BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS

IN THE MATTER OF:	)	
	)	
NATURAL GAS-FIRED, PEAK-LOAD	)	R01-10
ELECTRICAL POWER GENERATING	)	
FACILITIES (PEAKER PLANTS)	)	

TESTIMONY OF ROBERT J. KALEEL

Qualifications

My name is Robert Kaleel. I am the Manager of the Air Quality Modeling Unit in the Division of Air Pollution Control, Bureau of Air, at the Illinois Environmental Protection Agency (Agency). I have been employed by the Agency for twenty years with responsibilities for air quality modeling, planning, and regulatory development. I have also worked for a private consulting company as a specialist in air pollution modeling and permitting. I have a Bachelor of Science degree in meteorology from Northern Illinois University.

In my current position at the Agency, I am responsible for overseeing the development of dispersion modeling analyses to support various regulatory proposals and the review of air quality impact studies submitted in support of permit applications for major new sources in Illinois. In this capacity, I have supervised the Agency's review of the air quality impact analyses provided by the applicants for permits to construct the natural gas-fired peakers that are the subject of this hearing. I am also responsible for supervising the air quality modeling used to support the Agency's attainment demonstrations for the Chicago and Metro-East ozone nonattainment areas.

The purpose of my testimony today is to explain the expected air quality impacts from the construction and operation of the proposed natural gas-fired peakers. The Agency has relied upon the use of air quality models to simulate the effects of the peakers and to evaluate whether the operation of these sources threatens the attainment or maintenance of relevant air quality standards.

Air Quality Models

I would like to begin my testimony by describing what air quality models are and how they are used by the Agency in air quality planning and management. An air quality model is simply a set of mathematical equations relating the release of air pollutants to the corresponding concentrations of pollutants in the ambient atmosphere. Ambient air is the outdoor air to which people, structures, plants, and animals are exposed. Such mathematical relationships provide a technique for predicting the consequences of changing the amount of pollutants released into the air from either new or existing sources of air pollutants.

Air quality models are used to identify and evaluate the level of controls required to solve industrial and urban air pollution problems. They are applied in an engineering or analytical way to identify the causes of existing problems and in a planning or predictive way to project and avoid future problems. Air quality models are used to develop air pollution control plans for attainment and maintenance of acceptable air quality, assess environmental impacts expected from industrial expansion and urban development, and project the future air quality trends and patterns associated with regional planning options.

Modeling provides a quantitative link between sources of air pollutants and ambient air quality. Such a link is necessary when regulatory decisions must be made within the framework of the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments. The NAAQS are maximum pollutant concentration limits for ambient air anywhere in the country, as established by the U.S. Environmental Protection Agency (U.S. EPA). Primary NAAQS are established to protect the public health with a margin of safety and are based on known health effects in humans. Secondary NAAQS are based on vegetative and material effects and are intended to protect public welfare. The U.S. EPA and state air pollution agencies must ensure that the NAAQS are attained and maintained throughout the country. Table 1 in IEPA Exhibit 10 lists the NAAQS as promulgated by the U.S. EPA. Compliance with the NAAQS is primarily assessed with ambient air quality monitoring data, when that data exist. However, the geographical coverage and sampling frequency achievable in most monitoring systems limits the ability of the system to document all possible occurrences of high pollutant concentrations. Consequently, modeling analyses are frequently performed to determine if the standards are being attained and maintained in areas where it is suspected that air quality data do not include maximum possible concentrations.

The PSD program was established to maintain the ambient air quality existing on a specific baseline date. The PSD program applies, on a pollutant-specific basis, to areas of the country where existing air pollutant concentrations are below or better than the limits specified by NAAQS. PSD increments are ambient pollutant concentration limits, which legally define how much pollutant concentrations in an area can increase from a

set baseline level for all future time. In general, the baseline date is the date when the first complete PSD permit application affecting the area is submitted. Table 1 in Exhibit 10 lists the PSD increments as established by the U.S. EPA. As new emission sources come on-line and each increases ambient pollutant concentrations slightly, they are said to "consume the available increment." Significant deterioration is said to occur when the amount of new pollution would exceed the applicable PSD increment. Under the PSD program, significant deterioration beyond the PSD increment is not allowed. Further, air quality cannot deteriorate beyond the concentration allowed by the applicable NAAQS, even if not all of the PSD increment is consumed.

Air quality modeling is required during permit review for new major sources to ensure compliance with the NAAQS and PSD increments. The analysis must evaluate whether or not allowed emissions from the new source will cause of contribute to a violation of the NAAQS or will cause or contribute to exceedances of the PSD increments.

There are a number of different types of models ranging from quite simple to complex. The most frequently used simulation model for evaluating the dispersion of atmospheric contaminants is called the Industrial Source Complex (ISC) model developed by the U.S. EPA. The ISC is an appropriate model to evaluate local, or neighborhood-scale, effects where chemical reactions in the atmosphere are relatively unimportant in determining peak impacts. The ISC model was used for air quality impact analyses for those "criteria" pollutants (*i.e.*, pollutants for which U.S. EPA has established an NAAQS), such as particulate matter 10 microns in aerodynamic diameter

(PM10), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2), where peak impacts from the natural gas-fired peaking plants are expected to be local in scale.

Dispersion Modeling

The Agency has required each applicant for a new peaker plant to conduct an air quality analysis of the ambient impacts associated with the construction and operation of the proposed new source. The main purpose of the air quality analysis is to assess whether the emissions emitted from the proposed source, in conjunction with other applicable emissions from existing sources, will not cause or contribute to a violation of any applicable NAAQS or PSD increment.

The Agency has required that the air quality analyses be accomplished in a manner that is generally consistent with the requirements set forth in EPA's PSD regulations even though most of these sources are too small to be considered in the PSD program. For a new or modified source, compliance with any NAAQS is based upon the total estimated air quality, which is the sum of the ambient impacts from all existing sources of air pollution (which can be determined from a combination of modeling and ambient monitoring) and the modeled ambient impact caused by the applicant's proposed emissions increase. Compliance with applicable PSD increments considers only the impacts of the applicant's proposed emissions increase and the impacts of other emission sources constructed after the baseline date has been established for a particular pollutant.

The Agency has reviewed the modeling studies submitted for peaker projects to be located throughout the state. These projects range in size from as small as 25 MW to as large as 1000 MW. Emissions from these natural gas-fired units are typically small,

with NO_2 and CO being the pollutants emitted in greatest quantities (ranging from about 40 to 680 tons per year (tpy) for NO_2, and from 60 to 700 tpy for CO). Other air pollutants emitted from these units includes PM10 (10-360 tpy), SO_2 (5-250 tpy), and volatile organic compounds (VOCs) (2-130 tpy).

From the studies reviewed to date, none of the modeled impacts from these projects have been determined to exceed either the NAAQS or PSD increments for any of the relevant air contaminants. The highest impacts predicted for any of these units are compared to the appropriate Class II PSD increments in Table 2 in IEPA Exhibit 10. Even the largest of these facilities are not expected to cause impacts that approach the "ceilings" represented by the PSD increments and, therefore, do not constitute a significant deterioration as defined under PSD.

Although it has been demonstrated that the subject peaker plants will not cause impacts that exceed the PSD increments, it is not correct to conclude that all of these facilities have impacts that are insignificant. Under the PSD program, a source has an impact that is considered "significant" if it is shown, through modeling, that its potential impact exceeds an established "significant impact threshold," as defined under PSD. The "significant impact thresholds" are compared in Table 2 in Exhibit 10 to the maximum modeled impacts predicted from any of the peakers. From Table 2, at least the largest of the units have been shown to have impacts that are "significant," as defined under PSD, for at least NO_2 and PM-10. It is important to note, however, that the "significant impact threshold" does not represent an allowable "ceiling" in the same manner as the NAAQS or the PSD increments. Rather, the thresholds represent a trigger for the Agency to require more thorough modeling analyses. In the case of the sources in question, the

Agency has required that such detailed studies be performed even for those sources that are too small to trigger PSD review to ensure that the PSD increments and the NAAQS are protected.

Table 3 in IEPA Exhibit 10 provides a comparison of the highest impacts modeled for any of the peakers to the applicable NAAQS. To ensure compliance with the NAAQS, the impact of the proposed new emission source must be added to the impacts of all existing sources on a pollutant-specific basis. In Table 3 in IEPA Exhibit 10, I have assumed that the "worst case" impacts of existing sources can be represented by a "background concentration," which I have estimated by selecting the maximum concentrations observed by the Agency's monitoring network anywhere in the Chicago area in 1999 for each pollutant and averaging time. The sum of the "maximum peaker impact" and the "background concentration" is shown as the "total concentration" in Table 3, which can be compared to the NAAQS. For each pollutant and averaging time, the modeling results indicate that the NAAQS will not be exceeded. It should be noted that these data do not represent the results of any specific air quality study submitted to the Agency on behalf of a permit applicant. Rather these data, which conservatively combine the highest modeled impacts from any of the peakers with the highest measured concentrations (in 1999) from any of the monitoring sites in the Chicago area, are provided to illustrate that the operation of the peakers will not prevent compliance with the NAAQS.

Figures 1 through 4 in IEPA Exhibit 11 depict the expected geographic scale and magnitude of the impacts from a "large" natural gas-fired peaker that has been permitted by the Agency to operate in the Chicago area. Figure 1 shows the expected "footprint,"

or impact area, for NO_2. The shaded area on the figure represents the downwind area that may experience annual average NO_2 impacts from the proposed plant of at least 1 $\mu g/m^3$, the level of the significant impact threshold discussed previously. The peak annual NO_2 impact from this source is 3.24 $\mu g/m^3$. Thus, the impact of this facility can be considered significant (though the peak is much less than the NAAQS or PSD increment) within the area shaded on the map. The area shown on the map extends only a short distance from the plant's property line. It should be noted that most of the modeled impact shown here will result from the operation of the fuel heaters at the facility, not he natural gas-fired turbines themselves. The heaters typically have very short exhaust vents, which causes their impacts to be very close to the property line. The turbines, themselves, have much less of an impact than the heaters, less than 0.1 $\mu g/m^3$.

Figures 2, 3, and 4 depict the impact areas for the pollutants CO, PM10, and SO_2, respectively. For these pollutants, the maximum impacts shown on the figures are less than the significant impact thresholds *(i.e.*, the peaker's impact for these pollutants is not significant), so a lesser contour (or isopleth) value was chosen to illustrate the extent of the impact area. Again, the area affected by emissions from the source is somewhat localized.

To this point, I have described the methodologies and results of modeling performed by applicants for construction permits and reviewed by the Agency for criteria pollutants where the focus or concern about air quality effects is the localized area near the proposed source. The results of the studies reviewed to date have shown, to the Agency's satisfaction, that the natural gas-fired peakers permitted thus far will not threaten the NAAQS or PSD increments for NO_2, PM10, SO_2, and CO.

Photochemical Modeling

Now, I would like to discuss the Agency's efforts to ensure that the operation of the numerous natural gas-fired peakers will not hinder Illinois' efforts to reach attainment for the pollutant ozone. Presently, there are two areas of the State that are not currently meeting the 1-hour NAAQS for ozone, the Chicago and Metro-East metropolitan areas. Both of these areas have been the subject of extensive planning efforts by the Agency, not to mention numerous rulemakings by the Board, spanning almost two decades, with the goal of improving air quality to levels that attain the NAAQS.

Illinois has made great progress towards that goal, as shown by the ambient monitoring data illustrated in IEPA Exhibit 12. This figure depicts the trend in ozone air quality levels in the Lake Michigan area over the past ten years. The values shown represent the ozone design values at monitoring sites in the 4-state area that exceeded the NAAQS during the time periods indicated. The design value is the fourth highest 1-hour ozone concentration recorded at a given site in a 3-year period of record. Design values exceeding 0.124 ppm are in violation of the ozone NAAQS. From the Figure, it is apparent that ozone levels have improved dramatically in the last ten years, most notably in Illinois. During the 1987-1989 period there were numerous sites in the Chicago area that experienced violations of the NAAQS. The highest ozone design value in Illinois was 0.170 ppm, and the highest design value in the region, 0.190 ppm, was measured at Chiwaukee, which is at the Illinois-Wisconsin border. In the recent 1997-1999 period, there were no monitors in northern Illinois that are in violation of the 1-hour ozone NAAQS. The design value at Chiwaukee has been reduced to a level barely exceeding the NAAQS (0.126 ppm). Similar improvements are seen throughout the Lake Michigan

region and also in the multi-state St. Louis nonattainment area. Unfortunately, design values above the NAAQS are still observed in Wisconsin, as well as in the St. Louis area, so our efforts to improve ozone levels in the region are not yet completed.

To evaluate the impact of the peakers on ozone air quality, an entirely different modeling approach is required. A much, more complex, photochemical grid model, called the Urban Airshed Model – Version V (UAM-V), has been used by the Agency to address the urban- and regional-scale problem of ozone formation and transport. This model has been developed over a 10-year period as a result of the cooperative efforts of the four Lake Michigan states, under the technical direction of the Lake Michigan Air Directors Consortium (LADCO). This model has since been applied by other states and the U.S. EPA for ozone-planning applications in other parts of the country.

In recent months, LADCO and the four Lake Michigan states having been using the model to develop 1-hour ozone attainment demonstrations as required by the Clean Air Act. Illinois must submit an attainment demonstration for the Chicago area by December of this year. This demonstration must show, through the use of the UAM-V, that the control measures adopted, or to be adopted, by Illinois and other upwind states will result in air quality improvements sufficient to bring the area into attainment by 2007. Although this work is not yet completed, the Agency expects that implementation of U.S. EPA's NOx SIP Call, in conjunction with other control measures required by the Clean Air Act, will be sufficient to demonstrate attainment. To evaluate the effect of the peakers on ozone air quality, the Agency has applied the UAM-V for the attainment year, 2007, using model inputs (emissions, meteorology, etc.) developed by LADCO. The results of this modeling effort are shown in IEPA Exhibits 13 through 17.

Exhibit 13 represents the daily maximum 1-hour ozone concentrations for each day of the ozone episode, July 16-20, 1991, assuming control measure required by the CAA by 2007. An episode, for modeling purposes, represents the meteorological conditions for which appropriate model inputs have been developed that have been observed in the past to cause high ozone concentrations in the Lake Michigan region. To evaluate the air quality effects of expected changes in emissions, an emissions inventory that reflects those changes is input to the model with meteorological inputs derived from an historical episode (*i.e.*, conditions that have already occurred and are known to cause high ozone in the region). If meteorological conditions that are similar to those that occurred during July 1991 were to recur during 2007, then the concentrations illustrated in Exhibit 13 would be expected in the region, assuming full implementation of federally-mandated CAA control measures required by that time. This scenario, which does not include the NOx SIP Call, is provided as a baseline to compare subsequent model scenarios. Red colored contours indicate areas expected to exceed the 1-hour ozone standard. Based on these results, both the Chicago and St. Louis metropolitan areas may still exceed the ozone standard in 2007, unless control measures more stringent than those currently mandated by the CAA are implemented. Of the five days modeled, ozone level exceeding the standard are shown on one day downwind of Chicago (July 20), and on three days downwind of St. Louis (July 17,18, 20).

Exhibit 14 represents the daily maximum 1-hour ozone concentrations at each modeled grid cell assuming that the control measures required by the NOx SIP Call are implemented by 2007, in addition to the CAA controls. The results show that the magnitude and extent of ozone levels above the standard in Chicago and St. Louis are

substantially reduced. Modeled exceedances are still shown on one of the days modeled (July 20), although this does not mean that this scenario is not sufficient to demonstrate attainment. Since the ozone standard allows for some exceedances even in attainment areas, U.S. EPA's modeling guidance similarly allows for limited modeled exceedances in an attainment demonstration. My purpose here is not to present an attainment demonstration, but to use this scenario, which comes close to demonstrating attainment, to evaluate the incremental effect on air quality of the peakers.

Exhibit 15 is called a "difference plot." It doesn't show peak ozone concentrations expected from a particular emissions scenario, but rather shows the difference between two scenarios. In this case, the figure depicts the maximum difference in ozone levels expected in 2007 between the NOx SIP Call versus the Clean Air Act scenarios presented previously. Areas shown in blue and green are projected to experience air quality improvements due to the more stringent control requirements required by the NOx SIP Call, and the small areas shown in yellow and red may actually experience worse ozone concentrations, at times, due to the so-called NOx disbenefit. In general, the results indicate that widespread improvements in ozone levels, from 2 to more than 18 ppb, can be expected as a result of the SIP Call controls beyond the levels expected from CAA controls alone.

Exhibit 16 represents the daily maximum 1-hour ozone concentrations resulting from inclusion of NOx and VOC emissions from peakers in the SIP Call scenario. Emissions from both simple cycle and combined cycle turbines are included to ensure that the "worst case" scenario has been addressed. It is difficult to perceive any appreciable differences between this figure and the comparable Exhibit (Exhibit 14) for

the SIP Call scenario. This suggests that the impact of peaker plant emissions on overall daily maximum ozone levels is small.

A difference plot depicting the expected change in ozone levels expected as a result of the operation of the peakers is provided in Exhibit 17. Specifically, this figure shows the maximum daily change in ozone that can be expected when adding the emissions from the peakers to the NOx SIP Call scenario. Again, areas shown in yellow and red are areas where higher ozone levels are projected, and areas in blue and green are areas ozone levels are projected to decrease (an inverse response of the same NOx disbenefit phenomena mentioned previously) as a result of NOx emissions contributed by the new peakers. Note that the contour levels have been exaggerated compared to Exhibit 15 to show the smaller magnitude ozone response from this scenario. The results suggest that ozone concentration increases, of the magnitude of 1 to 4 ppb, can be expected from simultaneous operation of all the peakers on high ozone days. In general, increases in ozone levels of this magnitude can be expected in many areas in Illinois, including the Chicago metropolitan area. Comparing Exhibits 16 and 17, increases of 1 ppb or less can be expected in the areas of highest ozone, which are typically predicted to occur over Lake Michigan. Higher impacts from the peakers are predicted to occur in areas where the modeled concentrations are less than the NAAQS. Ozone changes due to emissions from the peakers are not indicated in the Metro-East area.

The expected emissions from the natural gas-fired turbines, or peakers, will not greatly affect the State's ability to demonstrate attainment of the 1-hour ozone standard. The model's response to projected emissions increases is small relative to the improvements in ozone air quality achieved to date and to improvements expected in the

coming years from control programs yet to be implemented. It should be recognized that the operation of these plants can be expected to cause increased levels of ozone within the Chicago metropolitan area, in areas of high population density. However, these areas already have, and should continue to have, ozone air quality levels that meet the 1-hour ozone standard.

Conclusion

This concludes my testimony. I will be happy to answer any questions.

Illinois Environmental Protection Agency

By_____

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DATED: August ___, 2000

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