



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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MEMORANDUM

SUBJECT: Use of ISC2 Direction-Specific Building Dimensions
in Modeling for Alcoa

FROM: *For J. Schmitt*
Edwin L. Meyer, Acting Chief
Source Receptor Analysis Branch, TSD (MD-14)

TO: James W. Yarbrough, Air Modeling Contact
Region 6 (6T-AP)

In response to your request, the Model Clearinghouse has reviewed your proposal to recommend the use of Huber-Snyder directional downwash for the modeling analysis of the Alcoa plant in Milam County Texas. Related to this, we also have discussed the technical details and history of the use of directional downwash. Based on these discussions we mutually agreed that use of the Huber-Snyder directional downwash was appropriate for the Alcoa plant. The following summarizes our discussions and rationale leading to that conclusion, as we recall it.

BASIS FOR THE ISSUE

On March 1, 1992, the testing and evaluation of the Industrial Source Complex (ISC2) model was completed and ISC2 became the preferred version for use in regulatory assessment modeling analyses. This new version of the ISC provides the capability of computing the hour-by-hour characterization of dispersion using direction-specific building dimensions for all building downwash situations. Prior to this release of ISC, use of hour-by-hour direction-specific building dimensions was limited to only situations with relatively low-level releases.

With the advent of the new version of the model, the question has arisen whether receptor-specific building dimensions should be used in all cases, or should the use of receptor-specific dimensions continue to be limited as before?

DISCUSSION

To understand this issue it is necessary to remember that the current ISC building downwash characterization is a composite of two approaches. The Huber-Snyder (1976) characterization is used if $h_e > h_b + \ell/2$, where ℓ is the $\min(h_b, h_w)$, h_b and h_w are the

building height and width, and h_e is the plume effective height. If the inequality is reversed the Schulman-Scire (1980) characterization is used. The Schulman-Scire characterization was added to the ISC model as part of Supplement A to the Guideline of Air Quality Modeling, which became effective on October 9, 1986. Up until this point, treatment of building effects was handled solely using the Huber-Snyder characterization.

The Huber-Snyder characterization: (1) enhances the vertical dispersion for effective heights below $h_b + 1.5\ell$, and (2) enhances the lateral dispersion when h_s/h_b is less than 1.2, where h_s is the stack height. The Schulman and Scire characterization augmented the Huber-Snyder characterization by: (1) reducing plume rise due to initial plume dilution, (2) making the vertical dispersion enhancement a linear function of the effective plume height, and (3) providing for the use of receptor-specific building dimensions.

As described in the December 1979 and December 1987 versions of the Industrial Source Complex (ISC) Dispersion Model User's Guide, the Huber and Snyder characterization was implemented using a single effective building width ℓ for all wind directions. The simplification of using only one building width for all wind directions was described in the user's guide as a necessary constraint imposed on the program in order to not sacrifice other desired ISC model features. The user's guide outlined a recommended procedure for refining the design concentration estimates if it was believed the design concentrations were a consequence of building downwash and the Huber and Snyder characterization was operative. It was recommended in these cases that the ISC model calculations be repeated for receptors near the source with the highest calculated concentration (or deposition) values using receptor-specific values of the building dimensions.

When the ISC model was revised to include the Schulman-Scire characterization, it provided for the use of direction-specific building dimensions and procedures were given on the manner in which the building dimensions were to be specified. No alterations were made at that time to the Huber and Snyder characterization, thus necessitating the continued practice of using a single effective building width for all wind directions. However, the recommended procedure for refining the design concentration estimates for receptors near the source with the highest calculated concentration (or deposition) values using direction-specific values of the building dimensions was continued.

CONCLUSION

Thus it is evident that at no time in history has there been any intention to preclude the use of direction-specific building dimensions with the Huber-Snyder characterization of building

effects on dispersion on the grounds that it was technically insupportable. To the contrary, the early versions of the ISC user's guide specifically mentioned that the Huber-Snyder characterization was implemented in a simplified form because of computer memory limitations. By extending ISC2 to provide for the use of hour-by-hour receptor-specific building dimensions for both the Huber-Snyder and the Schulman-Scire characterizations of building downwash, ISC2 obviates the use of the work-around solution previously in place for refining impacts resulting when Huber-Snyder downwash calculations were operative.

REFERENCES

Huber, A.H. and Snyder, W.H., (1976): Building wake effects on short stack effluent. Preprints Third Symposium on Atmospheric Diffusion and Air Quality, American Meteorological Society, Boston, MA, pp 235-242.

Schulman, L.L. and Scire, J.S., (1980): Buoyant Line and Point Source (BLP) Dispersion Model User's Guide. Document P-7304B, Environmental Research and Technology Inc., Concord, MA, pp 207.

APPLICATION

Based on the above rationale we agree with your position that the Huber-Snyder directional downwash should be used for the Alcoa case, where appropriate. Effectively this amounts to providing as input direction-specific building dimensions to ISC2; the model will then perform the correct calculations for whatever downwash algorithm is in effect.

If you have any questions please contact John Irwin at 919-541-5682.

bcc: Regional Modeling Contact, Regions I-X (with copy of incoming memorandum and list of FY-92 Clearinghouse memoranda)

FY-92 MODEL CLEARINGHOUSE MEMORANDA

<u>Date</u>	<u>Region</u>	<u>Subject</u>
10/16/91	IV	Dade County, Florida, Stack Height Increase
11/7/91	VI	Phelps Dodge--Hidalgo Modeling Protocol
11/15/91	VIII	ASARCO E. Helena Lead State Implementation Plan (SIP)
12/04/91	I	Proposal to Use a Non-Guideline Model to Satisfy Intermediate Terrain Policy in New Source Permitting (Pine State Power; Jay, Maine)
12/23/91	VIII	East Helena Lead SIP - Protocols for Design Value Determination, and Model "Verification"
12/26/91	VI	Information Copy of El Paso-Juarez PM-10 Modeling
01/13/92	I	NHARD Modeling Guideline
01/27/92	VIII	East Helena Lead SIP - Protocols for Design Value Determination and Model "Verification"; Clarification of Model Clearinghouse Memorandum of December 23, 1991
03/06/92	I	Modeling Credits for Stack Height Increases and Merging Flue Gases at Taunton Municipal Light Plant
04/06/92	V	Proposal for Resolving the SO ₂ State Implementation Plan Revision for Rhineland, Wisconsin
06/23/92	I	Ozone Modeling Requirements for the Lewiston-Auburn and Knox-Lincoln Counties' Moderate Ozone Nonattainment Areas in Maine
08/03/92	X	Healy Clean Coal Visibility Analysis

FY-92 MODEL CLEARINGHOUSE MEMORANDA (Cont'd)

08/18/92	III	Transcontinental Gas Pipe Line Corporation's Use of a Nonguideline Approach for Estimating the Amount of NO that is Converted to NO ₂
08/20/92	VI	Use of ISC2 Direction-Specific Building Dimensions in Modeling for Alcoa