ILLINOIS POLLUTION CONTROL BOARD
August 23, 1979

IN THE MATTER OF:)
) R78-3,4
EMISSIONS OF VOLATILE ORGANIC MATERIAL)

OPINION OF THE BOARD (by Mr. Dumelle):

This consolidated proceeding was initiated when the Agency filed a proposal on May 19, 1978 to amend Rules 201 and 205 of the Air Pollution Control Regulations. The proposal (R78-3) dealt with volatile organic emissions from solvent metal cleaning and petroleum refineries and was published in Environmental Register #172 on May 22, 1978. Hearings were held on R78-3 on July 10, 1978 in Chicago and July 12, 1978 in Springfield. Further amendments to Rules 201 and 205 were filed with the Board on July 18, 1978. These amendments (R78-4) concerned volatile organic emissions from surface coating operations, bulk gasoline plants, bulk gasoline terminals, liquid petroleum storage vessels, gasoline service stations and cutback asphalt. R78-4 was published in Environmental Register #176 on July 21, 1978. The two proceedings were consolidated on August 3, 1978. Additional hearings were held on August 28, 1978 and September 25, 1978 in Chicago and on August 30, 1978 in Springfield. Amendments to the Agency's consolidated proposal were published in Environmental Register #181 on October 16, 1978 and Environmental Register #182 on October 27, 1978. On January 29, 1979 the Board received a study from the Institute of Natural Resources entitled Economic Impact of Incorporating RACT I Guidelines for VOC Emissions into the Illinois Air Pollution Control Regulations, R78-3 and R78-4 (INR Document No. 79/01). Hearings were held on the study on March 5, 1979 in Chicago, March 9, 1979 in Rockford and March 12, 1979 in Decatur. The Agency presented an amended proposal at the March 5, 1979 hearing (Ex.66) which combined all prior amendments and suggested additional changes. Exhibit 66 was corrected at the March 12, 1979 hearing. On March 29, 1979 the Board adopted a Proposed Order which listed amendments to Rules 103, 104, 201 and 205 of the Air Pollution Control Regulations. The Proposed Order was published in Environmental Register #192 on April 3, 1979. On July 12, 1979 the Board adopted a final Order in this proceeding. This Opinion is intended to support and explain the Board's final Order.

NEED FOR THE REGULATION

Numerous violations of the ozone standard have been detected in various areas of Illinois. The highest ozone levels generally occur in the Chicago and St. Louis areas (R.102). The highest one-hour concentration measured in 1977 was 0.266 ppm (R.98). (For a description of the Illinois ozone monitoring system, see R.94-114 and Ex.8). Non-attainment areas for the old oxidant National Ambient Air Quality Standard (NAAQS) of 0.08 ppm consisted of the 23 following counties: Adams, Boone, Champaign, Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, LaSalle, Macon, Madison, McHenry, McLean, Peoria, Sangamon, St. Clair, Tazewell, Will, Williamson and Winnebago (R.25). All other areas of the State were unclassified because no ozone monitors were located in those areas.

During the time frame of the hearings in this proceeding, U.S. EPA revised the oxidant NAAQS based on new health effects information. The NAAQS was changed in the following respects: 1) the ozone NAAQS was changed from a level of 0.08 ppm to 0.12 ppm for both the primary and the secondary standard; 2) the chemical designation was changed from photochemical oxidant to ozone; 3) a statistical rather than a deterministic form of the standard has been adopted; and 4) the measuring method has been changed from a single one hour period to the highest one hour average on a given day (R.1294). In order for a particular site to be in compliance with the new standard, the number of days in which the highest one hour average ozone value exceeds 0.12 ppm must be less than or equal to once per year, averaged over three consecutive years (R.66).

The Agency re-evaluated the attainment versus non-attainment status of Illinois in light of the new standard and classified 20 counties as non-attainment. They are: Adams, Boone, Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, LaSalle, Madison, McHenry, Monroe, Peoria, Sangamon, St. Clair, Tazewell, Will and Williamson. The counties of Champaign, McLean, Macon and Crawford have been reclassified as attainment (R.1298), while all the other counties have been designated as unclassified (R.1299).

Part D of the Clean Air Act (42 U.S.C. §§7501-7508) prescribes actions which must be taken by all states in which the National Ambient Air Quality Standards (NAAQS) have not been achieved. Since many areas in Illinois have failed to meet the NAAQS for ozone (see non-attainment discussion, supra), these provisions of the Clean Air Act (CAA) must be addressed.

Section 172(b) of CAA [42 U.S.C. §7501(b)] states that Illinois must "...(2) provide for the implementation of all reasonably available control measures as expeditiously as practicable; [and] (3) require, in the interim, reasonable further progress [as defined in Section 171(1)] including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology;..." Section 171 (1) [42 U.S.C. §7501(1)] defines the term "reasonable further progress" as "...annual incremental reductions of the applicable air pollutant...which are sufficient...to provide for attainment of the applicable national ambient air quality standard by the date required in Section 172(a)." In this proceeding the applicable air pollutant is ozone. The date required in Section 172(a) is December 31, 1982 unless Illinois demonstrates this date cannot be met "...despite the implementation of all reasonably available measures..." In that case, the date becomes December 31, 1987.

The Clean Air Act includes sanctions which may be imposed against Illinois if these directives are not followed. Section 176(a) of CAA [42 U.S.C. §7206(a)] provides that certain highway construction funds must be withheld if Illinois does not follow the mandate of Section 172 in a timely fashion. Section 316 of CAA provides that grants for the construction of sewage construction works in certain areas may be withheld. Section 110(a)(2)(I) of CAA provides that Illinois must include a restriction in its State Implementation Plan (SIP) that prohibits the construction of any major stationary source in a non-attainment area after June 30, 1979 under certain conditions. This prohibition can be avoided if Illinois revises its SIP to comply with the provisions of Part D of CAA.

The amendments which the Board has adopted in this proceeding are part of Illinois' attempt to satisfy the requirements of CAA, avoid its sanctions, and bring oxidant levels down to safe levels.

On February 24, 1978 the Administrator of U.S. EPA issued a memorandum (Ex.2) outlining the actions each state would have to take before a revised SIP could be approved. Carbon monoxide and oxidant issues are addressed in Exhibit 2 in part as follows:

> "Adequate plans must provide for the adoption of reasonably available control measures for stationary and mobile sources.
>
> "For stationary sources the 1979 oxidant plan submissions for major urban areas must include, as a minimum, legally enforceable regulations to reflect the application of reasonably available control technology (RACT) to those stationary sources for which EPA has published a Control Techniques Guideline (CTG) by January, 1978...
>
> "For rural non-attainment areas, the O_x plan must provide the necessary legally enforceable procedures for the con-

> trol of large HC sources (more than 100 ton/year potential emissions) for which EPA has issued a CTG by January 1978..."

The Final Order in this proceeding represents the Board's interpretation of what constitutes RACT for each category of industry for which U.S. EPA had published a CTG by January, 1978.

It should be noted that the Board is not limited to adopting only RACT. Sections 10 and 27 of the Environmental Protection Act (the Act) provide the Board with authority to adopt emission standards and standards for the issuance of permits which promote the purposes of Title II of the Act. This broader authority under the Act has enabled the Board to deviate from some of the narrow restrictions of RACT to adopt amendments which are in fact more stringent than RACT and provide for a more equitable statewide approach to ozone nonattainment.

OZONE FORMATION AND CONTROL

"All the evidence presently available indicates that in the urban centers and adjacent downwind areas where severe oxidant problems occur, the major cause by far is photochemical oxidant formation" (Ex.37, p.4-1). Photochemical oxidant (O_x) is a mixture of pollutants which are formed in the atmosphere rather than emitted directly from sources of air pollution. Reactions of volatile organic compounds (VOC), oxides of nitrogen (NO_x), and oxygen in the presence of sunlight form a mixture of photochemical oxidants which consists of ozone (O_3), nitrogen dioxide (NO_2), peroxyacetylnitrate (PAN), smaller amounts of other peroxy compounds, and other photochemical products such as aldehydes, nitrous acid, nitric acid and formic acid (Ex.26).

Although there are still many unanswered questions about the formation of O_x in the ambient atmosphere, much information exists on the stoichiometry, kinetics and mechanisms of these reactions. Because of the need to simplify conditions in order to facilitate research, all the experiments on the mechanism of O_x formation have been done in laboratory smog chambers. However, there are limits to the validity of extrapolating research findings based on mixtures containing a limited variety of VOC to actual ambient conditions with a complex mixture of VOC. Paisie testified that all reactions that occur in the laboratory probably also occur in the ambient atmosphere, possibly with varying significance. However, there may also be reactions in the ambient atmosphere which have not been found in laboratory conditions (Ex.26).

The overall photochemical reactions process has two distinct stages which occur consecutively. In the first stage, nitric oxide (NO) is converted to NO_2 without an appreciable buildup of O_3 or other non-NO_2 oxidants. The second stage begins when almost all the NO has been converted to NO_2 and is characterized by a rapid buildup of O_3 and other oxidant and non-oxidant products. Several mechanisms exist for the formation of photochemical oxidants. The following are the main reactions in the formation of ozone:

$$NO_2 \qquad \overset{\text{UV}}{\underset{\text{Light}}{}} \qquad NO + O \qquad (1)$$

$$O + O_2 + M \qquad\qquad O_3 + M \qquad (2)$$

$$O_3 + NO \qquad\qquad NO_2 + O_2 \qquad (3)$$

$$XO_2 + NO \qquad\qquad NO_2 + XO \qquad (4)$$

$$2NO + O_2 \qquad\qquad 2NO_2 \qquad (5)$$

where: X is hydrogen (H) or organic radicals (R or RCO), and M is any third molecule which is available to carry off excess energy.

In step (3), the NO product from photolysis of NO_2 (step 1) reacts rapidly with and consumes O_3 to regenerate NO_2. If it were not for other processes which convert NO into NO_2, ozone would not accumulate to significant levels. However, as shown in steps (4) and (5), other conversion processes exist. The reaction of NO with XO_2 (step 4) is considered to occur to a greater degree than the reaction with molecular oxygen (O_2) shown in step (5). In step (4) the reaction of NO with RO_x occurs only in the presence of photochemically reactive organic compounds. If these compounds are present, the reaction can proceed rapidly enough to cause an atmospheric accumulation of significant levels of ozone; if reactive organics are not present, significant levels of ozone do not accumulate.

Recent research, based on computer simulation techniques, has led to the current theory that the hydroxyl radical ($HO^\cdot$) rather than atomic oxygen and ozone may be the most active chemical in the consumption of hydrocarbon (HC) and aldehyde reactants and thus be of major significance in the oxidation of organic and inorganic reactants. "The radicals $OH^\cdot$, $HO_2^\cdot$, and $RO_2^\cdot$ have also been identified as having major roles in the oxidation of NO into NO_2" (step 4)(Ex.37, p.4-8).

Even though oxidants can be formed from natural sources of hydrocarbons or be due to stratospheric ozone intrusion, most photochemical oxidant is formed from reactions of anthropogenic VOC and NO_x. Research by Buffalini has indicated that although ozone may be produced in rural areas from natural sources of VOC, the amount produced would not be sufficient to cause violations of the ozone standard. Violations of the ozone standard which have occurred in rural areas have been attributed to pollution transport (R.1140).

Meteorological factors play an important role in the formation of photochemical oxidants. Atmospheric mixing and diffusion are important in the transport and dispersion of oxidant precursors which have been emitted. Atmospheric stability, wind speed, and topography determine the rate and extent of atmospheric dispersion. Since some of the precursor reactions are photodissociations, sunlight and temperature affect the rate and extent of oxidant formation. Temperature has been found to have a significant positive effect. It has been suggested that at temperatures less than 55° to 60°F (13° to 16°C), concentrations of photochemical oxidants will not exceed 0.08 ppm (Ex.37, p.4-36).

In recent years, several studies of long range oxidant transport ("oxidant transport" refers to the transport of either oxidant/ozone or oxidant precursors) have been performed and found to occur on three geographical scales. "1) The urban scale transport, as a result of which the peak oxidant concentrations develop in the suburbs some miles downwind from the city-core area where the oxidant/ozone and their precursors originated; 2) The mesocale transport that encompasses land- and sea-breeze circulation, and the formation of urban oxidant plumes that create oxidant problems as far as 100 miles or more downwind from the source city; and 3) The synoptic scale transport, a much longer and broader range of transport associated with high pressure systems" (Ex. 37, p.4-38).

Results from the urban scale transport studies indicate "...that conditions at the center of source-intensive areas are not the most conducive conditions for oxidant accumulation, mainly because of the strong scavenging effect of oxidant precursors, especially nitric oxide. At higher elevations or at horizontal distances downwind from the sources, where the precursor scavenging effect is less important, oxidant concentrations are, in general, greater, and their levels are determined primarily by the intensity of the photochemical activity and ambient dilution." Peak oxidant concentrations for several cities have been measured at distances between 5 to 85 miles downwind of the city's center (Ex.36, p.4-38).

Numerous studies of mesocale and synoptic scale transport of urban oxidant plumes have concluded "that many cities produce urban oxidant plumes that cause elevated oxidant concentrations in downwind areas as far as 300 km (190 miles) or more from the source city" (Ex.37, p.39-40). A study of an episode of wide-spread haze with elevated ozone, concentrations in southern Florida reported that "...The source region appeared to be the industrial area among the states south of the Great Lakes making a transport distance of over 1000 miles (1600 km) of which 400 miles (640 km) were over the Gulf of Mexico. Both the haze and the ozone of its precursors may have been augmented along the route" (Ex.37, p.4-42). Such long range transport can only occur in an air layer aloft since ground level ozone would be destroyed by reactions with NO and VOC and reactions on surfaces.

Dr. Arnott from the Wisconsin Department of Natural Resources testified on ozone transport from Illinois into Wisconsin. It is his belief that Wisconsin cannot achieve the new ozone standard unless Illinois adopts and enforces state-wide VOC regulations (R.1574-5). Aerial monitoring for ozone done in 1976 found that ozone laden air enters Wisconsin from Illinois with higher concentrations above the ground than at ground-level (R.1571). Levels in excess of 0.2 ppm were measured above Belvidere and Rockford, Illinois (R.1572).

Based on studies of urbanized areas which have indicated that reduction of NO_x would be counter-productive due to the current HC to NO_x ratios, it has been concluded that control of organic compounds is necessary in order to reduce the ambient levels of photochemical oxidants (R.1138). A ten-year trend study of photochemical oxidant formation in the Los Angeles basin indicated that an 18% reduction in hydrocarbons was accompanied by a 19% reduction in ozone throughout the basin (R.1124). Another trend study of six cities with Continuous Air Monitoring Program (CAMP) stations indicated that a reduction in hydrocarbons was accompanied by a reduction in ozone (R.1125).

Lamping (from Standard Oil Company of Indiana on behalf of the Illinois Petroleum Council) tried to refute the need for hydrocarbon control. He cited a study of five American cities in which hydrocarbon emissions reductions occurred. In three of those cities ozone levels increased; and in a fourth there were no obvious changes in ozone levels (R.954-5). However, one must be careful in interpreting short-term trend studies such as the one cited by Lamping because of several problems: 1) The impact of meteorological phenomena is very significant, and at the present time it is almost impossible to normalize out the impacts of meteorology and just look at the chemistry (R.1148). 2) The emission inventories that accompany such studies are crude estimates of actual variations of hydrocarbon emissions from one year to the next (R.1149). 3) Problems inherent in monitoring location and technique can influence the ozone levels measured. For example, if the monitor is placed near a source of NO, the O_3 could be scavenged by the NO which could affect the levels of ozone monitored at that site (R.1150).

Based on information in the record, the Board finds that a reduction in hydrocarbon emissions is necessary in order to reduce ambient air ozone concentrations. This reduction will occur through the implementation of this rulemaking, RACT 2 and RACT 3 (still to come), the Federal Motor Vehicle Control Program, and vehicle inspection and maintenance (if necessary and adopted in Illinois).

The Board also finds that positive material reduction rather than substitution of less photochemically reactive hydrocarbons for more photochemically reactive hydrocarbons is needed for the following reasons:

1) Many organic compounds previously considered to have low reactivity have been found to be moderately or highly reactive in an urban atmosphere (R.34). Most early studies of reactivity have been done in chambers using a limited variety of organic compounds. Hence, possible interactions of organics with a complex mix of compounds would not have been studied (R.1147).

2) Compounds of low reactivity can form appreciable amounts of O_x under multiday stagnation periods (R.34). Many of the initial reactivity studies were done in smog chambers with irradiation times of about six hours. Information obtained since those studies indicates that longer periods of time than six hours should be examined (R.1144).

3) Some compounds of lower or negligible reactivity may have other adverse effects - including adverse health effects (R.34).

STATEWIDE CONTROL

The adopted regulations are not limited to non-attainment areas. The regulations cover a wider geographic area than mandated by U.S. EPA (R.1300, Ex.2). Several reasons support this choice. Urban emissions may extend beyond urban non-attainment boundaries and emissions of volatile organic compounds in the rural attainment areas will exacerbate ozone levels in these and other areas. Conversely, rural emissions may be transported into urban non-attainment areas resulting in increased ozone levels. These transport issues are discussed more specifically elsewhere in this Opinion. There are additional reasons for statewide applicability. U.S. EPA has indicated that it will not require offsets from non-urban new sources if an ozone SIP requires RACT on a statewide basis (P.C.#102, Attachment A). Statewide controls now will cause a greater improvement in air quality and thus allow future increases in emissions to be accommodated more easily. For example, unclassified areas throughout the state could conceivably become reclassified non-attainment on the basis of PSD monitoring data; however, the probability of this happening is less with statewide controls since air quality in the unclassified areas will be improving.

Statewide controls prevent industries located in one area of the state from gaining a competitive advantage over the same industries in another area of the state by virtue of not having to expend funds on controls. The Board notes that the previous Rule 205 of Chapter 2 applied statewide.

The Agency's "Rules For Issuance of Permits To New Or Modified Air Pollution Emission Sources Affecting Non-attainment Areas" (Ex.73) provide additional support for statewide applicability of controls. In those rules the Agency allows offsets for emissions of organic material to come from existing sources located within 100 miles of the new or modified source. For these existing sources to function as offsets, they must currently be negatively affecting air quality in the non-attainment areas; statewide controls are consistent with this.

The Agency also indicated that models used to predict emission control requirements are less accurate at ozone levels approaching the standard. These uncertainties help explain the difficulties in determining why some areas in Illinois are attainment and others are not (R.1303-4). This modeling uncertainty must be considered in determining the geographic applicability of control requirements.

The Board recognizes that a statewide program will prevent some individual sources from realizing pecuniary gain through later transfer of offsets (R.1728-30; P.C.#102). However, the Board finds that the above-mentioned reasons are sufficient to support the decision to have statewide applicability.

In order to determine the amount of hydrocarbon emission reduction that would be needed to attain the ozone standard, the Agency utilized the Empirical Kinetic Modeling Approach (EKMA) and did a city-specific analysis for the major urban non-attainment areas in Illinois (R.1341). Although the SAI Grid Model may be a "more realistic computer model" than EKMA (R.950), the Agency was unable to use it because they do not have the time or the necessary input to operate the SAI Grid Model (R.35). The use of other oxidant modeling methodologies was also investigated by the Agency. However, they testified that "the EKMA estimation technique is based on sound fundmental relationships and is able to consider many of the parameters that only the most sophisticated Lagrangian or Euclerian models can incorporate" (R.36). (EKMA was discussed further in the record by Sherman on R.36-40, Matheny on R.115-137 and Lamping on R.949-50).

Based on EKMA, the maximum emissions reductions required to meet the new ozone NAAQS are: 53% for the Chicago area (R.1343), 60% for the St. Louis area, and no additional reductions for Peoria which is expected to meet the standard by reductions in transportation-related pollution (R.1343). In order to achieve these emission reductions, it will be necessary to implement Reasonably Available Control Technology (RACT) on stationary sources throughout Illinois, transportation control measures and possibly vehicle inspection and maintenance in the St. Louis and Chicago Major Metropolitan Areas, and continued implementation of the Federal Motor Vehicle Control Program (FMVCP) (R.1284). However, FMVCP, transportation control measures and vehicle inspection and maintenance are not the subject of this proceeding and will not be discussed here.

COMPLIANCE SCHEDULES AND DEADLINES

As part of this rulemaking, the Board has adopted amendments to Rules 104 and 205(j) and a new Rule 205(m). When read together these amendments show the "reasonable further progress" called for in Section 172 of the CAA. These amendments call for compliance schedules which may be prepared individually for each source under Rule 104 or a source may choose to follow the categorical compliance schedules provided in Rule 205(m). These schedules are designed to satisfy the requirements of 40 C.F.R. §51.15. The schedules follow the suggestions from U.S. EPA which may be found in Group Exhibit 33 and in Public Comment 49. They represent a balance between "reasonable further progress" and economic capabilities (R.1791). By requiring reports of increments of progress, the Agency can keep abreast of problems which may arise in the development of new technologies such as the availability of low solvent technologies and the like (R.1792).

Compliance schedules and project completion schedules do not provide a means to delay compliance beyond the deadlines stated in Rule 205(j). Any source which cannot meet a 205(j) deadline will be required to seek a variance under Title IX of the Act and Part IV of the Procedural Rules. Section 35 of the Act states that any such variance granted by the Board must be consistent with the requirements of CAA (*see* Sections 110(a)(3), 110(i) and 113(d) of CAA and Public Comment 49) and will be subject to review by U.S. EPA (*see* Section 113(d)(2) of CAA).

RELATIONSHIP TO OLD RULE 205

The amendments to Rule 205 were adopted as additional emission controls - not as substitutes for existing requirements. This is being done to keep the existing Rule 205 enforceable in case any of the amendments are overturned by court order or disapproved as SIP revisions (R.234-5).

All users of organic material covered by Rule 205(f) are required to stay in compliance with that rule unless they are covered by the new Rule 205(n)(1). Once these sources have complied with the applicable standards in 205(n)(1), they will no longer be covered by 205(f). This relief is necessary to avoid conflicts between overlapping regulations. The relief does not apply to sources which elect to pursue alternative compliance under 205(n)(2) or are exempt under 205(n)(3). Sources which comply through the use of internal offsets in 205(n)(4) will qualify for this relief.

RACT AND THIS PROCEEDING

RACT has been defined as "the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility" (R.43). In response to the 1977 Clean Air Act Amendments, U.S. EPA has published Control Technique Guidelines (CTG) for fifteen emission source categories that were determined to be sources that could be further controlled by RACT (R.44). The purpose of this proceeding is to consider the implementation of RACT on these fifteen emission source categories. RACT is based on controlling emissions through reduction rather than through substitution. These reductions are to be achieved by retrofitting add-on control equipment, by changing to water-borne or high solids coatings in place of organic materials (R.44) or by converting to low-solvent coatings (R.50).

VOLATILE ORGANIC MATERIAL

As part of this proceeding, many definitions were either added or changed in order to clarify the rule changes. Most of these definitions are self explanatory and need no further discussion; others became issues during hearing. Nearly all of the latter group of definitions are discussed with the related rule. The definition of "volatile organic material" applies to several rules and consequently is discussed here. The reference to Rules 205(o) and (p), which were in the Agency Proposal, were left out of the final definition because the term "volatile organic material" is not used in either of Rules 205(o) or (p).

A major issue which arose during hearing was whether to exempt 1,1,1-trichloroethane (methyl chloroform) and trichlorotrifluoroethane from the definition of volatile organic material as the Agency originally proposed. Dow Chemical proposed exempting methylene chloride also. The debate did not center on the photochemical reactivity of these solvents in the troposphere (the layer of the atmosphere in which we live) since data from studies done by U.S. EPA and Dow Chemical show that methylene chloride and methyl chloroform do not react to form ozone there (R.1593); trichlorotrifluoroethane has been shown to be quite stable and does not form photochemical oxidants either (R.1534). Rather, the debate centered on the possibility that these solvents might cause adverse health effects due to human exposure to these solvents and/or due to depletion of ozone in the stratosphere, which begins at a height of about 6 miles above Earth (ozone in the stratosphere helps shield against some wavelengths of sunlight that have been associated with increased rates of skin cancer). Numerous exhibits (group exhibits 29, 56, 80, 84 and 85) and much testimony (R.182-199, 299-340, 471-477 and 1588-1674) centered on the health effects and stratospheric ozone issues. Testimony was presented that the amount of methyl chloroform in the atmosphere was increasing at an alarming rate. However, upon examination of the supporting evidence, one finds that this statement is based on only a few atmospheric measurements taken two years apart, by two different researchers, presumably at different locations; the levels were 65 ± 17 pptv in 1974 versus 89 ± 9 pptv and 100 ± 10 pptv in 1976 (Group Ex.29). In short, the Board finds the evidence presented on the issue that these solvents may deplete the stratospheric ozone layer to be inconclusive and largely based on speculation without solid scientific support.

Based on the information submitted on the health effects of exposure to either methyl chloroform or methylene chloride, it seems unlikely that exposure to either of these solvents in concentrations that are likely to occur in the ambient atmosphere would result in adverse human health effects. However, there are still many uncertainties regarding health effects. It should also be noted that the Occupational Safety and Health Administration has standards for exposures to both these substances. The standards are 350 ppm for methyl chloroform (R.1626) and 500 ppm for methylene chloride (R.1640). Hence, even without these regulations, exposure to these substances in the occupational setting would be limited.

Very little information was submitted regarding trichlorotrifluoroethane except for a statement that it is persistent in the atmosphere (R.1534) and a statement that it is so expensive that when it is used for degreasing that it will be controlled anyway in order to prevent loss.

The Board has decided not to exempt methyl chloroform (1,1,1-trichloroethane), methylene chloride, or trichlorotrifluoroethane from the definition of volatile organic material because these solvents have not been well tested for their toxicological properties and too many uncertainties exist regarding potential depletion of the stratospheric ozone layer. Due to the expense of these solvents, in many cases control of these solvents would have been implemented anyway (R.1611, 1612, 1664). Indeed, one witness stated that the majority of industries that he has seen are already controlling emissions and would be in compliance (R.191).

There was some discussion that methyl chloroform and methylene chloride are safer than many of the less costly chemicals for which they are substituted (R.1595, 1609-10, 1614) and that without the exemption, the more hazardous substances might be preferred. In response, it should be noted that the Board's decision does not prevent the use of methyl chloroform and methylene chloride. These compounds simply must be controlled like any other volatile organic material.

AMENDMENTS TO RULE 205

The following is a discussion of new Rules 205(k), (l), (m), (n), (o), (p), (q) and (r) which are a result of this proceeding. These rules cover the following fifteen RACT categories for which CTG's have been developed:

1. Petroleum Refinery Sources
2. Solvent Metal Cleaning
3. Bulk Gasoline Terminals
4. Bulk Gasoline Plants
5. Fixed Roof Storage Tanks
6. Cutback Asphalt
7. Service Stations, Stage I Control
8. Surface Coating of Large Appliances
9. Surface Coating of Cans
10. Surface Coating of Metal Coils
11. Surface Coating of Paper
12. Surface Coating of Fabric
13. Surface Coating of Auto and Light Duty Trucks
14. Surface Coating of Metal Furniture
15. Surface Coating of Magnet Wire Insulation

Rule 205(k) Solvent Cleaning

Solvent Cleaning, or degreasing, is a method of cleaning metal or other surfaces, such as electronic circuit boards (R.1539) with organic solvents in order to prepare those surfaces for painting, plating, repair, inspection, assembly, heat treatment, or machining. During the course of the hearings on the Agency proposals, the Agency recommended removing the word "metal" from "solvent metal cleaning" (R.1539, Ex.82). The intent was to clarify that the cleaning of circuit boards would be covered (R.1548). The focus of this regulation is on the organic solvents and type of equipment used, and not the substrate being cleaned. This rule is not meant to cover the situation in which a substrate is coated with a component, then certain areas of the component are selectively removed by a solvent (R.1549).

The three types of degreasing operations are: cold cleaning, open-top vapor degreasing and conveyorized degreasing (R.141-4). The degreasing solvents include petroleum and petroleum distillate derivatives, chlorinated hydrocarbons, ketones and alcohol (R.141). It has been estimated that in the United States, emissions from degreasers contribute 725,000 metric tons of VOC annually, which amounts to 4% of the total VOC emitted (R.144).

The U.S. EPA has calculated the average emission rate for cold cleaners to be 0.3 metric tons (0.33 tons) per year per unit (R.145). Waste solvent evaporation from solvent dumped on the ground and open containers is the greatest source of emissions from cold cleaners. Emissions from cold cleaners are also due to bath evaporation, solvent carryout, agitation and spray evaporation (R.144).

Open top vapor degreasers have emissions from (1) diffusion and convection, which is the largest source; (2) carryout; (3) the roof vent; and (4) waste solvent (R.146). According to U.S. EPA calculations, the average open-top vapor degreaser emits 2.5 $kg/hr./m^2$ of opening (0.5 $lbs./hr./ft.^2$) (R.146).

Solvent loss from conveyorized degreasers is associated with large and continuous work loads. Emissions per unit due to bath evaporation and waste solvents is less than with other degreasing methods. However, the total amount of emissions is significant due to the high volume of work (R.146).

Since emission standards for degreasers are not practical, Rule 205(k) requires specific control equipment and operating procedures which were developed to minimize emissions. Many industries already have these controls in place to prevent loss (R.193) and because the high cost of halogenated solvents makes it economical to recover the solvent by distillation and recycling (R.146). It has been estimated that compliance with Rule 205(k) as compared to no controls would result in a reduction in emissions from open-top vapor degreasers of 8,250 to 10,975 metric tons/year (9,150 to 12,200 tons/year); the reduction for cold cleaners would be 6,250 to 6,600 metric tons/per year (6,700 to 7,350 tons/year) (R.154). Since many of these controls are already in place, the actual emission reduction to be expected will be somewhat less.

Small cold cleaning operations with less than 6.8 kg (15 lb.) of emissions per day are exempt from the requirements of Rule 205(k). Although larger cold cleaners do not have to obtain an operating permit from the Agency, they must still comply with this rule. Vapor and conveyorized degreasers are required to obtain an operating permit. Since this rule is self explanatory, no further discussion is necessary.

Rule 103(i) has been amended to include cold cleaning degreasers among the classes of equipment which do not require operating permits. This was done to avoid the administrative burden the Agency would face in processing approximately 40,000 permit applications from relatively small pollution sources (R.656). These sources will still be required to comply with the requirements of 205(k)(2)(A) and (3)(A) unless they are exempt under 205(k)(1). The Agency will enforce these operating requirements through the inspection procedure (R.657).

Rule 205(1) Petroleum Refineries

Refineries include facilities which produce gasoline, kerosene, distillate fuel oils, residual fuel oil, lubricants or other products by distillation, cracking, extraction or reforming of unfinished petroleum derivatives. This rule, which includes equipment specifications and monitoring techniques for vacuum producing systems, wastewater (oil/water) separators, and process unit turnarounds, represents Reasonably Available Control Technology (R.169).

In Rule 205(1)(2), Wastewater (oil/water) Separator, it is specified that wastewater separators have equipment to control emissions of organic material unless an odor problem does not exist. If there is no odor problem, only volatile organic material needs to be controlled. The reason for this differential between organic material and volatile organic material is the possibility that some compounds would fit the first definition and create an odor problem, but have a low enough vapor pressure that they would not be covered by the second definition.

At the present time, all nine refineries in Illinois have control equipment for vacuum producing systems which meet RACT and follow the specified procedures for process unit turnarounds. Four out of the nine refineries already have covers on the oil/water separators which comply with this rule. For the other five, it is believed that the organic compounds are less than 1.5 psia, which will exempt them from control under the volatility criterion, unless they create an odor problem. If the oil/water separator causes an odor problem, controls will be needed (Ex.62, p.B-3).

Rule 205(n) Surface Coating

Rule 205(n)(1)(A) Surface Coating at Automobile or Light Duty Truck Manufacturing Plants

This rule applies to surface coating of the body, fenders, chassis, small parts, wheels, etc. of automobiles and light duty trucks. The term "automobile" refers to passenger cars or their derivatives which are capable of seating no more than twelve passengers. "Light duty trucks" means motor vehicles or derivatives which are rated at 8,500 pounds or less gross vehicle weight and which are designed for transportation of property (e.g. pickups, vans, etc.) (R.588).

Several methods of reasonably available control technology were discussed. They include:

1) Electrodeposition of water borne primer, which can only be applied directly over metal (R.590);

2) Low solvent primer and topcoat, which would require the fewest changes in operating requirements;

3) Carbon adsorption which, although technically feasible, requires large amounts of electricity (R.591);

4) Incineration for spray booths and primer and topcoat ovens, also technically feasible, but which requires high energy consumption;

5) Water borne top coats, which would require major process modification for retrofit at the two Illinois plants.

The rules for surface coating of automobiles and light duty trucks take into account the problems of the two plants in Illinois. The compliance plans for these plants reflect Ford's and Chrysler's schedules for bringing all their plants in the U.S. into compliance (R.1277).

Exact adherence to U.S. EPA RACT guidelines would require the equivalent of electrodip prime and water base topcoat (R.385). Even though the technology is in use at two California plants, the costs associated with meeting these limitations are very high. The high costs are associated with the use of water as a basis for the coatings. Flash tunnels and ovens would have to be lengthened to allow longer drying times. The oven temperature would have to be raised and humidity would have to be controlled. Incoming spray booth air would have to be filtered to remove dust which might adhere to the slower drying surfaces. Measures to prevent corrosion and rusting of equipment during shutdowns and process changes would have to be implemented (R.594-5).

Both Ford and Chrysler made their own recommendations for methods of compliance (Ex.41,75,71,79). Both methods would allow only slightly higher emissions, but the cost differential is significant (R.783). One of the coatings Ford expects to use is not fully developed yet (R.790). However, Ford has already spent $15 million to install an E-coat system which will upgrade corrosion protection on cars. Reduction of VOC emissions was a secondary consideration (R.791). This amount is included in Ford's estimate that it would cost them $32 million to comply (R.791).

Chrysler considers changing to water-base topcoats to be too expensive. However, they do support and will follow a program to achieve a higher solids content in their coatings (R.388). They consider the final repair guidelines to be reasonable and obtainable and plan to comply with them by 1982 (R.389). In order to reduce the amount of overspray and emissions, electrostatic paint facilities will be installed in the Belvidere plant by 1982 (R.389). Changing to 50% solids topcoat and 35% solids for final repair will reduce VOC emissions by approximately 57%, which is more than 700 tons of emissions per year (R.389).

Rule 205(n)(1)(B) Can Coating

Can coating includes the application of coating material to two- or three-piece cans by spraying or roll-coating and the use of side seam sprays (in three-piece cans) and end-sealing compounds. Due to the wide range in products for which cans are used, a variety of compounds must be used to meet all the coating requirements. Cans that contain food must meet FDA requirements for odor and taste as well as leak resistance. At the present time, American Can Company uses more than 40 different compounds at its two plants in Illinois. Approximately 90% of the compounds are solvent based. Some, such as the coatings used on cans for paint thinner or oil-packed fish, are water based (R.741). One problem with water-based compounds is that they require heated ovens or dryers (R.742).

Four types of control technology have been determined to be RACT for can coating. A list follows:

1) Incineration would be most applicable for sheet coaters, two-piece can coaters and three-piece interior body spray coaters because of the relatively high drying oven temperature and the concentration of organics in the oven gases. Side seam spray coat and end sealing compound applications are not as well suited to incineration because they are usually air dried. Due to air drying, the gas volume is large, usually at ambient temperatures, and contains relatively low concentrations of organics (R.616). An additional problem with incineration is that significant amounts of energy may be required (R.618).

2) Water-borne/high-solids/powder coatings.

   a) Low solvent coatings are available for some uses but are not available to replace all coatings at the present time (R.618).

   b) Water-borne coatings are presently in use for various applications. However, in order to expand their use, it may be necessary to replace some existing facilities (R.619).

c) High solids coatings are highly viscous since they contain only 20 to 30% volatile solvent by volume. Hence, the coatings may need to be heated before application (R.619).

d) Powder coatings approach 100% solids. A major change in the coating application equipment would most likely be needed to switch to powder coatings (R.620).

3) Carbon adsorption is most readily used as a control method on low temperature processes which use a limited number of solvents (R.620). If a single solvent is captured, it could be recovered for reuse during regeneration of the carbon bed. If numerous solvents are captured, it may be more economical to use the recovered solvents as boiler fuel than to distill them for reuse (R.621).

4) Ultraviolet curing involves the use of coatings which cure almost instantaneously in the presence of ultraviolet light. Hence, only a small amount of organic emissions are produced (R.621). Although it has been shown to be successful on some formulations, many coatings are still in the developmental stage and need FDA approval (R.622).

With the application of RACT in Illinois, the estimated 5,864 tons of VOC emitted annually from can coating operations would be reduced by 4,847 tons/year (R.623).

The internal offset provisions, which are discussed in more detail later, were originally developed for the can coating industry because of various problems the industry might have in meeting RACT limitations by the compliance dates. These problems include: (1) The possible decline of three-piece can side seam technology, in which case it would probably be more cost beneficial to put the research effort into two-piece technology; (2) Twenty-five percent of the coating materials in use represent a large number of coatings, each of which is used in small amounts. Hence, the cost of developing a low-solvent coating for a small volume use may outweigh the benefit; (3) As mentioned before, some of the coatings are used to coat cans in which food is packed. Reformulation of these coatings may take several years due to the need for FDA approval and the necessity of long term testing programs to determine if food contamination occurs (R.819).

Testimony by various suppliers of can coating compounds indicated that they expect that the can coating industry, through the use of internal offsets, will be able to comply by the specified compliance dates (R.829, 1510-16, 743).

In Rule 205(n)(1)(B) the Board has adopted six limitations on the emission of volatile organic material from can coating lines. In Rule 201 the Board has adopted eight new definitions to clarify the terms in 205(n)(1)(B). The Board has adopted these changes so that a specific emission limitation can be applied to each coating operation which is typically found in a can coating plant. This degree of detail is not intended to exempt any can coating operation which does not fit a narrow construction of any definition.

Rule 205(n)(1)(C) Paper Coating

Paper coating refers to the application of a surface coating to paper, metal foil, plastic films, pressure sensitive tapes, etc. This rule does not cover operations in which a material, such as plastic, is obtained in sheets and/or rolls and converted into a package (R.1526-7). Rotogravure is considered to be printing in this case and therefore will be covered by a different rule (R.517) since equipment that is used for printing and paper coating is excluded from this rule. Examples of paper coating products include adhesive tapes; adhesive labels; decorated, coated and glazed paper; book coverings; office photocopier paper; carbon paper; typewriter ribbons and photographic film (R.515).

Methods of compliance include incineration, carbon adsorption and substitution of low solvent or water-based coatings (R.273).

Witnesses from paper coating industries testified that they would prefer to work with water-based coatings because they are safer and more economical in the long run (R.460) and have production advantages (R.294). One company is planning to switch to solventless technology regardless of these regulations unless they would be forced to install add-on control equipment first (R.294). However, they have experienced problems with these coatings (R.462). The main problems associated with coating plastics and metal foils with water-based coatings is that the surface of these two substrates is hydrophobic. Hence, solvent is needed in the coating material to improve wettability and adhesion (R.749). A particular problem that one manufacturer has is that he must obtain FDA and customer approval for his product since it is used in medical devices (R.347,464). Therefore, he may not be able to meet the 1982 deadline (R.464). However, this manufacturer can still use the internal offset provision or apply for a variance (R.1160-1).

Rule 205(n)(1)(D) Coil Coating

The surface coating of metal coils refers to the coating of flat metal sheets or strips that come in coils. These metal coils have many uses such as cans, appliances, roof decks, shelving and gutters (R.539). Nine coil coating plants are located in Illinois; eight of them in the Chicago area (R.540). Approximately 90% of the VOC emissions come from the drying ovens. Several control options are available: incinerators, water-borne coatings and high solids coatings (R.540). Incineration with heat recovery appears to be the best control option (R.545). At the present time, high solids coatings have application problems; and water-borne coatings do not meet performance requirements (R.443). With the internal offset provision, the coil coating industry should be able to achieve the RACT limitation (R.764).

Rules 205(n)(1)(E) Fabric Coating and (F) Vinyl Coating

In these processes, a coating substrate is applied to fabric or vinyl by using a knife, roll or rotogravure. The coating adds qualities such as increased strength, stability, water or acid repellency, or appearance. All seven facilities in Illinois are located in the Chicago area (R.600). One manufacturer who has not yet installed any VOC controls is responsible for 83% of the 1,659 tons of VOC per year emitted by fabric and vinyl coaters in Illinois (R.608). Sixty-five to seventy-five percent of the solvent emissions from the coating line are emitted from the oven (R.600-602). Reasonably available control technology includes incineration with possible heat recovery, carbon adsorption with solvent recovery, and low organic solvent coatings such as high solids and water-borne coatings (R.605-606).

Rule 205(n)(1)(G) Metal Furniture Coating

This rule covers the application of a surface coating to metal furniture or metal parts of furniture. The coatings are applied by spraying, dipping or flowcoating and are used to protect against corrosion. In order to do this, the coating must be durable to withstand use and have good adhesion properties to avoid peeling and chipping. It must also be acceptable aesthetically (R.577).

There are six methods of controlling VOC from metal furniture coating operations. They are:

1) use of powder coatings;
2) application of water-borne coatings by electrodeposition;
3) application of water-borne coatings by spraying, dipping or flowcoating;
4) use of high solids coatings;
5) removing VOC emissions by carbon adsorption;
6) removing VOC emissions by incineration (R.580).

Add-on control devices (carbon adsorption and incineration) are the least cost effective (R.585). The metal furniture industry is an example of another industry for whom the internal offset provision may be essential (R.263,404) since the waterborne coatings currently available for dipping do not meet certain quality standards (R.260) and the technology does not exist to apply 70-80% volume solids paint under production conditions (R.255-6). If the required technology is not developed and in use by the required time, at least one source may need to apply for a variance (P.C.#100).

Of 27 facilities in Illinois, 14 would be exempted from these rules due to the 25 ton/per year size exemption (R.1527).

Rule 205(n)(1)(H) Large Appliance Coating

Doors, cases, lids, panels and interior support parts of residential and commercial washers, dryers, ranges, air conditioners and other large appliances are coated by spraying, dipping or flowcoating techniques. In addition to serving an aesthetic purpose, coatings must protect metal from corrosion due to moisture, heat, detergent and occasionally weather (R.534). Usually 50% of the emissions are from the coating and flashoff area with the rest coming from the oven area. The exact amount depends on the coating application (R.534). Three coatings suppliers support the emission limitation of 0.34 kg/l (2.8 lb./gal.) for large appliance coating (R.404, 443,764).

Rule 205(n)(1)(I) Magnet Wire Coating

Magnet wire coating is the coating of aluminum or copper wire with an electrically insulating varnish or enamel in preparation for use in electrical machinery. All five magnet wire insulation facilities in Illinois meet RACT. The most common form of compliance is incineration since most emissions are from the drying oven. Hence, the gases are already at a high temperature and contain moderate to high solvent loads (10-25% LEL) so that little additional fuel is necessary (R.548).

Rule 205(n)(2)(A)

Rule 205(n)(2)(A) provides for compliance with the emission limitations in Rule 205(n)(1) through the use of afterburners. It is necessary to specify a capture efficiency as well as a combustion efficiency to insure that emissions are captured and are vented to an afterburner (P.C.74). The Board believes that a capture efficiency on coating lines of 75% is RACT based on information in Exhibit 17 which cites an existing coating line from which 73% of the emissions are captured. However, some systems can be designed to capture more than this. If not, facilities can utilize the internal offset provisions to attain compliance (P.C.74).

Rule 205(n)(4) Internal Offsets

As mentioned previously, the emphasis in determining reasonably available control technology was on retrofitting add-on control equipment or changing to water borne or low solvent coatings (R.44). During the hearings, several coating suppliers testified on the availability of surface coatings that would meet RACT limitations (R.376-83,398-408,438-57, 758-68,813-22,1502-5). There are some coatings such as water-based electrodeposition, powder coatings, new resin systems, high solids and existing resin systems which are capable of meeting RACT at the present time (R.398). In addition, one supplier predicts that by 1982-83, 75-80% of the coatings necessary to meet RACT will be available (R.376). However, these technologies are not necessarily applicable to all segments of industry (R.399). Examples of problem areas include: auto coating, due to the high costs of converting to water-borne coatings; millwork production in wood, since water has a detrimental effect on wood substrate; precoated architectural finishes on metal coil stock, where low-solvent technology may not find an early breakthrough (R.378-9); and some can coatings which must also meet regulations of other agencies such as the Food and Drug Administration (R.815).

The Board agrees that in the long run, substitution of coatings which meet RACT for coatings which do not meet RACT is preferable to retrofitting coating lines with add-on control equipment. However, the Board is also cognizant of the possibility that not all of the required coatings will be available by the required date. Therefore, in order to provide incentive for the development and utilization of low solvent or solventless technology, an internal offset provision ("bubble") is included in Rule 205(n)(4). The "bubble" concept should allow the facilities the flexibility to over-comply on the lines where it is possible and use this over-compliance as an offset on the lines where the technology to comply either does not exist or is very expensive (R.1096).

For the most part, the formulas in Rule 205(n)(4)(A) are self-explanatory. Essentially this rule states that the sum of the VOC emissions that actually come from the "bubbled" coating lines can not exceed the sum of the allowed emissions from those lines.

Rule 205(n)(4)(C) limits the internal offset provision to include only those sources which are covered by RACT (R.1115). Control of fugitive emissions from distribution lines, valves, etc. will not be allowed as offset credit (R.1788). A daily averaging period is used since a longer averaging period, such as one month, could lead to the frequent shutdown of low solvent coating lines while still taking credit under the internal offset provision (R.1789).

Rule 205(o) Bulk Gasoline Plants, Bulk Gasoline Terminals, and Petroleum Liquid Storage Tanks and Rule 205(p) Gasoline Dispensing Facility

Rules 205(o)(1) and (2) and 205(p) require vapor recovery at certain bulk gasoline plants, bulk gasoline terminals and during transfer of gasoline from delivery vessels into stationary storage tanks at gasoline dispensing facilities, respectively. These rules apply to gasoline only and not to other VOC's which are used for fuel, such as fuel oil. Essentially, vapor recovery involves capturing vapors which would otherwise escape to the atmosphere during gasoline transfer operations and recovering those vapors by condensation. The condensate is then available for use. Leakage from the transport vessels would reduce the amount of gasoline available for recovery. Hence, rules to minimize leakage are included.

Several vapor balance (or vapor recovery) systems were discussed. They include the Wiggins tank wagon vapor balance system (R.842-44,85-76), the Houston-Galveston system (R.850-76), and other systems (R.879-84,662-90).

Aside from the costs involved, which will be discussed later, the major problems with vapor recovery are the method of detecting when the transports or tank trucks are full and the emergency shut off systems (R.977-88). Malfunction of these systems may result in a fire and explosion hazard (R.864, 977-88) which would have the potential to cause more severe injuries than spill and discharges from non-pressurized systems (R.1008). However, proper operation of these systems should not result in any greater hazard than if these systems were not in use.

Submerged fill is required in order to minimize the amount of vapors which would arise during splash loading.

Vapor balance for shipments of gasoline from vessels into storage tanks at bulk plants works without problems (R.876). The terms "bulk gasoline plant" and "bulk gasoline terminal" reflect the distinction between the two based on relative position in the chain of distribution and the manner in which gasoline is received at the facility (R.1270). Bulk gasoline terminals are required to utilize vapor recovery during transfer operations state-wide because, due to their size, they are larger sources of emissions. In addition, most terminals are located in or near large metropolitan areas. Out of 34 terminals state-wide, 12 are in the Chicago area and 7 are in the East St. Louis area. It is believed that most terminals are already equipped with vapor recovery systems or floating roofs (R.571). The required vapor balance systems should become cost effective as through-put increases (R.574).

Stage I vapor control at service stations involves VOC control during gasoline loading of storage tanks from transport vessels (R.643). Emissions are controlled by collecting the vapors which are displaced from the storage tank and returning them to the tank truck by the use of hoses and couplings to provide a "closed loop." The vapors are then taken back to the bulk plant or terminal for processing by a vapor recovery system or are routed to an on-site vapor recovery system (R.645). Approximately half of the state-wide emissions from the 8,000 service stations in Illinois are in the six-county Chicago area (R.645).

Vapor recovery for these two types of sources is required only in those counties which have or are near large metropolitan areas for economic reasons. About half of the gasoline dispensing facilities in Illinois are located within the thirteen counties listed below. Most bulk plants are located in rural areas of the state (R.841). When the probable improvements in air quality which would result from requiring vapor recovery in the rural areas of the state are compared with the relative cost of control and economic burden on a significant number of relatively small sources, it appears that vapor recovery at bulk gasoline plants and Stage I vapor recovery at gasoline dispensing facilities is RACT only in the listed counties (R.1791).

Unlike the rest of the rule changes in this proceeding, the rules on vapor recovery at bulk gasoline plants and gasoline dispensing facilities do not apply state-wide. They are required only in the following counties: Boone, Cook, DuPage, Kane, Lake, Madison, McHenry, Peoria, Rock Island, St. Clair, Tazewell, Will and Winnebago.

Size exemptions for bulk gasoline plants and gasoline dispensing facilities are included so that small operators who are not a major source of emissions will not have to utilize vapor recovery which would have provided relatively little return. Storage tanks with a capacity less than 2,000 gallons are exempt as recommended (R.1025). Since most, if not all, existing tanks on farms have a capacity less than 2,000 gallons and 575 gallons is the maximum size for an exemption for new farm storage tanks, (560 gallons is considered to be standard size (R.933)), it is unlikely that any farm storage tanks would be subject to these rules.

Rule 205(o)(3) Petroleum Liquid Storage Tanks

This rule requires certain equipment and operating procedures to minimize leakage of volatile petroleum liquid from large stationary storage tanks. The exemptions are listed in Rule 205(o)(3)(A). Crude oil storage tanks used to store produced crude oil and condensate prior to custody transfer with a capacity less than 442,675 gallons (10,540 barrels or 1,600,000 liters) are exempt due to economic consideration. If a petroleum liquid storage tank is used to store crude oil or condensate in crude oil gathering, the size cutoff for an exemption is 9,000 barrels.

A representative from Union Oil Company stated "the installation of internal floating roofs in existing tanks having a capacity of 10,000 barrels or more are proven emission reduction tools and over many years save enough valuable petroleum to pay for their installation (R.1690). However, retrofitting existing tanks which will be in use for only a few years may not be economical. "Virtually all new storage tanks incorporate floating roof technology" (R.1691). Data on emissions from crude storage tanks indicates that 10,000 barrel tanks emit 100 tons per year of volatile petroleum liquids (R.1540). Hence, 10,000 barrel tanks are not an insignificant source.

Fixed roof storage tanks are cylindrical steel tanks with permanent roofs which vary from being flat to cone-shaped. Emissions are controlled by an internal floating roof cover and routine inspections of the cover. Internal floating roofs are 90% efficient in reducing emissions from fixed roof storage tanks (R.564). Since the seals frequently last 20 years and the seal can be inspected for holes without emptying the tank, routine inspections can be made through roof hatches (R.1024) and emptying of the tank is not required. Emptying a tank and freeing the gas for safety reasons would take at least three days (R.1024).

Rule 205(q) Cutback Asphalt

Cutback asphalt is asphalt which has been diluted or "cutback" with petroleum solvents such as naphtha, kerosene or gasoline (R.630) to form a liquid. Road paving accounts for most emissions from cutback asphalt. VOC emissions also occur during manufacturing, mixing and storage of cutback asphalt. Emissions from the use of asphalt total 64,200 tons of VOC per year with most emissions occurring during the warmer months. The substitution of emulsified asphalt for cutback will control hydrocarbon emissions since the diluent in emulsified asphalt consists of 98% water and 2% non-VOC emulsifier (R.633). Since emulsified asphalt cannot be used at cold temperatures [it freezes at temperatures below 32°F (R.906)] and ozone is not formed at cold temperatures, the use of cutback asphalt is allowed between October 1st of one year and April 30th of the next year.

Although the work crews have to be more organized to apply emulsified asphalt (R.917-8), there are few differences in procedures or equipment needed to apply the two types of asphalt (R.637,917).

One problem which did arise is that due to differences in the amount of residual material in the two asphalts, one user must apply 33% more emulsified asphalt than cutback (R.1757). Another user also testified that he must use more emulsified asphalt than cutback (R.1767-8).

However, a third witness testified that ultimately emulsified asphalt will produce better roads (R.939).

Besides reducing VOC, there are several benefits from using emulsified asphalt. If the U.S. converted entirely to emulsified asphalt from cutback asphalt, the amount of energy saved annually would equal a five day through-put of the Alaskan pipeline operating at maximum efficiency (R.919). The energy savings would result from the use of fewer petroleum distillates and less energy needed to heat the asphalt since emulsified is applied at a lower temperature (120-180°F) than cutback (250-300°F). This temperature difference also makes emulsified safer for worker use (R.921). In addition, there is also less of a flammability hazard (R.939) and fewer odors are associated with emulsions (R.923).

Availability of emulsified asphalt should not be a problem (R.940).

Allowing the use of cutback asphalt from a long-life stockpile for repairing potholes and similar jobs after April 30th will avoid wasting cutback (R.1308). Cutback must be used for patches during winter as emulsions would freeze and break (R.1042). This exception applies to stock mixed with aggregate, but not raw liquid cutbacks (R.1308).

Prime coat essentially acts as an adhesive (R.906,910) and is used to prepare a surface such as raw concrete or raw rock for a seal coat (R.910). At the present time, no suitable emulsified prime coat materials exist (P.C.26). However, since the prime coat is usually applied immediately before paving, VOC emissions are trapped beneath the paving material and do not cause significant emissions to the atmosphere (P.C.26).

AFTERBURNER SHUT-OFF

Rule 205(r) specifies under what circumstances afterburners need not be operated. The Agency's monitoring data indicates a distinct ozone season in Illinois which lasts from April through October; no values in excess of the new Federal standard of 0.12 ppm have been observed in Illinois from November through March for the last four years (R.1309). The Board agrees with the Agency that this exemption, as written, will not adversely affect public health. This exemption will result in both a dollar and energy savings during these months.

The original Agency exemption applied only to natural gas fired afterburners. An industry representative suggested (R.1364) that the exemption be expanded to include oil-fired afterburners; the Agency concurred with this (R.1794). The Board agrees that this exemption should apply to oil-fired afterburners. It should be clear that this exemption does not apply to flares, such as those found at petroleum refineries (R.1310).

The U.S. EPA supported seasonal curtailment of afterburner use under somewhat more limited circumstances (R.1308, Ex.17). The Board finds that a statewide exemption is consistent with statewide controls. The exemption contains a requirement that these afterburners be operated if an ozone Advisory, Alert or Emergency is declared; this requirement will adequately safeguard against excessive volatile organic emissions from these sources which might occur during the period November 1 through April 1.

ECONOMIC IMPACT

The Institute of Natural Resources submitted a study entitled Economic Impact of Incorporating RACT I Guidelines for VOC Emissions into the Illinois Air Pollution Control Regulations (INR Document No. 79/01) (hereinafter "Study") (Ex.62). The Study examined the air quality consequences of the proposed regulations; considered benefits in terms of changes in health effects, crop damage and materials deterioration; estimated control costs to the regulated industries; and analyzed some secondary economic impacts. The consulting organization of Booz, Allen & Hamilton prepared a report for U.S. EPA entitled "Economic Impact of Implementing RACT Guidelines in the State of Illinois" (hereinafter "BAH Report") (Ex.65). The objective of the BAH Report was to determine the costs of controls needed to implement the RACT guideline limitations (R.1252). In a number of instances the BAH Report was used as a source by the Study authors for those portions of the Study dealing with control costs; however, the two are not identical. This is discussed below. The Study, the BAH Report and testimony developed at hearings provided the Board with a great deal of information with which to determine the economic reasonableness and to gauge the economic impact of the various proposals. The Board concludes that the regulation adopted is an economically reasonable method of reducing ozone pollution. There will be some adverse economic impacts on the People of the State of Illinois; these adverse impacts must be compared with the alternative, which is continued ozone levels in excess of the NAAQS and vulnerability to the economic sanctions of the Clean Air Act.

The Study provided an estimate of total capital costs of $15.6 million to bring bulk terminals into compliance (Ex.62, p.47). This estimate included costs for conversion from top-submerged loading to bottom loading for 90% of the bulk terminals in Illinois (P.C.75), totaling $5.7 million. Vapor recovery units were presumed added for all bulk terminals at a cost of $9.9 million. These cost estimates were based on industrial experience (Ex.62, p.47; P.C.75). Annualized costs, not including gasoline credit, were put at $3.6 million (Ex.62, p.49). The economic value of the recovered vapors was calculated to provide an overall net savings of $27 per ton of reduction in VOC emissions (Ex.62, p.48).

The estimates above were contested at hearings and through comment. The underlying emissions inventory, which affects cost effectiveness, was challenged (R.1216-21). Unit costs of conversion to bottom loading and control efficiencies were questioned (R.1774, Ex.89; P.C.71). The Board recognizes that the cost/effectiveness ratios can vary substantially depending on which estimates are used. Individual terminals may also vary from standardized estimates. The record contains representative estimates for a range of installations.

Differing degrees of control of VOC by bulk plants are required depending on geographic location and yearly throughput. The Study presented unit costs of control, estimated the number of affected installations, and combined these two to present a statewide impact (Ex.62, p.48-53). The addition of Boone County to Rule 203(o)(1)(G) would alter somewhat the statewide estimate; unit estimates are, of course, unaffected.

Industry testimony indicated that the unit costs for conversion of bulk plants may be somewhat understated, but generally are comparable to industry estimates (R.1743). These sources are among the few that are not controlled statewide. The Agency's proposals and the Board's Order recognize the economic burden of these controls. The rule applies to significant sources in areas where control of VOC is most needed; concerns of economy and efficiency have mandated that smaller sources be exempted.

The Agency proposal and the Board's Order contained requirements for storage tanks used to store crude oil or condensate in crude oil gathering [See 203(o)(3)(A)(4) and 203(o)(3)(B)]. Concerns for economy and efficiency have caused the Board to agree that a cutoff level of 9,000 barrels storage capacity is appropriate. The Illinois Petroleum Council has indicated that this will exempt 69 out of 101 existing tanks storing crude oil or condensate in crude oil gathering (Ex.87). The Illinois Petroleum Council and others had urged a higher exemption level; however, the Board finds that while retrofit costs on tanks this size may be substantial (Ex.86), so are the emission reductions gained (Ex.82). Thus, the 9,000 barrels exemption level is adopted.

Requirements for certain storage tanks remain unchanged; hence, no economic impact to those sources is attributable to this regulation.

Petroleum refineries in Illinois currently comply with Rules 205(l)(1) and (2). Hence, the adoption of these rules only requires continued operation in the current manner and no additional control costs nor emission reductions are anticipated. Rule 205(l)(3) may require some minor additional record-keeping requirements.

Rule 205(p) requires Stage I vapor control at gasoline dispensing facilities located in 13 counties of the State. The Agency estimated total conversion costs to be $2,000 per service station, exclusive of any gasoline recovery credit (R.648). The Study estimated typical capital costs of conversion to range from $600 to $2,000, depending on the system chosen (Ex.62, p.58).

The geographic scope of this rule follows that of the rule governing bulk plants; the reasoning is consistent. The limited coverage, combined with the size exemptions, will result in emission reductions where they are needed most in an economically efficient manner.

Rule 205(n)(1)(B) specifies numerical emission limits of VOC for can coating. Four types of control were discussed above. However, it is clear that the preferred and anticipated control method is water-borne or low solvent coating compounds (R.1510,723).

The exact economic impact on the can manufacturing industry is difficult to estimate due to the interplay of several factors. The first is that development of low solvent coating compounds cannot be guaranteed. The second factor is Rule 205(n)(4), the provision on internal offsets. The third factor is Rule 205(n)(2), the provision on alternative compliance. The compliance method of a given source will probably be unique, depending on how these factors apply to the source. For example, sources using end seal compounds may not be able to use low solvent coatings to comply by 1982 (R.1517); the method chosen for compliance will depend on the peculiar operating characteristics of that source. The Study (Ex.62, p.66-71) estimated compliance costs based on a combination of water borne coatings and incineration. An addendum to the Study (P.C.75) states that the BAH Report indicated an expected decrease in future incineration installation. Neither the Study (R.1200) nor the BAH Report (R.1254) considered the internal offset provision for can coating; hence the total cost estimates provided are of limited use. The Board agrees with the Can Manufacturers Institute that the approach taken is cost effective (R.1516).

Compliance by paper coaters is expected to be achieved through a combination of control equipment (incinerators or carbon adsorption units) and low solvent or water-based coatings. Neither the BAH Report (R.1254) nor the Study (R.1200) were able to include the impact of the internal offset provision in their estimates. Both the BAH Report and the Study estimate control equipment to cost three to four times that indicated in the CTG document (Ex.62, p.75; R.1377; P.C.75). The amount of control equipment necessary may also vary from source to source due to differences in exhaust stream organic concentrations.

Compliance through add-on equipment is not an inexpensive proposition; low solvent or water-based coatings may also entail substantial capital costs (R.1201). The emission reductions achievable are also substantial, however; a single large plant in Illinois will provide emission reductions in excess of 8,000 tons/year (R.1376; Ex.62, p.B-15; Ex.82). The combination of extended compliance dates, internal offsets and developing technology will insure that the emission reductions are obtained in a manner economically feasible for industry.

One major fabric coating installation was identified in the BAH Report (Ex.65, p.6-18) and the Study (Ex.62, p.78). Subsequent data identified additional sources (Ex.82). Compliance eventually will be by water borne or low solvent coating; add-on equipment may be required in the interim.

Strict adherence to U.S. EPA RACT numbers for surface coating of automobiles and light duty trucks would have reduced emissions at a prohibitive cost. The regulation as adopted is tailored to the two automobile manufacturing plants located in Illinois. With some exception (R.1406) the affected companies have generally indicated that the regulation as written represents acceptable, obtainable limitations. The requirements of the regulation will be met through high solids topcoats, rather than water borne topcoats. The Board has concluded that retrofitting these existing plants to handle water-borne topcoats is not economically feasible; the regulation as adopted, combined with the internal offsets provision, is an economically reasonable method of obtaining emission reductions from these automobile plants.

Compliance by large appliance coaters can be achieved by the use of existing coatings. Some plant modifications will be necessary (Ex.65, p.10-10). The BAH Report (Ex.65, p.10-17) and the Study addendum (P.C.75) estimated annualized costs for all affected industry to total $800,000. The BAH Report calculated that a "direct cost pass-through" would increase the price of a $311 appliance by 15¢ (Ex.65, p.10-17).

Rule 205(k) prescribes certain operating procedures and equipment requirements for solvent cleaning operations. Equipment retrofit cost estimates were formulated in both the BAH Report and the Study; differing estimates of the number of solvent cleaners (compare Ex.62, p.103 with Ex.65, p.11-19) produced disparate totals. Unit costs were fairly comparable. Small emission sources do not provide an economically feasible source of emission reductions and are exempted [see Rule 205(k)(1)(A)].

Testimony at hearing indicated that there are several related production and labor costs that were not included in the estimates of compliance costs (R.1431-48, 1459-79). Subsequent comment (P.C.86) indicated these costs are not negligible. Including costs of this nature does not alter the Board's conclusion that these controls are economically reasonable.

The nine coil coaters in Illinois were described by the Agency as currently meeting RACT emission limitations (Ex.39). This led both the Study (Ex.62, p.72) and the BAH Report (Ex.65, pp.4-10 to 4-12) to conclude that adoption of RACT for these sources would have no economic impact; the Board agrees.

Surface coaters of metal furniture are expected to comply by modifying existing equipment to handle high solids or water-borne coatings (Ex.65, p.8-11). Advances in coating technology are needed in some areas, for example, water borne coatings for dipping (R.260, P.C.100). In these instances, the internal offsets provision and/or the Board's variance mechanism may be essential in order to insure that no unreasonable economic burden is placed on the sources. Both the BAH Report (Ex.65, pp.8-12 to 8-17) and the Study (Ex.62, pp.87-92) indicate reasonable costs for the use of high solids and water-borne coatings.

The five identified surface coaters of magnet wire insulation currently control emissions with afterburners and incinerators. The BAH Report (Ex.65, p.9-1) and the Study (Ex.62, p.92) concluded that promulgation of the RACT emission limitations would have no economic impact on these sources; the Board agrees.

The substitution of emulsified asphalt for cutback will result in substantial emission reductions. Total statewide costs for retrofit of equipment and retraining of employees were estimated to total $229,000 (Ex.62, p.111; Ex.65, p.17-13).

Neither the BAH Report nor the Study predicted any continuing annual costs. However, the Board notes the testimony of some witnesses that increased application rates are necessary with emulsified asphalt (R.1757,1767-8). This may cause some economic impact, but it should be offset in the future since the price of emulsified depends less on the higher price of petroleum distillates than does cutback (R.923). Other incidental benefits include increased worker morale (R.923), increased worker safety (R.921) and considerable energy savings (R.919-20).

Although impossible to quantify for all surface coaters, the economic benefit of the internal offsets must be considered when analyzing the economic impact of the regulation. Its obvious impact will be to allow the most economically efficient blend of emission reductions to be used. It is of particular importance to those coaters who must await advances in coating compound technology.

Similarly, the Board's variance mechanism must also be considered, particularly when analyzing compliance dates in terms of developing technology. Although its impact is impossible to quantify, its effect is clearly to relieve unreasonable economic hardship.

Promulgation of these regulations should result in an improvement in human health. The adverse health effects of high oxidant levels which will be reduced are: sore throat, shortness of breath, cough, headache, hoarseness, wheezing, congestion, chest tightness, pain on deep inspiration, and throat tickle. The major improvements will take place in Lake, Cook and Madison counties in Illinois (Ex.62, p.29-30) since the largest reductions in ozone levels will occur in those areas. [Based on IEPA predictions, the second highest one-hour ozone reading will be reduced from 0.261 ppm to 0.132 ppm in Lake County (Ex.62, p.24).] Residents of neighboring states, such as Wisconsin, should also show improvements in health due to lesser amounts of ozone transported into those states.

An exact quantification of the improvement in health is not possible at this time due to the limited amount of information on dose-response relationships at ozone levels less than 0.20 ppm. A Japanese epidemiology study and the environmental chamber study by DeLucia and Adams indicate that ozone-induced symptoms develop at levels of 0.15 ppm. On the other hand, another epidemiology study carried out in Los Angeles by Schoettlin and Landau found that 0.25 ppm was the level at which asthmatics developed adverse health effects. A limited number of chamber studies seem to indicate that symptoms and pulmonary decrements develop in humans at ozone levels in the

0.25 to 0.37 ppm range (Ex.62, p.28-9). However, it appears that individuals who live in high ozone areas, such as Los Angeles, may adapt to ozone (R.1241). Hence it may be misleading to try to quantify changes in the health of Illinois residents based on studies performed on Los Angeles residents. Illinois residents may show adverse health effects at lower concentrations of ozone than Los Angeles residents.

As with the health effects information, a meager amount of information exists on the effects of ozone on Illinois crops. Since many other factors such as precipitation; temperature; soil fertility, texture, and drainage; and cultivation and planting methods can affect crop yield, it is difficult to predict what changes in crop yield can be attributed to ozone (Ex.62, pp.31-34). However, it appears that no increased yields in corn, soybeans, and possibly wheat will result from changes in ozone levels (Ex.62, p.35). However, it should be noted that the most significant changes in ozone levels will occur in metropolitan areas, while most farming occurs in areas where ozone levels already meet the NAAQS.

The Study also attempted to produce an estimate of the benefit in Illinois attributable to the implementation of RACT I in terms of decreased materials damage (Ex.62, p.36-8; Appendix E). The authors of the Study calculated this annual benefit to be $16.4 million which was described by the authors as "very uncertain" (Ex.62, p.38) and "a very rough estimate at best" (Ex.62, p.E-7).

All references to "An Act Concerning Administrative Rules" in Rules 103(a)(2), (b)(3), (c), (d), (e)(2) and 104(b)(3) have been deleted because the requirements of the Illinois Administrative Procedure Act (Ill. Rev. Stat., ch.127, §1001 et seq.) now apply automatically to all rulemaking by the Agency, as well as the Board.

Rule 103(l) has been deleted since Section 39(a) of the Act now states that a bond or other security shall not be required as a condition for the issuance of a permit.

The Board has elected to retain jurisdiction in this proceeding for two reasons. First, specific portions of the Board's Final Order may have to be revised in order to obtain Federal approval of the Illinois implementation plan. Second, the Board's intent in adopting these amendments may require clarification.

The record in the proceeding is not open for the addition of any new evidence. If substantive changes in the Final Order are necessary for Federal approval and can be justified by the record in its present form, additional amendments may be made without further hearings or economic impact analysis. Any change in the Final Order will require compliance with the provisions of the Illinois Administrative Procedure Act (Ill. Rev. Stat. ch.127, §1001 *et seq*.).

Messrs. Young and Werner dissent.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, hereby certify the above Opinion was adopted on the 23RD day of August, 1979 by a vote of 3-2.

Christan L. Moffett

Christan L. Moffett, Clerk
Illinois Pollution Control Board