Model Clearinghouse Information Storage and Retrieval System

Record Information Report

Record Number: 00-IV -02 Fiscal Year: 1900 Region: 04 Last Update:
Name: U.S. Sugar--Oct 99
12/20/99

State(s): FLORIDA
Pollutant(s): SO2
Regulation(s): PSD
Source(s): Sugar Mill
Model(s): ISC3
PRIME
Subject(s): Technical Credibility of Nonguideline Techniques
Urban/Rural: Rural Only
Oral/Written: Oral
Terrain: Essentially Flat Terrain
Guideline: Non-guideline
Database: Off-site
Involvement: Review and Comment
Record Comments:
Issue: Region IV has developed a draft of its evaluation of U.S. Sugar's proposed use of the ISC-PRIME model for a PSD analysis. The Region asked the C/H to provide comments on the draft.
Below is 1) the Region IV request to the C/H with the draft evaluation, 2) The C/H Comments on the draft, 3) a copy of Region X's April 29, 1998 approval of ISC-PRIME for a source in AK, which is reference by Region IV and by the C/H comments and, 4) a copy of Region IV's final approval letter to the State of FL regarding the U.S. Sugar proposal.

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1) Region IV request to the C/H
Attached is a draft of Region IV documentation on a case-by-case evaluation of the non-guideline model ISC-PRIME for application to the US Sugar facility in Florida. We would appreciate the C/H review comments and specific suggestions concerning:
1) Proper procedure for regional case-by-case approval of this non-guideline model
2) Other evaluation items to considered in the approval
3) Any text changes to improve letter/evaluation documentation.
Because Florida DEP issued their Preliminary Determination early in

October, we needs to provide our determination of the acceptability of
ISC-PRIME for this application by early next week. Therefore, I would
appreciate your comments by the end of this week,
Note: I will be out of the office Thursday and Friday of this week (10/28-29/99).
Let me know if you have any questions.
Thanks...sjk
CC: RTPMAINHUB.INTERNET(JOHNSON-BRENDA)
Mr. A. A. Linero, P.E.
Florida Department of Environmental Protection

Date: 07/31/00
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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 PSD permit application for the U.S. Sugar Corporation - Clewiston Mill dated June 1999 (received 7 July 1999). This application for an increase operation of the sugar refinery and Boiler No. 4. Our review comments excluding the air quality impact assessment were provided in our 20 September 1999 letter. The purpose of this letter is to provide our evaluation and determination associated with the use of the none-guideline ISC-PRIME dispersion and transport model for the assessment of ambient air impact assessments resulting from the proposed Clewiston mill PSD permit modifications. The PSD U.S. Sugar Clewiston Mill PSD permit application....[To Be Completed]

Evaluation of ISC-PRIME For Application To
U.S. Sugar Corporation Clewiston Mill's
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 the
U.S. Sugar
Corporation (U.S. Sugar) Clewiston Mill. One of FDEP's concern was the application of the
non-guideline ISC-PRIME dispersion and transport model to the ambient air
quality assessment
provided in the PSD application. The use of the guideline ISCST3 dispersion and
transport model
for the U.S. Sugar Clewiston Mill emission sources reveals very large predicted
SO2 and PM10
concentrations at the site boundary - concentrations that exceed the PM10 and
SO2 National
Ambient Air Quality Standards (NAAQS). The ISC-PRIME model run with the same
input
emission and receptor values also predict large concentrations but none exceeded the applicable
PSD increments nor NAAQS.
The ISC-PRIME model has been submitted to United State Environmental Protection
Agency's
(USEPA) Office of Air Quality Planning and Standards (OAQPS) for consideration
as a guideline
model. OAQPS has reviewed and tested this model. It was also reviewed at the

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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 will propose ISC-PRIME for inclusion as a guideline model, it has
not official
been proposed and public comment solicited. Therefore, ISC-PRIME is still 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 USEPA Region 4. The provides a summary of Region 4's appropriateness and
acceptability evaluation of ISC-PRIME for the assessment of ambient air impacts
for U.S. Sugar
Clewiston Mill's PSD application.
Reviewed Documents - ISC-Prime and U.S. Sugar Corporation
The following documents were reviewed in the case-by-case determination of the
appropriateness
and acceptability of the non-guideline ISC-PRIME dispersion and transport model
for the PSD air
quality impact assessment for the modification of 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;
29
April 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.

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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 the use of a non-guideline model is given in Section 3.2 of 40 CFR Part 51, Appendix W - Guideline on Air Quality Models (GAQM). In general, a preferred model must be shown to be not appropriate, and a non-guideline model or procedure shown to be available, more appropriate, and applicable for the application. The points that need to be addressed include:

Proposed model is more technically appropriate for the application.

Adequate data bases are available to perform the modeling analysis.

Performance evaluations of the model are in similar circumstances and show the model not to be bias towards underestimates of concentrations.

Proposed model shows superior performance when compared to reference model.

Technical Evaluation

The ISC-PRIME model was developed to improve the downwash algorithms of the ISCST3 regulatory model. Two important short comings 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 data representing neutral
stability,
moderate-to-high wind
speeds, 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 Sugar Mill are emissions from the
boiler

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stacks. These stacks
are located between 3 and 5 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 is expected to produce less realistic estimates of wake
dispersion
than ISC-PRIME.
The results of modeling using these two models for the Clewiston
facility
confirmed the expected:
ISC-PRIME produces 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 - based on wind tunnel experiments.
The
empirical data
used for ISC-PRIME were largely from 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
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 which should provided more realistic estimates of plume rise, dispersion,
and transport
conditions in the wake region - a condition applicable to the Clewiston application.
Performance Evaluation
Adequate Data Bases
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

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statistical tests
performed to determine the significance of performance differences observed.
Thus, adequate
data bases exist for both the development and evaluation of model performance.
In terms of the data needed to run ISC-PRIME, the input data requirements are
the same as

ISCST3 with the exception of building dimensions. Similar to the BPIP program
providing
building information for ISCST3 running, a complimentary program **** has been
developed to
provided the needed building information for ISC-PRIME. Therefore, adequate
input data exist
to perform ISC-PRIME model analysis.
Bias of Model
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). Evaluation of both ISCST3 and ISC-PRIME against the independent
data bases
show that for these downwash producing meteorological conditions, the two
models's
performances were comparable with ISC-PRIME performing slightly better 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
emission, plant, and receptor conditions used in the ISC-PRIME model evaluation
was performed
to determine applicability of the evaluation to the Clewiston model application.
Of the evaluation
data bases used for ISC-PRIME, the Bowline Point and the Lee Power Plant data
are 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 are
expected to be representative of those at Clewiston. Although the data bases
used for ISC-
PRIME performance evaluation were not from onsite nor closely similar facilities, they are
believed to representative of the type of conditions experienced at U.S. Sugar
Clewiston.
The performance evaluations of ISC-PRIME and ISCST3 models demonstrates generally as well
or better performance of ISC-PRIME for the prediction of maximum concentrations
during

downwash conditions. ISC-PRIME did not demonstrate a bias toward under predictions. Thus,

the independent contractor and independent data bases evaluations demonstrated
ISC-PRIME
overall performance as good as, or better than ISCST3.
Comparison With Reference Model
The previous section discussion of under prediction bias included comparison of
ISCST3 and
ISC-PRIME model results to independent concentration data bases. As indicated,
the
independent evaluations showed the ISC-PRIME model as well as or better than the
ISCST3
model in predicting maximum concentrations.
USEPA 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 results of this consequence analysis showed both
models produced the same
results when run without building input data. The PRIME algorithms
do not
interfere with no downwash function of ISCST3.
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.,
produce 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 better
than those provided by ISCST3.
Conclusion and Recommendation
Based on the superior technical features contained in ISC-PRIME and the more
current and
complete data basis used in its development and evaluation, it is concluded that
ISC-PRIME is a
technically better model than ISCST3 and that it is expected to be at least as
good, if not better, at
predicting the maximum impacts during downwash conditions. In terms of application to the U.S.
Sugar Clewiston facility, it appears that ISC-PRIME should provide a more
realistic but
conservative estimate of the maximum downwash concentrations from this facility.
Therefore,

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ISC-PRIME is considered applicable and appropriate for application to air
quality impact
assessment for the U.S. Sugar Company's Clewiston Sugar Mill.
2) C/H Comments:
Comments on 10/25/99 draft material supporting the use of ISC-PRIME for U.S.
Sugar
Clewiston PSD air quality analysis.
D. Wilson
10/26/99
In general, the supporting material is very good and there is no doubt the use
of ISC-PRIME is
the more appropriate model for the PSD analysis. The comments below are intended primarily to
clarify the language on the relationship of the supporting material to Guideline
on Air Quality
Models language.
1. In the cover letter to the State of FL, which is I understand is

still being
developed, Region IV
should try to include the points that Region X included in their
4/29/98 letter
to AK on the use of
the ISC-PRIME model for the GVEA facility.
2. Under the Basis for the Evaluation, it is good that reference is
made to
Section 3.2 of the
Guideline. This clearly provides the authority for selecting the
nonguideline
model. As we
discussed on the phone, the material in Section 3.2 is a little bit
confusing in
regard to what
exactly applies in the U.S. Sugar situation. My take is that in
paragraph a of
Section 3.2,
alternative (2) is what really applies here. The preferred ISC3 model
is
appropriate; otherwise it
would not be the Guideline. The point is that PRIME is more
appropriate. With
that thought,
you might want to change fuzzy up your wording that states that the
preferred
model is not
appropriate.
3. The "adequate data bases" requirement, seems to come from Section 3.2
e ii in
the Guideline,
which I take to mean the data bases needed to run the model in the
application,
and not the data
bases used in the off-site performance evaluation. If you agree, then
you might
want to address
that issue in a statement separate from your section on performance
evaluations.
Probably the
only points you would need to make is that the data needed to run ISC-
PRIME is
the same as the
data needed to run ISC3 with the exception that more detailed
information on
stack geometry is
needed for ISC-PRIME; such data are available for U.S. Sugar.
The "adequate data bases" subtitle under "performance evaluations" could
just be

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re-titled "data bases."

4. The "Performance Evaluations" section might be better if it were labeled "Off-site Performance Evaluations." Then an introductory statement or two to that section could explain that there are no on-site data bases available at U.S. Sugar but that performance evaluations in similar circumstances do exist. Then point out that the Guideline allows the use of off-site performance evaluations in such circumstances. Maybe you could use some language from the Region X letter, in their 3rd paragraph under performance evaluations. Maybe this could be done better than I have suggested, but the important point is to clearly state that an on site evaluation is not possible but that allowable off site evaluations provide the requisite support.

5. As we discussed on the telephone, in the last sentence of the second paragraph under Bias of the Model, it would be better if we could remove the phrase "nor closely similar facilities."

3) Region X April 29, 1998 approval of use of ISC-PRIME

April 29, 1998
OEA-095
Robert W. Hughes
Manager, Permits and Compliance
Alaska Department of Environmental Conservation
410 Willoughby Avenue. Suite 105
Juneau, Alaska 99801-1795

Re- Review of the ISC-PRIME model, GVEA Healy Power Plant Air Quality Control No- X049

Dear Mr. Hughes;

This is in response to your February 4, 1998 request that EPA approve the use of the ISC-PRIME model (version 97224) to assess the ambient air quality impact of the Golden Valley Electric Association (GVEA) Healy Power Plant in Healy, Alaska.

We have reviewed the documentation supplied to us by GVEA in support of their use of a non-Guideline model, i.e. a model not currently recommended in EPA's Guideline on Air Quality Models (40 CFR 51, Appendix W). Our evaluation (summary enclosed) of their submittal has shown that ISC-PRIME is technically superior to the EPA-recommended model,

ISCST3.
Moreover, ISC-PRIME appears to perform as well or better than the ISCST3 model
in
comparisons of the model predictions to observed concentrations. These performance evaluations

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show that ISC-PRIME is not significantly biased toward under-estimation of
maximum
concentrations. Therefore, we believe ISC-PRIME is appropriate for this application.

We hereby grant approval for the use of the ISC-PRIME model for
assessment of air
quality impacts of the Healy Power Plant for this application for a permit
revision. In accordance
with our Agency's division of responsibilities with respect to non-Guideline
model approval, this
approval by EPA Region X is a case-specific approval and should not be construed
to imply
approval for applications of ISC-PRIME to other sources. EPA's Office of Air
Quality Planning
and Standards is currently considering generic approval of the ISC-PRIME model,
and, if
appropriate, OAQPS will propose the approval of the generic application of
ISC-PRIME later this
year.

Please note that in your process for revision of the Healy Power Plant
air quality control
permit, you must give public notice of this case-specific use and approval of
the ISC-PRIME
model as the basis for this permit revision, and give opportunity for a public
hearing on this
matter.

If you have any questions, or if we can be of further assistance,
please contact Rob Wilson

of my staff at (206) 553-1531.
Sincerely,
Janis Hastings, Director
Office of Environmental Assessment
enclosure
copies w/ enclosure to;
Bud Rolofson, National Park Service, Denver
Joan Darnell National Park Service, Anchorage
Michele Brown, Commissioner, ADEC, Juneau
John M. Stone ADEC, Juneau
James Baumgartner, ADEC, Juneau
Kathryn Lamal, (GVEA, Fairbanks
Joseph A. Tikvart, EPA/OAQPS, Research Triangle Park NC

Summary Evaluation of the Golden Valley Electric Association Proposal for Use of the ISC-PRIME Model
Robert B. Wilson
U.S. Environmental Protection Agency, Region 10
April 29, 1998
Introduction

In a letter dated February 4, 1998, the Alaska Department of Environmental Conservation

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(ADEC) requested EPA Region 10 approval of the use of a model, 1SC-PRIME, which is not currently recommended a EPA's Guideline on Air Quality Models (40 CFR 51, Appendix W. The Golden Valley Electric Association has employed the ISC-PRIME model in its request to ADEC for a revision to its operating permit for its power plant in Healy, Alaska. Specifically, GVEA is seeking higher limits on the short-term emissions of sulfur dioxide (SO2) from Unit I of the Healy Power Plant. The use of the ISC-PRIME model, in lieu of the EPA recommended ISCST3 model, indicates that additional amounts of S02 can be emitted from the Healy Unit I stack without causing exceedances of the National Ambient Air Quality Standards.

The ISC-PRIME model was developed by the Electric Power

Research
Institute (EPRI)
and its contractors over the past approximately four years. GVEA has been one of
several
sponsors of this effort. EPRI and its contractors have compared the ISC-PRIME
model to EPA's
ISC3 model, and evaluated the performance of the two models against observed
concentrations.
The technical reports of EPRI's form the basis for GVEA's requested approval of
the use of the
ISC-PRIME model.

This submittal of ISC-PRIME to EPA Region 10 is the first time the
model has been
considered for approval In a regulatory action. EPA Region 10's evaluation of
GVEA's submittal
is presented below. EPRI has subsequently submitted the ISC-PRIME model to EPA's
Office of
Air Quality Planning and Standards (OAQPS), requesting that ISC-PRIME be listed
as a
generically recommended model in EPA's Guideline on Mr Quality Models. If
appropriate,
OAQPS will formally propose ISC-PRIME for Guideline status later this year.

Documents Reviewed

I) "Air Quality Construction Permit Application," submitted to Alaska Department of Environmental Conservation, Air Quality Control Permit to
Operate, No 9431-AAOOI, for the Healy Power Plant, submitted from Golden Valley
Electric
Association, Inc., Fairbanks, Alaska, December 24, 1997, which includes:

a) Cover letter from Kathryn Lamal, GVEA, to John Stone, ADEC, dated December 24, 1997.

b) "Air Quality Dispersion Modeling Report to Support Request for Modification
of Air Quality
Control Permit to Operate No. 9431-AAOO1 for the Golden Valley Electric Association, Inc
Healy Power Plant, submitted to the ADEC, prepared for Alaska Industrial

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Development and Export Authority and GVEA, prepared by RTP Environmental Associates, Inc., Boulder, Colorado, and Steigers Corporation, Englewood, Colorado, December 1997.

c) ADEC Air Quality Control Permit to Operate No. 9431-AA001, May 12, 1994, and cover letter from Leonard Verelli, ADEC, to Frank Abogg, GVEA, dated May 12, 1994.

d) ADEC Final Supplemental Technical Analysis Report, May 6, 1994, for Healy Power Plant.

e) Electronic files Containing the ISC-PRIME model and associated programs, input. and output files, developed in support of the modeling documented in Item b above.

f) Results of the Independent Evaluation of ISCST3 and ISC-PRIME," prepared by Robert Paine and Frances Lew, ENSR, Electric Power Research Institute Report TR-2460026, W03527-02, November 1997, including Appendices A through EE

2) "Consequence Analysis for ISC-Prime," prepared by Robert J. Paine and Frances Lew, ENSR, Electric Power Research: Institute Report TR-2460026, W03527-02, November 1997, including Appendices A through EE.

3) PRIME Model & Documentation,' CD-ROM, EPRI, January 16, 1992, and PRIME Model & Documentation - Addendum Diskette,~ January 20, 1998.

4) Letter from Kathryn Lamal, GVEA, to James Baumgartner, ADEC, dated February 18, 1998, regarding revision to GVEA's Air Quality Construction Permit to Amend Alaska Air Quality Permit to Operate 9431-AA001 for the Healy Power Plant, Healy, Alaska.

5). "Development and Evaluation of the PRIME Plume Rise and Building Downwash Model," by Lloyd L. Schulman, et al., Earth Tech, Concord, Massachusetts, undated, draft journal article submitted to Atmospheric Environment, EPA Region 10 Review Copy, received March 1998.

Evaluation Criteria

The evaluation of the ISC-PRIME model, in comparison to the ISCST3 model, centers on two basic elements. The first is the technical basis of the model i.e. assessing which model is superior from a theoretical standpoint. The second is model performance, i.e.. determining whether ISC-PRIME performs as well or better than the ISCST3 model in

comparisons of the
models' predictions to observed concentrations. An important feature of a
regulatory model s
performance is the avoidance of a bias toward significant under-prediction.
Technical Evaluation
Two important capabilities offered by the ISC-PRIME model (and not
offered by the
ISCST3 model) are the ability to predict concentrations in the building cavity

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region, and the
ability to assess the affects of actual stack location relative to the building.
This second capability
is especially important for the Healy case, where the Unit I stack is both
separate and upwind
from the Unit 2 boiler building during critical downwash conditions. The Unit 2
boiler building is
the primary determinant of the near-field dispersion of the Unit 1 plume. The
ISCST3 model is
not able to explicitly account for the stack-building separation. Thus, ISCST3
would be expected
to produce a less realistic simulation of near-field dispersion for the Healy
case, in comparison
with the ISC-PRIME model.
The downwash algorithms in both the ISC-PRIME model and the ISCST3
model are
semi-empirical and therefore, the technical underpinnings of both models are
based on the
measurements of laboratory experiments (wind tunnel tests). The semi-empirical
aspects of
ISC-PRIME are based largely On an extensive series of wind tunnel experiments
performed by
EPA at its fluid modeling facility during 1992 and 1993. The development of the

downwash
algorithm in ISCST3 preceded the availability of these data sets, and it therefore does not reflect
the broader technical basis offered by these more recent wind tunnel data.
Because ISC-PRIME is
based on more extensive wind tunnel data sets, the technical basis for the
ISC-PRIME downwash
algorithm is stronger than that for the- ISCST3 model.

The plume rise algorithm in ISC-PRIME is based on numerical integration of theoretical
equations for conservation of mass, momentum, and energy. The model accounts for
streamline
ascent over the building, and streamline decent in the lee of the obstruction
ISC-PRIME also
accounts for vertical wind shear effects caused by the wind flow about the
building; in particular.
the wind speed deficit in the lee of the building is modified as a function of
downwind distance.
These features of ISC-PRIME compose a more sophisticated treatment of the
physics associated
with downwash when compared to the simpler analytical treatments in the ISCST3
model. These
factors should allow ISC-PRIME to produce a more realistic simulation of plume
rise and
dispersion from short stacks, such as, the Unit I stack at the Healy Power
Plant.
Performance Evaluation

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Several data bases, including observations from wind tunnel studies,
numerical model
results, and both short-term tracer and long-term operational field measurement
programs, were
employed by EPRI's contractors m the development and evaluation of ISC-PRIME.
Four data

bases were retained to perform an independent evaluation of the model after completion of the development phase. The evaluation was independent in that the data bases were not used in the model development and the effort was conducted by a contractor who was not the model developer. Model performance was evaluated against the four independent data bases according to a protocol previously reviewed by EPA Region 10. A number of performance measures were used in the evaluation, and statistical tests were employed to determine the significance of differences observed In model performance. Results of the independent evaluation demonstrated that the overall performance of the ISC- PRIME model is as good or better than the ISCST3 model.

Meteorological conditions of near-neutral stability and moderate or higher wind speeds are traditionally considered most conducive to producing building wake effects (plume downwash conditions) and associated high ground-level concentrations. The occurrence of these conditions in the Healy area is not uncommon, and, in fact, both the ISCST3 and the ISC-PRIME model were consistent in producing the maximum 24-hour average concentrations during such near-neutral, moderate-to-high wind speed conditions. Thus, the performance of the models is most relevant under these downwash conditions as compared to other types of meteorological conditions. The evaluation of the models against the independent evaluation data bases showed that for near-neutral, moderate-to-high wind speed conditions, the two models' performances were comparable, with ISC-PRIME perhaps performing slightly better than ISCST3.

A site-specific data base from the Healy Power Plant, which would prove the most relevant basis to evaluate model performance, does not exist. Therefore, the similarity of the circumstances at the Healy Power Plant to the circumstances associated with the

evaluation
data bases is a factor
in this evaluation. A comparison of stack parameters (buoyancy flux and momentum
flux) shows

that the Healy Unit 1 stack compares favorably with the stacks in two of the
four independent
evaluation data bases, namely, the Bowline Point and the Lee Power Plant data
bases. [Note that
since the Healy Unit 1 stack emissions were the only significant contributor to
maximum modeled
concentrations, the Healy Unit 2 stack is not considered in this comparison.] A
comparison of
stack height to building height ratios shows that the Healy case (Unit 1 stack
height to building
height ratio of 0.77) is comparable to the lower stacks in the AGA data base
(ratios of 0.80, 0.86,
and 2.00). None of the other three independent data bases had stack height to
building height
ratios less than one. Unfortunately, the AGA stack parameters (buoyancy and
momentum fluxes)
are an order of magnitude less than the corresponding Healy Unit 1 parameters.
Thus, none of the independent evaluation data bases are closely similar to the
Healy case for
both stack parameters and stack/building geometry. To summarize the data bases
against
which ISCST3 and ISC-PRIME were tested, we can classify them in three
categories. in order of
decreasing technical primacy: on-site, closely similar, and other downwash data
bases. Relative to
the Healy case, all of the independent evaluation data bases fal. into the last
category, and the
model performance evaluation can not be as technically compelling as if

the data
bases were
developed from data obtained at the Healy site, or at plant sites that
are more
closely similar to
the Healy site.

The performance evaluations of the ISC-PRIME and ISCST3 models
demonstrate that
'SC-PRIME generally performs as well or better than ISCST3 for
predicting
maximum impacts
during downwash conditions, with no apparent bias toward under-
prediction.
However, because
the data bases employed in the evaluations are not closely similar to
the Healy
site, the evaluation
results are only suggestive (rather than conclusive) evidence that ISC-
PRIME
would be expected
to perform better than ISCST3 for the Healy application.

Additional Notes

Some sensitivity testing of the ISC-PRIME model was performed
by EPA
Region 10 for
the Healy application. Several of the inputs to ISC-PRIME for the Unit 1
source
(including stack
height, stack temperature, and exit velocity), and for the Unit 2
building
dimensions, were

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modified both slightly and significantly to investigate the sensitivity
of the
maximum concentration
estimates to these changes. The observed model sensitivity was judged to
be
physically
reasonable. Receptor spacing was also investigated in the area of
maximum
predicted
concentrations along the northwest plant boundary. By increasing the
number of
receptors in the
maximum impact area, maximum concentrations were identified that were
slightly
higher than

those reported by GVEA.

In addition to being submitted to EPA Region 10 for the Healy application, the ISC-PRIME model has been submitted to EPA's Office of Air Quality Planning and Standards (OAQPS) for their review and consideration of proposing the model as a preferred model the Guideline on Air Quality Models (40 CFR 51, Appendix W). In their review, OAQPS identified a coding error in the model, such that, when certain low wind speed, stable conditions are encountered, the model ceases to operate. This error has apparently been corrected by the model developer, and a revised version of the model will soon be available. These revisions to the model are not expected to cause substantive changes in the model predictions for the conditions that are critical to the permitting decision for the Healy case. This should, however, be verified by re-running the Healy case with the revised ISC-PRIME model when it becomes available.

Conclusions and Recommendations

On the strength of the data bases employed during the development of the ISC-PRIME model, and because of the improved and more physically realistic capabilities of the model, it is concluded that ISC-PRIME is technically superior to the JSCST3 model in this circumstance. While there is no conclusive evidence from the performance evaluations that ISC-PRIME would be expected to be a more accurate predictor of maximum impacts for the Healy application, the performance evaluations with the independent data bases do suggest that ISC-PRIME is generally as good or better than the ISCST3 model for predicting maximum impacts during downwash conditions. Furthermore, while both the difficulties in modeling the complexities of plume downwash and the limitations of available data bases lead to uncertainties in the assessment of model performance for this application, it appears that ISC-PRIME has no

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significant bias toward under-prediction of maximum impacts. Therefore, it is recommended that the ISC-PRIME model, in lieu of the ISCST3 model, be considered acceptable for application to the Healy case

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4) Final Region IV approval letter for U.S. Sugar

November 4, 1999

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,
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 concern is the application of the
non-guideline ISC-
PRIME dispersion and transport model to the ambient air quality assessment. The
use of the

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guideline ISCST3 dispersion and transport model for the U.S. Sugar Clewiston
Mill emission
sources reveals very large predicted SO2 and PM10 concentrations at the site
boundary -
concentrations that exceed the PM10 and SO2 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 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 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 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)

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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 short comings of the ISCST3 downwash
treatment
are the inability to predict concentrations in the building cavity (near wake)

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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, 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 3 and 5 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
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 ISCST3 running, a supplementary

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program
BPIPPRM has been developed to provided the needed building information for the
running of
ISC-PRIME. Therefore, adequate input data exist 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 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's 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 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.

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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 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., produce 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-

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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-