oregon's Notice of Construction Approval process, Intel, EPA, and ODEQ representatives jointly estimated that Intel potentially makes, on average, between 150 and 200 operational changes per year which are likely to be subject to state minor construction approval actions or a determination by ODEQ that no review is needed. Under state rules, ODEQ is required to process a notice of construction approval within 60 days of receipt. Construction cannot commence before this time unless ODEQ grants an earlier approval or rules that one is not necessary.

- Intel, through its internal operational change control process, identified 355 completed strategy papers to change its processes and 522 tool installations during the two-year period from 1999 - 2000. The changes reflected in these totals typically involve equipment installations (new or relocated tools) and process changes (new chemical usage, changes in chemical mixtures, alterations in tool operating parameters).

- Examining these two sources of data for operational change activity at the Aloha facility, Intel estimated that it conducted approximately 300 to 400 operational changes ("change events") during this two year period.

- Applying Oregon's Notice of Construction approval to these changes, Intel estimated that approximately 2/3 of the changes would have triggered Oregon's minor construction permitting process. This produces an estimate of between 200 and 265 changes (100 to 130 changes per year) subject the state's minor Notice of Construction approval process.

- Intel further indicated that, during 1996, the facility completed 350 change strategy papers representing approximately 170 changes that would have been subject to Oregon's Notice of Construction approval process.

- Detailed discussion about the nature and timing of these changes and the different data sources eventually produced an estimate of between 150 and 200 operational changes per year likely subject to Notice of Construction approval process.

Further discussion with EPA, Intel, and ODEQ representatives produced some additional perspectives on this estimate.

- The individual changes identified in the Intel change strategy papers fell loosely into two categories: those associated with the revamping of fabs for purposes of producing next generation semiconductors (a process which takes place every 18 to 24 months); and those associated with fine tuning existing processes for purposes of, for example, increasing product yields or preventing pollution. The former category are associated with a very time sensitive new product critical path and therefore time delays associated with these changes have potentially substantial opportunity costs. The changes associated with the latter

category tend to be linked to the need to iteratively modify the production process to achieve optimum performance. Intel indicated that this type of process experimentation is substantially more attractive to them when it operates in an environment of low administrative friction.

- ODEQ representatives indicated that, in practice, it applies a reasonableness test to operational changes and tends not to require Notice of Construction Approvals for operational changes involving less than a 1 ton/year increase in the maximum capacity to emit of the stationary source. ODEQ therefore indicated that potentially many of the changes ultimately may not have required state approval. Intel indicated, however, that, as a matter of sound business practice, it prefers to manage its operational changes in accordance with a strict interpretation of the Oregon requirement particularly in light of the federal enforceability associated with operating under a title V Federal Air Operating Permit. In addition, Intel stated that even if all the estimated changes ultimately did not require formal approval, each would have required a significant discussion with ODEQ before dispensing with the need to obtain an approval. As a result, Intel's "perception" of the need for up to 150 to 200 Notice of Construction Approval actions per year is used as the basis for estimating impact.

- ODEQ representatives also indicated that there would been at least the possibility of "grouping" certain of the changes Intel identified into a single Notice of Construction Approval action, thereby lowering the overall number of permitting actions required. Intel believed that while some contemporaneous grouping of similar or same project-related equipment might have been possible, it would not have lowered the number of changes dramatically and that the total processing time would not have been appreciably affected. ODEQ representatives agreed that the most efficient and effective means to address the high number of changes and the uncertainty of which might trigger ODEQ's requirements was the advanced approval approach utilized in the P4 permit.

4.1.b How many minor NSR permits and/or title V permit revisions were necessary (i.e., not covered under the advance approval)?

During the title V permit term, Intel made one substantive title V permit modification (Application No. 016312). This permit modification addressed the following changes:
(1) A reduction of Intel's annual VOC PSEL from 190 tons/year to 160 tons/year (condition 12). This change was made as a voluntary effort by Intel to donate 30 tons/year VOC capacity to emit to the state to assist with regional efforts to improve air quality;
(2) Justification for deleting periodic monitoring and recordkeeping for insignificant activities, since the provisions were deemed by ODEQ to not improve compliance with applicable requirements (conditions 13,22, and 27);
(3) A revision to language in the permit requiring Intel to implement the approved P2 program, to acknowledge that Intel had a pre-existing P2 program (condition 16);
(4) A provision of additional explanation regarding monthly HAP monitoring; and
(5) Administrative changes including a change of the name of the facility contact person, and minor language clarification changes.

Several additional administrative permit amendments were made during the permit term, primarily to

modify the name of Intel's facility contact person.

No minor NSR permits were needed by Intel during the title V permit term.

4.1.c Contrast these results with implementation under a conventional permit design for the same source.

- **What approach would the source have taken for changes that utilized a flexible permit provision, absent that provision?**
  - **S not made the change**
  - **S taken steps to avoid triggering requirements (e.g., netted out of major NSR)**
  - **S complied with full major/minor NSR permitting**
- **Were any other conditions taken to address applicable requirements other than NSR? If so, which ones?**
- **How much time & resources were saved by utilizing the flexible permit provision(s), compared to the option you would have chosen above?**

As mentioned, under a conventional permit, Intel estimated that it would have been subject to approximately 150 to 200 notice of construction permitting actions per year. Intel indicated that a traditional permitting approach would require them to build in 60 additional days to the implementation of most of these changes to accommodate the permitting process, while their typical business requirement is to make such operational changes in 60 days or less. Intel indicated that such potential delays would require the company to focus future investments on facilities where such constraints did not exist.

Intel did indicate that up to 1/3 of the identified changes may have sufficient lead time to run the construction approval process in parallel with other change implementation activities (e.g., ordering equipment) and, therefore, the overall implementation schedule would not be effected by the permitting action. At the same time, the discussion did indicate that running the permitting process in parallel with equipment purchases or other pre-construction activities left these actions at risk that DEQ might disapprove or require changes to the proposed operational change.

Intel estimated that each Notice of Construction Approval action would require approximately 8 hours of staff time with each hour valued at $150. This translates into an administrative cost of $1,200 per permit action and an annual cost between $180,000 and $204,000. Intel indicated that the administrative cost savings were not necessarily a big driver for them. Instead, Intel representatives indicated that, assuming they have a fairly fixed Environmental, Health, and Safety (EHS) budget and staffing, time spent on administering construction permit actions would divert attention and focus away from more forward looking activities such as their design for environment program and ongoing, in-process pollution prevention efforts.

From the standpoint of potential opportunity costs associated with the 60 day permit action delays associated with case-by-case approvals, Intel has estimated that operational delays can represent an opportunity cost of several million dollars in just a few days.

During discussions exploring Intel's pollution prevention activities during the permit term a further negative consequence of a conventional permitting approach was identified. Intel indicated that

successful pollution prevention initiatives directed at on-going processes can be iterative in nature. That is, the company typically needs to conduct a series of experiments on its manufacturing process to see if the changes produce the desired results. Intel indicated that many of these individual changes could be subject to individual construction permitting actions thus imposing a very jagged, stop and go aspect to the experimentation process. Intel indicated that, under such conditions, operations personnel might well view experimentation for purposes of pollution prevention as being very disruptive of the manufacturing process and therefore recommend that it not proceed.

Documentation

4.2 What problems, if any, did you encounter regarding the following:

4.2.a Tracking of fugitive emissions

4.2.b Inclusion of emissions from startups, shutdowns, and malfunctions

4.2.c Inclusion of emissions from insignificant emissions activities

4.2.d Missing data

4.2.e Use of/updates to emission factors

4.2.f Application of ROPs (amount of errors noted) and missing critical assumptions

4.2.g Required content of logs

4.2.h Use of advance notices

The EPA Review Team did not identify any documentation problems related to the permit or associated recordkeeping requirements. Intel's documentation and recordkeeping associated with the P4 permit appeared to be thorough and well-organized.

No monitoring problems were identified regarding tracking of fugitive emissions or emissions from startups, shutdowns, and malfunctions. Because the monitoring approach is based on the amount of VOC input to the system, any fugitive emissions from the subfab or fab or emissions from startups, shutdowns, or malfunctions are accounted for in the material balance emissions tracking approach. In addition, no problems were encountered associated with inclusion of emissions from insignificant emissions activities. ODEQ made a determination during the permit application review that inorganic HAP emissions from this source were insignificant; therefore, quantifying inorganic HAPs is not required. An estimate of the emissions is required only once each permit term. Semi-annual inspection to determine that the activities using inorganic HAPS have not been modified in such a manner that would increase the emissions above the aggregate insignificant emissions limit is required; the results of these inspections are maintained in a log. During the site visit, the EPA Review Team and Intel discussed the inorganic HAP emissions and no problems or issues were identified; no significant changes to the activities that would result in emissions in excess of the insignificant limit had been made. (The EPA Review Team did not ask to review the inspection log). With regard to problems associated with missing data, the EPA Review Team concluded that there were none. Since monitoring is based on the amount of material delivered to the subfab (raw material usage) and production rates, the amount of material used and production rates are always known and missing data is not an issue. VOC usage records and production records necessary for conducting the material balance and determining the VOC emissions for the PSELs are available and were reviewed by the EPA Review Team. No problems were encountered.

Emission factors are not used for determining annual VOC emissions; the annual VOC emissions are based on the actual measurement of VOC usage. However, a bimonthly EF is calculated and used (in conjunction with weekly production data) for determination of the weekly VOC emissions for

compliance with the weekly PSEL. Documentation is available for calculation of the bimonthly emission factors (bimonthly VOC usage and production rates). No problems were noted during the review. Emissions factors are used for calculating emissions from the boilers. No problems were encountered with the use of these emission factors.

Advance notices are not required. A notice of completion is required to be submitted with the semi-annual report for any advance-approved change if the maximum capacity to emit for the semi-annual period from any stationary source is greater than the maximum capacity to emit at the end of the six-month period covered by the previous semi-annual report. One notice of completion was filed during the permit term.

One documentation issue was reported during the permit term by ODEQ Inspector David Sellers in the Inspection Report from April 24, 1996. The report indicates that "Intel is reporting inorganic HAP use not inorganic HAP emission. They will need to modify records and reporting in terms of emissions. A letter will be sent to Intel on this matter." The report also indicates that inorganic HAP emissions for 1995 were 3.0 tons/year, well below the 10 tons/year limit imposed by the permit. Intel and an ODEQ representative indicated that the reporting adjustment was subsequently made by Intel.

Quality/Quantity of Information

4.3 What was the quality and the quantity of monitoring data received?

4.3.a. Are CEMS in place? If yes, were data provided?

4.3.b. Were stack tests performed? If yes, were results provided?

4.3.c. Was parametric monitoring performed? If yes, were results provided?

4.3.d. Were any other monitoring approaches used? If yes, were data provided?

ODEQ representatives indicated that they believe that the quantity and quality of monitoring data required by the permit and received from Intel was sufficient to determine compliance with permit conditions. See questions 2.1.b and 2.4 for descriptions of monitoring requirements and the quantity of data required by the title V permit.

The ODEQ title V Permit Application Review Report presents a rationale for the monitoring approaches used in the permit. All monitoring approaches required by the permit received EPA approval and have been deemed to be consistent with EPA monitoring policy and guidance. The monitoring requirements associated with the annual and short-term VOC PSEL utilize a combination of chemical mass balance, parametric monitoring, and stack testing. A material balance of VOC usage is the primary monitoring approach. Parametric monitoring was performed only on the wet scrubber for FAB 4, which was shut down during the first 10 months of the permit period. Testing was conducted to determine the control efficiency associated with a wet-scrubber for VOC emissions from FAB 4. In addition, testing was conducted to provide information on the inorganic HAP emissions, which were subsequently determined to be insignificant. No continuous emissions monitoring systems (CEMS) are used at the Intel Aloha facility. ODEQ representatives indicated that they believe that the chemical mass balance approach in use by Intel at the time of permit application was more than sufficient to determine source compliance with the VOC PSELs and other permit conditions on a continuous basis. During EPA's May 2001 site visit, Intel provided the EPA Review Team access to data associated with all monitoring procedures (i.e., material balance data, parametric monitoring data, stack test reports). The EPA Review Team agreed with ODEQ's assessment that the quantity and quality of monitoring data was sufficient to determine compliance

on a continuous basis.

4.4 What was the percentage/amount of site-wide emissions subject to enhanced monitoring, recordkeeping, reporting and/or controls that were greater than required by applicable requirements under a conventional permitting approach?

No additional enhanced monitoring was required. It is difficult to state what the applicable requirements for this source would be under a "conventional" permit for most states. ODEQ is perhaps unique in that prior to the title V permit this source had an Oregon operating permit which included a Plant-Site Emission Limit (PSEL). States without the PSEL requirement would not necessarily require the comprehensive mass balance across the full facility as in the case of Intel.

4.5 Did actual changes made match their up-front descriptions? If not, why not and how were the discrepancies addressed?

Yes. ODEQ representatives indicated that the changes made by Intel under the title V permit were fully consistent with those envisioned during permit design and that the changes were made in a manner consistent with the constraints imposed by the permit.

4.6 How many changes (e.g., potential NSR triggering events) are identified in the logs?

See question 4.7 below.

4.7 What types of information and level of documentation detail are included in the logs?

Under the P4 title V permit, Intel's approach for evaluating the regulatory aspects of potential changes differed from that required under a conventional title V permit. Under the permit, Intel first needed to assess whether or not the change would fit within the category of changes advance-approved by the permit. Only in instances where the change did not fit the criteria and constraints for the advance approval would Intel examine the need for obtaining case-by-case Notice of Construction Approval. It is important to note that the permit's basis for compliance demonstration rested with the source's demonstration that its emissions remained below applicable PSELs.

Intel was required to submit a Notice of Completion to ODEQ if the maximum capacity to emit of any stationary source at the end of the 6-month period covered by the most recent semi-annual report is greater than the maximum capacity to emit at the end of the 6-month period covered by the pervious semi-annual report (see permit condition 17.h.ii.). This notice was required to summarize any advance-approved changes made during the reporting period. Intel needed to file a Notice of Completion one time, included with its semi-annual monitoring report in 1997. A description of the information included in this Notice of Completion is included under question 4.9.

Although not required by the permit, Intel maintains a rigorous internal operational change control process for making modifications to manufacturing processes and equipment. When Intel employees desire to make a process or equipment change, they must first prepare a change strategy paper that describes the change in detail, along with anticipated benefits and an implementation plan. The proposed change (described in the change strategy paper, or "whitepaper", as it is called by Intel) is then reviewed by a team of engineers and managers representing multiple Intel facilities to determine whether or not the change should be made. This change review process includes a formal assessment of the environmental management implications associated with the change, including an estimation of the anticipated impact on air emissions (if any) and a determination of whether the

change satisfies the pre-approval conditions. Intel also maintained a tool installation log. Therefore, while under the permit Intel was not required to maintain a log of changes made that was accessible to ODEQ inspectors or the public, the change strategy papers have afforded Intel the ability to retroactively assess the number of changes made during the permit term that, in the absence of their P4 permit, could potentially have triggered the need to submit for case-by-case Notice of Construction approvals. See question 4.1.a for information on the number of changes made during the permit term.

4.8 Was there any confusion over the location of new emissions units and what requirements are applicable to them? If so, please describe the confusion and how it was resolved.

ODEQ representatives indicated that they had no limits on their ability to detect non-compliance and that, during the semi-annual compliance audits conducted during the permit term, they did not identify or document any instances of misinterpretation or confusion with requirements and/or emissions unit location. The EPA Review Team found no evidence that there had been any confusion over the location of new emissions units and associated applicable requirements.

4.9 What types of information and level of documentation detail are included in the notices?

If certain criteria were met (*see questions 4.6 and 4.7*) Intel was required to submit to ODEQ a Notice of Completion. Intel met these criteria during one period and therefore submitted a Notice of Completion as part of its semi-annual report in 1997. Intel organized the Notice to reflect the information requested under permit condition 25.c. Information included:

> 25.c.i. A summary description of the new and/or modified activities that caused the increase in the maximum capacity to emit of EU1. Changes were listed in bullet format, with brief (2-6 sentence) descriptions of the change, including the type of change and the change location. For example, the 1997 Notice of Completion included the following change description:
>
> "In January 1997, Fab 5 discovered a correlation between a process defect and the resist chemical in Lithography. Use of resist increased 25 percent in the first six months of 1997 (H1 '97) as compared to the previous six months (H2 '96) due to testing required to evaluate batches of resist from the manufacturer."
>
> 25.c.ii. Date of completion and the date new and/or modified activities commenced or were planned to commence.
>
> 25.c.iii. The net increase in capacity of EU1 due to the new and/or modified activities.
>
> 25.c.iv. A brief summary describing how the increases in the capacity to emit of EU1 have been offset by pollution prevention activities, such that the weekly VOC PSEL for EU1 is not exceeded.

4.10 Were the calculations required by the permit included in or attached to the on-site log?

Intel maintained paper copy records of data and calculations required by the permit, as well as the partially automated electronic files (e.g., spreadsheets) used to generate most paper copy files and the semi-annual and annual monitoring reports submitted to ODEQ. While the paper copy records

did not always indicate the specific calculation being performed to produce a particular (labeled) column of data, the formulas in the underlying spreadsheet could be referenced to understand how the required calculations were being made using the input data (e.g., chemical usage, wafer start, production activities).

Intel's emissions monitoring spreadsheets (electronic files) were available to inspectors for on-site review upon request. Inspectors were able to view formulas and calculations made on the spreadsheets, and they typically walked through the calculations for a particular time period to verify the accuracy of Intel's calculations. During the flexible permit review site visit in May 2001, Intel also made the electronic spreadsheet files available to EPA Review Team members for examination.

5. DESIGN ADEQUACY OF THE FLEXIBLE PERMITS

General inquiries based on subsequent implementation of the flexibility provisions

5.1 Were any applicable requirements omitted?

The EPA Review Team did not find evidence of any applicable requirements that were omitted from the permit.

5.2 Was monitoring sufficient?

5.2.a Does the permit utilize appropriate monitoring methodologies based on the types of emissions units involved?

ODEQ representatives indicated they believe the monitoring methods utilized in Intel's title V permit were sufficient to demonstrate compliance with all applicable requirements accurately and consistently and to ensure that the permit was enforceable in a practical manner. While ODEQ (with approval from EPA) concluded that the VOC chemical mass balance monitoring approach was sufficient to assure compliance with applicable requirements, Intel and ODEQ decided to revise the monitoring approach for Intel's current air operating permit (a synthetic minor Air Contaminant Discharge Permit). Based on research performed by Intel during the title V permit term, Intel found that it could determine more accurately actual VOC emissions by moving to the use of parametric monitoring and emissions factors for various types of equipment within the semiconductor manufacturing process. Intel indicated that this emissions monitoring approach has assisted environmental staff in their efforts to discuss potential P2 initiatives with manufacturing engineers.

Under the chemical mass balance approach, short-term emissions data did not always produce accurate actual emissions for a particular short-term period, although overestimates or underestimates of emissions would be fully offset in the adjacent reporting periods ensuring overall accuracy over time. This situation occurred since chemicals were reported as fully consumed when brought on site and the VOC content of solvent wastes was subtracted following analyses of waste shipments, causing the VOC usage/emissions data to not always get counted in the appropriate reporting period. In practice, Intel remained below its annual and short-term VOC PSEL with a sizable compliance margin throughout the permit term (including those short-term periods which may have over-reported actual emissions).

The EPA Review Team monitoring assessment found the permit utilized appropriate monitoring

methodologies based on the types of emissions units involved. Some questions were raised over the discontinuity between Intel's weekly PSEL and the solvent recovery accounting method used to determine compliance, since the solvent recovery accounting was delayed by a number of days after the solvent has been used and was not tallied more frequently than bi-monthly. The EPA Review Team found these questions to be of little consequence because the plant activity appears to be relatively consistent and the margin of compliance is large. The material balance methodology used for VOC emissions tracking, as well as the EF/activity (fuel usage) approach used for the natural gas-fired boilers were found to be acceptable.

Although the monitoring requirements for the performance of the VOC scrubber for FAB 4 used an appropriate methodology (i.e., operating parameter monitoring), the elements of the monitoring approach, were they relevant to the source's ability to assure compliance, should have been improved by including an operation and maintenance requirement that relates scrubber water flow rate with the flow corresponding to the optimum VOC removal efficiency, as verified through source testing.

By way of example, current guidance for monitoring control device operating parameters suggests the permit include the following elements:

a) specific description of how the operating parameter is to be measured,
b) the frequency of measurement,
c) the averaging period for the measurements, if appropriate, and
d) the specific operating range that defines when an excursion from normal operation has occurred and corrective action and reporting is required.

Moreover, a requirement to record the scrubber water flow rate on a daily basis would be appropriate.

5.3 Were there any problems translating the advance approval concepts into actual permit provisions?

No difficulties were identified, aside from the need to redefine "emissions unit" to allow for inclusion of more than one stationary source. (See questions 2.6 and 2.7.)

5.4 Were the advance-approved categories of changes sufficiently well-defined to cover the actual changes made? If not, how were these changes made?

Both Intel and ODEQ representatives indicated (and exhibited) that complete clarity existed with respect to the types of specific changes covered by the categorical advance approval. The P4 effort produced a permit that substantially increased the clarity both for ODEQ and Intel with regard to the Clean Air Act regulatory status of Intel's operational changes. The permit accomplished this by focusing on outcomes (desired maximum emission levels) and then instituting monitoring, reporting, and recordkeeping (MRR) to assure compliance with this outcome. In effect then, the permit treated all Intel operational changes that fit within the constraints of the pre-approval identically irrespective of whether or not they would have, under a conventional permit, triggered case-by-case Notice of Construction Approval. As a result, the relevance of the "grey zone" surrounding the minor NSR applicability determination was eliminated (providing Intel and ODEQ with certainty) and any incentive to "push the envelope" on an applicability determination in favor of not submitting notification and waiting up to 60 days was removed.

5.5 Did the permit contain all calculation procedures/ROPs needed by the source to determine applicability and assure practical enforceability? If not, how did the source determine applicability and assure practical enforceability?

In all but one instance (see paragraph below), the permit contained clear and replicable calculation procedures necessary to determine compliance and assure regulatory enforceability, based on the monitoring methods selected for use in the permit. Refer to question 2.3 for justification by ODEQ of the monitoring approaches employed in the permit.

One area of confusion arose among the EPA permit review team members related to the calculation procedures for the weekly determination of the "total cm^2 of wafer processed" (permit condition 24.e.). This number was used to calculate both the bi-monthly VOC emission factor and the weekly RACT determination. The permit does not define a procedure for calculating the "total cm^2 of wafer processed". ODEQ's Permit Application Review Report (see page 27) indicates that "the amount (cm^2) of wafer start" for the weekly period would be used. In practice, Intel multiplied the amount (cm^2) of wafer start by the number of activities performed per wafer during the weekly period to calculate the "total cm^2 of wafer processed". Intel indicated that this approach provided for a more accurate calculation of emissions because of the tight link between the number of process steps and VOCs used/emitted per cm^2 of wafer. ODEQ indicated that they were aware of and verbally approved of this calculation procedure.

5.6 Were all critical assumptions for ROPs use and/or emissions tracking also included in the permit? If not, how were these gaps addressed?

See question 5.5 above.

Tool Specific Inquiries

5.7 Clean Buildings

5.7.a What safeguards were imposed to prevent the overloading of the control equipment?

5.7.b Were any emissions excluded from the central control device? Were they subject to any applicable requirements, and, if so, how were they accounted for in the permit?

Not applicable to the Intel Aloha P4 permit.

5.8 Replacement Conditions

5.8.a Were the mass balance based formulae adequate to limit actual emissions? If not, what were the inadequacies and how were they corrected by the source and permitting authority?

5.8.b Were all critical assumptions for using the formulae contained in the permit? If not, what were the inadequacies and how were they corrected by the source and permitting authority?

Yes, except as noted under question 5.5.

5.9 P2 Provisions

5.9.a Was P2 adequately recognized and encouraged by the design of the permit? If not, why not and what changes could be made to better recognize and encourage P2?

ODEQ and Intel reported that the permit conditions effectively recognized and encouraged pollution

prevention, although they indicated that the P2 program development and reporting requirements (permit condition 16) were not necessary to encourage P2. See question 7.3 for a detailed discussion of P2 and the design of Intel Aloha's permit.

5.10 Fugitive Emissions

5.10.a How dependent on changes in fugitive emissions was the ability of the source to comply with any cap?

Changes in fugitive emissions did little to affect Intel's ability to meet its PSEL for VOCs for several reasons. First, Intel had a significant margin of compliance (actuals to allowables) under its VOC PSEL. Second, fugitive VOC emissions accounted for a relatively minor portion of the facility's overall VOC emissions. Third, it does not appear that there were significant fluctuations from month to month in fugitive VOC emissions, which largely result from routine cleaning and maintenance activities. Intel reported a large reduction in fugitive VOC emissions that occurred in late 1997 at the facility as the result of Intel's pollution prevention program. Intel replaced the use of 100 percent isopropyl alcohol for surface and janitorial cleaning in the cleanrooms with ultra-pure water as well as wipes saturated with 6 percent isopropyl alcohol. Based on emissions reduction data presented in Intel's change "strategy paper", this initiative resulted in reduced fugitive isopropyl alcohol emissions of approximately 5 tons/year. It should also be noted that fugitive emissions were fully accounted for in the facility's monitoring, recordkeeping, and reporting methods (i.e., material balance).

6. PRACTICAL ENFORCEABILITY OF THE FLEXIBILITY PROVISIONS

6.1 Assess the overall practical enforceability of the permit's flexibility provisions.

6.1a Does the permit require monitoring, recordkeeping and reporting in appropriate time intervals (e.g., daily records for daily limits)?

6.1b Can an inspector visiting the site determine historical and contemporaneous compliance with the flexible permit from records maintained on site?

6.1c Does the permit contain a legal obligation for the source to adhere to the terms and conditions of the limitation?

6.1d Does the permit rely on the efficiency of an air pollution control device for compliance with an emissions limit? If so, how is that efficiency determined and shown to be accurate?

ODEQ representatives indicated that inspectors were able to determine Intel's compliance with the title V permit during on-site inspections using monitoring, reporting, and recordkeeping information prepared and maintained by Intel, as required under the permit. To test for compliance associated with the VOC PSELs, the current ODEQ compliance inspector for the Intel Aloha facility indicated that during an inspection, inspectors would typically sit down with chemical usage data at Intel and work through the calculations to "spot check" Intel's VOC emissions calculations for a representative period. This inspection approach is also referred to in several of ODEQ's inspection reports prepared during the title V permit term.

During the May 2001 site visit, the EPA Review Team was able to fully reproduce Intel's calculations for a selected period during the permit term. The EPA Review Team determined that monthly VOC usage provides adequate monitoring and recordkeeping for practical enforceability of

the annual limit. The team did express some initial concern that the bi-monthly resolution of waste solvent recovery tallies impedes or delays an accurate determination of weekly VOC emissions. However, the team believed that the margin of compliance and the steady-state operation of the facility over time mitigates this concern. Finally, the team determined that the monthly fuel usage records provide adequate information for determining compliance with the monthly and annual limits for the boilers.

The permit does contain a legal obligation for the source to adhere to the terms and conditions of the limitation. For part of the permit term, the permit relied on the efficiency of an air pollution control device for compliance with the emissions limit. It should be noted, however, that during this period, the control device was not critical for enabling Intel to comply with its emissions caps during its period of performance due to the large margin of compliance. During the first 10-month period of the permit, a wet scrubber was used to control emissions from FAB 4. During this 10-month period, the calculation of the VOCs emitted from FAB 4 accounted for the reduction achieved by the scrubber for three compounds. The removal efficiency for these three compounds was determined by an emissions test to determine the compound specific efficiencies. However, FAB 4 subsequently was shut down and the scrubber was no longer used.

A carbon adsorber is used to control some VOC emissions from FAB 5; however, compliance with the emission limit is not dependant on the efficiency of this device. The amount of VOC recovered by the carbon adsorber is small and, given the large margin of compliance, is not a factor in whether the facility is in compliance. Furthermore, the quantity (mass) of VOC recovered by the carbon adsorber is determined, on an on-going basis, by analysis of the waste prior to shipping off-site. The material balance equations directly account for the amount of recovered VOC (i.e., the amount of VOC recovered is subtracted from the calculated VOC input (usage)).

6.2 Does the permit require the correct type and amount of information (in logs, notices, monitoring data, etc.) to determine the number and duration of any deviations?

ODEQ representatives indicated that they believe that the monitoring, reporting, and recordkeeping requirements specified in the permit, and associated information contained in Intel's logs, was sufficient to determine compliance status and to detect and characterize potential deviations.

The EPA Review Team monitoring assessment determined that the permit requires the correct type of information for conducting and documenting the material balance and for reporting the results and any deviations. The monitoring specifications for one parameter, the VOC scrubber liquid flow rate, could be improved upon as noted in 5.2(a) above. Including a more specific description of the monitoring frequency, averaging period (if any) and indicator (operating) range would more clearly define deviations.

6.3 What was the nature and duration of any deviations?

No deviations were reported by Intel during the permit term, and no deviations or compliance violations were identified by ODEQ or EPA during the permit term.

6.4 Can all calculations required by the permit, including ROPs, be duplicated? Can anybody understand and apply them consistently?

ODEQ representatives (and inspection reports) indicated that during inspections of the Intel facility,

agency inspectors routinely walked through or duplicated monitoring calculations called for in the permit to "spot check" Intel's compliance with the permit. ODEQ personnel familiar with the permit did not report any problems with understanding the calculations or with being able to duplicate calculations during inspections.

The EPA Review Team monitoring assessment determined that all calculations required by the permit are sufficiently documented and can be duplicated. The calculations are maintained by Intel in a spreadsheet that is available for ODEQ and EPA inspection. (See question 5.5 for additional information related to the permit and monitoring replicability.)

6.5 Does the permit clearly set forth the applicable requirements for every change made by the source? If not, what additional information is necessary?

ODEQ representatives indicated that they believed that the permit clearly established the applicable requirements for the advance-approved changes identified in the permit. The permit states that advance-approved changes only encompass changes in which "no new applicable requirement is triggered." (*See permit condition 17.g., page 13*). Changes that trigger new applicable requirements would also trigger agency notification and potentially additional requirements that are not described in the permit.

6.6 Were there any issues associated with off-permit notices (e.g., adequacy of descriptions)?

No off-permit notices were made during the permit term.

6.7 Compare the "ease" of inspecting sources with flexible provisions to that of inspecting similar sources with conventional permits. For the units affected by flexibility provisions, what worked well and what posed difficulties?

ODEQ representatives expressed that there seemed to be no noticeable difference between inspecting the Intel permit and other similar sources. They also indicated that Oregon inspectors are accustomed to assessing compliance with emissions cap provisions, due to Oregon's PSEL requirement that applies to all stationary sources in the state with air operating permits.

6.8 Compare the compliance rate (to date) of flexible provisions within the permit with compliance rates of conventional regulatory permits governing the same types of changes at similar sources, and for similar types of changes with the same source under previous conventional permits.

ODEQ representatives reported that Intel's Aloha facility had an exemplary compliance record prior to and during the title V permit term (i.e., state found no violations). ODEQ representatives reported that at least one high-tech, semiconductor/electronics firm (not an Intel facility) in ODEQ's Northwest Region has experienced compliance problems.

7. PERMIT COSTS, BENEFITS & VALUE ADDED

7.1 Did the flexible permits provide you with benefits in terms of: practical enforceability; information flow; environmental/emissions results; economic results; etc.?

Representatives from ODEQ and Intel both reported that they were pleased with the benefits derived from the flexibility provisions in Intel's title V permit. This appreciation of the benefits was in part

demonstrated by the fact that the recently issued synthetic minor ACDP for Intel Aloha preserved the key flexibility provisions that were contained in the P4 title V permit.

ODEQ representatives identified the following benefits associated with Intel's flexible title V permit:

- Intel reduced VOC emissions during the title V permit term from 82.5 tons/year (1995) to 55.6 tons/year (1999) while significantly increasing production. During the permit term, Intel donated 30 tons/year of VOC capacity to emit to the state to assist with meeting area air quality improvement goals. From 1991 to 1999, Intel reported achieving a 93 percent reduction in VOC emissions on a production basis (e.g. emissions per wafer chip manufactured). During this period, Intel experienced a net increase in production of 490 percent. During the permit term, HAP emissions remained constant despite increased production. Aggregate organic HAP emissions totaled 8.6 tons in 1995 and 8.2 tons in 1999. Aggregate inorganic HAP emissions totaled 3.3 tons in 1995 and 3.1 tons in 1999.
- The permit facilitated Intel Aloha's emissions reduction efforts to achieve "synthetic minor" source status.
- By aggregating HAP emissions into inorganic and organic categories for PSEL reporting procedures for Intel, ODEQ was able to secure a lower limit on HAP emissions than legally required.
- The permit saved ODEQ significant staff time associated with processing notice of construction applications from Intel Aloha. Intel estimated that in the absence of the flexible permit ODEQ would have needed to process approximately 150 to 200 additional notice of construction applications per year. Even at a very low estimate of 2 staff hours per application, the staff time implications are significant (300 to 400 hours).
- Operational flexibility provided by the permit likely helped to ensure that the State of Oregon benefitted from continued Intel investment in R&D and manufacturing operations in Oregon. As a major employer of skilled labor in the greater Portland area, retention of Intel facilities and investment has been politically and economically important to the state. Intel representatives emphasized the validity of this benefit, indicating that a decision to invest more than $50 million in new manufacturing capacity in Oregon was pending in 1995, and was somewhat contingent on whether or not Oregon would continue to provide an environment conducive to Intel's need for operational flexibility and frequent change.

Intel representatives identified the following benefits associated with the flexible P4 permit:

- The advance-approved changes in the permit likely saved Intel Aloha hundreds of business days associated with making operational and process changes to ramp up production for new products, respond to market demands, and optimize production processes (see question 4.1 for a more detailed discussion of avoided time delays under the flexible permit). Industry estimates of the opportunity costs of production downtime and time delays run as high as $5 million per day due to lost sales to computer makers and other factors. The estimated 150 to 200 changes per year[3], combined with the ODEQ approval timeframe of up to 60 days

[3]Estimates from Intel of the number of changes made per year under the flexible permit that would have triggered the need for notice of construction approval under a conventional permit.

per change[4], indicate that there would likely have been significant delay under a conventional permitting scenario. Even if few delays would have resulted in production downtime or missed market opportunities, the costs would likely have been significant under a conventional permitting scenario, as many of the changes improved the cost-competitiveness of Intel's products. Intel representatives indicated that it is likely that the impact of continued time delays would be to redirect Intel's production investment and operating facilities to locations more conducive to change (e.g., other U.S. states or to other countries where Intel operates such as Ireland or Israel).

- The permit increased certainty at Intel regarding applicability of regulatory requirements, by eliminating the relevance of the "grey zone" associated with determining whether a process, operational, and equipment change would trigger minor NSR. This reduced the business risk associated with making operational and process changes.
- The permit created an environment of reduced friction for making changes that met the definition of advance-approved changes, provided that the facility remained in compliance with PSELs and RACT. This afforded Intel engineers with significant latitude to optimize production processes, improve product yields, and reduce pollution.
- Under a conventional permit, Intel would have needed to prepare approximately 150 to 200 notice of construction applications per year (that were not required under the flexible permit). Intel estimated that each application would have required an average of approximately 8 hours, resulting in 1,200 to 1,600 hours of staff time per year. Assuming personnel costs of approximately $150-$200 an hour, each notice of construction application would cost approximately $1,200-$1,600. Without the flexible permit, Intel might spend approximately $180,000-$320,000 per year on submitting notice of construction applications under a conventional permit.
- Intel also reported that the permit greatly reduced opportunity costs associated with time of environmental staff. By reducing the time associated with permit applications and modifications, existing environmental staff were able to focus on P2 activities and other areas of environmental improvement.

7.2 Did the flexible permit allow you (the source) to better plan your operations (e.g., longer planning horizon)? If so, how? Please give examples of activities that could be planned better with flexible permit, with details as to how typical permits do not allow similar planning.

Intel representatives reported that the flexibility provisions in the title V permit created an environment of certainty that was highly conducive to business planning. Plant managers had assurance that they could make certain operational, equipment, and process changes and avoid potential time delays associated with permitting, provided that they remained below the plant-site emissions limits (PSELs). For example, during the title V permit term, FAB 15 was rapidly ramped from a product development stage into high volume manufacturing for the Pentium II. This was accomplished without permit modification, since the changes were advance-approved and Intel was able to remain below its PSELs.

[4]Under Oregon rules, ODEQ has up to 60 days to process notice of construction approval applications. Twenty-one days was selected as a reasonable estimate of the average actual time associated with receiving notice of construction approval from ODEQ.

7.3 What P2 activities did you undertake during the term of the flexible permit?

7.3.a Which P2 activities, if any, would you have performed even without the flexible permit?

7.3.b Did having the flexible permit change the timing or extent of your P2 efforts?

7.3.c What emissions reductions were achieved as a result?

7.3.d How much environmental benefit do you perceive in P2 provisions?

7.3.e Have P2 provisions helped enhance permit flexibility and/or efficiency?

Intel undertook numerous P2 activities during the title V permit term. Intel and ODEQ representatives reported that three flexibility conditions in Aloha's title V permit created incentives for P2. These include:

- Permit condition 14 contains specifications for meeting the required VOC RACT determination. The source-specific, performance-based VOC RACT standard covers Intel's entire range of wafer fabrication processes and provides a strong incentive for Intel to use P2 to meet RACT.
- Permit condition 17 advance approves Intel to make certain operational and process changes affecting VOC emissions without triggering minor New Source Review (NSR) at the time of the change, as long as Intel meets all applicable requirements including a federally-enforceable VOC emissions cap. However, to qualify for this pre-approval, Condition 17 specifies that Intel cannot alter or add to its control technology requirements, and that any emissions increases must be offset by reductions through pollution prevention to remain below the emissions caps.
- Permit condition 19 gives Intel a regulatory incentive to limit its generation Hazardous Air Pollutant (HAP) emissions. Under this condition, Intel agrees to reduce aggregate HAP emissions (organic and inorganic) to a greater degree than federally required in exchange for not having to specify individual HAP emissions.

During the permit term, Intel dramatically reduced VOC emissions while significantly increasing semiconductor chip production. See question 7.5 for information on actual emissions reductions. A summary of specific P2 projects implemented by Intel during the permit term is presented in Table 7.3 below.

Table 7.3 **Intel Aloha P2 Projects and Resultant Emissions Reductions**

Year	*Reduction*	*Amount*	*P2 Activity*	*Other Benefits*
1997-1998	VOC emissions	5 TPY	100% IPA wipes replaced with 6% IPA wipes and ultra-pure water.	
1998	PRS use	50 TPY	Extended time between solvent bath re-fills.	$1.9 million savings/yr
1998	VOC emissions	1 TPY	Reduced dispense volume (onto wafers) for photoresist by 23%.	$330,000 in savings/yr
1998	VOC emissions	1.6 TPY	Reduced Solvent Vapor Bath refresh frequency.	$200,000 in savings/yr
1998	VOC emissions	1.3 TPY	Reduced Solvent Vapor Bath refresh frequency (different equipment than above).	

Year	*Reduction*	*Amount*	*P2 Activity*	*Other Benefits*
1998	VOC emissions	0.15 TPY	Improved process to reduce the amount of polymide dispensed per wafer.	$160,000 in savings/yr
1998	Polymide Use	35%	New delivery method pumps to prevent polymide outgassing.	$530,000 in savings/yr
1997	VOC emissions	1 TPY	Reduction in I-line photoresist dispense volume.	Savings from $21 to $34 million for all fabs over the life of the product
1997	C2F6 emissions	50% per wafer	C2F6 gaseous chamber clean process conversion.	
1997	VOC emissions	25% per wafer	Nitride passivation CF4 clean time reduction.	
1997	VOC emissions	1.5 TPY	40% use reduction of resist dispensed on the wafer.	$700,000 in savings/yr
1997	VOC emissions	0.5 TPY	G-line TOK resist reductions.	$275,000 in savings/yr
1997	VOC emissions	1 TPY	Reduced PRS-3000 solvent bath replenishment.	$100,000 in savings
1997	VOC emissions	2 TPY	Photoresist stripper reduction.	
1995	VOC emissions	5%[1]	Use of less volatile edge bead removal solvent.	
1994	VOC emissions	21 TPY	Photolithography cup rinse process improvements.	$148,000 in savings/yr
1994	VOC emissions	10 TPY	Removal of glycol ether resist.	
1994	Glycol ether	1.2 TPY	Photolithography dispense pump replacement.	

7.4 How useful is the annual P2 report?

7.4.a How useful was it to have the source track P2 activities and their results?

ODEQ representatives indicated that the required P2 annual progress reports were generally interesting, although not useful for compliance assurance activities. They also indicated that very few ODEQ staff actually reviewed Intel's submitted P2 reports (e.g., typically only the ODEQ permit engineer/inspector). ODEQ and Intel representatives expressed that they did not receive any public inquiries or information requests regarding Intel's P2 activities at Aloha.

EPA representatives have expressed that the P2 progress reports have been useful in their efforts to document and communicate the P2 results achieved by Intel under the P4 pilot effort. The information has been included in various fact sheets about EPA's P4 initiative. Intel indicated that the P2 reporting requirement was of limited value to the company, as it was not relevant to

demonstrating compliance with the PSELs or other emissions requirements, and it was not an important driver for the company's P2 efforts. For Intel, the change strategy papers captured the details of individual P2 projects and results, while the PSEL monitoring requirements tracked overall reductions in emissions. It should be noted that the P2 reporting requirements were omitted from Intel's subsequent synthetic minor ACDP, since they were not deemed sufficiently useful by ODEQ or Intel.

7.5 Describe the type and amount of emissions reductions made to comply specifically with emissions caps/PALs (e.g., when you added or expanded units, or increased use of units, how did you ensure that emissions would stay below the PAL or emissions cap?).

7.5a Did your emissions per unit of production (e.g., lbs/widget or lbs/mmBTU) go down, stay the same or go up during the term of the flexible permit?

7.5.b In the absence of a PAL or emissions cap, please explain how you would have accommodated those same expansions or increases in use.

- **Would emissions have differed?**
- **Would you have been able to net out of NSR/PSD review?**
- **Would you still have triggered title V permit modification tracks?**
- **Would you not have made the change?**

See question 7.1 for information on Intel Aloha emission reductions. In practice, Intel operated well below its VOC emissions caps (PSELs) during the title V permit term. Therefore, in most cases, the primary driver for Intel to reduce VOC emissions resulted from the facility's goal to become a minor source for air pollution, and not to remain under the VOC PSELs. Intel reported that in the absence of an emissions cap and flexibility provisions, it would have had difficulty implementing many of the changes that resulted in reduced emissions.

7.6 Did the timing and/or design of the PAL influence the timing of additional control equipment and/or pollution prevention? If so, how and why?

Intel indicated that "the permit encouraged the use of pollution prevention over add-on control equipment". Intel reported that the primary driver for accelerated P2 at the Aloha facility was the stated company goal of reducing air emissions to below the major source regulatory threshold (i.e., from title V major source status to synthetic minor status). Importantly, however, Intel indicated that the flexibility afforded by the advance-approved changes and the PSELs were essential to creating an environment of less regulatory and administrative friction in which the facility could make operational and equipment changes needed to lower source emissions to a synthetic minor level.

7.7 Do you believe any of the flexible approaches are transferable to other jurisdictions/sources? If so, which ones? For what sources? Why are these approaches transferable?

Intel reported that they strongly believe that the basic flexible permitting techniques developed for the Aloha facility are transferable to their other jurisdictions and sources. To support this contention, Intel representatives pointed to the flexible permitting techniques that have been transferred to Intel facilities in Colorado, Massachusetts, Texas, and Arizona (Intel's Chandler, Arizona facility received a flexible air permit as part of EPA's Project XL). Intel indicated that operations at all of their fabrication facilities share similar needs for frequent tool installs, change-outs, and process modifications.

Intel representatives expressed that the greatest benefits were derived from the advance approval conditions which, in conjunction with the PSEL emissions caps, afforded Intel the ability to rapidly respond to market demands and to conduct P2 activities. Intel indicated that the P2 permit conditions in the Aloha title V permit may have usefulness for some sources, but that they did not desire to transfer them to other Intel facilities. Intel expressed that the advance approvals and emissions caps created the real drivers in the permit for P2, and that the P2 program development and reporting conditions (see permit condition 16) were not useful since Intel already has well-developed P2 programs across the company. Also, Intel did not see how such provisions could be built into a permit for a new greenfield facility, since in that case the baseline emissions are zero. Intel representatives also stated that the company now includes the ability to secure flexible air permitting techniques as a factor in siting decisions for new Intel facilities (note: the air attainment status of the location is also considered in facility siting decisions).

ODEQ representatives indicated that they believe that the flexible permitting techniques used in the Intel Aloha title V permit are transferrable to other sources, provided that the sources meet certain criteria (see question 1.18). ODEQ has incorporated flexibility provisions into a draft air permit for one other high-tech/electronics firm in the Portland area. [Note: all permitted stationary air sources in Oregon have PSELs.] An ODEQ representative indicated that finalization of EPA guidance and policy associated with flexible permitting techniques would increase interest and efficiency at ODEQ for transferring such techniques to other facilities.

7.8 Compare a conventional permitting approach to that taken under flexible permits in terms of:

7.8.a Environmental performance, including emissions trends, emissions increases/reductions, emissions gaps between actual and allowable emissions, and other notable environmental results;

7.8.b Overall development effort and ongoing maintenance costs (what were/ have been the investments of both the permitting authority and the source?)

- **Which type of permit has more up-front costs (uses more resources)?**
- **What is the difference in up-front transaction costs?**
- **Which type of permit has fewer implementation costs?**
- **What is the difference in the implementation costs?**

7.8.c Number of permit actions/modifications required, as well as associated transaction costs or costs avoided (e.g., source reductions in opportunity cost, permitting authority value added for advance notice, of MRR, control devices, etc.)

See question 7.1 for a discussion of the key comparisons between flexible permit and conventional permit.

8. OTHER ISSUES

Future Flexible Permit Development

8.1 Do you anticipate any changes in the next version of the flexible permit?

8.1.a If so, what changes would you request/make (e.g., additions and subtractions) and why?

8.1.b Do you believe the existing regulations already provide for such changes? If so, how? If not, why not?

Intel Aloha's title V permit expired in 1999. In November of 1999, Intel was issued a new state Air Contaminant Discharge Permit (ACDP) by ODEQ. This marks a change from a title V permit to a synthetic minor permit for the source, although many of the flexibility provisions contained in the title V permit have been preserved in the ACDP. The ACDP contains PSELs for VOC, boiler emissions, and HAPs, as well as pre-approval conditions to address minor NSR. A few previously-mentioned changes have been made to the ACDP. First, the P2 permit conditions (e.g., P2 program plan, P2 progress reports) have been eliminated from the permit since they were deemed by ODEQ and Intel to not be relevant to compliance determination and to not be useful to ODEQ or Intel in promoting pollution prevention. Second, the monitoring approach has been modified to move from chemical mass balance to increased reliance on parametric monitoring and use of emission factors. Intel and ODEQ concurred that these modifications would result in better emissions monitoring at the facility.

8.2 Do you believe there be any value added by EPA's finalizing guidance in this area? If not, why not? If so, how?

Yes, ODEQ representatives indicated that they believe agency officials are more hesitant to utilize flexible permit provisions since EPA's guidance related to this area has not been finalized. Intel representatives also expressed that they are strongly supportive of EPA in its effort to finalize guidance related to flexible permitting. Intel representatives indicated that the company's willingness to devote significant staff time and resources to assisting EPA with the Flexible Permit Implementation Review effort attest to the importance that Intel attaches to this initiative.

8.3 Will you have any flexible permit writing/implementation training needs?

ODEQ representatives indicated that EPA will likely need to provide training support and technical assistance to states and permitting authorities related to flexible permitting techniques. Intel and ODEQ representatives indicated that it would be helpful to have EPA document the intent of various rules and guidance associated with flexible permitting.

8.4 Do you have recommendations for web-site materials?

ODEQ representatives suggested that an EPA web-site devoted to flexible permitting techniques would be useful if the site contained sample permit language and/or permit conditions. No specific suggestions for materials or fact sheets were received from ODEQ, although ODEQ representatives indicated that it would be useful to have fact sheets or materials that describe specific flexible permitting techniques and provide examples of their use. ODEQ and Intel also indicated that it would be useful if EPA web-site materials provided guidance regarding the types of changes that trigger New Source Review.

8.5 What else could EPA do to limit the up-front design costs?

ODEQ representatives indicated that up-front permit design costs could be greatly reduced as a permitting authority gains experience with use of flexible permit conditions. They also indicated that finalization of EPA guidance (and other potential EPA materials and resources supporting flexibility provisions) could serve to reduce permit design costs, as permitting authorities would have a clearer understanding of the requirements that need to be met to receive EPA approval of flexible permit provisions.

8.6 How do you predict your up-front transactions costs would have compared if you had undertaken the same flexible permit for the same source with EPA guidance and the mentioned support structure already in place?

ODEQ representatives predicted that future design costs for flexible permits would be generally equivalent to those of conventional permits, plus any costs needed to design site-specific limits for the source. There were multiple "firsts" associated with the development of the Intel Aloha permit (e.g., first title V permit in Oregon, first P4 permit, first permit to use P2 provisions) that resulted in the significant costs to develop Intel's initial flexible permit at Aloha.

8.7 How much time do you believe must pass before the reduced costs of overseeing the flexible permit would compensate for the higher up-front design cost?

ODEQ representatives reiterated that the high initial permit development costs associated with the Aloha P4 title V permit primarily resulted from the pioneering nature of the permit (e.g., Oregon's first title V permit, EPA's first P4 permit, first permit to contain P2 provisions, need for source-specific RACT determination). Subsequent flexible permitting development efforts undertaken by ODEQ for Intel's Aloha facility (synthetic minor ACDP) and IDT Corporation demanded little, if any, additional development time compared with conventional permit development efforts. ODEQ representatives also pointed the example of the Oregon Green Permits Program, indicating that the additional time and costs associated with developing flexible permit conditions, compared with conventional permitting efforts, were negligible and primarily associated with screening potential applicants for eligibility to participate in the program. ODEQ representatives suggested that increased permit development time results primarily from (1) the inclusion of conditions that are unique to the specific source (e.g., source-specific RACT determination, detailed descriptions of advance-approved changes), or (2) the use of new flexibility techniques that have not received prior approval from EPA related to their legality and enforceability (e.g., the case with Aloha's P2 permit conditions).

ODEQ representatives mentioned, however, that they were able to save some time during permit development by not attempting to develop a comprehensive, detailed list of specific changes or categories of change to be covered under the advance approvals. ODEQ believes that this degree of specificity with regard to advance-approved changes in this instance was unnecessary to determine compliance or to protect environmental quality.

Source Screening Criteria

8.8 What criteria should be used to reject inappropriate flexibility proposals from sources (e.g., relevance of compliance history, P2 commitment, potential for environmental benefit, sustainable compliance over the long term)?

See question 1.18.

Public Outreach

8.9 How can these permits be better communicated to the public (e.g., consistency with air program goals; potential improvements to monitoring, recordkeeping, reporting, etc.)?

ODEQ representatives did not identify any areas of improvement for communicating with the public regarding the Intel Aloha title V permit.

8.10 What fact sheets would be useful to the permitting authority, source and the public?

See question 8.4.

8.11 When and how should up-front meetings (i.e., before public comment period) be used to address potential public concerns? How should concerns from those meetings be addressed?

ODEQ representatives indicated that the Department advocates the use of up-front meetings to address potential public concerns. ODEQ representatives stated that up-front meetings can help achieve the following:

- inform the interested public of the permitting/regulatory requirements and procedures that will be followed in the permitting process;
- provide information to the public pertaining to the facility's operation and associated emissions and pollution controls;
- introduce the permit applicant with interested members of the community and make them aware of the community's concerns, providing the applicant with an ability to design for proactive measures to eliminate or mitigate community concerns before facility construction commences; and
- to help ODEQ identify public concerns early in the permitting process to help it address these concerns as best as can be done under its regulatory authority.