UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

SEP 23 1988

4APT/APB-aes

Mr. Clair Fancy, Deputy Chief
Air Quality Management
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Dear Mr. Fancy:

Enclosed is a copy of our draft preliminary determination and permit conditions for the amended PSD permit for the Crystal River Plant.

Region IV plans to publish the public notice for this action on October 6, 1988. Please provide any comments you have on the draft preliminary determination to us by October 5, 1988. In the event that you cannot comment by October 5, 1988, you may still make your comments available to us during the 30 day public comment period.

Please call me or Mr. Wayne Aronson of my staff at (404) 347-2864 if you have any questions.

Sincerely,

Bruce P. Miller

Bruce P. Miller, Chief
Air Programs Branch
Air, Pesticides, and Toxics
Management Division

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DER - BAQM

Enclosures (3):
1. Draft Preliminary Determination
2. Copy of Public Notice
3. Assessment of Salt Deposition Impacts at Crystal River

cc: Dr. J. P. Subramani w/enclosure

U.S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365
404/347-3004

Public Notice No. 88FL149 DATE: October 6, 1988

NOTICE OF PROPOSED MODIFICATIONS OF NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT AND PREVENTION OF SIGNIFICANT DETERIORATION PERMIT

The U.S. Environmental Protection Agency (EPA) proposes to modify the National Pollutant Discharge Elimination System (NPDES) Permit No. FL0036366 to the Florida Power Corporation (FPC); P.O. Box 14042, St. Petersburg, FL 33733; for its Crystal River Power Plant, Units 4 and 5; Crystal River, Citrus County, Florida. EPA also proposes to modify the Prevention of Significant Deterioration Permit (PSD) No. PSD-FL-007. The proposed permit modifications will remove limitations and monitoring requirements related to salt drift from the Unit 4 and 5 cooling towers from the NPDES permit and place them in the PSD permit. The PSD modification would also allow an increase in drift rate and would require an increase in environmental monitoring requirements. The proposed NPDES permit modification does not change any limitations on the amounts of pollutants allowed to be discharged in wastewaters from the facility. The facility generates and transmits electricity (SIC Code 4911).

EPA has conducted an evaluation of the potential environmental impacts to plants, animals, groundwater, and soils in surrounding areas and has concluded that there will be no significant long term unacceptable environmental impacts from the modification of these permits. EPA also has required the FPC to conduct an air quality demonstration to show that the particulate PSD increments and ambient air quality standards are protected. The preliminary determination has concluded that:

- Best Available Control Technology (BACT) is represented by drift eliminators (Thermotec Spectra - C) for the control of total suspended particulates (TSP).

- The additional TSP Class II increment consumption incurred by the addition of Unit 4 and 5 cooling towers to the PSD permit is 10 percent of the annual mean TSP increment and 29 percent of the 24-hour TSP increment. The maximum degree of TSP Class II consumption for the entire FPC plant including other increment consuming sources within the area is 10 percent of the annual mean TSP increment and 30 percent of the 24-hour TSP increment. The maximum Class II increment concentration occurs at a distance of less than 1/4 of a mile from the center of the FPC plant.

- For the Class I Chassahowitsika Wilderness Area, the additional degree of TSP increment is less than one percent of the annual increment and three percent of the 24-hour increment. The maximum Class I increment consumption from all PSD sources within the area is three percent of the annual increment and 12 percent of the annual increment and 12 percent of the 24-hour increment.

- The maximum combined pollutant concentration from all TSP sources at the FPC plant and other sources in the area will be less than the National Ambient Air Quality Standards (NAAQS). The NAAQS are levels set by EPA which identify the ambient concentrations necessary to protect human health and welfare with an adequate margin of safety.

Persons wishing to comment upon or object to any aspects of permit modifications, or wishing to request a public hearing, are invited to submit same in writing within thirty (30) days of the date of this notice to the Office of Congressional and External Affairs, Environmental Protection Agency, 345 Courtland Street, N.E., Atlanta, Georgia 30365, ATTN: Public Notice Coordinator. The public notice number, NPDES number and PSD number should be included in the first page of comments.

All comments received within the 30-day period will be considered in the formulation of final determinations regarding the permits. Any interested person may, within the 30-day period, request a public hearing. Where there is a significant degree of public interest in the proposed permit modifications, the EPA Regional Administrator or designated agent will hold a public hearing.

After consideration of all timely written comments and the requirements and policies in the Act and appropriate regulations, the EPA Regional Administrator will make determinations regarding the permit modification. If the determinations are substantially unchanged from those announced by this notice, the EPA Regional Administrator will so notify all persons submitting written comments. If the determinations are substantially changed, the EPA Regional Administrator will issue a public notice indicating the revised determinations. Requests for an evidentiary hearing may be filed after the Regional Administrator makes the above-described determinations. Additional information regarding an evidentiary hearing is available in 40 CFR 124, Subpart E (48 FR 14278 - April 1, 1983), or by contacting the Office of the Regional Counsel at the above address or at telephone number 404/347-2335.

The application is available for public inspection during normal business hours, 8:30 a.m. to 5:00 p.m., Monday through Friday, except legal holidays.

Copies of the modeling demonstration and revised preliminary determination are available for review at the following locations:

1. EPA Region IV
   Air Programs Branch
   345 Courtland Street, N.E.
   Atlanta, Georgia 30365

2. Florida Department of Environmental Regulation
   Bureau of Air Quality Management
   Twin Towers Office Building
   2600 Blair Stone Road
   Tallahassee, Florida 32301

DRAFT

Preliminary Determination

and Permit Conditions

Florida Power Corporation Crystal River Plant

Citrus County, Florida

Amendment to
PSD Permit
(PSD-FL-007)

Prevention of Significant Deterioration
(40 CFR 52.21)

October 5, 1988

I. INTRODUCTION

On February 27, 1980, EPA Region IV issued PSD permit PSD-FL-007 to Florida Power Corporation (FPC) for the construction and operation of coal fired boilers 4 and 5 at their Crystal River Plant. In addition to these new units, FPC also constructed two natural draft cooling towers to serve boilers 4 and 5. At the time PSD permit PSD-FL-007 was issued, EPA Region IV did not incorporate the natural draft cooling towers into the PSD permit. Salt drift rates for these two cooling towers were included in the National Pollutant Discharge Elimination System (NPDES) permit No. FL 0036366 issued on April 3, 1981 and reissued on June 26, 1986.

On May 11, 1988, FPC requested that EPA remove the salt drift rates for these two cooling towers and modify the existing PSD permit to include emissions from the cooling towers serving units 4 and 5. The purpose of this amended PSD permit is to add the two natural draft cooling towers (4 and 5) to the PSD permit and to remove from the NPDES permit the emission limits on the drift eliminators for the cooling towers. To affect this change FPC has made additional drift measurements at natural draft cooling tower 5 and has prepared dispersion modeling to support a revision to the PSD permit. The revision will effectively remove a drift rate limit on each tower and replace the limit with an increased lb/hr emission rate and require salt deposition monitoring and environmental assessment.

The only pollutant that must be addressed is particulate matter. Both total suspended particulate (TSP) and PM-10 (particulate less than 10 microns in size) need to be addressed in this analysis. At the present time the PSD increments are measured as TSP and the National Ambient Air Quality Standards (NAAQS) are measured as PM-10. In order to assure a worst case analysis, all particulates were assumed to be emitted as PM-10. Natural draft cooling towers do not have significant emission rates for any other pollutant.

II. RULE APPLICABILITY

The Crystal River site is located in Citrus County, Florida. This County is attaining the NAAQS for all criteria pollutants. In attainment areas, all fossil fuel steam electric plants of more than 250 mm Btu/hr which would emit greater than 100 tons per year (TPY) of any regulated pollutant must submit a Best Available Control Technology (BACT) determination, an ambient air quality analysis, a source impact analysis, and an additional impact analysis (covering soils, vegetation, and visibility) for each pollutant emitted in significant amounts. In addition, a Class I impact analysis is required because the source is located within 100 kilometers of the Chassahowitzka National Wilderness Area. These analyses were provided with the original application for PSD permit PSD-FL-007. However, this application did not include an analysis of the natural draft cooling towers.

III. PSD APPLICABILITY DETERMINATION

Title 40 of the Code of Federal Regulations, Section 52.21, requires that each pollutant subject to PSD review undergo a PSD analysis. Only those emissions equal to or greater than the PSD significant emission rate need to undergo this anlysis. The only pollutant subject to review for this revised permit is TSP which will have an emission limit greater than the significant emission rate for TSP which is 25 tons/year.

Based upon the emission calculations, the total annual tonnage of the regulated air pollutant emitted [illegible] to the atmosphere is listed as follows:

Pollutant	Maximum Annual Emissions (Tons/year)	PSD Significant Emission Rate (Tons/year)
Total Suspended Particulate	766.5	25

IV. BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION (BACT)

New source performance standards for natural draft cooling towers have not been established. However, for salt water natural draft cooling towers, the amount of salt water drift is controlled by drift eliminators. Drift eliminators consist of a fill made of static plastic inserts which allow for the removal of small particulate by centrifugal force. Drift eliminators are the only effective type of emission controls for natural draft cooling towers. Therefore, BACT for these natural draft cooling towers is drift eliminators (Thermotec Spectra - C).

Although the design of drift eliminators has changed and has been improved since the installation of the Crystal River drift eliminators, EPA has determined that for this revised permit, BACT is the technology that was available at the time the original PSD application was determined complete (December 28, 1977).

V. AIR QUALITY ANALYSIS

The air quality impact of the natural draft cooling towers 4 and 5 has been completed and used in conjunction with (1) an analysis of all permitted PSD particulate sources and with (2) an analysis of the NAAQS. Based on these analyses, EPA has reasonable assurance that the particulate sources at the Crystal River Plant will not cause or contribute to a violation of any PSD increment or ambient air quality standard.

A. Modeling Methodology

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used in the air quality impact analysis (UNAMAP version 6, change 3). This model determines ground-level concentrations of gaseous and solid pollutants emitted into the atmosphere by point, area, and volume sources. The model incorporates pollutant removal mechanisms such as deposition or transformation. The ISCST model also allows for the separation of sources, building wake downwash, and various other input and output features. Both screening and refined analyses were completed using this model. The source parameters and sources modeled are given below.

Part 1. FPC CRYSTAL RIVER PLANT MODELED PSD SOURCES

Source	UTM-E (km)	UTM-N (km)	Stack Height (M)	Exit Temp. (K)	Exit Velocity (M/S)	Diameter (M)	Emission Rate (gm/sec)
FPC Blr. 4 100% Load	334.649	3205.373	178.2	396	21.03	7.77	78.2
FPC Blr. 5 100% Load	334.648	3205.272	183.0	396	21.03	7.77	79.4
FPC Blr. 4 75% Load	-	-	-	390	18.14	-	58.7
FPC Blr. 5 75% Load	-	-	-	390	18.14	-	59.6
FPC Blr. 4 50% Load	-	-	-	385	15.24	-	39.1
FPC Blr. 5 50% Load	-	-	-	385	15.24	-	39.7
FPC Twr. 4	334.298	3205.431	-	311	3.3	65.2	22.05
FPC Twr. 5	34.295	3205.185	-	311	3.3	65.2	22.05

Part 2. OTHER MODELED PSD SOURCES

Source	UTM-E (km)	UTM-N (km)	Stack Height (M)	Exit Temp. (K)	Exit Velocity (M/S)	Diameter (M)	Emission Rate (gm/sec)
Florida Mining and Materials (FMM)							
Source Number 1	21700	-35400	27.43	470	7.48	4.88	2.72
Source Number 2	21700	-35400	15.24	477	21.85	2.29	2.36
Florida Crushed Stone (FCS)							
Source Number 1	25700	-42900	97.60	381	13.71	4.88	14.82

Part 3. OTHER MODELED FPC NAAQS SOURCES

Source	UTM-E (km)	UTM-N (km)	Stack Height (M)	Exit Temp. (K)	Exit Velocity (M/S)	Diameter (M)	Emission Rate (gm/sec)
FPC Blr. 1 100% Load	334.306	3204.210	152.0	417	40.54	4.57	45.9
FPC Blr. 2 100% Load	334.245	3204.211	153.0	422	48.77	4.88	58.3
FPC Blr. 1 75% Load	-	-	-	406	30.48	-	34.4
FPC Blr. 2 75% Load	-	-	-	411	36.88	-	23.0
FPC Blr. 1 50% Load	-	-	-	395	20.42	-	43.7
FPC Blr. 2 50% Load	-	-	-	400	24.99	-	29.2

Part 4. OTHER MODELED NAAQS SOURCES

Source		UTM-E (km)	UTM-N (km)	Stack Height (M)	Exit Temp. (K)	Exit Velo-city (M/S)	Dia-meter (M)	Emission Rate (gm/sec)
FMM	Number 3	21700	-35400	9.15	302	10.70	0.91	4.69
FMM	Number 4	21700	-35400	22.90	302	7.01	0.91	4.69
FMM	Number 5	21700	-35400	21.00	440	38.40	0.61	4.29
FMM	Number 6	21700	-35400	15.20	444	8.84	3.05	1.27
FMM	Number 7	21700	-35400	25.30	364	15.80	0.91	4.55
FMM	Number 8	21700	-35400	44.20	299	48.50	0.61	4.29
FMM	Number 9	21700	-35400	65.38	302	24.10	0.61	4.69
FMM	Number 10	21700	-35400	43.00	302	10.70	0.91	4.32

Five years of sequential hourly meteorological data were used in the modeling analysis. Both surface and upper air data from the National Weather Service in Tampa, Florida (1981-1985) were used. Since five years of data were used, the highest, second-high, short-term predicted concentrations are compared with the appropriate short-term ambient standard or PSD increment. The highest predicted concentrations were used for comparison with the long-term standards (annual).

All EPA regulatory options in the ISCST model were used. The rural option of the model was chosen. Downwash (building wake effects) was not used since all sources were at their GEP stack height.

The initial set of screening model runs determined the approximate location of the highest, second high concentrations for the Class II PSD increments and NAAQS analysis. A polar coordinate receptor grid with 36 radials ten degrees apart and ten downward distances from 0.5 km to 7.5 km was used. A Class I analysis included receptors spaced every 200 meters from 21.3 to 23.9 kilometers between 153° and 181°. In this initial screening analysis several sources were colocated and particle deposition was not included.

A second analysis for the Class II PSD area was done which included all sources at their exact locations. Particle deposition factors were included as follows in the analysis.

PARTICLE SIZE DISTRIBUTION DATA USED IN THE ISCST MODEL

Particle Size: Diameter (um) Range	Particle Size: Diameter (um) Average	Particle Size: Radius (um)	Particle Size: Average (cm)	Mass Distribution Percent	Settling Velocity (cm/s)	Settling Velocity (m/s)	Reflection Coefficient
0-30	15	7.5	0.00075	0.0	0.7	0.007	0.80
30-70	50	25	0.00250	11.9	7.4	0.074	0.55
70-90	80	40	0.00400	11.7	19.0	0.190	0.28
90-110	100	50	0.00500	15.1	29.8	0.298	0.0
110-130	120	60	0.00600	13.4	42.8	0.428	0.0
130-150	140	70	0.00700	11.6	58.3	0.583	0.0
150-180	165	82.5	0.00825	13.1	81.0	0.810	0.0
180-240	210	105	0.01050	14.2	131.0	1.310	0.0
240-400	320	160	0.01600	9.0	304.0	3.040	0.0

This analysis included 252 receptors in a radial grid at distances of 0.8 km to 4.0 km centered on cooling tower 4. A refined analysis was then done with receptors every 100 meters and at crosswind intervals of 2 degrees.

For the PSD Class I refined increment analysis, receptors were also defined to the nearest 100 meters and at crosswind intervals of 2 degrees.

B. Modeling Results

Summaries of the maximum TSP concentrations for comparison to the PSD Classes I and II increments and the NAAQS are as follows:

MAXIMUM TSP SCREENING CONCENTRATIONS FOR COMPARISON TO THE PSD CLASS I, CLASS II, AND AAQS ANALYSIS (ug/m^3)

	PSD Class I			PSD Class II			NAAQS				
Year	Concentration	Direction (°)	Distance (km)	Concentration	Direction (°)	Distance (km)	Modeled Sources	Background+	Total	Direction (°)	Distance (km)
24-Hour											
1981	1.2	181	21.3	11.0	270	2.4	11.0	88	99.0	270	2.4
1982	0.98	181	21.3	9.8	230	1.5	9.8	88	97.8	230	1.5
1983	1.2	173	21.5	10.0	220	1.5	10.0	88	98.0	220	1.5
1984	1.0	175	21.4	10.6	260	1.5	10.6	88	98.6	260	1.5
1985	0.98	173	21.5	10.2	250	1.5	10.2	88	98.2	250	1.5
Annual											
1981	0.16	153	23.9	1.92	260	1.1	1.95	42	44.0	260	1.1
1982	0.11	178	21.3	1.53	240	1.1	1.54	42	43.5	240	1.1
1983	0.12	170	21.6	1.43	240	1.1	1.48	42	43.5	240	1.1
1984	0.13	181	21.3	1.84	240	1.1	1.86	42	43.9	240	1.1
1985	0.10	178	21.3	1.76	240	1.1	1.79	42	43.8	240	1.1

Note: PSD Class I increments are 10 ug/m^3, 24-hour average, and 5 ug/m^3, annual average; PSD Class II increments are 37 ug/m^3, 24-hour average and 19 ug/m^3 annual average; PSD significance levels are 5 ug/m^3, 24-hour average, and 1 ug/m^3, annual average.

+ Based on FPC monitoring data collected from July 1986 to June 1987, second highest 24-hour and highest annual average concentration.

MAXIMUM REFINED PREDICTED TSP CONCENTRATIONS FOR COMPARISON TO PSD INCREMENTS AND AAQS

Source Air Quality Requirement	24-hour	Annual
PSD Class I Analysis		
PSD Increment-Consuming Sources	1.2	0.16
Class II Allowable Increment	10	5
PSD Class II Analysis		
PSD Increment-Consuming Sources	11.2	1.9
Class II Allowable Increment	37	19
AAQS Analysis		
Existing and PSD Increment-Consuming Sources, Background	99.2	44.0
Florida TSP AAQS	150	60

As shown in these tables, the maximum predicted concentrations are below the applicable maximum allowable PSD increments and NAAQS.

C. Analysis of Existing Air Quality

Preconstruction ambient air quality monitoring data are required for all pollutants subject to PSD review. In general, one year of quality assured data using EPA reference methods, or equivalent methods, must be submitted. Sometimes less than one year of data, but not less than four months, may be accepted when EPA approval is given. An exemption to the monitoring requirement can be obtained if the maximum air quality impact, as determined through air quality modeling, is less than a pollutant-specific de minimis concentration. In addition, if current monitoring data already exist and these data are representative of the proposed source area, then these data may be used at the discretion of the reviewing authority. For TSP the de minimis ambient impact level is 10 ug/m^3. At the time of the original PSD application, air quality impacts for TSP were less than the de minimis value and preconstruction monitoring was not required. However, FPC does maintain a TSP monitor near the Crystal River site and the most recent year of monitoring data was used to determine TSP ambient background levels.

VI. ADDITIONAL IMPACTS ANALYSIS

A. Impacts on Soils and Vegetation

Cooling towers will lose a portion of the circulating water due to evaporation and to entrainment of water droplets in the air used to acheive the cooling. The water droplets contain similar salt concentrations as the circulating water. These salt water droplets, known as salt drift, are deposited on the land as salt deposition. The salt deposition contains sodium and chloride ions which can cause long-term damage to soils and vegetation. The amount of salt deposited on the surrounding land and plant leaf surfaces determines if damage may occur. Salt drift models exist which use environmental, meteorological, and operational variables to predict the amount of salt deposited on areas surrounding cooling towers.

A natural salt drift exists near large bodies of salt water. The natural salt deposition from the Gulf of Mexico on the land near the Crystal River Power Complex has been measured to range from 3.4 to 6.7 g/m^2-yr.[1] The biotic communities in the Crystal River area contain a majority of plant species that have adapted to the salt deposition.[2]

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[1]KBN Engineering and Applied Sciences, Inc., Environmental Assessment of Salt Drift Impacts from Florida Power Corporation Crystal River Plant, June 1988.
[2]Ibid.

A salt drift model has been developed for the cooling towers operating at the Crystal River Power Complex and salt deposition rates have been predicted for the areas surrounding the cooling towers.[3] EPA has developed a worst case operating scenario augmenting the salt deposition rates predicted by the model and a worst case analysis of the natural salt deposition.[4] These worst case salt deposition rates were used to assess the potential damage to the soil and indigenous vegetation of Crystal River. The maximum worst case salt deposition (including worst case background deposition) is 16.2 g/m^2-yr for off site areas. There should be no impacts to the soil. The species that have low tolerance to salt may be adversely impacted by the salt deposition. However, those species that have low resistance to salt are primarily found at the low-lying vegetation level, and the taller plants, which are predominantly salt tolerant species, reduce the amount of salt deposited on the sensitive species. Therefore, the damage to sensitive species will be reduced.

There are approximately five acres of off-site freshwater marshes that may be impacted by the salt drift. These marshes contain about one-third low resistance species and do not contain tall vegetation. The potential impacts to the freshwater marshes may cause a species shift where more salt tolerant species will gradually become more predominant in the freshwater marshes.

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3 KBN Engineering and Applied Sciences, Inc., Environmental Assessment of Salt Drift Impacts from Florida Power Corporation Crystal River Plant, June 1988.

4 U.S. Environmental Protection Agency, Office of Policy and Management, Region IV, Assessment of Salt Deposition Impacts at Crystal River, August 31, 1988.

B. Impact on Visibility

A Level I visibility screening analysis was performed to determine if any adverse visibility impacts may occur in the Class I area. The analysis showed that there was no potential for an adverse impact on visibility in this area. The potential visibility impact due to cooling towers 4 and 5 may be found in Appendix A to this report.

C. Growth-Related Air Quality Impacts

The proposed facility is not expected to significantly change employment, population, housing, or commercial/industrial development in the area to the extent that a significant air quality impact will result.

D. Noncriteria and Unregulated Pollutants

Natural draft cooling towers do not emit significant amounts (as defined in the PSD regulation) of any noncriteria pollutant or unregulated pollutants.

E. GEP Stack Height Determination

Natural draft cooling towers are not subject to the Good Engineering Practice (GEP) stack height regulations.

VII. FINAL PERMIT

Part I. - Specific Conditions

1. Emission Limitations

   a. Cooling tower emissions from each unit individually shall not exceed the following:

      Total Suspended Particulate: 175 lb/hr

2. Compliance Tests

   a. Unit 4 tower shall be tested after October 1, 1988, but no later than December 31, 1988. The first compliance test for unit 5 tower shall be conducted after January 1, 1992, but not later than May 1, 1992. Additionally, units 4 and 5 shall be tested no less than once every five years thereafter, during the same periods of the respective calendar years.

   b. The following test methods and procedures shall be used for compliance testing:

      (1) Particulate emissions shall be measured by the sensitive paper (SP) method for each cooling tower.

      (2) Testings shall be done at either the drift eliminator level within the tower or at the tower exit plane.

      (3) For demonstrating compliance with the applicable emission limit, not less than three tests shall be conducted. All valid data from each of these tests shall be averaged in demonstrating compliance. No individual test result shall determine compliance or noncompliance. The emissions rate reported as a percent of the circulating water as well as lb/hr and total dissolved solids in the cooling tower basin(s) and intake water shall be reported for each test.

3. Air Pollution Control Equipment

   a. Within three months after permit issuance, all areas adjacent to concrete structures within the unit 5 tower shall be properly sealed to assure that the drift eliminators are not bypassed.

   b. Not less than once every three months, the drift eliminators of both towers shall be inspected from the concrete walkways by FPC staff or representatives to assure that the drift eliminators are clean and in good working order. Not less than annually, a complete inspection of the towers shall be conducted by a manufacturer of drift eliminators or by a consultant with recognized expertise in the field.

c. An inspection protocol shall be submitted prior to the first field inspection. Certification that the drift eliminators are properly installed and in good working order shall be made at the time of submission of the reports noted below.

4. Reporting

a. Reports on tower testing and inspection shall be submitted according to the following timeframe:

(1) Within 30 days after sealing of Unit 5 Tower (See item VII.I.3.a., above)

(2) Within 30 days after all visual inspections of the drift eliminators, and

(3) Within 45 days after the compliance testing of either the unit 4 or unit 5 tower.

b. Should either tower emission rate exceed 175 lb/hr, the permittee shall do the following:

(1) Notify EPA and the Florida Department of Environmental Regulation (FDER) of the occurrence within 10 days of becoming aware of the situation.

(2) Provide an assessment of necessary corrective actions and a proposed schedule of implementation within an additional 20 days.

(3) Expeditiously complete corrective actions.

(4) Retest the tower within three months after the correction is completed.

(5) Submit the testing report within 45 days after completion of said tests.

5. Ambient Monitoring

a. The permittee shall continue the salt drift monitoring program approved by EPA and the FDER on January 6, 1981, and January 28, 1981, respectively. Reports shall be submitted quarterly to EPA and FDER.

b. Florida Power Corporation shall submit to EPA Region IV and FDER, by no later than November 30, 1988, a plan to expand and modify the existing monitoring program. This expanded monitoring program must be approved by FDER and EPA and shall include the following:

(1) An increase in the number of deposition monitors and monthly vegetation monitoring locations to include a representative number of freshwater marshes and coastal hammock and coastal hydric hammock communities.

(2) Initiation of a soil salt sampling program which includes obtaining baseline soil salt concentration data by sampling soil at representative locations.

(3) Initiation of a surface water salt sampling program which includes obtaining baseline surface water salt concentration data by sampling water in a reprentative number of fresh water marshes.

(4) Inclusion of deposition, soil, fresh water, and vegetation monitoring stations on appropriate portions of Hollins Corp. land.

(5) Collection of data to more accurately determine the natural background deposition at Crystal River.

Upon approval the revised plan shall be expeditiously implemented.

c. If, as determined by EPA, FDER, or the permittee, the monitoring data indicate that significant impacts are occurring to the surrounding area, the permittee shall consult with EPA and FDER to mitigate these impacts. Within 60 days thereafter, FPC shall submit to EPA and FDER an assessment of the damage, options to reduce the impact, and a proposed course of action to correct the damage. Upon the direction of the EPA or FDER, FPC shall implement corrective action. Should the data indicate that no significant impacts are occurring to the surrounding area, the permittee, after consultation with and approval by the Director of the EPA Region IV Air, Pesticides, and Toxics Management Division and FDER, may reduce or eliminate the monitoring program.

6. Addresses for submitting reports are:

EPA Region IV

Chief, Air Compliance Branch
U.S. Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Florida Department of Environmental Regulation (DER)

Deputy Chief, Compliance and Ambient Monitoring
Bureau of Air Quality Management
Florida Department of Environmental
Regulation (DER)
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

PART II. - General Conditions

1. The permittee shall provide EPA and FDER with 30 days notice prior to conducting any compliance testing required under specific condition 2.a.

2. The permittee shall retain records of all information resulting from monitoring activities and information indicating operation parameters as specified in the specific conditions of this permit for a minimum of two (2) years from the date of recording.

3. If, for any reason, the permittee does not comply with or will not be able to comply with the emission limitations specified in this permit, the permittee shall provide EPA and FDER with the following information in writing within 10 days of such condition:

   (a) description of noncomplying emission(s),

   (b) cause of noncompliance,

   (c) anticipated time the noncompliance is expected to continue or, if corrected, the duration of the period of noncompliance, and

   (d) steps taken by the permittee to reduce and eliminate the noncomplying emission.

   Failure to provide the above information when appropriate shall constitute a violation of the terms and conditions of this permit. Submittal of the aforementioned information does not constitute a waiver of the emission limitations contained within this permit.

4. Any proposed change in the information contained in the final determination regarding facility emissions or changes in the quantity or quality of materials processed that would result in new or increased emissions or ambient air quality impact must be reported to EPA and FDER. If appropriate, modifications to the permit may then be made by EPA or FDER

to reflect necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause violation of the emission limitations specified herein.

5. In the event of any changes in control of ownership of the source described in the permit, the permittee shall notify the succeeding owner of the existence of this permit and both EPA and FDER of the change in control of ownership within 30 days.

6. The permittee shall allow representatives of the FDER or representatives of the EPA, upon presentation of credentials:

   (a) to enter upon the permittee's premises, or other premises under the control of the permittee, where an air pollutant source is located or in which any records are required to be kept under the terms and conditions of this permit;

   (b) to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit, or the Clean Air Act;

   (c) to inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

   (d) to sample at reasonable times any emissions of pollutants; and

   (e) to perform at reasonable times an operation and maintenance inspection of the permitted source.

7. The conditions of this permit are severable, and if any provision of this permit or the application of any provisions of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected.

ASSESSMENT OF SALT DESPOSITION IMPACTS AT CRYSTAL RIVER

Environmental Protection Agency

Office of Policy and Management

Region IV

August 31, 1988

Assessment of Salt Deposition Impacts at Crystal River

PURPOSE

The Environmental Protection Agency (EPA) has prepared this report to support permit decisions for discharges to waters of the United States under the Clean Water Act and emissions to the air under the Clean Air Act. This report directly responds to the comments and the concerns presented by Dixie M. Hollins and Louie N. Adcock (Hollins Corporation) at the public hearing held on June 22, 1988 and subsequent written comments on a proposed NPDES permit. These comments raised questions regarding the impacts of salt drift from the proposed modifications and additions to the cooling towers at Florida Power Corporation's (FPC) Crystal River Power Plant.

Florida Power Corporation has requested that they be allowed to operate their Units 4 and 5 cooling towers at higher drift rates than currently permitted. FPC is also proposing to add cooling towers for Units 1, 2, and 3 to reduce current unacceptable thermal impacts from present operation. These actions would result in increased salt deposition on the area. This report evaluates the potential impact to the area's vegetation and water resources resulting from the several possible permitting scenarios. The scenarios are: initial permit conditions, current emissions, FPC's requested changes in emissions for units 4 and 5, and the addition of proposed helper cooling towers for units 1, 2, and 3. Conclusions and recommendations are presented following this evaluation.

BACKGROUND

This section of the report gives a brief history of the Crystal River power plant complex and cites some of the earlier reports addressing salt drift .

FPC's Crystal River power plant complex is located on the Gulf of Mexico in northwestern Citrus County, Florida outside of the town of Crystal River, Florida. In January 1981 the EPA issued an Environmental Impact Statement (EIS) which examined and discussed the impacts of the construction and operation of two 695 megawatt capacity coal-fired electric generating plants at the existing Crystal River Complex. Prior to the EIS, FPC issued a Site Certification Application (SCA) for Crystal River Units 4 and 5 in 1977. The SCA was a support document for FPC's application to construct the coal-fired power units. FPC has been operating Units 1, 2, and 3 since 1966, 1969, and 1977 respectively. Units 4 and 5 have been operating since 1982 and 1984 respectively.

Mitigating measures were developed in the EIS to reduce adverse impacts from the construction and operation of Units 4 and 5. The EIS recommended conditions to the issuance of FPC's NPDES permit. Specific conditions addressing the impact of salt drift were included in the permit and are: 1), the maximum drift rate of the cooling towers of Units 4 and 5 shall be 0.0005% of the circulating cooling water, and 2), FPC shall conduct and report results of a vegetation and salt deposition monitoring program acceptable to the EPA and the Florida Department of Environmental Resources (FDER). The maximum allowable drift rate of 0.0005% was, at the time of the EIS, thought to be the lowest achievable drift rate using the best drift eliminator technology available.

Since the initiation of operation of Unit 4 in October, 1982, FPC has submitted monthly vegetation impact reports and annual salt deposition monitoring reports to the EPA.[1] Additionally, EPA has prepared a salt drift impact analysis (Crystal River Cooling Tower Salt Drift Evaluation, December 23, 1987). The December 1987 report was prepared to address four natural draft cooling towers to be used to reduce the thermal discharge of Units 1-3. The assessment included the salt deposition from Units 4 and 5 operating at a drift rate of 0.0023%. Also, FPC issued a salt drift analysis report in June 1988 to address the combined salt drift of increasing the drift of Unit 4 and 5 cooling towers and the additional drift of the helper cooling towers for Units 1, 2, and 3.[2] When unit 4 was placed in operation and tested, it was found to be in compliance with the permitted drift rate. However, it was found to be operating significantly below its designed thermal efficiency. In an attempt to increase the cooling capability of the Unit 5 cooling tower, the spray system for the tower was modified during construction. When the Unit 5 tower was started up and tested, it was found to have increased thermal efficiency (over Unit 4), but the measured drift rate exceeded the permitted drift rate limit. As directed by EPA, FPC instituted studies of how the drift rate could be reduced and conducted an evaluation of the impact of the increased salt drift. Based on the results of this evaluation and ongoing environmental studies, FPC has requested that EPA increase the permitted drift rates for Units 4 and 5 cooling towers. While FPC's request is being considered, EPA has issued an administrative order allowing FPC to operate Unit 5 cooling tower at the elevated drift rate as long as there are no adverse impacts of the salt drift on the indigenous vegetation.

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[1]Crystal River Salt Drift Annual Reports, 1982-83, 1983-84, Applied Biology, Inc.

Crystal River Salt Drift Annual Report, 1984-85, Florida Power Corporation

Crystal River Salt Drift Deposition Monitoring Annual Reports 1985-86, 1986-87, KBN Engineering and Applied Sciences, Inc.

[2]Submittal to EPA of revised deposition contours, June 1988, KBN/FPC

SALT DRIFT ANALYSIS

This section of the report describes the amount of salt drift and salt deposition occurring and expected to occur at the Crystal River facility. Salt drift modeling has been performed and the salt deposition rates have been predicted by the model. The deposition predicted by the model is compared to the current salt deposition monitoring data.

Units 1-3 are presently cooled using a once-through salt water system, that is they do not use cooling towers. FPC proposes to construct helper (nonrecirculating) cooling towers to reduce the thermal impact of the liquid waste discharge of Units 1-3 to the Gulf of Mexico (Crystal Bay). These cooling towers will be operated only as necessary to assure that the plant discharge temperature does not exceed 97.0 °F as an instantaneous maximum nor 96.5 °F as a maximum three hour average. Therefore, the towers will not be operated if plant discharge temperatures remain below 96.5 °F. Although periodic operation of the towers could begin as early as late April during unusual warm weather conditions and extend until late October, near continuous operation of the towers will generally not occur except during the summer months (June through September).

The cooling process in a cooling tower is primarily due to evaporation. To achieve this evaporation, the water to be cooled must be brought into contact with large volumes of air. This contact of air and water results in the entrainment of small droplets (drift particles) in the air from the top of the cooling tower to the atmosphere. Since the water used at the site is salt water from the Gulf, the drift droplets contain a high concentration of dissolved salts (primarily sodium chloride with smaller amounts of potassium and manganese salts).

Drift particles from cooling towers do not stay entrained in the air indefinitely. The salt drift is carried by prevailing winds and falls (due to gravity) as salt deposition on the land around the cooling tower. The amount of salt deposited on any specific area is generally dependent upon its distance from the cooling tower, its location relative to the tower and to the prevailing winds, the height of the cooling tower, the cooling water and ambient air temperatures, and environmental conditions such as topography and locations of surface waters. Using meteorological data, the size of the drift droplets, the height of the cooling tower, the temperature of the exit gases, and the salt emission rate, it is possible to calculate the salt deposition at various locations around the cooling tower. This type of calculation, called salt deposition modeling, is complex and is subject to errors based on the assumptions and periods used for data averaging. However, a model can be compared to field data and used to make decisions about projected salt drift and its impact to the environs surrounding the cooling tower.

Areas that are close to large salt water bodies receive natural salt deposition from wind blown salt water droplets. The EIS stated that the area received a natural background salt deposition from the Gulf of Mexico of 3.4 g/(m^2-yr). Two years of pre-operational monitoring (1980 and 1981) indicated background salt deposition rates of 3.5 and 6.7 g/(m^2-yr).[3] Additionally, the FPC annual deposition monitoring reports suggest that the data from the Open Control monitoring location (see Figure 1) could be used as an approximation to determine background deposition.[4] EPA's report, here in, will use high values of background deposition to give the analyses a conservative (i.e. worst case) bias. The measured pre-operational value of 6.7 g/(m^2-yr) is averaged with the Open Control measured deposition rate for the 1985/86 monitoring period. For use in this calculation, the modeled deposition at that location of 2.2 g/(m^2-yr) was subtracted from the monitored value of 7.8 g/(m^2-yr) to yield a calculated 1985/86 background of 5.6 g/(m^2-yr). The average of these values (5.6 and 6.7), 6.2 g/(m^2-yr), is used in this report as the total annual background salt deposition for the Crystal River site. In their June, 1988 report, KBN Engineering and Applied Sciences, Inc. (KBN) stated that 2.5 g/(m^2-yr) of the annual salt deposition is contained in rainfall. The annual background dry salt deposition used in this report is therefore 3.7 g/(m^2-yr).

McVehil-Monnet Associates performed modeling analyses for the operation of the cooling towers at Crystal River.[5] This modeling shows only the predicted salt deposition from the cooling towers and does not include the annual background salt deposition. Figure 2 shows the expected annual salt deposition contours from Units 4 and 5 cooling towers operating at a drift rate of 0.0005% (i.e. the NPDES permit conditions).[6] Figure 3 shows the expected annual salt deposition contours from Unit 4 and 5 cooling towers at the existing conditions of an average drift rate of 0.0014% (Unit 4 at 0.0005% and Unit 5 at 0.0023%) at an 81% capacity factor with a concentration of dissolved solids in the cooling water of 32,000 parts per million (ppm).[7] Table 1 lists the annual salt deposition rates at the monitoring locations as extrapolated from the modeled results (Figure 3) for Units 4 and 5 cooling towers at the existing drift rate and the total annual salt deposition rates (i.e. predicted deposition from Units 4 and 5 plus background deposition).

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[3]Submittal to EPA of revised deposition contours, June 1988, KBN/FPC.

[4]Crystal River Salt Drift Deposition Monitoring Annual Reports, 1985-86, 1986-87, KBN Engineering and Applied Sciences, Inc.

[5]Cooling Tower Drift Deposition Crystal River Units 4 & 5 Florida Power Corporation (0.0005%), (0.002% Drift Rate), and (0.005% Drift Rate) Cooling Tower Drift Deposition Crystal River Units 1,2,3,4 & 5 Florida Power Corporation (0.0005% Drift Rate), and (0.002% Drift Rate), McVehil-Monnett Associates, March 1986

[6]Ibid

[7]Submittal to EPA revising deposition contours and modified by memorandum of Charles Kaplan, Water Management Division, EPA Region IV, June 28, 1988.

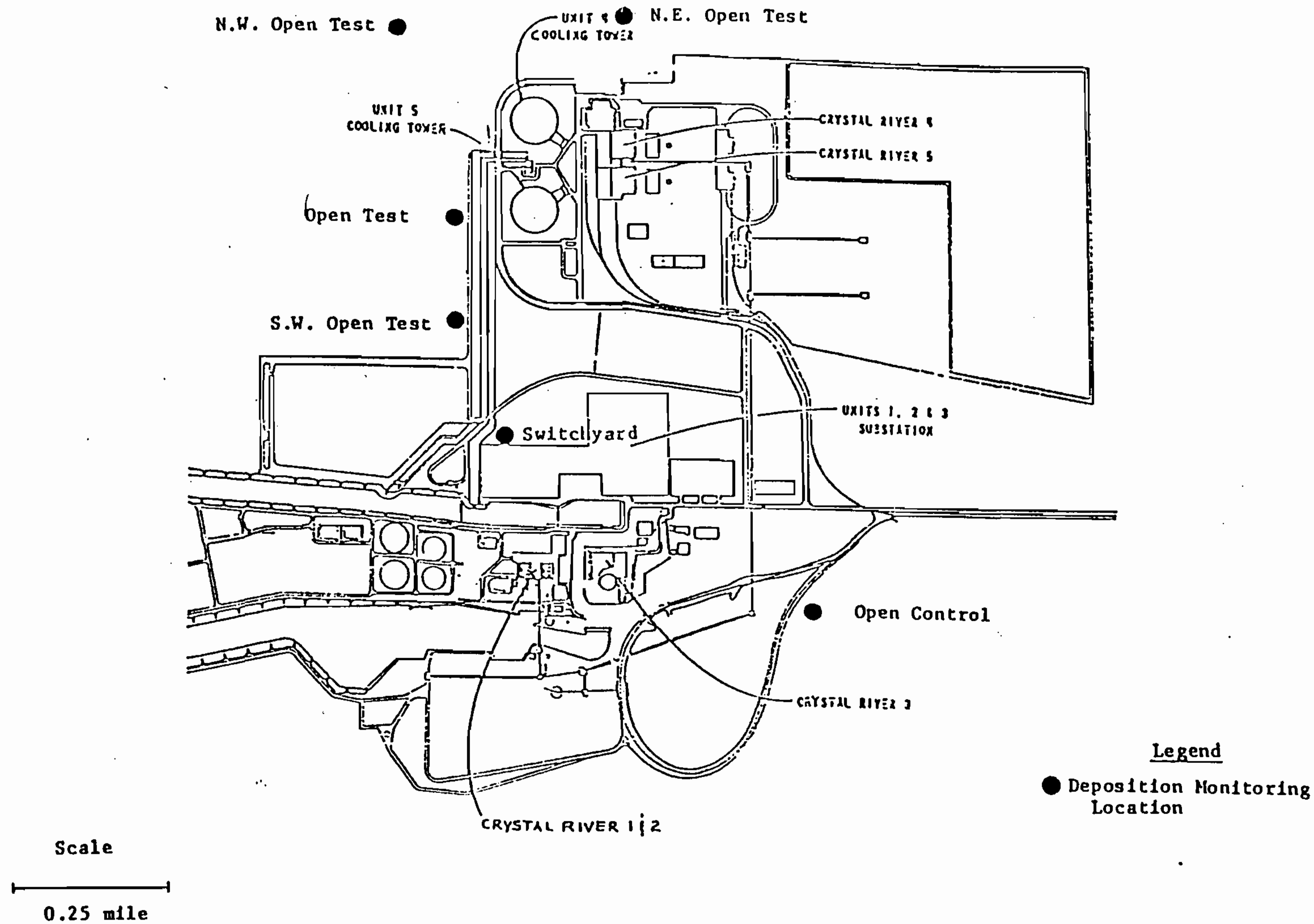

Figure 1. Monitoring Locations for FPC Crystal River Deposition Network

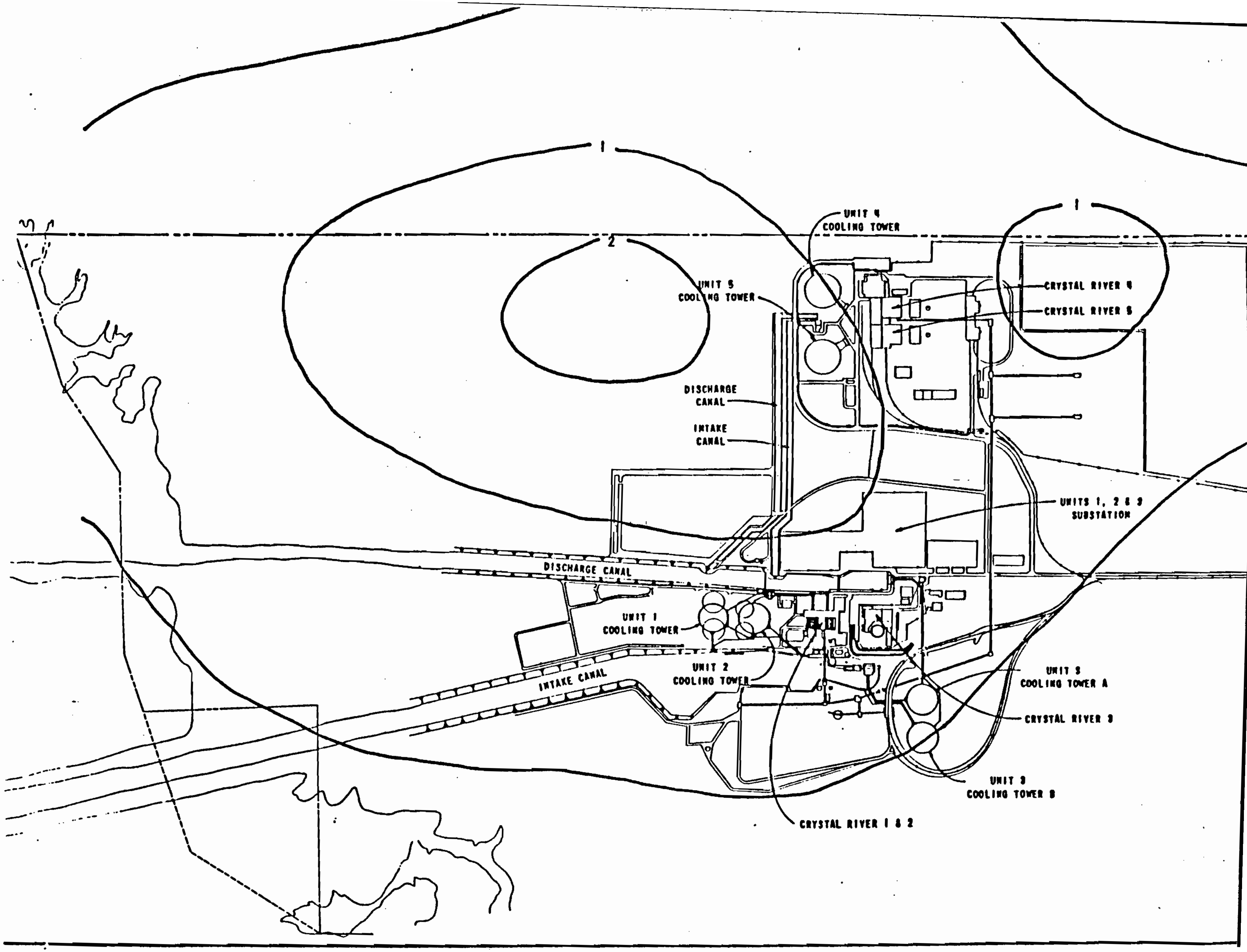

FIGURE 2
Originial Permitted Salt Deposition: Units 4 and 5 at Drift Rate of 0.0005%, No Helper Towers

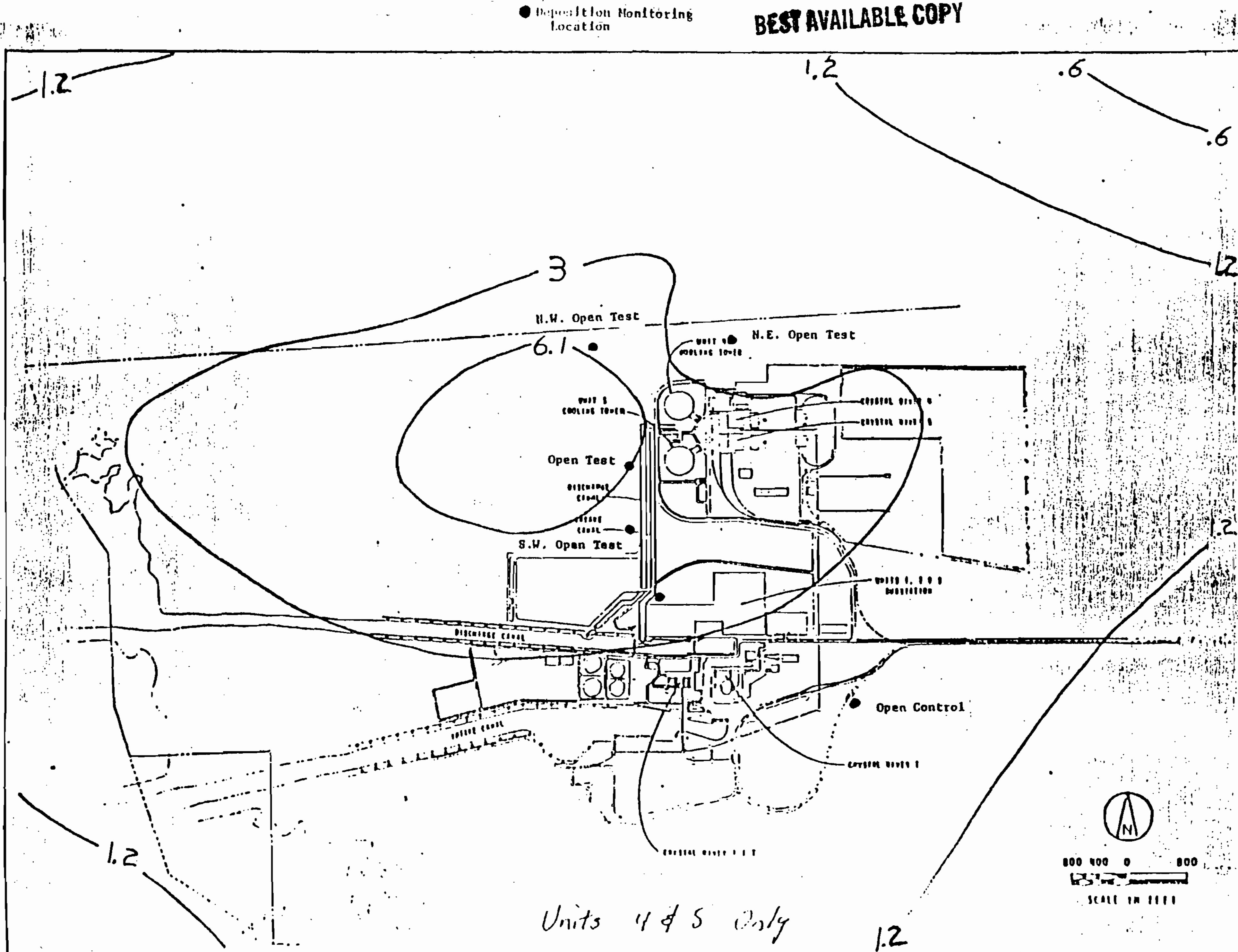

FIGURE 3

Predicted Annual Salt Deposition (g/m^2) from existing conditions for Cooling Tower Units 4 and 5, 32,000 ppm total dissolved solids in cooling water.

The open bucket method is used to collect the salt deposition at Crystal River.[8] Measurements of the salt collected in the buckets are made monthly and the data are reported as annual deposition rates. Table 2 displays the measured annual deposition rates as reported in the 1985/86 and 86/87 annual Salt Drift Deposition Monitoring Reports. The annual monitoring periods are from October 1985 through September 1986 (for the 1985/86 annual report) and October 1986 through September 1987 (for the 1986/87 annual report).

Table 1

Predicted Annual Salt Deposition

(Values reported in $g/(m^2-yr)$)

	Units 4 and 5[1]	Total[2]	Dry Total[3]
Open Test	6.1	12.3	9.8
NW Open Test	5.9	12.1	9.6
NE Open Test	2.7	8.9	6.4
SW Open Test	5.3	11.5	9.0
Open Control	2.2	8.4	5.9

1 Extrapolated from Figure 3.
2 Includes the Average Annual Background Deposition (6.2 g/m^2-yr).
3 Includes the Average Annual Background Dry Salt Deposition (6.2 $g/(m^2-yr)$ - 2.5 $g/(m^2-yr)$ from rainfall).

Table 2

Annual Measured Total Deposition

	1985/86 g/m^2	1986/87 g/m^2
Open Test	7.9	7.5
NW Open Test	10.3	6.0
NE Open Test	13.4	6.7
SW Open Test	9.7	7.6
Open Control	7.8	4.1

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[8] Crystal River Salt Drift Annual Report 1983-84, Applied Biology, Inc., May 7, 1986.

The measured annual salt deposition at the monitoring sites reported in the 86/87 annual report are all less than the total deposition predicted by the model for those locations. For the 85/86 monitoring period all the monitoring sites, except the NE Open Test site, had measured deposition rates which were higher than the model's predicted rates. Tables 3 and 4 list the measured deposition rates for the two monitoring periods, the average predicted deposition rates, and the percent difference between the modeled rates and the measured rates. Note that the model predicts the NW Open Test to receive 36% greater salt deposition than the NE Open Test site would receive, but the NE Open Test site received higher salt deposition than the NW Open Test site for both monitoring periods.

Table 3

Modeled Deposition vs Measured Deposition (1985/86)

Monitoring Location	Measured Deposition $(g/m^2\text{-}yr)$	Modeled Deposition $(g/m^2\text{-}yr)$	Percent Difference [(mod/meas) - 1] x 100%
Open Test	7.9	12.3	56
NW Open Test	10.3	12.1	17
NE Open Test	13.4	8.9	-34
SW Open Test	9.7	11.5	19
Open Control	7.8	8.4	7

Table 4

Modeled Deposition vs Measured Deposition (1986/87)

Monitoring Location	Measured Deposition $(g/m^2\text{-}yr)$	Modeled Deposition $(g/m^2\text{-}yr)$	Percent Difference [(mod/meas) - 1] x 100%
Open Test	7.5	12.3	64
NW Open Test	6.0	12.1	102
NE Open Test	6.7	8.9	33
SW Open Test	7.6	11.5	51
Open Control	4.1	8.4	105

Figure 4 shows the expected annual salt deposition from Unit 4 and 5 cooling towers at a drift rate of 0.0023%.[9] Figure 5 shows the expected annual salt deposition from Units 4 and 5 cooling towers (at a drift rate of 0.0023%) and the helper cooling towers for Units 1-3 (at a drift rate of 0.002%).[10]

In conducting its evaluation of potential salt drift impacts, EPA selected a worst case scenario more critical than the one used by KBN in its June 1988 report. The EPA analysis assumed: 1) continuous operation of the existing and proposed cooling towers for Units 1-5 during the summer months (June through September) where KBN used an operating factor of 81% for Units 4 and 5, 2) a salt drift quantity for Units 4 and 5 cooling towers based on a total dissolved solids (TDS) concentration (i.e. the amount of salt in the circulating water) of 38,000 parts per million (ppm) where KBN used 32,000 ppm, 3), a salt drift quantity for Units 1-3 based on TDS of 32,000 ppm where KBN used 29,100 ppm, and 4) a worst case natural salt deposition of 6.2 g/m^2-yr where KBN used 5.1 g/m^2-yr. The TDS concentrations used by EPA are the highest measured historical values from the tower with the maximum concentrations during the month with the highest values since the Unit 4 cooling tower began operation. The TDS concentration for Units 1-3 cooling towers is lower than the TDS for the Units 4 and 5 cooling towers because Units 1-3 towers use nonrecirculating cooling towers and will not concentrate solids in the circulating water as much as recirculating towers (Units 4 and 5 towers) do. Table 5 lists the daily salt deposition rates at worst case short duration conditions as noted above. These daily deposition rates are used in the Vegetation Impact Analysis presented later in this report.

Six scenarios are evaluated in this report reflecting six different sets of operating conditions and associated salt drift. The first scenario is the original permit conditions; Units 4 and 5 cooling towers operating at a 0.0005%, and Units 1-3 using once through cooling. The second scenario is the existing conditions at Crystal River; Unit 4 cooling tower operating at 0.0005% drift rate, and Unit 5 operating at a drift rate of 0.0023%, and Units 1-3 using once through cooling. Scenario 3 is increasing the drift rate of Unit 4 and leaving all other conditions the same. This scenario corresponds to FPC's request to change the permitted drift rate to 0.0023% for the cooling towers for both Units 4 and 5. Scenario 4 is the addition of the proposed helper cooling towers to the original permit conditions; Units 1-3 cooling towers operating at a drift rate of 0.002% each, and Units 4 and 5 cooling towers operating at a drift rate of 0.0005% each. Scenario 5 is the addition of the proposed helper cooling towers to the existing conditions; Unit 4 cooling tower drift rate being 0.0005%, Unit 5 cooling tower drift rate being 0.0023%, and Units 1-3 cooling towers drift rates being 0.002% each. Scenario 6 is increasing of Unit 4 drift rate and adding the proposed helper cooling towers; Units 4 and 5 cooling towers drift rates being 0.0023% each, and Units 1-3 cooling towers drift rates being 0.002% each.

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[9] Submittal to EPA revising salt deposition contours, KBN/FPC, June 1988.

[10] Ibid.

⊙ Deposition Monitoring Location

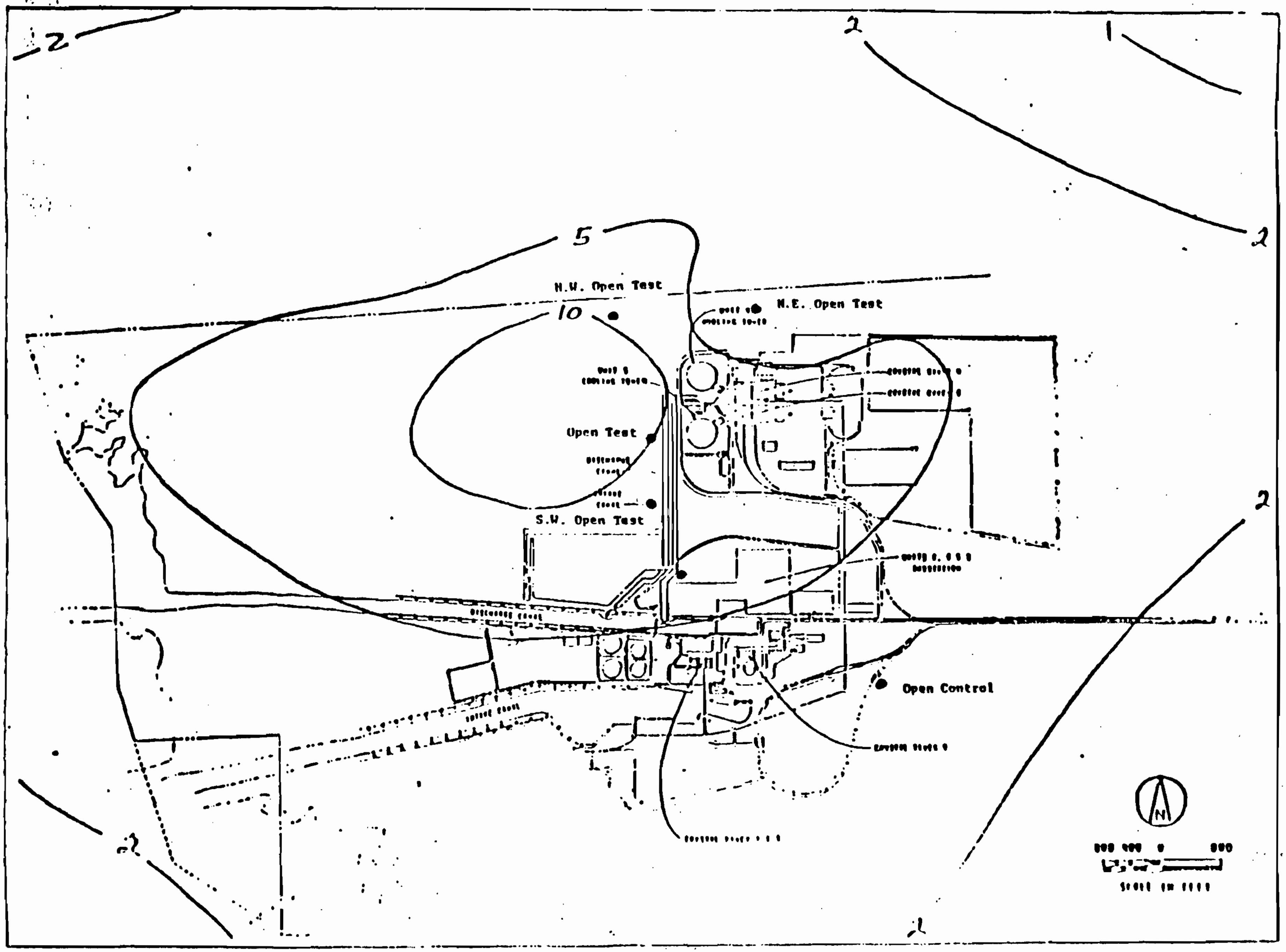

FIGURE 4

Annual Salt Deposition (g/m^2) predicted from Model for Units 4 and 5 Cooling Towers at 0.0023%, Drift Rate, 32,000 ppm Total Dissolved Solids. (Proposed change to Unit 4).

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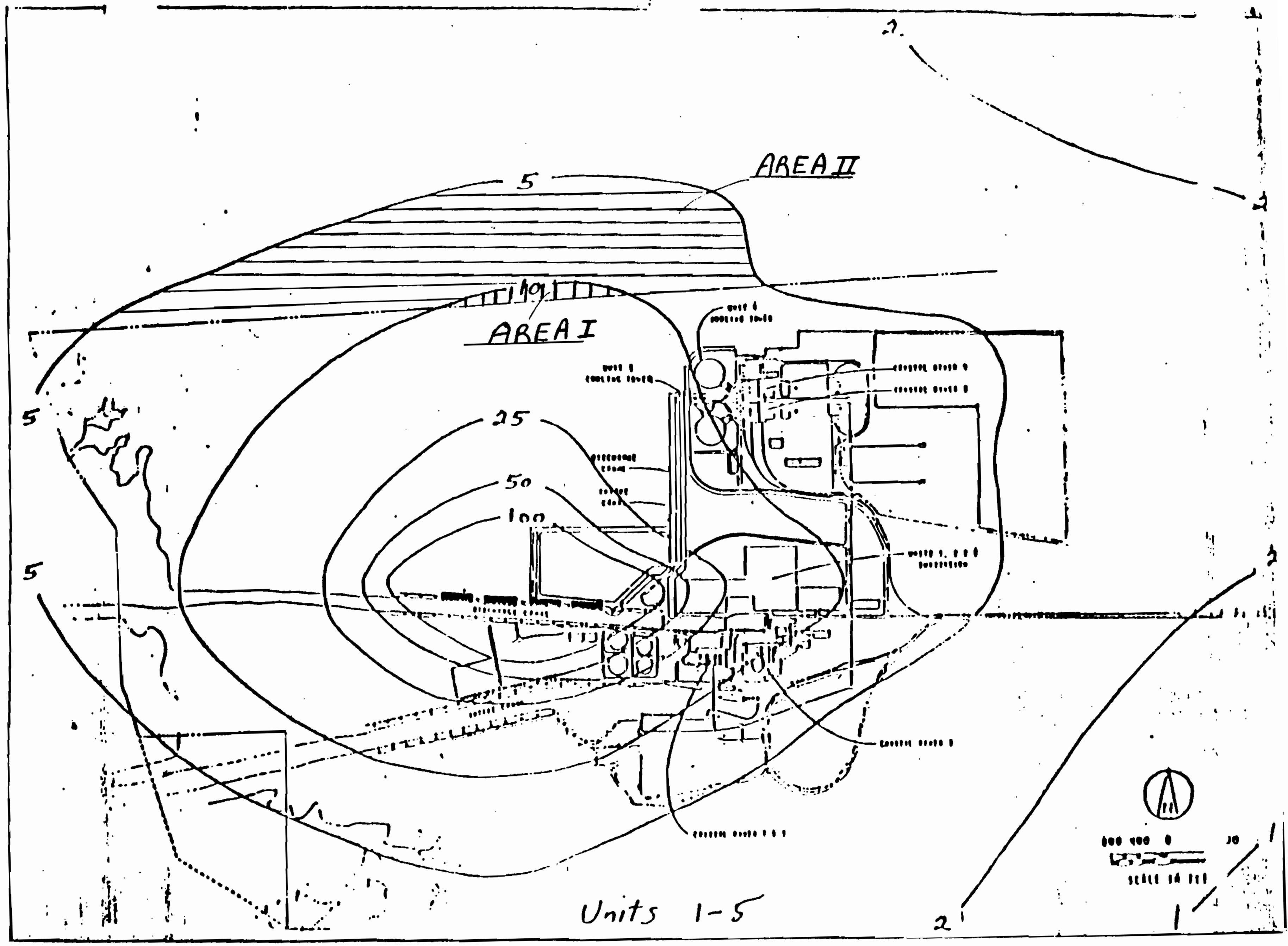

FIGURE 5
Proposed maximum Deposition: Units 4 and 5 at Drift Rate of 0.0023%, Helper Cooling Towers at 0.002%

Table 5

Crystal River Units 1-5 Cooling Towers
Worst-Case Daily Deposition Rates

(g/m^2-day)

A. Deposition at northern property line on Figure 5 (Used for Area I assessment)

Scenario	Units 4 & 5	Units 1-3	Background	Total
1	0.009	0.0	0.010	0.019
2	0.024	0.0	0.010	0.034
3	0.040	0.0	0.010	0.050
4	0.009	0.028	0.010	0.047
5	0.024	0.028	0.010	0.062
6	0.040	0.028	0.010	0.078

B. Deposition at the 5 g/m^2-yr contour north of the plant on Figure 5

Scenario	Unit 4 & 5	Units 1-3	Background	Total
1	0.003	0.0	0.010	0.013
2	0.010	0.0	0.010	0.020
3	0.016	0.0	0.010	0.026
4	0.003	0.009	0.010	0.022
5	0.010	0.009	0.010	0.029
6	0.016	0.009	0.010	0.035

C. Deposition at an average of A and B (Used for Area II Assessment)

Scenario	Unit 4 & 5	Units 1-3	Background	Total
1	0.006	0.0	0.010	0.016
2	0.017	0.0	0.010	0.027
3	0.028	0.0	0.010	0.038
4	0.006	0.019	0.010	0.035
5	0.017	0.019	0.010	0.046
6	0.028	0.019	0.010	0.057

D. Deposition at the 2 g/m^2-yr contour north of Area II

Scenario	Unit 4 & 5	Units 1-3	Background	Total
1	0.001	0.0	0.010	0.011
2	0.004	0.0	0.010	0.014
3	0.006	0.0	0.010	0.016
4	0.001	0.004	0.010	0.015
5	0.004	0.004	0.010	0.018
6	0.006	0.004	0.010	0.020

Description of Scenarios:

1: Permitted drift rate, both towers at 0.0005%
2: Existing conditions, Unit 4 tower at 0.0005% and Unit 5 tower at 0.0023%
3: Requested drift rate increase for Unit 4 tower to 0.0023%
4: Scenario 1 with Units 1-3 helper towers at drift rate of 0.002%
5: Scenario 2 with Units 1-3 helper towers at drift rate of 0.002%
6: Scenario 3 with Units 1-3 helper towers at drift rate of 0.002%

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VEGETATION IMPACT ANALYSIS

This section of the report describes the indigenous vegetation at Crystal River and provides an analysis of the impact of salt deposition (described in the previous section) on the vegetation of two areas north of the plant. These areas (shown on Figure 5 as Areas I and II) are selected because they are the land off of FPC property predicted to have the greatest impact from the salt deposition from the cooling towers.

Figure 6 shows the biotic communities that are found in Areas I and II.[11] Table 6 lists the percentages of the types of vegetation found in the biotic communities.[12] Using Table 6 and Figure 6, Area I and II can be described by area, types of vegetation, and the sensitivity of the vegetation to salt. The vegetation in area north of Area II is primarily planted pine, however due to the distance from the FPC power facility, detailed figures and biotic information is not available.

Area I is a 15-20 acre crescent shaped tract of Hollins Corp. land adjacent and just north of the FPC northern property boundary. Area I vegetation is coastal hydric hammock which is a mixture of isolated hammock areas and wetland forests. The most abundant species found in the hydric and coastal hydric communities are very salt tolerant, defined as very tolerant, tolerant and high resistance species. The next most common species are the low resistance species, and the least common species are moderate resistance species.

Area II is a 250-300 acre tract of Hollins Corp. land containing 110-130 acres of coastal hydric hammock, 55-65 acres of salt marsh, 55-65 acres of planted pine, 25-35 acres of mixed vegetation and evergreen scrub, and approximately 5 acres of fresh water marshes. Salt marsh is made up of 100% of species that have a very high tolerance to salt. The planted pine community at Crystal River comprises mostly plants that have a moderate resistance to salt. Plants with high resistance to salt damage are the next most common type of vegetation in the pine plantation, and low resistance species are the least common. The mixed vegetation and evergreen scrub communities are a mix of the coastal hydric hammock, mesic hammock, and the planted pine communities and display vegetation sensitivity that is a combination of the three other biotic communities, mostly moderate and high resistance species with the remainder being low resistance species.

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[11] EPA superimposed the contour lines from Figure 5 (herein) over Figure 2-1 from Environmental Assessment of Salt Drift Impacts of Florida Power Corporation Crystal River Units 1,2,3,4 & 5 with Natural Draft Cooling Towers, KBN, August, 1986. Figure 2-1 represents the biotic communities at Crystal River.

[12] Ibid.

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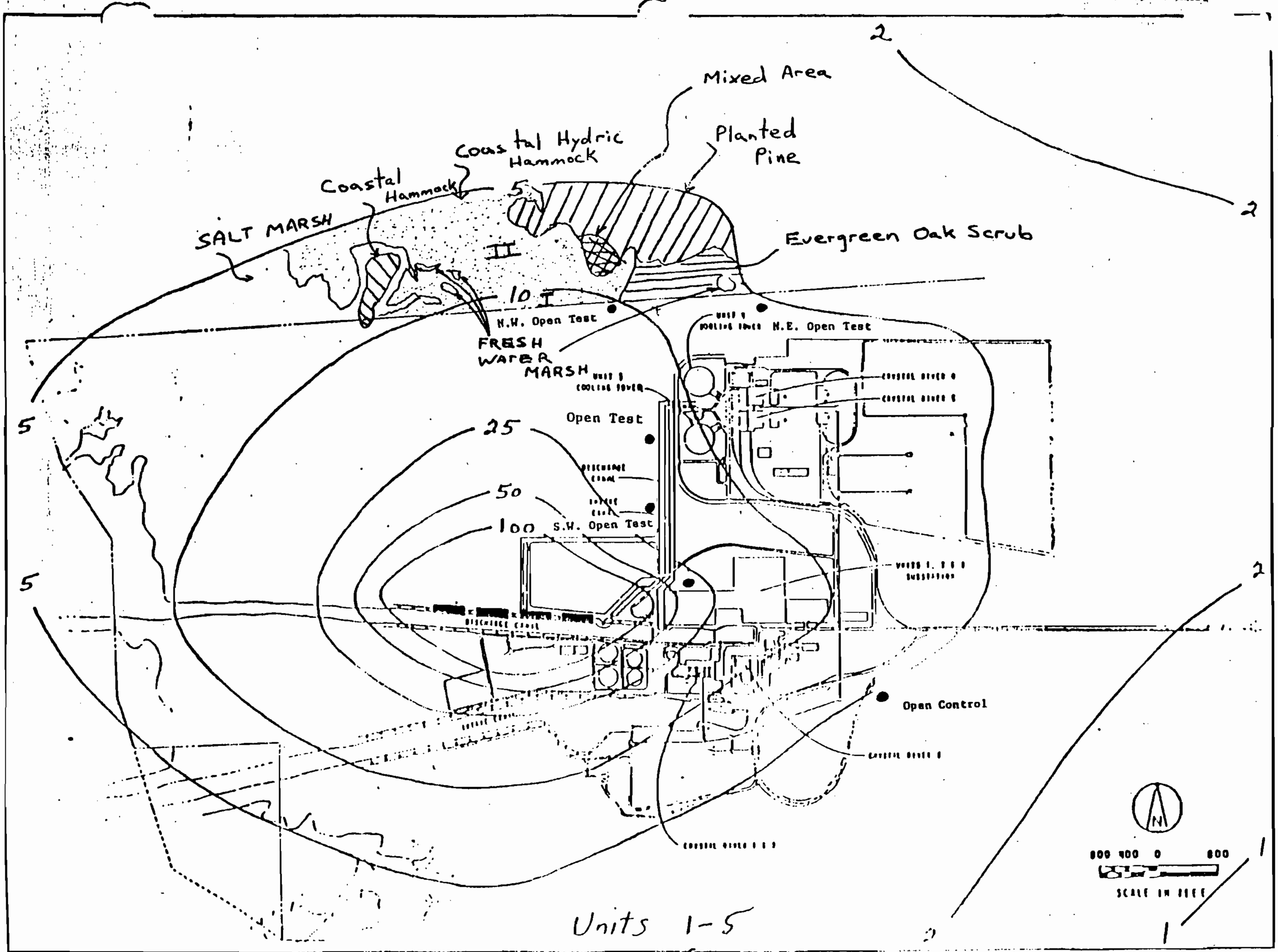

FIGURE 6
Areas Affected by Proposed Maximum Deposition

Table 6

Population Percentages* of
Vegetation Species at Crystal River

(Overstory/Understory)+

Biotic Community	Resistance Levels: Very Tolerant, Very High, High	Moderate	Low	Very Low, Intolerant
Coastal and Coastal Hydric Hammock	82.4 %	7.3 %	10.3 %	0.0 %
Mesic and Hydric Hammock	50.9 %	33.5 %	15.6 %	< 0.5 %
Pine Flatwoods and Pine Plantation	13.6 %	86.4 %	0.0 %	0.0 %
Freshwater Marsh	The freshwater and saltwater marshes do not			
Saltwater Marsh	contain an overstory/understory vegetation level.			

(Shrubs and Herbaceous Species)++

Biotic Community	Resistance Levels: Very Tolerant, Very High, High	Moderate	Low	Very Low, Intolerant
Coastal and Coastal Hydric Hammock	64.7 %	11.8 %	23.5 %	< 0.5 %
Mesic and Hydric Hammock	52.8 %	16.7 %	30.4 %	< 0.5 %
Pine Flatwoods and Pine Plantation	38.3 %	46.8 %	14.9 %	< 0.5 %
Freshwater Marsh	37.0 %	31.5 %	31.5 %	< 0.5 %
Saltwater Marsh	100 %	0 %	0 %	0 %

+ Overstory/understory are two different layers in a plant community. Tall trees, such as cypress and oak, comprise the overstory, and trees of medium height, such as dogwood and maple, comprise the understory.

++ The shrubs and herbaceous species are the low lying plants in the community. Grasses, bushes and other short vegetation make up this level of plant communities.

* For overstory/understory, percentages are of Total Importance Value Index. Importance value is a parameter used in quantifying vegetation population data; importance value = the sum of the relative density, relative dominance, and relative frequency of a species.

For shrubs and herbaceous species percentages are of Total Ground Cover.

The biota in the Crystal River area is made up of a majority of salt tolerant species (see Table 6). The overstory/understory vegetation level contains more salt tolerant vegetation than the low-lying species. This could be expected since the natural salt drift of the region (from the Gulf of Mexico) is carried on the prevailing winds and will tend to impact the overstory/understory vegetation more than the shrubs and herbaceous species. The less salt resistant species have developed more readily at the ground because the upper level of vegetation provides a shield from salt deposition for the ground cover vegetation. The two marsh communities do not contain an overstory/understory. The saltwater marsh, due to its highly saline water and its proximity to the Gulf of Mexico, comprises 100% salt resistant species. The freshwater marsh communities contain approximately one third each of high, moderate and low resistance species.

In accordance with their NPDES permit, FPC has maintained and conducted vegetation and salt deposition monitoring programs since approximately 1979. Additionally, a vegetation survey was included in work done for the Site Certification Application (FPC, 1977). The vegetation monitoring consists of monthly inspections of tagged individual plants at selected locations, quarterly aerial infrared photography of the area in a one mile radius circle around the FPC site, and quarterly biotic inspections of the monitoring locations. The locations used for the deposition monitoring are used for the vegetation monitoring (see Figure 1). KBN Engineering and Applied Sciences, Inc. (KBN) was contracted by FPC to prepare quarterly and annual salt deposition monitoring reports for the 1985/86 and 1986/87 periods. The two annual reports conclude that, although few symptoms of salt accumulation damage were documented, there were no consistent patterns or symptoms of salt accumulation damage to the vegetation in the Crystal River area. The reports also state that the indigenous vegetation was generally in good condition. The reports from the previous years also documented that there was no salt damage discovered by the vegetation monitoring.

KBN included in their June 1988 report a grouping of plant species by their relative resistance to salt accumulation damage. The groups ranged from very intolerant to very tolerant. Data was provided for the ranges of salt accumulation which would be expected to cause threshold damage to the plants and damage to 50% of their leaves (50% leaf damage). These accumulation levels were used to determine how long salt deposition could be tolerated on the plants before threshold and 50% leaf damage might occur. The levels expected to cause damage through accumulation have been determined through laboratory and highly controlled field experimentation. The threshold damage level is when the vegetation starts to show signs of stress. The 50% leaf damage level is when 50% of the vegetation's leaves are showing symptoms of stress. Salt accumulation damage is often evidenced by necrosis. Table 7 lists these plant groups and the average salt accumulation levels needed to produce threshold damage and 50% leaf damage to the species in the groups. For brevity, the lists of the species found in the groups have been replaced by a representative species for each group. These representative species were chosen because they are found in the biotic communities at Crystal River.

Table 7

Accumulation Levels Causing Damage To Various Species at Crystal River

	Threshold Damage (g/m^2)	50% Leaf Damage (g/m^2)
Very Tolerant (Marsh Elder)	> 4	> 10
High Resistance (Live Oak)	3	7
Moderate Resistance (Slash Pine*)	.7	2.5
Low Resistance (Red Maple)	.3	.8
Very Intolerant (Flowering Dogwood)	0.04	.2

* Slash Pine is the predominant species found at the Crystal River Planted Pine area. Virginia Pine is listed as moderately resistant to salt accumulation damage and Pitch Pine is listed as highly resistant to salt accumulation damage. Slash Pine was chosen to be moderately resistant to give the analysis a conservative bias.

Table 8

Time Between Rainfall Events

Days Between Rainfall Events*	Number of Occurrences	Number of Occurrences Equal to or Longer
0	171	368
1	55	197
2	39	142
3	25	103
4	16	78
5	17	62
6	9	45
7	9	36
8	4	27
9	2	23
10	4	21
11	3	17
12	2	14
13	1	12
14	2	11
15	0	9
16	0	9
17	1	9
18	1	8
19	3	7
20	0	4
21	0	4
22	2	4
23	0	2
24	0	2
25	0	2
26	0	2
27	1	2
28	0	1
29	0	1
30	0	1
31	1	1

* Rainfall events 0.11 inches/hr or greater.

This data as provided by KBN is for the four summer months (June, July, August, September) for the following ten years: 1974, 75, 78, 79, 81, 82, 83, 84, 85, and 1986.

The KBN report of June 1988 discusses how rainfall events of 0.11 inch/hr or greater will wash accumulated salt residue from the leaves of the plants and presents an analysis of determining how often it must rain to prevent various salt deposition rates to reach accumulation levels that cause threshold damage and 50% leaf damage. Table 8 lists the number of occurrences for ten years, during the summer months, that the time between rainfall events was equal to and/or longer than 1 day through 31 days.[13]

The deposition rates (modeled and measured) for the operating conditions of the 1985/86 and 86/87 monitoring periods are used in the same analysis that KBN used in the June 1988 report. The results of the calculations are listed in Table 9 along with the salt deposition rates (from Tables 3 and 4 and corrected for salt deposition from rainfall) displayed as daily deposition rates. Also included in Table 9 are the number of occurrences during the summer months of 1986 (i.e. during the 85/86 monitoring period) when the time between rainfall events was equal to or longer than the calculated times ("dry periods") necessary for salt deposition to accumulate to the levels which might cause threshold and 50% leaf damage to vegetative species with low and moderate resistance to salt accumulation. The data for the summer months of 1987 (i.e. during the 86/87 monitoring period) have not been made available.

From the impact analysis, vegetation damage from salt accumulation greater than threshold damage to low resistance species should not have occurred in the 1985/86 monitoring period. This corresponds to the results of the vegetation monitoring. Since threshold damage is very difficult to recognize in field studies, it is understandable that no consistent patterns of salt accumulation damage to the indigenous vegetation have been found at Crystal River. And, although the modeled deposition rates were different than the measured deposition rates, the rates predicted by the model would not have caused damage greater than threshold damage to low resistance species.

The daily deposition rates listed in Parts A and C of Table 5 are used in an analysis identical to the one used by KBN. Table 10 lists for each operation scenario, the number of days between rainfall events needed to cause threshold damage and 50% leaf damage to species in Area I that have low and moderate resistance to salt accumulation. Table 11 lists the same information for the species in Area II. The two tables also list the number of times that "dry periods" equal to or longer than that required for the two levels of impact have occurred in the ten years of rainfall data in Table 8. Species more resistant to salt accumulation damage than moderately resistant species are not listed because the shortest time between rainfall events to cause threshold damage to high resistance species is 39 days, a very low probability event during the summer months in Florida, and an event that did not occur during the ten years of record used for the analysis.

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[13] Surface Observations at Tampa, FL National Weather Service Station (#12842).

The deposition rates listed in Tables 10 and 11 include a natural daily dry salt deposition of 0.010 g/m²-day (6.2 g/m²-yr ÷ 365 days/yr). The deposition rates used for the Area II analysis are taken from Part C of Table 5. The deposition rates presented in Part C are averages of Parts A and B. The salt deposition represented by the contour lines in Figure 5 change gradually from one contour line to the next. Area II is large enough that the average of the two contour lines (from Figure 5) is more representative of the deposition rate than either the higher or the lower figure. Area I, on the other hand, is not very large and is close enough to the contour line that using the deposition rate of that contour line is appropriate.

Table 9

Vegetation Impact Analysis
For the 85/86 and 86/87 Monitoring Periods

Monitoring Locations & Salt Deposition Rate[1] (g/m²-day)	Damage Causing Salt Accumulation Levels (g/m²) — Low Resistance Species: Threshold (0.3)		50% leaf damage (0.8)		Moderate Resistance Species: Threshold (0.7)		50% leaf damage (2.5)	
	Days[2]	Occur[3]	Days	Occur	Days	Occur	Days	Occur
Open Test								
Modeled (0.027)	11	3	30	0	26	0	93	0
Meas. 85/86 (0.015)	20	0	54	0	47	0	169	0
Meas. 86/87 (0.014)	22	–	58	–	51	–	182	–
NW Open Test								
Modeled (0.026)	11	3	30	0	27	0	95	0
Meas. 85/86 (0.021)	14	3	37	0	33	0	117	0
Meas. 86/87 (0.010)	30	–	80	–	73	–	261	–
NE Open Test								
Modeled (0.018)	17	1	46	0	40	0	143	0
Meas. 85/86 (0.030)	10	4	27	0	23	0	84	0
Meas. 86/87 (0.012)	26	–	70	–	61	–	217	–
SW Open Test								
Modeled (0.025)	12	3	32	0	28	0	101	0
Meas. 85/86 (0.020)	15	2	41	0	35	0	127	0
Meas. 86/87 (0.014)	21	–	57	–	50	–	179	–
Open Control								
Modeled (0.016)	19	1	49	0	43	0	155	0
Meas. 85/86 (0.015)	21	0	55	0	48	0	172	0
Meas. 86/87 (0.004)	68	–	182	–	160	–	570	–

[1] The measured deposition rates listed in Tables 3 and 4 are reduced by 2.5 g/m²-yr, the annual salt deposition contributed as rainfall, then divided by 365 days/yr.

[2] Days : Indicates the number of days without rainfall for salt deposition to accumulate to the indicated levels which might cause damage.

[3] Occur: Indicates the number of occurrences when damage may have occurred in the summer months of the monitoring period. For example, at the measured deposition rate at the SW Open Test site, threshold damage could have occurred two times because there were two dry periods that lasted 15 days or longer in the summer months in 1986. The 85/86 data is used with the deposition rates predicted by the model.

– : Indicates that the rainfall data has not been made available.

Table 10

Area I
Vegetation Impact Analysis

Salt Deposition Rate (g/m²-day)	Low Resistance Species — Damage-Causing Accumulation Levels (g/m²): Threshold (0.3)		50% Leaf (0.8)		Moderate Resistance Species: Threshold (0.7)		50% Leaf (2.5)	
	Days[1]	Occur[2]	Days	Occur	Days	Occur	Days	Occur
Scenario 1* 0.019	16	9	42	0	37	0	132	0
Scenario 2 0.034	9	23	24	2	21	4	74	0
Scenario 3 0.050	6	45	16	9	14	11	50	0
Scenario 4 0.047	6	45	17	9	15	9	53	0
Scenario 5 0.062	5	62	13	12	11	17	40	0
Scenario 6 0.078	4	78	10	21	9	23	32	0

1. Days: indicates how many days are needed between rainfall events to reach the indicated accumulation levels that might cause damage.

2. Occur: indicates the number of occurrences in the ten years of record that the calculated time between rainfall events occurred. For example, at the deposition rate of Scenario 4 (0.047 g/m²-day) it would require six days without rain- fall for the salt accumulation to reach the level that would cause threshold damage to low resistance species. There have been forty-five occurrences of dry periods six days or longer in the ten years of record.

* Scenarios and deposition rates as presented in Table 5.

Table 11

Area II

Vegetation Impact Analysis

Low Resistance Species / Moderate Resistance Species

Damage-Causing Accumulation Levels (g/m^2)

Salt Deposition Rate (g/m^2-day)	Low Resistance: Threshold (0.3)		Low Resistance: 50% Leaf Dam. (0.8)		Moderate Resistance: Threshold (0.7)		Moderate Resistance: 50% Leaf Dam. (2.5)	
	Days[1]	Occur[2]	Days	Occur	Days	Occur	Days	Occur
Scenario 1* 0.016	19	7	50	0	44	0	156	0
Scenario 2 0.027	11	17	30	1	26	2	93	0
Scenario 3 0.038	8	27	21	4	18	8	66	0
Scenario 4 0.035	9	23	23	2	20	4	71	0
Scenario 5 0.046	7	36	17	9	15	9	54	0
Scenario 6 0.057	5	62	14	11	12	14	44	0

1. Days: indicates how many days are needed between rainfall events to reach the indicated accumulation levels that might cause damage.

2. Occur: indicates the number of occurrences in the ten years of record that the calculated time between rainfall events occurred. For example, at the deposition rate of Scenario 4 (0.035 g/m^2-day) it would require nine days without rainfall for the salt accumulation to reach the level that would cause threshold damage to low resistance species. There have been twenty-three occurrences of dry periods nine days or longer in the ten years of record.

* Scenarios and deposition rates as presented in Table 5.

The data from Tables 10 and 11 are used to assess the impacts to Areas I and II vegetation. Each Scenario is presented and described, and the impacts are presented as how frequently the two different types of damage (threshold and 50% leaf damage) may occur. The terms used to describe potential damage frequency include four ranges of the number of occurrences during the ten years of record that the time between rainfall events was long enough to cause damage.

<u>rarely</u>: means that there were 1 to 4 occurrences

<u>occasionally</u>: means that there were 5 to 14 occurrences

<u>regularly</u>: means that there were 15 to 24 occurrences

<u>often</u>: means that there were 25 or greater occurrences

The salt deposition rates are predicted for worst case conditions. The impact period is during the summer months with elevated operating factors and higher salt concentrations in the circulating water. The measured deposition rates were less than the modeled rates in nine out of ten cases (Tables 3 and 4), implying the model presents worst case. Most of the biotic communities being impacted have upper vegetation levels that contain majorities of salt tolerant species which provide shielding for the more salt sensitive species in the groundcover vegetation level. For these reasons, the actual damage is expected to be less than predicted by this worst case analysis.

<u>Area I Evaluation</u>

The data for this impact evaluation is presented in Table 10. Area I is 15 to 20 acres of Hollins Corporation land at the northern property boundary of the FPC Crystal River Complex. Coastal hydric and hydric hammock are the vegetative communities found in Area I. The overstory/understory vegetation of these communities are predominantly composed of salt tolerant species. The majority of the low resistance species found in the hydric and coastal hydric communities are found in the low lying vegetation level. The impacts to the majority of the low resistance species will be less due to the shielding effect of the upper level vegetation.

Scenario 1, original permit conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and no helper towers: The analysis predicts occasional (7 occurrences in ten years of data) threshold damage to low resistance species.

Scenario 2, existing conditions, Unit 4 cooling tower drift rate = 0.0005%, Unit 5 cooling tower drift rate = 0.0023% and no helper towers: The analysis predicts regular (23 occurrences in ten years of data) threshold damage and rare (2 occurrences in ten years of data) 50% leaf damage to low resistance species. Rare (4 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 3, increasing the drift rate of Unit 4 cooling tower, Units 4 and 5 cooling tower drift rates = 0.0023% and no helper towers: The analysis predicts threshold damage to low resistance species often (45 occurrences in ten years data). Occasional (9 occurrences in ten years of data) 50% leaf damage is predicted for low resistance species. Occasional (11 occurrences in ten years of data) threshold damage to moderate resistance species is also predicted.

Scenario 4, adding the helper cooling towers to the original permit conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and Units 1-3 cooling tower drift rates = 0.0023%: The analysis predicts threshold damage to low resistance species often (45 occurrences in ten years of data). Occasional (9 occurrences in ten years of data) 50% leaf damage is predicted for low resistance species. Occasional (9 occurrences in ten years of data) threshold damage to moderate resistance species is also predicted.

Scenario 5, adding the helper cooling towers to the existing conditions, Units 4 cooling tower drift rate = 0.0005%, Unit 5 cooling tower drift rate = 0.0023%, Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts often (62 occurrences in ten years of data) occurrences of threshold damage and occasional (12 occurrences ten years of data) occurrences of 50% leaf damage to low resistance species. Regular (17 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 6, increasing the drift rate of Unit 4 and adding the helper towers, Units 4 and 5 cooling tower drift rates = 0.0023% and Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts often (78 occurrences in ten years of data) occurrences of threshold damage and regular (17 occurrences in ten years of data) occurrences of 50% leaf damage to low resistance species. Regular (23 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Area II Evaluation

Table 11 lists the data used in this evaluation. Area II is 250 to 300 acres of Hollins Corporation land north of Area I. The impacts to the biotic communities with overstory/understory vegetation levels will be less than the impacts described below. However, the ten acres of freshwater marshes found in Area II do not have an upper vegetation level. The impact of the salt drift on the low resistance species will not be reduced by shielding from taller plants. This impact may cause a species shift in the marshes. Over time salt tolerant species may become more abundant and there may be fewer low resistance plants.

Scenario 1, original permit conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and no helper towers: The analysis predicts occasional (seven occurrences in ten years of data) threshold damage to low resistance species. No other damage from operating at permitted drift rates is predicted.

Scenario 2, existing conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and 0.0023%, respectively, and no helper towers: The analysis predicts regular (seventeen occurrences in ten years of data) threshold damage and rare (one in ten years of data) 50% leaf damage to low resistance species. Rare (two occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 3, increasing drift rate of Unit 4 cooling tower, Units 4 and 5 cooling tower drift rates = 0.0023% and no helper towers: The analysis predicts threshold damage to occur often (27 occurrences in ten years of data) and 50% leaf damage to occur rarely (4 occurrences in ten years of data) to low resistance species. Occasional (8 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 4, adding the helper towers to the original permit conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts regular (23 occurrences in ten years of data) threshold and rare (two occurrences in ten years of data) 50% leaf damage to low resistance species. Rare (4 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 5, adding the helper cooling towers to the existing conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and 0.0023%, respectively, and Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts threshold damage to occur often (32 occurrences in ten years of data) and 50% leaf damage to occur occasionally (9 occurrences in ten years of data) to low resistance species. Occasional (9 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Scenario 6, increasing the drift rate of Unit 4 and adding the helper cooling towers, Units 4 and 5 cooling tower drift rates = 0.0023% and Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts threshold damage to occur often (62 occurrences in ten years of data) and 50% leaf damage to occur occasionally (11 occurrences in ten years of data) to low resistance species. Occasional (14 occurrences in ten years of data) threshold damage to moderate resistance species is predicted.

Other Areas

Salt deposition north of Area II can be assumed to be the same as the deposition described in Part B of Table 5 for areas close to the 5 g/m^2-yr contour line and approach the deposition described in Part D of Table 5 for areas closer to the 2 g/m^2-yr contour line. The 2 g/m^2-yr contour line is not completely drawn on the figures that accompany this report. Salt deposition from the cooling towers will decrease with distance from the cooling towers until it reaches a negligible level. The area between the 5 and 2 g/m^2-yr contour lines and north of the FPC property boundary is estimated to be between 1,000 and 2,000 acres. Planted pine is the predominant biotic community. Salt marsh and coastal hydric and hydric hammock comprise the rest of the area between the 2 and 5 g/m^2-yr contour lines.

In the same method used for Areas I and II, the deposition rates from Part B of Table 5 is used to evaluate the impacts to the vegetation outside of and closely adjacent to Area II. Likewise the deposition rates from Part D of Table 5 will be used to evaluate impacts to areas close to the 2 g/m^2-yr contour line.

Scenario 1 of Part B, permitted conditions, Units 4 and 5 cooling tower drift rates = 0.0005% and no helper towers: The analysis predicts rare (2 occurrences in ten years of data) occurrences of threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 2 of Part B, existing conditions, Unit 4 cooling tower drift rate = 0.0005%, Unit 5 cooling tower drift rate = 0.0023% and no helper towers: The analysis predicts occasional (9 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 3 of Part B, increasing the drift rate of Unit 4, Units 4 and 5 cooling tower drift rates = 0.0023% and no helper towers: The analysis predicts occasional (14 occurrences in ten years of data) threshold damage and rare (1 occurrence in ten years of data) occurrences of 50% leaf damage to low resistance species. The analysis predicts rare (2 occurrences in ten years of data) occurrences of threshold damage to moderate resistance species.

Scenario 4 of Part B, adding the helper towers to original permit conditions, Units 4 and 5 cooling towers drift rates = 0.0005%, Units 1-3 cooling towers drift rates = 0.002%: The analysis predicts occasional (11 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 5 of Part B, adding helper towers to existing conditions, Unit 4 cooling tower drift rate = 0.0005%, Unit 5 cooling tower drift rate = 0.0023%, Units 1-3 cooling tower drift rates = 0.002%: The analysis predicts regular (21 occurrences in ten years of data) threshold damage and rare (1 occurrences in ten years of data) 50% leaf damage to low resistance species. The analysis predicts rare (2 occurrences in ten years of data) of threshold damage to moderate resistance species.

Scenario 6 of Part B, adding helper towers and increasing drift rate of Unit 4, Units 4 and 5 cooling tower drift rates = 0.0023%, Units 1-3 cooling tower drift rates = 0.002%: the analysis predicts regular (23 occurrences in ten years of data) threshold damage and rare (2 occurrences in ten years of data) 50% leaf damage to low resistance species. The analysis predicts rare (4 occurrences in ten years of data) threshold damage to moderate resistance species.

The damage described above is <u>at</u> the 5g/m²-yr contour line. The salt deposition and the potential for damage is reduced as the distance from the cooling towers is increased. The damage described below, is <u>at</u> the 2 g/m²-yr contour.

Scenario 1 of Part D, permitted conditions, Units 4 and 5 cooling towers drift rates = 0.0005% and no helper towers: The analysis predicts rare (2 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 2 of Part D, existing conditions, Unit 4 drift rate = 0.0005%, Unit 5 drift rate = 0.0023% and no helper towers: The analysis predicts rare (4 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 3 of Part D, increasing Unit 4 cooling tower drift rate, Units 4 and 5 cooling tower drift rates = 0.0023% and no helper towers: The analysis predicts occasional (7 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 4 of Part D, adding helper towers to permitted conditions, Units 4 and 5 cooling towers drift rates = 0.0005% and Units 1-3 cooling towers drift rates = 0.002%: The analysis predicts rare (4 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 5 of Part D, adding helper towers to existing conditions, Unit 4 cooling towers drift rate = 0.0005%, Unit 5 cooling tower drift rate = 0.0023% and Units 1-3 cooling towers drift rates = 0.002%: The analysis predicts occasional (9 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

Scenario 6 of Part D, adding helper towers and increasing Unit 4 cooling tower drift rate, Units 4 and 5 cooling towers drift rates = 0.0023% and Units 1-3 cooling towers drift rates = 0.002%: The analysis predicts occasional (9 occurrences in ten years of data) threshold damage to low resistance species. There is no other damage predicted for this scenario.

<u>SOIL IMPACTS ANALYSIS</u>

The EIS and the SCA described the soils and geology of the Crystal River area (see Figure 7).[14] Studies using irrigation water of various salt concentrations have shown that sensitive crops (e.g. corn, tomatoes) displayed no adverse reactions to irrigation with water having salt concentrations up to 500 parts per million (ppm).[15]

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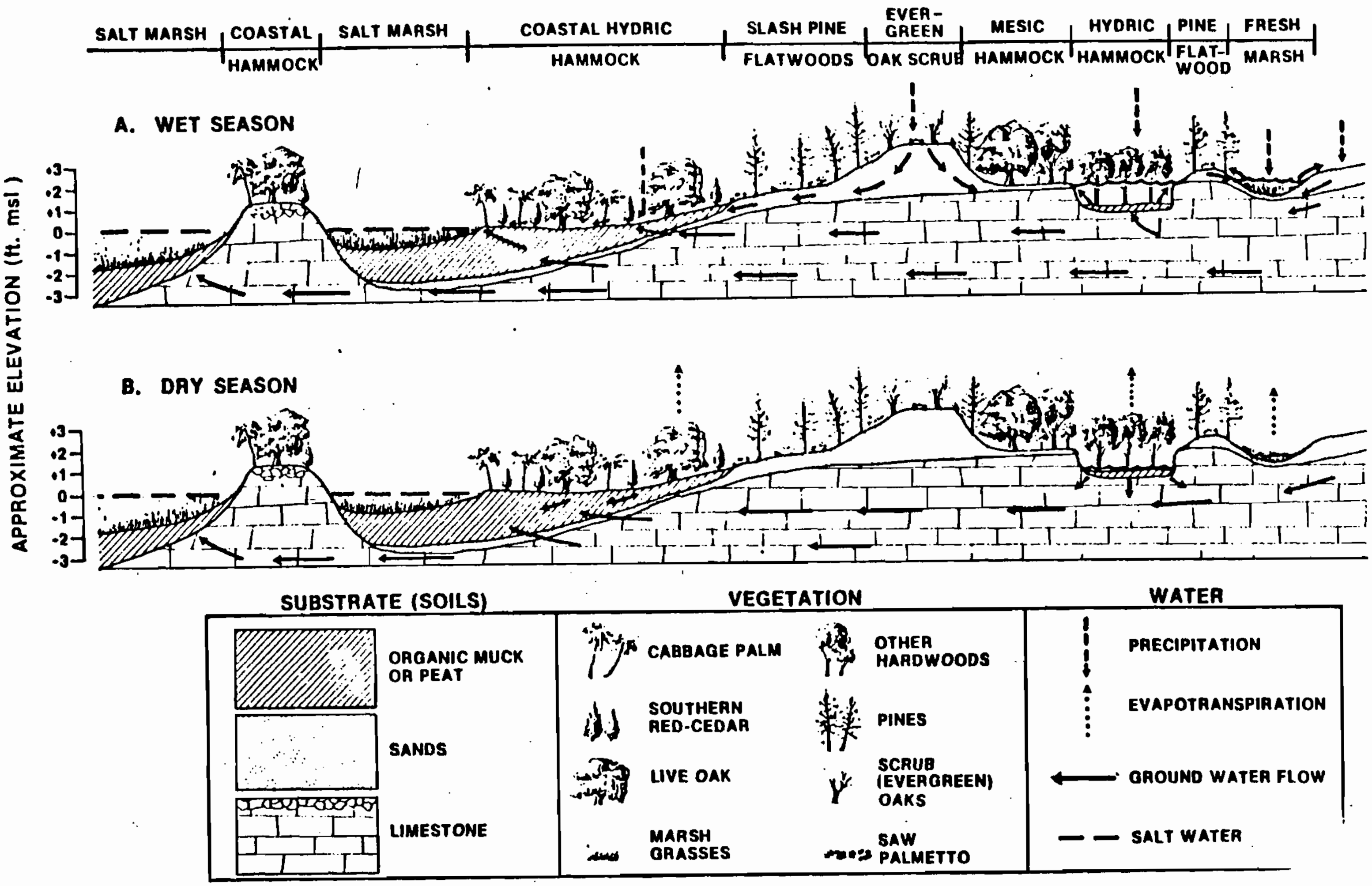
[14]Environmental Impact Statement Florida Power Corporation Crystal River Units 4 and 5, EPA Region IV, EAB, NEPA Compliance Section, July 1980

[15]Quality Criteria for Water, EPA, July 1984.



Figure

CONCEPTUALIZED PLANT/SOIL/WATER RELATIONSHIPS OF THE PROPOSED PLANT SITE

SOURCE: ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., 1977

FLORIDA POWER CORPORATION

PROPOSED CRYSTAL RIVER UNITS 4 & 5

CITRUS COUNTY, FLORIDA

FIGURE 7

Similar studies have shown that soils in arid and semiarid climates display no adverse conditions or build up of inorganic constituents from irrigation with water having salt concentrations up to 480 ppm.[16] Humid climates, like those similar to the Crystal River area, have mitigating effects on salt accumulation impacts on soil.

To address the concerns of salt accumulation in soil, a salt solution can be simulated by assuming to dissolve the annual salt deposition into the annual net rainfall. Then, this simulated salt solution can be applied to the soil. A worst case scenario would be to maximize the salt deposition and minimize the net rainfall. The average annual rainfall in the Crystal River area is 50 inches per year.[17] The evapotranspiration rate for that part of Florida ranges from 44 to 48 inches per year.[18] The worst case scenario would require 19.2 g/m^2-yr of salt (6.2 g/m^2-yr background salt deposition plus 13.0 g/m^2-yr maximum proposed salt deposition due to salt drift at FPC northern property boundary) dissolved into a net rainfall of two inches per year to yield a "solution" of 347 ppm salt in water. This value is below the concentrations needed to cause adverse impacts on soils in arid and semiarid regions.

SURFACE WATER IMPACTS

The geology at Crystal River is one of sandy soil intermixed with limestone formations (see Figure 7). In some places the limestone is very near the surface and can create pockets of sandy soil that are separated from the main body of soil. This separation also includes the groundwater that is entrained in the soil. The groundwater in the area is hydraulically affected by the Gulf of Mexico and in areas close to the shore the groundwater can become brackish. However, the pockets separated by the limestone will hold freshwater and support freshwater hammock vegetation species.

The hydraulic characteristics of the freshwater pockets, as shown in Figure 7, are not isolated but are interactive with the main body of ground water and the seasonal changes in precipitation. During dry periods the water in the freshwater hammocks tends to drain through the limestone due to the lowering of the groundwater table. The freshwater marshes become dry. During wet periods, the hammocks will fill with water from the groundwater table and the marshes tend to overflow.

To consider a worst case scenario, the freshwater pockets can be assumed to be entirely isolated and the salt water solution from the SOIL IMPACTS ANALYSIS can be "poured" into the freshwater pockets. This maximum solution of 347 ppm should have no adverse affects to the water or the vegetation in the freshwater pockets.

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[16]Land Treatment of Municipal Wastewater, Army Corps of Engineers, 1977.

[17]Water Atlas of United States, Geraghty, Miller et al, 1976.

[18]Ibid.

It is expected that the freshwater pockets do not concentrate salt. They interact with the groundwater (i.e. they are not entirely isolated), there is a net positive rainfall in the area, and the salt water impacting them is not very concentrated in salt. However, because the freshwater pockets are very complex systems, it is recommended that baseline data be collected and a monitoring program be installed to determine the impacts that may occur to the freshwater pockets.

CONCLUSIONS AND RECOMMENDATIONS

The current salt deposition at Crystal River has not been shown to be causing damage to the indigenous vegetation. Either of the two proposed changes to the operating conditions (i.e. increasing the drift rate of Unit 4 cooling tower and the addition of helper cooling towers for Units 1-3) will increase the total salt deposition to levels that may occasionally cause serious (i.e. 50% leaf damage) damage to plant species with low resistance to salt in Areas I and II. The combined effect of the two proposed changes results in a salt deposition rate that may regularly cause threshold damage to moderate resistance species on a small portion of Hollins Corporation land (Area I). It is expected that there will be no observable damage to the vegetation north of Area II.

The analysis is presented on a worst-case basis. The measured salt deposition has been less than amounts predicted by the model. It is likely that the salt deposition will be less than the amount used in the analysis. Additionally, the natural division of the plant species in the biotic communities (overstory, understory, and groundcover) will reduce the amount of salt impacting the species with low tolerance to salt accumulation damage.

The freshwater marshes, comprising only five acres, do not have the advantage of the shielding effect of upper vegetation levels. This relatively small amount of wetlands should not be destroyed by the salt deposition impacts, but a species shift may occur causing the more salt tolerant plant species to slowly comprise more of the freshwater marshes.

There should be no adverse impacts to soils from the salt deposition of any of the proposed changes or the combination of the two. The amount of salt being deposited is below levels shown to be safe to soils. The same can be said regarding the concentration of salt in the non-saline surface waters. The surface waters of concern, the freshwater pockets, have interaction with the groundwater, and in the event that they become isolated, the salt being deposited in the freshwater is not sufficient to cause salt concentrations in the water which would be expected to cause damage to the vegetation growing in the freshwater pockets.

In summation, implementing either or both of the proposed operational changes at Crystal River has been predicted to result in adverse impacts to the environs of the area. These impacts are expected to be localized and affect only the most sensitive species. Also, this analysis is believed to overestimate the amount of damage.

EPA believes that the benefit derived from the improvement of the aquatic habitat and the improved efficiency of the cooling towers substantially outweighs the potential adverse impacts to the local area's terrestrial vegetation. Over 800 acres of aquatic habitat will be improved to meet water quality standards. This area's estuarine waters are important resources which must be protected under the requirements of the Clean Water Act and Florida Water Quality Standards. The uncertain loss or damage to low resistance species on 300 acres or less, although of concern, is not considered sufficient to allow continuance of violations of water quality standards or the continuance of low efficiency use of the cooling tower for Unit 4.

Due to the uncertainty surrounding this analysis and to assure that significant impacts do not occur, the following conditions should be placed on the EPA, PSD permit modifications for Units 4 and 5:

A. Florida Power Corporation shall continue the existing vegetation impact and salt deposition monitoring program. Florida Power Corporation shall submit to EPA Region IV and FDER, by no later than October 31, 1988, a plan to expand and modify the existing monitoring program. This expanded monitoring program must be approved by FDER and EPA and shall include the following:

   1. An increase in the number of deposition monitors and monthly vegetation monitoring locations to include a representative number of freshwater marshes and coastal hammock and coastal hydric hammock communities.

   2. Initiation of a soil salt sampling program which includes obtaining baseline soil salt concentration data by sampling soil at representative locations.

   3. Initiation of a surface water salt sampling program which includes obtaining baseline surface water salt concentration data by sampling water in a representative number of freshwater marshes.

   4. Inclusion of deposition, soil, fresh water, and vegetation monitoring stations on appropriate portions of Hollins Corp. land.

   5. Collection of data to more accurately determine the natural background deposition at Crystal River.

B. In the event that significant damage to terrestrial plants occurs, FPC shall immediately report such findings to EPA and the FDER. Within 90 days thereafter, FPC shall submit to EPA and FDER an assessment of the damage, options to reduce the impact, and a proposed course of action to correct the damage. Upon the direction of the EPA or FDER, FPC shall implement corrective action.