

ILLINOIS POLLUTION CONTROL BOARD
December 29, 1983

IN THE MATTER OF:)
)
SULFUR DIOXIDE EMISSION) R80-22(B)
LIMITATIONS; VILLAGE OF WINNETKA)

FIRST NOTICE. PROPOSED OPINION.

OPINION OF THE BOARD (by J. D. Dumelle)

At the outset, this rulemaking included a proposal by the Illinois Environmental Protection Agency (Agency) to limit the sulfur dioxide emitted from existing fuel combustion sources in the Chicago, St. Louis (Illinois) and Peoria major metropolitan areas to 1.8 pounds per million British thermal units (lbs/mBtu) of actual heat input. The Village of Winnetka (Village) sought to include a site specific rule so that its utility plant could emit up to 5.7 lbs/mBtu of sulfur dioxide. A draft Opinion was issued by the Board on August 30, 1982 and the rules proposed for First Notice were published on September 17, 1982. The Opinion proposed to deny the Village the requested site-specific limitation for two reasons. Although the Village had participated in the rulemaking, it was not until hearings in June of 1982 that the specifics and the supporting evidence of the Village's request became known. The Board reasoned that this did not provide sufficient time for notice to or response from concerned public. Secondly, the draft rules in R80-22 included an adjudicatory format for existing individual sources to seek relaxed, alternative limits. In the draft Opinion, the Board cited the Village's utility plant as a possible candidate for the new exemption procedure.

Preferring a site-specific rule the Village exercised its right to request an additional hearing during the First Notice period (Ill. Rev. Stat. 1981, ch. 127, par. 1005.01(a)). On October 8, 1982 the request was granted and the subject of the additional hearings limited to the Village's petition. To avoid delaying the adoption of the rules already proposed, on October 14, 1982 the Board ordered the R80-22 docket divided and the Village's site-specific rulemaking assigned to Docket B. When the proposed rules (Docket A) were adopted as final on February 24, 1983, the Village's utility plant was exempted from the 1.8 lbs/mBtu limit pending the outcome of Docket B. This Opinion principally pertains to Docket B.

After separating the Village's request from the whole of R80-22 two more hearings were held in Winnetka on November 3

and December 15, 1982. As noted above, information pertaining to the Village's request was also entered at the June 1 and 22, 1982 hearings.

Where Tower Road meets Lake Michigan in Winnetka, the Village owns and operates a electrical generating plant which supplies the power needs for the Village's 13,000 residents and small businesses. There are no major industrial users within the two and half mile radius serviced and the Village does not generate additional power for sale. (R. 843) On site are five boilers and two diesel generators. Two boilers are in wet storage and are not currently permitted by the Agency; a third, Boiler No. 4, is permitted to operate on gas or oil. Boiler No. 8, which was built in 1964, is the principal power source with a rated capacity of 125,000 pounds of steam per hour or 12.5 megawatts. This boiler is equipped with a multiclone dust collector and ash recirculation. Boiler No. 7, built in 1948, also operates on coal and has a rated capacity of 70,000 pounds of steam per hour or 65 megawatts. Both diesels were installed in 1979 and are of a rated capacity of 2,500 pounds of steam per hour. All seven sources vent from a common stack. Currently, boiler No. 8 produces 85 to 87 percent of Winnetka's energy needs on a day to day basis. Boiler No. 7 is used to generate the additional electricity when the demand is predicted for a period greater than eight hours. If not, Boiler No. 4 or the diesels are utilized. Annually, Boiler No. 7 provides approximately only 2 percent of the necessary kilowatt hours. (R.852)

Of the 23 million tons of coal consumed annually by Illinois utilities, the Village's plant consumes approximately either 45,000 tons of Illinois coal or 54,000 tons of western coal. (R.1053) Twenty percent more western coal must be purchased to make up for its lower heat value and higher moisture content. Including delivery costs western coal costs approximately \$75 per ton, whereas Illinois coal costs approximately \$53 per ton. The Village is currently burning Illinois coal, specifically coal from Orient No. 3 mine, pursuant to a permit issued by the Agency in April, 1982. Since the Village has been allowed to use Illinois coal it has provided 90 percent of Winnetka's electricity (R.899). Under a short term contract, 450 tons are delivered weekly after being screened and washed to reduce the sulfur content and dust. Since Illinois coal has been used, the highest sulfur content measured has been 2.14 percent. The Village is requesting to use Illinois coal with a maximum sulfur content of 3.2 percent, (R.911,877).

To demonstrate that Illinois coal of this quality could be burned at its power plant, without installing additional pollution control equipment and without violating applicable ambient air quality standards, the Village offered a two part modeling study (Ex. 12 and Ex. 22). Particulate matter con-

centrations, as well as sulfur dioxide concentrations were calculated. The first phase considered the actual operating requirements during 1979. That is Boiler No. 8 was assumed to provide the baseload, with Boiler Nos. 4 and 7 and the diesels providing additional power when necessary. The second phase assumed both Boiler Nos. 7 and 8 at full load. Aside from those parameters premised on the hypothetical load, the input data remained much the same for both parts of the study. At each phase, two computer runs were made each assuming the use of a different Illinois coal, that from Orient No. 3 mine and from Fidelity No. 11 mine.

The dispersion model developed and used by the Village was premised on the United States Environmental Protection Agency's (USEPA) Single Source Model known as the CRSTER. The data requirements, processing techniques and input/output formats were modified to develop a non-guideline, Case 1 model. The principle variation was premising the atmospheric stability data on meteorological data from the Zion nuclear power plant, 23 miles to the north, as opposed to that from Midway and O'Hare Airport which are eight and twelve miles inland, respectively. The Zion meteorological data satisfies the federal requirements (10 CFR 50, App. B), but the CRSTER model had to be modified to accommodate this more representative lakefront information. Mixing heights were specifically developed for this site based on real information compiled by Argonne National Laboratory for the Chicago area in the late 1960's instead of predicting values from vertical temperature profiles and hourly surface temperatures (Holzworth inferential technique). To verify that the changes did not substantially alter the CRSTER's program, the modified program was tested using 24 hours of test data from the CRSTER model. The differences in result were within 0.2 percent.

The Village's modeling was intended to calculate hourly concentrations for an entire year. It used a grid consisting of ten down range receptors and seventy-two radials. Consequently the running 3 hour and 24 hour concentrations, as well as the annual arithmetic/geometric mean concentrations were measured at 720 locations over the surrounding lake and land mass. From these predictions the highest concentrations of the pollutant could be identified and assessed against the applicable air quality standards.

The modeling program included certain constants. The stack's diameter was set at three meters, the temperature at 350° F, (or 375° F for the full load model) and its height at 57 meters. At this height the stack is considered consistent with good engineering practice, that is, high enough above the plant's roof and other obstructions to avoid interference or induced turbulence. Rural dispersion coefficients were used instead of urban coefficients. According to USEPA methodology, given the non-industrial characteristics of the Winnetka area, these are more appropriate than the latter. The reference plane was the

plant's rooftop which was level with the 19 meter high bluff the plant abuts to the west. This was the only terrain factor taken into account.

Other program input varied on an hourly basis. Wind speeds, directions, temperature, and atmospheric stability were included at actual hourly values from 1979. Representative values for boundary levels were selected from real mixing height data based on the Argonne study. A value of 1000 meters was used for daylight hours; 100 meters for night hours when wind speeds were equal to or less than 10 miles per hour; and 200 meters when wind speeds were higher. These hourly values, along with the above described constants, were run first, with the coincident operating loads actually experienced in 1979, and then again assuming Boiler Nos. 7 and 8 to be operating at full load. The size of the load, as well as the heat value of the coal can alter the stack gas exit velocity and the amounts of sulfur dioxide emitted. The following table lists the highest concentrations predicted at both loadings, along with sulfur content and heat value for each type of coal.

TABLE 1

Coal	Sulfur Content	Heat Value	Load	Annual	24 Hour	3 Hour
				(80ug/m ³)	(365ug/m ³)	(1300ug/m ³)
Orient No. 3	1.77%	11,780 Btu/lb	Actual	2	69	318
			Full	2	71	361
Fidelity No. 11	3.19%	11,054 Btu/lb	Actual	4	133	610
			Full	4	132	618

The modeling assumed background concentrations to be zero. However adding the model's highest predicted values and the highest measurements recorded at nearby monitors in Skokie, Wilmette and Waukegan provides an estimate of the combined impact, should the Village be granted the relaxation. These estimates are the hypothetical worst case scenarios since the highest values from the model and monitors are being added regardless of the time and date predicted or recorded. Table 2 compares the sum totals to the short term and annual standards, using values measured in 1980. (Monitored values reported for 1981 were checked and found to be lower).

TABLE 2 (ug/m³)

Coal		Modeled	Measured	Sum	Standard
Orient #3	Annual	2	25	27	80
	24-Hour	69	165	234	365
	3-Hour	318	291	609	1300

<u>Coal</u>		<u>Modeled</u>	<u>Measured</u>	<u>Sum</u>	<u>Standard</u>
Fidelity	Annual	4	25	29	80
#11	24-Hour	133	165	298	365
	3-Hour	610	291	901	1300

In proposing the 1.8 lbs/mBtu limit for the Chicago major metropolitan area, the Agency identified only two sources as possible candidates for a more relaxed limitation. (R. 562) For that reason it did not generally propose a higher emission rate. The Village's power station was one of those two sources. An Agency memorandum of January 21, 1982 evaluating the Village's modeling found that a 5.7 lb/mBtu limit would not cause violations of the short term standards. (Ex. 11) However, the Agency considered additional modeling necessary. (R. 596)

The Village completed its modeling analysis in March, 1982 and submitted additional information pursuant to Agency's inquiry. The Agency in turn evaluated the model to verify that it was conservative. It used the guidelines recommended in the CRSTER model and maximum load at 5.7 lbs/mBtu was assumed for every hour of the entire year. Evaluation of only one year was considered necessary since on-site data had initially been used.

The Agency's verification run only assumed the use of Fidelity No. 11 coal since it has the highest sulfur content of the two types. Like the Village's model it did not include background levels. As indicated below in Table 3 the Agency's model resulted in levels proximate to or below those predicted by the Village's single source modified model. Using the same methods and background levels assumed by the Village, the hypothetical impacts are also calculated.

TABLE 3 (ug/m³)

<u>Standard</u>	<u>Village Highest</u>	<u>Agency Highest</u>	<u>Background</u>	<u>Village Background</u>	<u>Agency Background</u>
Annual (80ug/m ³)	4	5.6	25	29	31
24 Hour (365ug/m ³)	133	66	165	298	231
3 Hour (1300ug/m ³)	610	315	291	901	606

Comparison of the above figures indicates that the Agency's modeling verifies that the Village's model was conservative when compared to the CRSTER model.

The Village investigated installation of pollution control equipment in order to meet the 1.8 lbs/mBtu limit and still utilize Illinois coal. Installation of wet scrubbers was

estimated to necessitate capital expenditures of \$3.2 million dollars. However, this alternative was prohibitive, not due to the costs, but because land was not available to facilitate storage facilities, slurry mixing plants, slurry holding areas venture and separators. The Village also noted that the delivery of lime, the noxious odors created by the formation of hydrogen-sulfide gas and the increased steam plume would be a nuisance to the plant's residential neighbors. (R. 836) By interim order, the Board requested that the Village investigate the possibility of dividing its stack in order to increase exit velocity. It was hoped that the resulting increased plume rise, in combination with the plant's stack height, could negate any effect the lake breezes might have in increasing downwash or boundary interference and reduce alleged odor nuisances. Division proved impossible since the stack is made of metal. The Village's engineers also noted that increased exit speed will not affect final plume rise because it is a function of volumetric flow, which is a constant. (Public Comment #30).

The Economic Impact Study prepared by the Department of Energy and Natural Resources did not specifically consider the Winnetka facility and the economic ramifications should it be allowed to burn Illinois higher sulfur coal. The Village did provide numerous details. From 1958 until 1975 it made an estimated profit of \$11,999,000 or \$638,000 per year. \$3 million of that was paid to the Village in dividends. Another \$1.5 million was contributed to the Village's operating expenses. (R. 976) The net worth of the plant was \$3,710,000 in 1957, \$8,613,000 in 1975 and \$11,000,000 in 1982. Improvements at the plant were paid for out of earnings.

Before 1971, the plant produced all of the Village's energy needs. Then an interconnect with Commonwealth Edison was completed. By 1973 the Village was purchasing base load power and generating power only to meet intermediate and peak power demands. To keep purchase power costs at 4.1¢ per kw/hr in the late 1970's and early 1980's the Village continued to generate intermediate and peak power. If it did not the price would have been 5.5¢ per kw/hr. The Village also sought to keep minimal its firm or demand power costs from Commonwealth Edison. Since burning Illinois coal under the Agency issued permit, the Village has been producing over 90 percent of its energy demands and purchasing only economy power from Commonwealth Edison.

In addition to the lower power costs and revenue generated which aid its residents, the Village claimed socio-economic benefits due to its plant's operation on Illinois coal. The Village is committed to using Illinois coal and although it will not purchase large amounts of it, some increased economic activity should be generated in Illinois. The Village's plant employs 18 persons. Finally, the Village anticipates that it will be able to provide its residents with power when other areas are

experiencing power outages. Several examples of power failures were testified to during hearing, but the Village countered that these occurred while it was buying from Commonwealth Edison, prior to its burning Illinois coal.

At hearing Citizens for a Better Environment (CBE) proffered a critical review of the modeling analysis provided by the Village. The review was three part: (1) a discussion of the coastal meteorological adversely affecting pollutant dispersion; (2) the inapplicability of the Village's model and the underlying CRSTER model in assessing the Village's lakefront facility; and (3) specific problems with select model input data and modeling assumptions. CBE's presentation was subsequently reviewed and commented on by the Village, to which CBE responded at hearing and in written comments.

CBE began with an explanation of meteorological phenomena pertinent to coastal environments. Of primary concern in evaluating adverse effects to pollution dispersion at the shoreline is the thermal internal boundary level (TIBL). A TIBL, which consists of heat moisture and momentum, forms due to the physical discontinuity of water and land surfaces when the cold water surface air comes into contact with warmer land surface air. The TIBL starts at the shoreline and its height gradually deepens to a maximum of 500 feet as the distance inland increases. If the stable plume from the stack intercepts with the TIBL, fumigation results; if it is below the TIBL's ceiling, trapping results. Fumigation occurs primarily on sunny days, whereas trapping occurs on overcast days or at night. Either condition affects ground level concentration of pollutants.

CBE suggested several models developed to specifically address the effects of lake breeze circulation and gradient onshore flow on TIBL formation which would have been preferable to accurately predict ground level concentrations for the Winnetka facility. Furthermore, CBE believed that the modified CRSTER model developed by the Village was inappropriate because the underlying model was applicable to rural areas uncomplicated by terrain and coastal influences. As such it did not sufficiently account for maximum ground level concentrations under conditions of gradient onshore flow, continuous fumigation or lake breeze circulation.

CBE acknowledged that the Village's use of meteorological data from Zion was preferable to that from Midway or O'Hare. However, it disagreed with the method the Village used this data to determine atmospheric stability. That method, known as the Delta T method, CBE argued was for low emission sources such as nuclear reactors, not stacks at fossil fuel plants. CBE also disagreed with the use of the power law formula to extrapolate windspeeds for measure at 10 meters at the Zion tower. Since windspeeds were also measured there at 38 and 76 meters, CBE

argued that these would have been preferable. Finally, CBE argued that the constant mixing heights chosen by the Village did not adequately take into account deviations caused by TIBLs.

In response, the Village verified that the Delta T method was appropriate for determining atmospheric stability in modeling its facility. (Ex. 24, 25) The Village believed it preferable because it requires the fewest assumptions (R. 1258). CBE later agreed that the Delta T method was appropriate for sources with stacks as low as the Village's but offered that it should not be relied on solely. (P.C. 23, at 34) As for wind speeds, the Village compared those measured at 76 meters at the Zion facility to those derived by the power law formula and found them similar. (R. 1263) Finally, the Village explained that its model took into consideration trapping since the modeled plume height was less than the assumed mixing heights during both daytime and nighttime calculations. Its model assumed the presence of a TIBL, but its height was always considered greater than the stack's plume rise. Had lesser mixing height values been modeled, the Village alleges that lower ground levels would have been predicted. The Village contends that these assumptions make the model more conservative. (R. 1267-71) Although its model accounted for trapping, it did not consider the effects of fumigation. According to the Village, fumigation was not of practical concern since six conditions would have to exist simultaneously, but also because it believed the modeled facility's plume height never to be higher than the boundary's ceiling, making interception, i.e. fumigation, impossible.

The critical review provided by CBE raised alternative modeling parameters and suggested that a site specific model would be appropriate. CBE believed a number of models to be more appropriate in assessing pollution dispersion from the lakefront facility. Prior to CBE's review, the Agency believed the data input to be sufficiently source specific that only one year be considered under worst case conditions. There is no federally approved modeling program for lakefront or coastal environments. After CBE's critical review, the Agency still believed the modeling adequate for the proposed relaxation to be approved federally.

Given the responses to the inquiries posed by CBE, the Board is able to conclude that the Village's modeling incorporated sufficient meteorological data similar to that likely to occur at and near its facility. Also it used techniques considerate of lakefront atmospheric conditions, and violations of the applicable standards are not approached. The record in this matter now includes the parameters developed for the facility, as well as an assessment of alternatives. Short of developing site specific meteorological information, the Village's model as developed, adequately accounted for the lakefront environment and indicated that the applicable air quality standards and public health and welfare will not be endangered. Furthermore, since the facility and its emissions are considered to be small and the Zion meteo-

rological data was used, a site specific model is unwarranted. The Board having reviewed the testimony and comments on the modeling format and the results, concludes that the ambient air quality standards for sulfur dioxide are not violated and an adequate margin of safety for health and growth is preserved. The Winnetka facility is located in a residential area with stabilized energy demands. The surrounding area is also unlikely to be developed industrially. Therefore, the Board need not assess hypothetical consumption of Prevention of Significant Deterioration increments.

Citizens from Winnetka testified concerning odor and noise nuisances associated with this facility. Likewise citizens testified about not having experienced such nuisances. The issue of odor is highly debatable. Different persons experience different sensitivity thresholds. Furthermore it is difficult to isolate an odor to its source at a particular point in time. That time would also be difficult to relate to the 3 or 24 hour air quality standards for sulfur dioxide. The Agency submitted data from the U.S. Department of Transportation which lists the sulfur dioxide odor threshold at 3 parts per million, which can be converted to 7,873 micrograms per cubic meter. (R. 1298) This is significantly greater than the applicable standards.

Although the questions of odor and noise nuisance are not properly before the Board in this rulemaking, the citizens's concerns were addressed in the Board's order for additional information. The Village responded that it had not received or been notified of nuisance complaints since May of 1982. (P.C. 30) The Village also explained a malfunction, but did not believe it caused any environmental problems. Finally, the Village submitted correspondence between itself and a resident exchanged to resolve a noise problem.

This rulemaking solely addresses sulfur dioxide emissions. Nevertheless the Board would be reluctant to grant a relaxation which would in turn aggravate another environmental problem. In this instance the alleged odors nuisances are not documented to be linked to the use of medium sulfur coal at the facility since Spring of 1982. Should persons experience nuisances, they are free to negotiate with the Village or bring an action before the Board to resolve those issues.


In granting the relaxed emission limit as a site specific rule for the Village of Winnetka's power plant, the limitation shall be expressed as a mass emission limit. This will eliminate use of a poorer quality of fuel at reduced loads which in turn could result in lower plume heights and higher ground level pollutant concentrations. The Village's modeling which considered Nos. 7 and 8 Boilers to be operating at full load adequately demonstrated that violations of the applicable standards will not

result at an emission rate of 5.7 pounds per million British thermal units of actual heat input.

This Opinion supports the Board Order of December 1, 1983.

Board Member Bill Forcade abstained.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, do hereby certify that the above Opinion was adopted on the 29th day of December, 1983 by a vote of 6-0.



Christan L. Moffett, Clerk
Illinois Pollution Control Board