UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
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4APT-ARB

Mr. A. A. Linero, P.E.
Administrator/New Source Review Section
Florida Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

SUBJ: Use of ISC-PRIME
PSD Permit Application
U.S. Sugar Corporation Clewiston Mill
Clewiston, Florida

Dear Mr. Linero:

Thank you for providing the Prevention of Significant Deterioration (PSD) permit application for the U.S. Sugar Corporation - Clewiston Mill, dated June 1999. This application requests an increase in the operation of the sugar refinery and Boiler No. 4. Our review comments excluding the air quality impact assessment were provided in our September 20, 1999, letter. The purpose of this letter is to provide our evaluation of the appropriateness of the use of the none-guideline ISC-PRIME dispersion and transport model for the ambient air impact assessments resulting from the proposed Clewiston Mill modifications.

The justification for the use of the non-guideline model [i.e., model not recommended in the United States Environmental Protection Agency's (EPA) Guideline on Air Quality Models (40 C.F.R. 51, Appendix W)] was provided in the U.S. Sugar Clewiston Mill PSD permit application. This justification, combined with available articles and documents on the development and performance of the ISC-PRIME model, were the basis of our review and evaluation.

The reviewed articles and development documents reported ISC-PRIME to perform as well as or better than ISCST3 when predicted maximum concentrations are compared to observed measurements. ISC-PRIME was also found not to be significantly biased toward under-estimation of maximum concentrations. A summary of our case-by-case evaluation of ISC-PRIME for the U.S. Sugar Clewiston application is provided as an attachment.

Based on our evaluation of ISC-PRIME, EPA concurs with the use of this model for the Clewiston Mill air impact assessment. In accordance with EPA's division of responsibility with respect to non-guideline model approval, this EPA Region 4 case-by-case approval for the U.S.

Sugar Clewiston application is not an endorsement for use by any other source. EPA's Office of Air Quality Planning and Standards (OAQPS) is currently considering a generic approval of ISC-PRIME. If generically approved, ISC-PRIME may become a guideline model for general application.

It should be noted that any public notice of this project must include the fact that the air quality impact assessment was performed using a case-specific approved non-guideline ISC-PRIME model. The public must be provided an opportunity to comment and have a public hearing on this matter.

Thank you again for the opportunity to review and comment on this PSD application. If you have any questions, or if we can be of further assistance, please contact Mr. Stan Krivo of the EPA Region 4 staff at (404) 562-9123.

Sincerely,

Douglas Neeley

R. Douglas Neeley
Chief
Air and Radiation Technology Branch
Air, Pesticides and Toxics
Management Division

Attachment

cc: Joseph A. Tikuart, EPA/OAQPS
Cleve Holladay, FDEP
Tom Rogers, FDEP

Evaluation of ISC-PRIME For Application To
U.S. Sugar Corporation Clewiston Mill
Air Quality Impact Assessment

Introduction

The Florida Department of Environmental Protection (FDEP) has reviewed the Prevention of Significant Deterioration (PSD) permit application for a modification of U.S. Sugar Corporation (U.S. Sugar) Clewiston Mill. One of FDEP's concerns is the application of the non-guideline ISC-PRIME dispersion and transport model to the ambient air quality assessment. The use of the guideline ISCST3 dispersion and transport model for the U.S. Sugar Clewiston Mill emission sources reveals very large predicted SO_2 and PM10 concentrations at the site boundary - concentrations that exceed the PM10 and SO_2 National Ambient Air Quality Standards (NAAQS). Use of the ISC-PRIME model with the same input emission and receptor values also predicts large concentrations, but none that exceed the applicable PSD increments nor NAAQS.

The ISC-PRIME model has been submitted to the United State Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards (OAQPS) for consideration as a guideline model. OAQPS have reviewed and tested this model. It was also reviewed at the 1998 Regional/State/Local Agency Modelers Workshop. With a few restrictions, the Workshop participants recommended ISC-PRIME be included as a guideline air quality model in the next revision to the Guideline on Air Quality Models (GAQM).

Although OAQPS may propose ISC-PRIME for inclusion as a guideline model, this has not officially been proposed and public comment has not been solicited. Therefore, ISC-PRIME remains a non-guideline model that must be evaluated and approved for application on a case-by-case basis. The U.S. Sugar PSD application is the first time the ISC-PRIME model has been used in a regulatory application in EPA Region 4. The following is a summary of EPA Region 4's review of U.S. Sugar's justification of the appropriateness of ISC-PRIME for the assessment of ambient air impacts.

Reviewed Documents - ISC-Prime and U.S. Sugar Corporation

The following documents were reviewed in the case-by-case justification for the use of the non-guideline ISC-PRIME dispersion and transport model for the PSD air quality impact assessment of planned modifications of the U.S. Sugar Clewiston, Florida facility.

1. Hastings, Janis; "Review of the ISC-PRIME model, GVEA Healy Power Plant Air Quality Control No. X049"; Letter from U.S. Environmental Protection Agency Region 10 to Alaska Department of Environmental Conservation; April 29, 1998.

2. Paine, Robert J., and Frances Lew; "Project Prime: Evaluation of Building Downwash Models Using Field and Wind Tunnel Data"; Undated article and presentation slides developed by ENSR Corporation for Electric Power Research Institute (EPRI) Project RP 3527-02.

3. Paine, Robert J., and Frances Lew; "Results of the Independent Evaluation of ISCST3 and ISC-PRIME"; Final Report; Electric Power Research Institute; November 1997.

4. Shulman, Loyd L., David G. Strimaitis, and Joseph S. Scire; "Development and Evaluation of the Prime Plume Rise and Building Downwash Model"; Undated draft journal article by Earth Tech, Concord, MA.

5. Staff Report; "Consequences Analysis of Using ISC-PRIME Over the Industrial Source Complex Short Term Model"(Draft); U.S. Environmental Protection Agency; April 1998.

6. U.S. Sugar Corporation; "Information Submittal No. 3 - PSD Permit Application for Boiler No. 4 and the Sugar Refinery at the Clewiston Mill"; 13 September 1999.

7. U.S. Sugar Corporation; "PSD Permit Application for United States Sugar Corporation Clewiston Boiler No. 4 and Sugar Refinery," prepared by Golder Associates Inc.; June 1999.

Basis of Evaluation

The evaluation criteria for a case-by-case approval of an alternate or non-guideline model are given in Section 3.2 of 40 CFR Part 51, Appendix W - Guideline on Air Quality Models (GAQM). Section 3.2 presents three separate conditions under which an alternate model can be approved. The second condition is the basis for the justification of ISC-PRIME (i.e., statistical performance evaluation using measured air quality data results in the alternate model having better performance than a comparable guideline model). The issues addressed in Region 4's evaluation of the appropriateness and applicability of ISC-PRIME for the U.S. Sugar application include:

- Technical appropriateness of the model for the application.
- Appropriate data bases available to perform the modeling analysis.
- Model performance evaluations appropriate to U.S. Sugar and demonstrate no bias toward underestimates of concentrations.
- Better model performance when compared to reference guideline model.

Technical Consideration

The ISC-PRIME model was developed to improve the downwash algorithms of the ISCST3 regulatory guideline model. Two important shortcomings of the ISCST3 downwash treatment

are the inability to predict concentrations in the building cavity (near wake) and to assess the affects of stack location relative to the influencing downwash structure. In addition, the downwash routines of ISCST3 were developed largely from ambient data representing neutral stability, moderate-to-high wind speeds, and winds perpendicular to the building face, with non- or low-buoyant plumes. These limitations were addressed in the development of ISC-PRIME.

Of major concern at the Clewiston Mill are emissions from the boiler stacks. These stacks are located between three and five building lengths from the buildings controlling downwash. Although EPA studies of the effects of building downwash within wakes show reduction as the stack's distance from the controlling building is increased, ISCST3 uses the full downwash effects independent of stack location in the wake region. Thus, ISCST3 modeling of the Clewiston emissions may produce less realistic estimates of wake dispersion than ISC-PRIME. Ambient concentrations from these two models for the Clewiston facility show ISC-PRIME with smaller concentrations in the wake region.

In terms of the basis of the downwash algorithms in the ISCST3 and ISC-PRIME models, both models' algorithm are semi-empirical. The empirical data used for ISC-PRIME were largely from an extensive series of USEPA performed wind tunnel experiments in 1992 and 1993. The ISCST3 downwash algorithms pre-date these experiments. Because ISC-PRIME is based on more extensive wind tunnel data sets, it has a stronger technical base than ISCST3.

On a theoretical basis, ISC-PRIME uses the conservation equations of mass, momentum, and energy. This model accounts for the streamline ascent over structure and decent in the wake region. Also the wind shear effects about and downwind of structures are accounted for in ISC-PRIME. Therefore, the theoretical basis of ISC-PRIME is technically more sophisticated than ISCST3 and may provide more realistic estimates of plume rise, dispersion, and transport conditions in the wake region - a condition applicable to the Clewiston application.

In terms of the data needed to run ISC-PRIME, the input data requirements are the same as ISCST3 with the exception of building and stack configurations and dimensions. Similar to the BPIP program providing building information for running ISCST3, a supplementary program BPIPPRM has been developed to provide the needed building information for the running of ISC-PRIME. Therefore, adequate input data exists to perform ISC-PRIME model analysis for U.S. Sugar Clewiston.

Data Bases For Model Development And Performance

The data bases used in the development of ISC-PRIME included wind tunnel studies, numerical model results, and both short-term tracer and long-term field measurement programs. An independent evaluation of the completed model was performed by an EPRI contractor using four data bases. This was an independent evaluation as it was: 1) Conducted by a contractor not involved with model development; and 2) Data bases used in evaluation were not used in the

model development. A number of performance measures were considered and statistical tests performed to determine the significance of the performance differences observed. Thus, adequate data bases exist for both the development and evaluation of model performance.

Performance Evaluations

Comparison With Data Bases

In the assessment of ISC-PRIME model performance, meteorological conditions that produce the highest ground-level concentrations were used (e.g., near-neutral stability and moderate to high wind speeds). Comparsion of both ISCST3 and ISC-PRIME predicted concentrations against the independent data bases show that for these downwash producing meteorological conditions, the two models performances were comparable, with ISC-PRIME performing slightly better (i.e., better agreement with observations) than ISCST3.

Site specific data from the Clewiston facility site would provide the most relevant basis for model performance evaluation. These data were not available so a review of the similarity of the emissions, plant configuration, and receptor conditions used in the ISC-PRIME model evaluation was performed to determine the applicability of the evaluation to the Clewiston application. Of the evaluation data bases used, the Bowline Point and the Lee Power Plant data were the most similar to the boilers at the Clewiston facility in terms of stack heights (87 and 65 meters respectively) and stack to building ratios (1.3 and 1.5 respectively). The buoyant and momentum fluxes for these power plants are expected to be representative of those at Clewiston. Although the evaluation and development data bases were not obtained under the same plant configuration as U.S. Sugar Clewiston, they are believed to relevant and representative of the U.S. Sugar Clewiston.

Comparison With Reference Model

The performance evaluation comparisons of the ISC-PRIME and ISCST3 models demonstrated ISC-PRIME with generally as well or better agreement with observed maximum concentrations during downwash conditions. ISC-PRIME did not demonstrate a bias toward under predictions. Thus, an independent evaluation demonstrated ISC-PRIME with an overall performance as good as, or better than, ISCST3 in downwash conditions.

EPA performed its own consequence analysis of the ISC-PRIME software and EPRI reports. This consisted of verifying that ISCST3 and ISC-PRIME produced the same results when no building dimensions were included, confirming the independent modeling results, and determining the consequences of using ISC-PRIME for building downwash applications.

- The consequence analysis showed that both models produced the same results when run without building input data. The PRIME downwash algorithms do not interfere with the

proper operation of the model under no downwash conditions.

- The three field studies used in the EPRI independent evaluation showed ISC-PRIME tends to be less conservative than ISCST3 but more conservative (i.e., produces larger concentrations) than the observed values.

- For cavity analyses, output differences between ISCST3 and ISC-PRIME were dependent on stack location, stack to building height ratios, urban/rural setting, and downwind distances. ISC-PRIME and ISCST3 converge on common concentrations beyond 1 km and are the same beyond 10 km.

In summary, ISC-PRIME provides overall conservative estimates of concentrations that are more realistic than those provided by ISCST3.

Conclusion and Recommendation

Based on the application of Section 3.2 of 40 CFR Part 51, Appendix W (Guideline on Air Quality Models) for the evaluation of the use of an alternate model, ISC-PRIME appears appropriate and applicable for the U.S. Sugar Clewiston air quality impact assessment. ISC-PRIME appears to be technically better than ISCST3 and is better at predicting maximum concentrations during downwash conditions. In terms of application to the U.S. Sugar Clewiston facility, it appears that ISC-PRIME would provide a more realistic but conservative estimate of the maximum downwash concentrations from this facility, while also providing concentrations equal to ISCST3 predictions beyond the wake region. Therefore, ISC-PRIME is considered applicable and appropriate for application to the air quality impact assessment for the U.S. Sugar Company's Clewiston Mill.